National Natural Science Fund Guide to Programs 2019

National Natural Science

Foundation of China

Brief Introduction

The *National Natural Science Fund Guide to Programs 2019*, in accordance with the *National Natural Science Foundation Regulations* and relevant documents on program management, details the reform of National Natural Science Funding System, gives instructions on the application requirement, explains the definition of application quota and introduces the funding policies for various types of programs in 2019. It provides applicants with useful guidance on making independent selections of topics to seek support from the National Natural Science Fund. The *Guide* introduces the exploration, talent, instrument and convergence program categories in separate sections. It is an important basis for the allocation of the National Natural Science Fund, and also a must-read reference for applicants.

This book can be used as a reference for researchers in universities and colleges of higher education and research institutions, and for people working in areas of S&T management and policy research.

Editorial Committee

Foreword

The CPC Central Committee and the State Council of the People's Republic of China attach great importance to basic research. After the 18th National Congress of the Communist Party of China was convened, a series of major decisions and arrangements were made to promote the development of basic research in China. As General Secretary Xi has pointed out, “Basic research is the source of the entire scientific system, and the key solution to all scientific and technological problems”, “We must aim at the forefront of the world's science and technology, strengthen basic research, achieve breakthroughs in forward-looking basic research and deliver leading-edge original results”. He also emphasizes that science and technology is the field that needs constant reform the most. We are in an era where a new round of scientific and technological revolution is rising, innovation-driven development has become a global consensus, new scientific research paradigm is forming, the crossing and convergence of disciplines is ever more closer, and basic research is facing critical opportunities and challenges.

To achieve the great goal of becoming the world's leading science and technology power, the National Natural Science Foundation of China (hereinafter abbreviated as NSFC), guided by President Xi Jinping’s Socialist Thoughts with Chinese Characteristics for the new era, earnestly implementing the spirit of the Party’s 19th National Congress, and Second and Third Plenary Sessions, has conducted in-depth analysis of the new situation, new tasks and new requirements facing China's basic research and science funds, and developed the overall goal and roadmap of NSFC's reform in the new era based on repeated research and extensive consultation. The overall goal and roadmap of NSFC's reform, approved on the First Plenary Meeting of the 8th NSFC Council in June 2018, are stated as follows.

In accordance with the arrangements of the CPC Central Committee and the State Council, and in order to strengthen the Party's leadership in science funding, it is hereby approved to identify four major funding categories in line with scientific natures of research as funding creative and timely ideas to achieve excellence in science, focusing on the frontiers of science in unique ways to lead the cutting edges, supporting application-driven basic research to

enable breakthroughs, and encouraging transdisciplinary leading-edge research to promote convergence; to establish an artificial intelligence-assisted category-specific peer review mechanism featuring “Responsibility, Credibility and Contribution”; to construct layout of funding systems that stem from the inherent logic and landscape of the knowledge system and promotes knowledge and application integration, with the goal of building a science funding system for the new era that is guided by advanced concept, equipped by well-established mechanism and operated in a fair and efficient manner in the next 5 to 10 years, and making fundamental contribution in strengthening original innovation capacity to become world's leading science and technology power.

NSFC will follow the roadmap and timeline of the reform to implement the tasks step by step in a planned manner, and to make the most of the unique advantage of science fund and its basic role in supporting the development of world's leading science and technology power. In 2019, NSFC will take Key Program and part of General Program as a trial for application through four funding categories and category-specific review, select and fund innovative projects that in line with the science funding policies. Trial for other reform tasks will be implemented gradually. We kindly ask researchers to pay close attention to science funding policy updates and give us precious comments and suggestions, so as to ensure better performance of the reform.

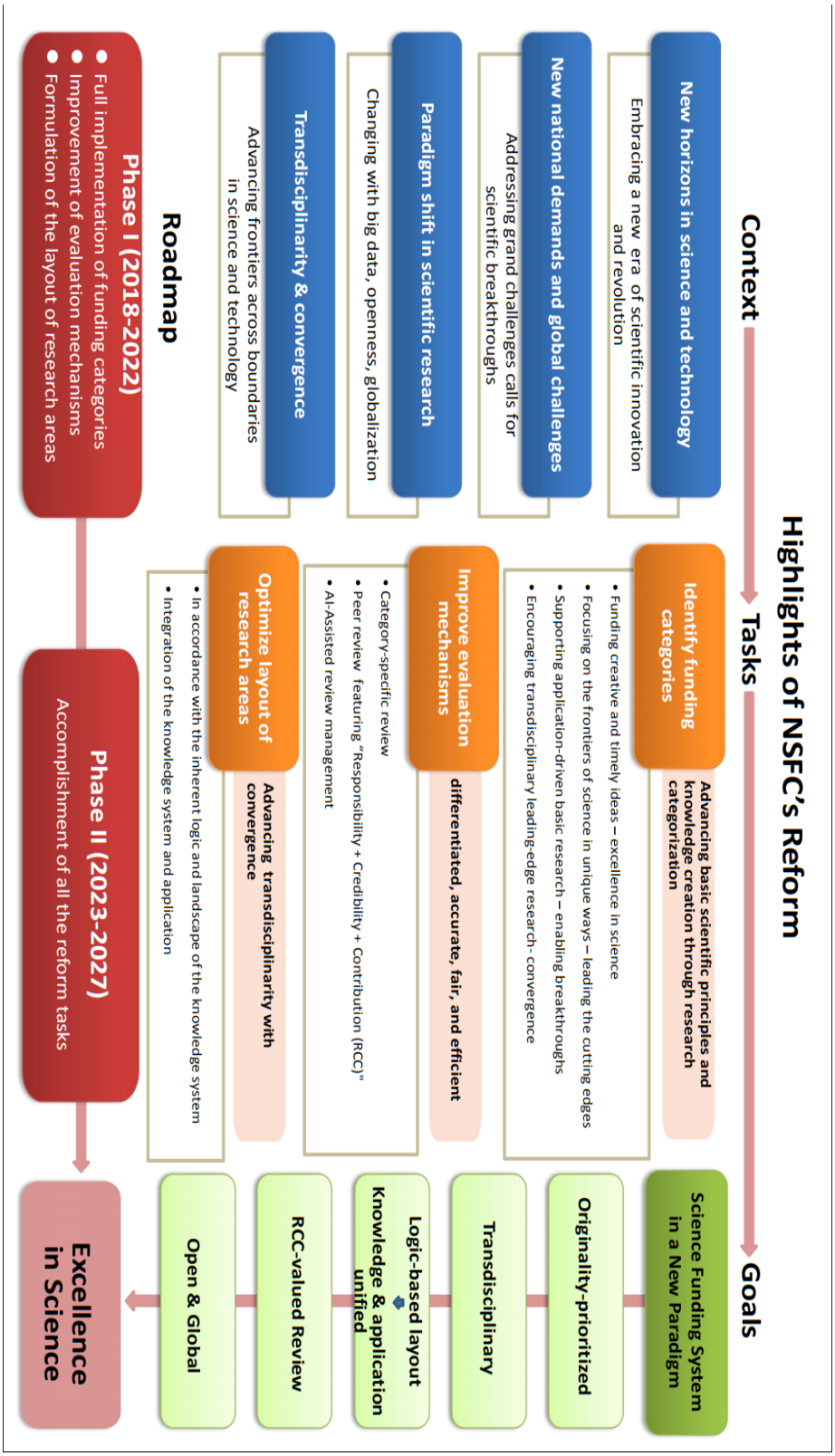
In order to reflect the principle of openness, fairness and justness and help scientists better understand NSFC’s funding policies, the *Guide* is published for all applicants to select proper categories of programs, research topics, areas and directions when they apply for funding.

Applicants shall carefully read 2019 NSFC Reform Initiatives, Information on Application, Application Limit, and application requirements for relevant types of programs. For General Program, please read carefully. Any special requirements for any type of program are indicated in the *Guide*. For General Program, in addition to the overall funding statistics, the funding principles and specified requirements as well as notes on applications are introduced too. Special requirements for other types of programs are introduced in the main text of this *Guide*.

The *Guide* mainly introduces the application of various types of projects submitted during the concentrated reception period of 2019. Calls for proposals not released during the batch application period will be announced on NSFC’s website (http://www.nsfc.gov.cn). Applicants and host institutions are advised to pay due attention.

NSFC will continue to strictly follow the *National Natural Science Foundation Regulations* and relevant guidelines for program management, standardize management procedures and optimize the peer review mechanism, strictly observe pertinent regulations on conflict of interest and confidentiality, and sincerely cherish the supervision from the scientific community and the general public. All researchers are welcome to submit high-quality applications for the National Natural Science Fund.

Editorial Committee
December 15, 2018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2019 NSFC Reform Initiatives

NSFC adheres to Xi Jinping's thought on socialism with Chinese characteristics for the new era, thoroughly implements critical requirements stated in a series of documents such as "Several Opinions of the State Council on Comprehensively Strengthening Basic Scientific Research", "Opinions on Deepening Project Review, Talent Evaluation, and Institutional Evaluation Reform", and "Notice of the State Council on Several Measures for Optimizing Scientific Research Management and Improving Scientific Research Performance", and defines three major reform tasks under the guidance of the overall goal of building national natural science funding system for the new era. They are: identifying four major funding categories based on scientific natures of research, adopting a peer-review mechanism featuring "Responsibility + Credibility + Contribution (RCC)" with the assistance of artificial intelligence so as to ensure category-specific evaluation, and optimizing layout of funding systems to support convergence between knowledge and application according to the inherent logic and landscape of knowledge system. NSFC will launch pilot programs first and gradually expand to all programs to ensure thorough implementation of the reform tasks.

In 2019, NSFC will initiate a series of reform measures, with an emphasis on establishing category-specific application and evaluation mechanism. Other measures will also be launched.

I. Pilot category-specific application and review

In accordance with the funding categories for the new era, NSFC has selected some types of programs and some disciplines to test the category-specific application and review procedures, so as to lay a foundation for establishing a differentiated program management mechanism.

i. Definition of four scientific natures of research

1. **"Funding creative and timely ideas to achieve excellence in science".** For this category, scientific problems stem from researchers' inspirations and

new ideas with a distinctive feature of originality. It aims to support free exploration that is likely to produce original results from scratch.

2. **"Focusing on the frontiers of science in unique ways to lead the cutting edges".** For this category, scientific problems come from the hot topics, difficulties and emerging fields with a distinctive feature of leading and groundbreaking. It aims to achieve pioneering results through unique paths, and to lead or expand the frontiers of science.

3. **"Supporting application-driven basic research to enable breakthroughs".** For this category, scientific problems are derived from national critical demands and the main battlefield of economy, with a distinctive feature of application-driven, problem-driven and goal-driven. It aims to address the core scientific problems behind technical bottlenecks, and to facilitate the transformation of basic research results.

4. **"Encouraging transdisciplinary leading-edge research to promote convergence".** For this category, scientific problems are common across multiple disciplines with a distinctive feature of transdisciplinarity. It aims to achieve major breakthroughs through transdisciplinary research, and promote convergence of knowledge system.

ii. Scope of pilot category-specific application and review

In 2019, NSFC chooses **Key Program** and **General Program in selected disciplines** to conduct pilot category-specific application and review. Details of the selected disciplines for General Program are as follows.

Departments	Application Codes	Disciplines
Mathematical and Physical Sciences	A04	Physics I
Chemical Sciences	B01-B08	Synthetic Chemistry, Catalysis and Surface/Interface Chemistry, Chemical Theories and Mechanisms, Chemical Metrology, Materials Chemistry and Energy Chemistry, Environmental Chemistry, Chemical Biology, Chemical Engineering and Industrial Chemistry
Life Sciences	C07	Cell Biology
Earth Sciences	D05	Atmospheric Science
Engineering and Materials Sciences	E01, E06	Metallic Materials, Engineering Thermophysics and Energy Utilization
Information Sciences	F04, F05	Semiconductor Science and Information Devices, Information Optics and Photoelectric Devices
Management Sciences	G03	Economic Sciences
Health Sciences	H16	Oncology

*Please note that applicants shall select the full 6-digit or 4-digit code when choosing the code.

iii. Notice to applicants

In order to carry out the category-specific review, the applicant shall select the scientific nature of research according to the key scientific problems and research contents to be solved when filling out the application of the Key Program or General Program in selected disciplines and justify the choice. When the proposed research falls in multiple categories, the applicant shall select the most appropriate one that best describes the characteristics of his/her research. NSFC shall organize the reviewers to conduct a classification review based on the scientific nature selected by the applicant.

II. Exploring and building joint funding system in the new era

In 2019, based on the principle of "meeting national demands, introducing diversified investment, encouraging resource sharing, and promoting multi-party cooperation", NSFC will strengthen top-level design, and support forward-looking basic research with emphases on the core scientific problems in key areas and major scientific problems in emerging transdisciplinary areas to address the urgent needs of regions, industries and enterprises. NSFC has jointly funded and established **National Natural Science Foundation Regional Innovation and Development Joint Fund** and **National Natural Science Foundation Enterprise Innovation and Development Joint Fund** with cosponsors to gradually formulate joint funding system for the new era and further improve the efficiency of fund use.

Guide to Programs for "National Natural Science Foundation Regional Innovation and Development Joint Fund" and "National Natural Science Foundation Enterprise Innovation and Development Joint Fund" will be published separately in January 2019. For host institutions and applications, please stay tuned.

Please note: Program of Joint Funds listed in this *Guide* refers to the joint funds under the implementation period of the agreement. For detailed requirements, please refer to the corresponding chapter of this *Guide*.

III. Improving management of Basic Science Center Program

After learning from the pilot Basic Science Center Program, NSFC further standardized the funding and management of the Program. Applicants can

submit applications to NSFC through their host institutions during the concentrated reception period of 2019. Funding period will be a maximum of "5 + 5" years, with a 5-year funding period and a possible extension of 5 years. The direct cost is no more than 80 million yuan (no more than 60 million yuan for Mathematics and Management Sciences programs) per 5 years. For detailed requirements, please refer to "Basic Science Center Program" in this *Guide*.

IV. Improving funding mode of Science Fund for Creative Research Groups

In 2019, NSFC will continue improving its funding mode of Science Fund for Creative Research Groups. With funding amount remaining unchanged, the funding period will be reduced from 6 years to 5 years. Extended funding will be abolished, and no longer be available for projects that are ongoing (approved during 2013-2018) and newly approved (approved in 2019 and beyond).

V. Optimizing Talent Program portfolio

To implement requirements of the CPC Central Committee and the State Council on the work of science and technology talents, NSFC will optimize and integrate funding system for Talent programs under the direction of Central Talent Work Coordination Group. For Joint Research Fund for Overseas Chinese Scholars and Scholars in Hong Kong and Macao, the Two-Year Funding Projects will no longer be available from 2019; and the Extended Funding Projects will no longer be available from 2020. **Requirements on coordinating National Science Fund for Distinguished Young Scholars, Excellent Young Scientists Fund and other national science and technology talent plans will be in line with the unified arrangements by Central Talent Work Coordination Group and announced separately.**

VI. Further simplifying requirements on application

i. Reducing application materials

When applying for the National Science Fund for Distinguished Young Scholars and Science Fund for Creative Research Groups, the applicant no longer need to provide recommendation from Academic Committee or Expert Panel; post-doctoral researchers who apply for the General Program, Young

Scientists Fund and Fund for Less Developed Regions as the applicant, no longer need to provide letter of commitment from host institutions.

ii. Simplifying management requirements on some programs

Participants are no longer listed in the Young Scientists Fund applications, so that reviewers will focus on the applicant's capability to independently lead a project and conduct innovative research. The scope of pilot paperless application will be expanded to Young Scientists Fund.

iii. Implementing representative publication evaluation system

In order to make reviewers focus on the quality, contribution and impact of researchers' remarkable achievements, the upper limit of the number of representative publications listed in the CV of applicant and participants is changed from 10 to 5, and the number of academic awards and representative research results other than publications is changed from no limit to no more than 10 items.

VII. Pilot program open to Hong Kong and Macao SARs researchers

According to *Several Provisions on Encouraging the Participation of Hong Kong SAR, Macao SAR Colleges and Universities and Research Institutes in the Central Financial Science and Technology Plan* (*Special Program, Funds, etc.*) (*Trial*) issued by Ministry of Science and Technology and Ministry of Finance, NSFC will open Excellent Young Scientists Fund to researchers in some institutions in Hong Kong and Macao SARs as a pilot program in 2019. Please stay tuned for further notice on detailed application requirements.

VIII. Strengthening scientific integrity

According to *Several Opinions on Further Strengthening Scientific Integrity* issued by the General Office of the CPC Central Committee and the General Office of the State Council, NSFC will implement the requirements for scientific integrity in the whole process of application, review, process management, completion and supervision and evaluation, in order to promote the scientific spirit and advocate innovation culture.

Applicants and host institutions are reminded that: while the applicant and the host institution signed *Letter of Commitment to Upholding Fairness* online in 2018, **the applicant and participants, the host institution and cooperative**

institutions shall co-sign *Letter of Commitment to Scientific Integrity* included in the application before submission in 2019.

Information on Application

In applying for NSFC funds in 2019, applicants and their host institutions shall first read carefully the following documents: *the National Natural Science Foundation Regulations* (hereinafter referred to as *Regulations*), this *Guide*, relevant guidelines for program management, *Regulations on National Natural Science Fund Management*, and notifications and announcements pertaining to application. Should there be any conflicts between guidelines for program management and *Regulations* and this *Guide*, *Regulations* and this *Guide* shall prevail. Applicants and their host institutions shall comply with the following provisions.

I. Eligibility of applicants and requirements on applications

i. Eligibility of applicants

1. As the principal investigator (PI), the applicant should comply with Article 10 Clause 1 of *Regulations*, i.e., the applicant has (1) the experience of undertaking basic research program(s) or other basic research activities; (2) a senior academic rank (title) or a doctoral degree, or recommendation from two researchers who are in the same research field and have a senior academic rank (title). Besides, those who apply for certain types of programs shall meet other specific requirements. (For more information, please refer to the text of this *Guide*.)

When a domestic or overseas applicant not employed full-time at his/her host institution submits the application, he or she should provide the copy of the employment contract from the host institution and the statement (with seal from the personnel department of the host institution) for his or her position, employment period and working hours per year together with the hard copy of application form.

The applicants for the Fund for Less Developed Regions should be full-time employees in the specified host institutions (for more information, please refer to “Fund for Less Developed Regions” in this *Guide*), or the technical personnel following national policy and sent by the Central

Organization Department on the 3-year or longer aiding mission in Xinjiang and Tibet, who should provide the supporting materials of the aiding mission issued by organization or personnel department of the aided institutions. Part-time employees in the specified host institutions, technical personnel from the specified host institutions affiliated to Chinese People's Liberation Army or host institutions outside the regions are not qualified to apply for the Fund for Less Developed Regions.

2. When a researcher conducting basic research satisfies the requirements as prescribed in the preceding paragraph but has no employer or whose employer is not a registered host institution, on the condition that he or she has obtained the consent from a registered host institution, he or she is eligible to apply for the General Program and Young Scientists Fund, but cannot apply for other programs.

Under this circumstance, the applicant shall fill in truthfully personal information in the basic information page of the proposal and research experiences in CV, together with the agreement signed with the host institution (for more information please refer to Article 13 of the *Guideline on Management of National Natural Science Fund Host Institutions*) in the hard copy of the application form.

Researchers with overseas identity who are not employed in any host institution shall not apply for NSFC programs as researcher with no employer or whose employer is not a registered host institution.

3. Students pursuing the postgraduate degree (not obtained by the deadline for NSFC submission) cannot apply for any fund as the PI. However, with the supervisor's consent, in-service personnel can apply for certain categories of programs through the employment institution. The applicant should submit the hard copy of application with the following attachments: signed certification of the supervisor's consent which explains the connection between the dissertation and the proposal, and the guarantee of working hours and conditions after the project starts, etc. In-service personnel pursuing postgraduate degrees whose host institution is not a registered host institution cannot apply for any fund as the PI.

In-service personnel pursuing postgraduate degrees can apply for the following program types: General Program, Young Scientists Fund, and Fund for Less Developed Regions. But in-service personnel pursuing the master degree cannot apply for Young Scientists Funds.

4. Researchers with overseas identity who are employed at the host institutions cannot apply for or participate in NSFC programs both as the

international or regional collaborator and domestic researcher at the same time. If the researcher is funded by the Joint Research Fund for Overseas Chinese Scholars and Scholars in Hong Kong and Macao, or the International (Regional) Joint Research project (including Key International (Regional) Joint Research Program and International (Regional) Joint Research Program under Agreements/MoUs) as the foreign PI, he or she cannot apply for other types of program as the PI before these projects are completed, vice versa. If the applicant has on-going projects other than these two types, he or she cannot apply for Joint Research Fund for Overseas Chinese Scholars and Scholars in Hong Kong and Macao, or participate in the International (Regional) Joint Research project (including Key International (Regional) Joint Research Program and International (Regional) Joint Research Program under Agreements/MoUs) as the foreign PI.

5. Researchers employed at postdoctoral research centers can apply as PIs for the following programs only: General Programs, Young Scientists Fund and Programs of Joint Funds.

6. To avoid duplication of funding, NSFC Department of Management Sciences and National Social Science Fund shall jointly limit applications. Please refer to Page 52 of this *Guide* for detailed requirements.

ii. Requirements on applications

1. The proposal shall be prepared by the applicant in person and in accordance with the outline. The applicant and the main participants should fill in their CVs accordingly. Please note that any unlawful or confidential content shall not appear in the proposal. The applicant shall be responsible for the authenticity and legitimacy of the proposal submitted.

2. In accordance with program types, the applicant shall make correct choice of the "funding category", "subclass introduction" and "annotation". Content that requires "choosing" can only be chosen in the pull-down menu; content that requires "filling out" can be written in words; some program's annotation attachments should be written strictly in accordance with this *Guide*.

3. **In 2019, pilot category-specific application and review based on the four scientific natures of research will be adopted for the whole Key Program and General Program in selected disciplines.** When preparing proposals for the abovementioned Programs, applicants shall choose one out of the four scientific natures according to the critical scientific problem they aim to solve and the research they hope to conduct, and justify their choice in the proposal. When the proposed research fits multiple scientific natures, applicants

shall choose one that best describes the characteristics of their proposed research. For detailed requirements, please refer to "2019 NSFC Reform Initiatives" in this *Guide*.

4. In 2019, applications for Key Program and Excellent Young Scientists Fund will continue to be paperless; and **Young Scientists Fund will be incorporated into pilot paperless application**. In process of the submission, the host institution shall only confirm the online application and the attachments, without having to submit a hard copy. After the project has been approved, the signature and seal page of the application form shall be attached to the Project Plan and submitted. The signature and seal information shall be consistent with that of the electronic application.

5. **In 2019, Letter of Commitment to Scientific Integrity is incorporated into the application. Only after the letter is signed by the applicant, main participants, host institution and cooperative institutions, can the application be submitted.** For programs with pilot paperless application, the applicant shall sign the letter electronically and submit it online to the host institution, and the host institution shall sign the letter to confirm and submit the application to NSFC.

6. **If the proposed research involves issues related to scientific research ethics and scientific and technological security (such as biosecurity, information security, etc.), the applicant shall strictly follow relevant national laws, regulations and codes of ethics.** For applications involving scientific research ethics and scientific and technological security, the applicant shall provide the corresponding attachment materials in accordance with the requirements of relevant scientific departments (the electronic version of the application shall be accompanied by a scanned copy).

7. For 2019, some modifications have been made on the application codes. Applicants shall choose the appropriate code from the "National Natural Science Foundation Application Code" in the appendix of this *Guide* in accordance with the research direction or research field. Particular attention shall be paid to:

(1) When choosing the code, try to select the full code including the last digit (six or four digits).

(2) "Application Code 1" is reference for deciding NSFC's accepting department and selecting the panel experts. "Application Code 2" is supplementary. For some programs, applicants shall choose designated Application Code 1 or 2.

(3) Key Programs, Major Research Programs and Joint Funds Programs, etc., have special requirements for the application code. For details, please refer

to the relevant sections in this *Guide*.

(4) NSFC further promotes the standardization of "application code", "research direction" and "key word". Applicants should accurately select "Application Code 1" and the corresponding "research direction" and "key word" when filling out the proposal form.

(5) For any questions in regard to the application code, please contact relevant scientific departments.

8. The hard copy of application (except for the type of pilot paperless application) should be signed by the applicant and main participants. For participants outside the host institution (including post-graduates), their work places are seen as collaborative research institutions whose information shall be included in the proposal's basic information form and whose official seal should be included on the sign and seal page. The name of the institution and that on the seal shall be identical. The official seal should be used, if the institution is registered at NSFC, and the corporate seal should be used if otherwise (except for the type of pilot paperless application).

The foreign researchers as the main participants shall be seen as individual participants and their foreign work places should not be seen as collaborative research institutions. If the researcher is unable to sign in person, a paper document with the signature, stating his or her consent to participate and perform the related responsibilities, shall be sent via mail or fax and submitted with the paper form proposal as attachments (except for the type of pilot paperless application).

The number of any proposal's collaborative institutions shall not exceed two (unless specified otherwise).

9. Applicants and the main participants with a senior academic rank (title) shall indicate in the proposal if:

(1) They have more than one host institution when applying or participating in NSFC projects in one year;

(2) They have different host institutions for on-going NSFC projects.

10. If a research has received funding through other sources, the applicant should specify the funding details and their difference and connection with the current proposal. Applying for funding from different funding agencies for the same research content should be avoided.

If an applicant applies for different types of NSFC programs during the same year, he or she should specify in the application the other NSFC program applications, their titles and information, and the connection and difference with the current application.

11. The start time for research in proposal shall be January 1, 2020; the finish time shall be December 31, 20xx, depending on the funding periods (unless otherwise specified in this *Guide*).

12. The applicant and the main participants shall use the same and only document of identity for application.

When filling in names of oneself and main participants, the applicant shall make sure the names are in standard characters and exactly the same as the ones on documents of identity. Those who have received funds as applicants or main participants using other identification shall declare and provide details in the proposal. Host institutions are accountable for verification.

iii. About application reception conditions

According to the *Regulations*, the application for NSFC funds shall not be accepted under any of the following circumstances:

1. The applicant does not meet requirements stated in the *Regulations*, *Guide* and relevant management methods.

2. The application materials do not comply with conditions in this *Guide*.

3. The number of proposals does not comply with the Application Limit's conditions.

II. Requirements on scientific integrity

To enhance scientific research integrity, further strengthen basic information management and prevent scientific misconduct in science fund application, NSFC proposes instructions and requirements on scientific integrity to be followed.

i. About personal information

1. The science fund project shall be applied for by the applicant himself or herself. It is strictly prohibited to apply under another's name, or fabricate false applicants and main participants.

2. Applicants and main participants shall truthfully fill in the personal information and be responsible for its authenticity; at the same time, the applicant shall also be responsible for the authenticity of the personal information of all the main participants. It is strictly prohibited to forge or provide false information.

3. The academic degree information of applicants and main participants shall be consistent with on the diploma. The time of degree acquisition shall be

the same as on the diploma.

4. Applicants and main participants shall faithfully and accurately fill in the title information of their formal employment at host institutions. Forgery or providing false title information is strictly prohibited.

5. Applicants who are unemployed or whose employer is not a registered host institution shall truthfully fill in the work unit and the employment information. Giving false information is strictly prohibited.

6. Applicants and main participants shall faithfully and accurately complete their curricula vitae. It is strictly prohibited to forge or alter relevant information.

7. Applicants shall accurately provide the information of their postgraduate and postdoctoral (including visiting fellow) tutors, and fill in the names and titles separately.

ii. About research content

1. The applicant shall fill out the body part of the proposal in accordance with the *Guide*, instructions indicated in the online application system and requirements of the outline, and faithfully fill in relevant research work and research contents. Plagiarism or fraud is strictly prohibited. Violation of law and regulations, codes of ethics and regulations regarding S&T security is also strictly prohibited.

2. When filling in the research achievements such as papers, patents and awards, the applicant and main participants shall strictly follow the requirements of the outline, list the names of all authors (or inventors) of the research results following the rules for order, mark them accurately, and shall not alter the order of authors (or inventors), falsely mark first or corresponding authors, or omit marking co-first authors or corresponding authors.

3. Applicants and main participants shall strictly abide by the academic norms and codes of conduct recognized by the scientific community and shall not include research results that are generated from scientific misconducts such as forgery, tampering, plagiarism, entrusting “third party” to compose or submit the proposal, and peer-review fraud as the basis of applying for science funds.

4. Proposals with same or similar research contents shall not be submitted by different applicants through different host institutions to apply for different types of programs simultaneously. Projects that have already been funded are not allowed to be proposed.

5. If the research content has been funded through other channels or programs, applicants shall state the funding situation and the difference and

connection with the proposed project in the application. Applicants shall not submit the same research content to different funding agencies.

iii. Other relevant requirements

1. Applicants shall inform main participants of the relevant contents of the application and the scientific integrity requirements, so as to ensure that main participants fully understand the relevant contents of the application and are responsible for the authenticity, completeness and compliance of the contents involved.

2. Host institutions and collaborative institutions shall implement the requirements of the "Several Opinions on Further Strengthening Scientific Integrity" issued by the General Office of the CPC Central Committee and the General Office of the State Council, examine and verify application materials more strictly, and eliminate exaggeration and falseness and even fraud.

3. Prior to submitting the proposals, applicants and main participants together with host institutions and cooperative institutions shall pledge not to be involved in any form of activities that will be likely to impact the fairness of review.

III. Responsibilities of host institutions

1. Host institutions should strictly abide by the *Regulations, Guide, Regulations on Fund Management of National Natural Science Fund Host Institutions*, other relevant notices and management methods and Funding Management Method, Budget Preparation Notes and Notes on National Natural Science Foundation of China Program Budget Form.

2. Host institutions shall implement "Several Opinions of NSFC on Further Strengthening the Science Fund Management of Host Institution", seriously fulfill the responsibilities of management, and strengthen and standardize science fund management.

3. **Host institutions shall establish a mechanism on scientific research ethics and science and technology security review to prevent ethical and security risks.** In accordance with relevant laws, regulations and codes of ethics, host institutions shall establish and improve scientific research ethics and scientific and technological security management systems; strengthen ethical review mechanism, process supervision, and liability system for biosecurity, information security and other scientific and technological security; improve the

sense of responsibility and legal awareness of scientific research personnel with regard to scientific research ethics, science and technology security, etc., through publicity, education and training.

4. Host institutions are held accountable for the eligibility of applicants, and shall examine and verify the authenticity and completeness of proposals. No confidential content shall be included in the proposal.

5. Host institutions that allow applicants without employer or whose employer is not a registered host institution as listed in Article 10 Clause 2 of *Regulations* to apply for funds via their institutions shall bear the responsibilities listed in Article 13 of *Regulations*, sign the written contract and attach it to the proposal.

6. **When submitting hard copy of applications, host institutions shall also submit *Letter of Commitment to Scientific Integrity by Host Institution* that is signed by the legal representative and sealed, with the list of proposed projects enclosed.** Proposed projects shall be listed separately as pilot paperless application and paper application. Incomplete application will not be accepted by NSFC.

IV. Accountability

1. Applicants and main participants violating the abovementioned requirements and commitments, once discovered, shall be punished depending on the severity of the situation by NSFC in accordance with the provisions of the *Regulations* and the *Guide*. Those suspected of scientific research misconduct as forgery, falsification, plagiarism, and research results generated from entrusting "third party" to compose or submit the proposal and peer review fraud will be transferred to NSFC Supervisory Committee for investigation and handling.

2. Host institutions that neglect management and fail to perform the duties of examining the authenticity, completeness and compliance of the application materials, or host institutions and cooperative institutions violating commitments, shall be punished depending on the severity of the situation by NSFC in accordance with the *Regulations*, *Guide* and other provisions.

Application Limit

I. Application limit in general

1. Applicants shall only apply for one type of program once in a year, excluding Integrated Program and Strategic Research Program in the Major Research Plan, Scientific Activity Program in Special Program and International (Regional) Exchange Program; for Joint Funds, the same type refers to the same program title.

2. Applicants cannot apply for the same type of program if they received funding for General Program, Key Program, Major Program, Major Research Plan Program (excluding Integrated Program and Strategic Research Program), Program of Joint Funds (referring to the Joint Fund with the same name), Fund for Less Developed Regions, and International (Regional) Joint Research Program (unless otherwise notified) as the PI in the previous year.

3. For Special Fund for Research on National Major Research Instruments (department recommendation) or Basic Science Center Program, applicants shall only apply for one project in the same year.

4. Applicants and main participants shall only apply for and participate in one project for Funds for Creative Research Group or Basic Science Center Program in the same year.

II. One-year suspension from application after unsuccessful application for the General Program for two consecutive years

Applicants with unsuccessful application for the General Program both in 2017 and 2018 (including eligibility rejection) cannot apply for General Program as the PI in 2019.

III. Restriction on the total number of projects for researchers with a senior academic rank (title) applying for and undertaking

i. Limit for researchers with a senior academic rank (title)

The total number of the following programs a researcher with senior academic rank (title) applies for (including as applicant and main participant) and undertakes (including as applicant and main participant) shall not exceed three: General Program, Key Program, Major Program, Major Research Plan (excluding the Fostering Program and Strategy Research Program), Program of Joint Funds, Young Scientists Fund, Fund for Less Developed Regions, Excellent Young Scientists Fund, National Science Fund for Distinguished Young Scholars, Key International (Regional) Joint Research Program, International (Regional) Joint Research Program under Agreements/MoUs with direct cost of more than 2 million yuan per project (only the PI are counted, main participants are not counted), National R&D Program for Major Research Instruments (including Special Fund for Major Research Instruments and Special Program of National Major Research Instruments), Basic Science Center Program, and Emergency Program and Special Program with funding period of over one year (unless otherwise specified; and except for the bureau (division) ad hoc task and soft research projects under Emergency Program, and scientific activities projects under Special Program).

ii. Limit for researcher without a senior academic rank (title)

1. The total number of projects a researcher applies for or undertakes as the PI should not exceed one. The PI of Young Scientists Fund Program can apply for General Program in the last year of the program. During the stage of application, the Excellent Young Scientists Funds and National Science Funds for Distinguished Young Scholar are not counted. They are counted after the formal application and before NSFC makes the final funding decision, and also after the approval.

2. Under the premise of adequate time and energy, the total number of projects a researcher applies for or undertakes as main participant is not limited.

3. In case a researcher receives the senior academic rank (title), the projects he or she undertakes as the PI shall be counted into the total number whereas those a researcher undertakes as the major participant shall not.

iii. Special requirements for some types of programs

1. Excellent Young Scientists Fund Program and National Science Fund for Distinguished Young Scholars

At the stage of application, Excellent Young Scientists Fund and National Science Fund for Distinguished Young Scholars are not counted, but are counted before receiving NSFC’s formal funding decision and after approval.

2. Basic Science Center Program

At the stage of application, Basic Science Center Program is not counted, but is counted before receiving NSFC's formal funding decision and after approval.

The PI and main participants (key members) shall not apply for any NSFC grants before the awarded project concludes except for National Science Fund for Distinguished Young Scholars and Excellent Young Scientists Fund, neither can they use similar materials to apply for any S&T Programs.

The PI and main participants with senior academic rank (title) who is funded by Science Fund for Creative Research Groups shall not apply for Basic Science Center Program; however, application is allowed in the year of conclusion.

3. Special Fund for Research on National Major Research Instruments

Researchers with senior academic rank (title) shall apply (as applicant and main participant) for Special Fund for Research on National Major Research Instruments only once in the same year.

When funded, the PI shall not apply for any other NSFC funds other than the National Science Fund for Distinguished Young Scholars before the awarded project concludes.

The total number of Special Fund for Research on National Major Research Instruments (including Special Program on National Major Research Instruments) and the National Major Instrument Equipment R&D Program by Ministry of Science and Technology a researcher applies for (including as applicant and main participant) and undertakes (including as PI and main participants) shall not exceed one.

4. International (Regional) Cooperation Program

PI who undertakes an International (Regional) Cooperation project shall not apply for this type of program as applicant.

IV. The limit on the PI for accumulated number of funding

1. For Young Scientists Fund, Excellent Young Scientists Fund, National Science Fund for Distinguished Young Scientists, and Science Fund for Creative Research Groups, the applicant can receive the funding only once.

2. Beginning from 2016, for Fund for Less Developed Regions, the applicant's accumulated number of funding cannot exceed three. Projects approved in and before 2015 are not counted.

V. Programs not subject to the total number limit

There is no number limit for Science Fund for Creative Research Groups, Joint Research Fund for Overseas Chinese Scholars and Scholars in Hong Kong and Macao, Tianyuan Fund for Mathematics, International (Regional) Joint Research Program under Agreements/MoUs with direct cost of no more than 2 million yuan per project, International (Regional) Exchange Program, Research Fund for International Young Scientist, ad hoc and soft projects by bureaus and divisions under Emergency Program, scientific activity projects under Special Program, other types of program with funding period of no more than 1 year, and other programs specified in this *Guide*.

Special notice

1. During the evaluation period (prior to NSFC's final decision), the proposal shall be counted in the total number limit.

2. In the case that applicants engaged in multiple host institutions apply for or undertake through different host institutions, the Limit is still applicable.

3. In case of an inconsistency between other management regulations and this Limit in terms of total project numbers, the latter shall prevail.

Contents

General Program

General Program supports scientists to do basic research on bottom-up based topics within the funding scope of NSFC to conduct innovative research and promote a balanced, coordinated and sustained development of all disciplines.

Applicants should meet the following qualifications:

(1) With the experience of undertaking basic research projects or doing basic research;

(2) Have senior professional title or PhD degree, or are recommended by two professionals with senior academic positions (titles). Post graduate students are not eligible to apply for the General Program, but part time graduate students may apply through their employers if agreed upon by their supervisors.

Applicants should be familiar with the current situation of relevant research in China and the world, capable of leading a research group to conduct research. Applicants should follow the guideline to prepare proposals. The proposed research should be of significance and feature scientific merits, sound thematic basis, new ideas, identical objectives, reasonable and detailed research contents and feasible research schemes. The number of collaborative institutions for General Program projects should not exceed 2, and the duration of General Program projects is 4 years (except for PIs as in-site post-doctoral researchers, whose duration of the project should be determined based on the written commitment from the host institutions, and start time should be January 1, 2020 and finish time should be December 31, 20XX). The funding of the General Program projects in 2018 is shown in the table below.

In 2018, NSFC funded 18,947 General Program projects, with direct cost of 11.15289 billion yuan. The average funding intensity was 588,600 yuan per project. The number of funded projects increased by 811 over 2017 with an increase rate of 4.47%. The success rate was 20.46%, which is 2.13% lower than that in 2017 (22.59%). Please refer to the sections of each department for detailed funding information about General Program.

In 2019, NSFC selects certain disciplines in the General Program to implement the pilot application and review based on 4 natures of science topics. For more information on the trial disciplines for General Program, please

refer to the table in “2019 NSFC Reform Initiatives”.

When preparing the application for General Program in trial disciplines, the applicant should select the nature of science topic based on the key scientific problems to be solved and the research content, and clarify the reasons for choosing the science nature concerned. In the case of multiple science genres, the applicant should choose the science nature that **best matches and summarizes the application.**

NSFC shall organize respective review by experts based on the science nature the applicant chooses.

The average funding intensity for direct cost for General Program is basically the same as that in 2018. Please refer to the sections of each department for detailed funding information about General Program. Applicants are advised to prepare their research proposals in line with the instructions by respective science departments on funding scale.

Funding of the General Program Projects in 2018

Unit: 10,000 yuan

Departments	No. of applications	Awards				Success rate (%)
		No. of awards	Funding for direct cost	Average funding for direct cost	Share of NSFC total funding for direct cost (%)	
Mathematical and Physical Sciences	6,544	1,743	104,640	60.03	9.38	26.64
Chemical Sciences	7,811	1,737	113,180	65.16	10.15	22.24
Life Sciences	12,664	3,048	177,470	58.23	15.91	24.07
Earth Sciences	7,111	1,895	117,210	61.85	10.51	26.65
Engineering and Materials Sciences	16,863	3,199	192,088	60.05	17.22	18.97
Information Sciences	10,558	2,007	120,037	59.81	10.76	19.01
Management Sciences	4,519	803	38,544	48.00	3.46	17.77
Health Sciences	26,552	4,515	252,120	55.84	22.61	17.00
Total or average	92,622	18,947	1,115,289	58.86	100.00	20.46

Department of Mathematical and Physical Sciences

Mathematical and physical sciences are important foundations of natural science, and the precursor and basis for the development of contemporary science. In their own development, mathematical and physical sciences also provide theories, methods and means for other disciplines. Research findings in mathematics and physics play a key role in promoting the progress of both basic and applied scientific disciplines. Disciplines in mathematical and physical sciences are peculiar in characteristics, such as big differences between or among disciplines, and pure theoretical research (such as mathematics, theoretical physics, etc.) and experimental studies. Many disciplines feature "mega-science", such as high-energy physics, nuclear physics, astronomical physics, high temperature plasma physics, etc.

Mathematical and physical sciences have extensive interactions with other sciences, for example, with information science, life science and management science, physics with materials science, life science, information science and chemistry, astronomy with earth science, and mechanics with engineering science, material science and earth science. The interactions produce a series of interdisciplinary and cross-boundary disciplines and new research areas have emerged, and at the same time research objects and areas in mathematical and physical sciences are also expanding.

The Department will continue to increase its support on basic research that takes as its primary goals advancing the disciplinary development, promoting original innovation and training talented researchers and meeting the needs of national long-term development, as well as interdisciplinary research within the Department and with other departments.

In 2018, the Department received 6,544 applications for General Programs, which is 740 more than 2017, increasing 12.75%. 1,743 projects were funded, the funding rate was 26.64%, and the funding per project was 600,300 yuan in average. The funding per project was 520,000 yuan for mathematics, 633,100 yuan for mechanics, 631,500 for astronomy, 631,000 for physics I and 631,000 for physics II.

According to the strategic needs of the development of mathematical and physical sciences and the overall plan of project funding, the Department has taken some measures in project funding performance and has strengthened macro guidance. In 2019, the Department will continue to pay attention to the following aspects:

(1) Emphasize on fostering outstanding young talents. In 2018, the PIs under the age of 40 in General Program projects reached 54.79%. In 2019, the Department will further increase funding for young researchers and expand funding scale for applicants under age 40, so as to have more young scientists funded and improve their research capability.

(2) Give more emphasis on creative research and disciplinary development. Multi-level funding to suit the needs of research will be adopted. More funding will be given to studies on developing experimental methods and techniques with innovative ideas aiming at the actual needs. We advise applicant to pay attention to this policy.

(3) Strengthen macro planning, and give preferential support to basic problems in frontier areas and mathematical physics problems in areas of major national needs, so as to

promote sustainable development in these areas.

In 2019, preferential support will be given to the following areas:

(i) Key scientific problems in new types of energy;

(ii) Key scientific problems in deep space exploration, aerospace, and marine sciences;

(iii) Innovative research in defense and civil military integration;

(iv) Human health;

(v) Modeling, algorithm and analysis of big data and deep learning;

(vi) Key technologies for physics and detection of gravitational wave;

(vii) New computation method and standard software;

(viii) Advanced method and key technology of experimental research and development of new instruments.

Funding for General Program Projects in Department of Mathematical and Physical Sciences in 2017 and 2018

Unit: 10,000 yuan

Divisions		2017			2018		
		Projects	Direct cost	Success rate (%)	Projects	Direct cost	Success rate (%)
Mathematic	Mathematics I	229	10,990	30.41	226	11,752	27.70
	Mathematics II	240	11,520	27.52	263	13,676	25.81
Mechanics	Basic problems and methods in mechanics	8	498	29.63	9	572	25.71
	Dynamics and control	67	4,276	28.76	67	4,236	26.48
	Solid mechanics	142	9,179	28.34	160	10,138	26.53
	Fluid mechanics	83	5,433	28.42	82	5,183	26.54
	Bio-mechanics	26	1,707	28.26	29	1,832	26.85
	Explosive and impact dynamics	37	2,411	28.91	36	2,286	26.47
Astronomy	Astrophysics	49	3,149	29.52	49	3,113	28.00
	Astrometry and celestial mechanics	38	2,497	28.79	54	3,391	25.84
Physics I	Condensed matter physics	217	14,085	28.78	220	13,924	26.54
	Atomic and molecular physics	49	3,170	29.34	45	2,836	26.63
	Optics	127	8,204	28.86	133	8,352	26.65
	Acoustics	45	2,901	29.03	40	2,526	27.03
Physics II	Fundamental physics and particle physics	84	5,047	28.97	96	5,707	28.07
	Nuclear physics, nuclear technology and its applications	97	6,195	28.53	97	6,175	26.15
	Particle physics and nuclear physics experimental facilities	69	4,972	28.40	74	4,840	25.52
	Plasma physics	66	4,246	30.14	63	4,101	27.04
Total or average		1,673	100,480	28.82	1,743	104,640	26.64
Direct cost per project		60.06			60.03		

Please indicate the research directions in the note section of the application form when applying for these projects, and choose the proper application code.

(4) As the governmental investment in the National Natural Science Fund is changing, the average funding for mathematical and physical research projects will also be changed accordingly. Please see the following table for average funding intensity for General Program projects for reference. The funding intensity for experimental research projects will be higher than that of theoretical research projects.

In 2019, the average funding per project for General Programs will be the same as 2018.

In 2019, the Division of Physics I will use experiment on new method of application and evaluation. For detailed information, please refer to "2019 NSFC Reform Initiatives" in this *Guide*.

Division of Mathematics

The Division encourages creative research on important issues in the mainstream and frontier of mathematics, explorations of new ideas, new theories and methods in mathematics and interdisciplinary applications, inter-crossing of different branch disciplines with mathematics, and applied mathematical research on practical issues. Applicants are required to have sound research background and capability. Proposal should be prepared based on deep understanding of the current status of the research involved, main issues and relevant research methods and available approaches. The Division encourages researchers to consolidate research team, foster talents and promote academic exchanges through the funded research projects. Research direction adjustment is allowable when needed.

For basic mathematics, the funding aims at maintaining stable development of research directions where China is traditionally strong and has comparatively large-scale research capability, promoting fast development of research areas that are within the mainstream of international mathematical research but relatively weak in China, and promoting interdisciplinary research among branches of mathematics. Focus is given to algorithm, grid theory and its algorithm, geometrical method in representation theory, comparative geometry and geometric analysis in non-smooth space, application in of modern harmonic analysis in number theory, associate geometry and geometric measure, random analysis method and application, and mathematical problems in quantum field theory.

The funding for applied mathematics and computational mathematics aims at improving applications in solving practical problems, and gives more emphasis on basic theory and new methods with strong practical background and sound potentials for application. NSFC encourages mathematical modeling of practical problems, analysis and computation, and statistical methods and theory for big data, supports research on mathematical physical logic, algorithm complexity, discrete probability modeling, optimal algorithm, and combinational algorithm. Focus is given to applied researches such as mathematical modeling and theory of new materials, uncertainty theory in data processing, coding theory and information security, mathematical modeling and analysis in environmental and energy sciences, bio information and life system, pathogenesis and

control of infectious disease, mathematical methods for complex bio process and development of diseases, statistical methods in industry and medical science, statistical and optimization method in deep learning and artificial intelligences, modeling and analysis in economic prediction and financial risk management, and mathematical theory and new method for industrial, medical imaging and image processing.

Division of Mechanics

The Division mainly supports research on basic problems and methods in mechanics, studies in areas of branches of mechanics such as dynamics and control, solid mechanics, fluid mechanics, biomechanics, explosion and impact dynamics. The Division supports projects with creative ideas in the frontiers of mechanical research on the one hand and projects closely related to the sustainable development of economy, society and national security, and the development of engineering and technology on the other hand. The Division encourages experimental research using the available experimental facilities and key labs in China and advocates interdisciplinary research conducted by scientists from different disciplines.

Research on basic issues and methods in mechanics should focus on theoretical studies on mathematical methods, rational mechanics and physical mechanics, and strengthen the intercrossing with mathematics and physics.

Applications for research in areas of dynamics and control should pay attention to the theory and methods of nonlinear dynamics, strengthen research on vibration and control of complex systems, dynamic modeling and analysis of problems involving the coupling of solid, flexible bodies, fluid, and magnetic bodies, and promote development of non-smooth and multi-body system dynamics. The Division encourages studies on key issues of dynamics and control problems in major engineering projects, and encourages experimental studies on dynamics and control.

Applications in the area of solid mechanics should give more consideration to intercrossing with physics, materials science, chemistry, information and biological sciences, and strengthen on proposing and studying topics in major engineering application, expand basic theory of continuum mechanics, and promote the development of multi-scale mechanics and multi-field coupled mechanics. Proposals in such areas will be encouraged as follows: the constitutive theory of materials at macro, meso and micro scales; the theory of strength, crack, fatigue and failure mechanism; the mechanical behavior of new materials and structures; experimental measurement techniques and representation methods, new theory and method in computation mechanics and high performance computational software; structural optimization, completeness and safety evaluations, and the deformation, damage mechanism of rock and soil media and stability of rock mechanical engineering, etc.

Applications in fluid mechanics should pay attention to studies on the laws and mechanisms governing complex flows. The Division encourages researches on rarefied gas flow, hypersonic aerodynamics, aerodynamic noise, especially theory, simulation and experimental studies on high temperature, high pressure and compressible turbulent flow, high speed hydrodynamics, multi-phase complex flow, and key fluid dynamic problems in aerospace, energy and ocean, environment and disaster, and transportation areas.

Applications in biomechanics should pay attention to bio mechanical and mechanical biology problems related to human health and disease and sport competitions, biomechanical mechanism and transformation medicine related to non-infectious diseases such as cardiovascular, bone joint and cancer, and studies on new theory, methods and technologies in experimental studies on biomechanics.

Applications for explosive and impact dynamics should pay attention to frontier areas and major national needs, closely focus on the safety issues of relevant engineering projects, and strengthen theoretical and experimental studies on the dynamic mechanical behaviors of materials, structural response to explosive impacts and detonation mechanisms, dynamic loading and diagnosis.

The Department continues to support studies on instruments, new experimental methods and techniques with innovative ideas. Applicants for this type of application should mark "Experimental Techniques and Instruments" in the application form. The Department will keep supporting projects in computational software development, giving stress on the integration and standardization research on the development of the computational mechanics software which may produce independent or shared IPR. Applicants for this type are requested to mark "Computational Mechanics Software" in the application form. Applicants of the above two types of projects should have relevant research background.

Division of Astronomy

The Division mainly supports researches on astrophysics, basic astronomy, astronomical instruments and technology. In accordance with the trend of astronomical development in the world and the present situation in China, the Division supports research proposals with emphasis on the development of technology and instrumentation. Studies based on existing observation apparatus or facilities to be built soon in China will be encouraged. The Division promotes the combination of innovative ideas, observation and theories, and studies on new technologies and methodologies for astronomy, especially those closely related to mega-science projects under construction in China. Interdisciplinary research is strongly encouraged so as to gradually build up research teams with special features and influence in international scientific communities. International cooperation and exchange will be given much attention.

In the General Program projects funded in recent years, a good balance has been achieved between astrophysics (including galaxies and cosmology, stellar and the Galaxy, solar and extra solar planetary system, and solar physics), basic astronomy (including astrometry and celestial mechanics) and astronomical technology and methods (including the history of astronomy). Young researchers have become the main force in astronomical research and more than half of the awardees are under the age of 40.

In 2019, in addition to strengthening continuous support for projects integrating theory and observation and projects conducted by young scientists, the Division will emphasize on interdisciplinary research with physics, space science, earth science and information science, etc., maintain support on research on advantageous directions, promote research related to using large observatory facilities in China, and foster research topics that have the potential of making breakthroughs. The Division encourages research on basic

physical process on celestial bodies, celestial chemical evolution, and celestial bodies in the solar system, extra solar system planetary system, infrared astronomy, space astronomical measurement, and astronomical research that addresses the national needs. The priority will be given continuously to researches in basic astronomy, astronomical technology and methods, and to relative small scaled astronomical research institutions.

In the next few years, the Division plans to give special support to pre-research around the research based on equipment that has already been built or being built, and conceptual studies on new technologies that are urgently needed for large-scale telescope and space exploration. For applicant in these research areas, please mark "Major S&T Basic Facilities Project" or "New Astronomical Technology" in the application forms.

Division I of Physics

The funding scope of the Division covers research on condensed matter physics, atomic and molecular physics, optics, acoustics and new research areas formed between these four disciplines and other disciplines.

According to the current status and requirements of disciplinary development, the Division pays attention to study on experimental methods and techniques motivated by creative ideas, encourages researches in new computational methods and simulation software closely related to experimental physics and explorative types, key basic physical issues serving national needs, and new physical concepts and methods in interdisciplinary areas. We encourage especially in-depth and sustained studies on important physical problems that have not become hot topics, and researches in basic physical problems on devices, and new areas and directions.

For the funding in condensed matter physics, the Division will pay attention to quantum physics in electron related systems, macro quantum phenomenon, quantum phenomena and quantum effects in various low dimensional and small-scale systems, solid state quantum information and quantum computation, strengthen self-spinning and magnetism, topological state, physics and device physics and advanced technologies and methods of characterization, structural and physical properties of surface and interface physic in extreme conditions, and physical problems in energy transformation, transport, and storage, and expand physics and application of advanced functional materials. Encouraged areas include physical issues and experimental methods related to soft matters, biophysics, and AI. We pay special attention to creative studies on material, device and physics having important application prospects.

For areas of atomic and molecular physics and optics, the Division encourages researchers to pay attention to atomic, molecular and cluster structures and dynamics, interactions of atomic and molecular systems, interactions between laser and atoms, propagation process of light in new media and its characteristics, quantum frequency markers, quantum metrology, quantum information, physics and methods of precision atomic and molecular spectra and precision measurement, strengthens basic and applied research on high resolution, high sensitivity laser spectrum, cold atom and molecule and its interaction with light field, micro nano photonics, optical mechanics, and surface plasma exciter, optical field regulation. The Division encourages research on frontier physical

issues in photonics and optical electronics and interdisciplinary subjects.

In the area of acoustics, according to the major needs, studies on key fundamental acoustic problems will be encouraged. Physical acoustics and interdisciplinary research in marine acoustics, ultrasonic and acoustic effect, noise and control, new acoustic materials and devices, acoustic energy exchanger, and issues in information technology, etc., will be in priority.

In 2019, the Division will use experiment on new method of application and evaluation. For detailed information, please refer to "2019 NSFC Reform Initiatives" in this *Guide*.

Division II of Physics

The Division mainly supports research on fundamental physics, particle physics, nuclear physics, nuclear technology, accelerator physics and detectors, plasma physics, and synchronized radiation techniques and methods.

For fundamental physics, funding will be focused on original studies and interdisciplinary research with other disciplines. Emphasis will be given to important theoretical physical issue arising from scientific experiments and applications.

For particle physics and nuclear physics, the Division will support creative theoretical and experimental research, in particular, the combination of theoretical and experimental studies related to selected large-scale experimental facilities that are in operation, upgrading or to be completed soon both in China and abroad. Funding will be used to guide research towards the understanding of important physical rules related to the latest experimental results, such as the theory and experiments of phenomenology in particle physics and interdisciplinary research of nuclear physics under extreme conditions with nuclear astrophysics and other disciplines.

For support to nuclear technology, accelerator and detector, low-temperature plasma and synchronized radiation method and technology, it is hoped that fundamental issues should be drawn from the disciplinary development, national demands and intercrossing with other disciplines, which may facilitate a deeper understanding of physical laws underlying the development of the disciplines and important applications at the same time. Emphasis will be laid on key technologies and innovative ideas in methodology and intercrossing with other disciplines. In addition, the exploration of mechanisms and rules governing the interaction of matter with instantaneous, high energy, high power and strong field radiation (such as charged particles, X/γ, neutron and electromagnetic fields) are key areas for funding. Attention will be given to new acceleration principles, nanometer micro-beam, high power ion beam, strong current accelerators, plasma radiation source in accelerator and detector and plasma research, and physics and key technologies of all other advanced radiation sources. The Division gives strong support to new types of nuclear detection technology and method such as large area, high counting rate, high temporal resolution, low cost and weak signals, etc., and relevant studies on nuclear electronics.

For nuclear fusion and plasma physics, more attention will be given to the exploration of new diagnostic means related to large facilities which are in operation at present or will be built soon. In particular, basic research on advanced magnetic

confinement fusion and new approaches to inertial confinement fusion and related fundamental physical problems, and computer simulation and experimental studies of various kinds of plasma will be stressed.

In order to make more efficient use of limited funds, the Division encourages researchers all over China to make full use of big science facilities, small and medium equipment to conduct research, so as to achieve sustainable development in the research. The Division encourages experimental studies with innovative methods of high resolution diagnosis and detection, and, as well as the development of experimental facilities, detection and diagnosis devices which are important for the development of accelerators, detectors and gravitational wave detection. Applicants may increase the funding request in applications in these areas according to the actual needs. Projects with more young scientists involved in the research team under the same condition will be preferred.

In 2019, the Division provides special funding to support creative ideas on developing and improving instruments and equipment, advanced experimental technology and method, advanced method and key technology in nuclear exploration and nuclear electronics, and studies on radiation physics, radiation protection and environmental protection, etc.

Department of Chemical Sciences

Chemical Science is to study the composition, structure, property, reactions and transformations of matters; it is the fundamental means which creates new molecules and builds new materials, and it is the central science which is closely intercrossed and permeated with and into other disciplines. Chemical engineering is aimed to accomplish the transfer and conversion of matters and energy by making use of the principles of the basic disciplines, and to solve scientific issues raised in the large-scale production of chemical materials and products.

The mission of the Department is to improve the overall quality and international status of China’s fundamental research in chemistry and chemical engineering, and foster creative talents and groups in chemistry and chemical engineering research with international impact. The Department supports multi-level and multi-scale research on the reaction, process and function at different levels of atoms, molecules, molecular aggregation and condensed state, as well as studies on the complex chemical system, in order to realize the precise control and logic cognition of chemical synthesis, process and function. In accordance with major scientific problems arising from the national economy, social development, national security and sustainable development, research on chemical sciences and chemical engineering is encouraged for exploring their role in fields of life, materials, energy, information, resources, environmental science and human health. The Department emphasizes the combination of microscopic and macroscopic research, static and dynamic states, theoretical research and empirical development of novel experimental methods and precise analytical technologies, and fundamental experiments and process engineering. It is also encouraged to introduce the latest theories, technologies and achievements from other disciplines into the research in chemical science and chemical engineering for facilitating the sustainable development of research, fostering innovation and interdisciplinary studies,

and supporting the emerging frontiers in research.

Funding for General Program Projects in Department of Chemical Sciences in 2017 and 2018

Unit: 10,000 yuan

2017				2018			
Disciplines	Projects	Direct cost	Success rate (%)	Divisions	Projects	Direct cost	Success rate (%)
Inorganic Chemistry	200	12,883	26.60	Synthetic Chemistry	301	19,584	23.39
Organic Chemistry	241	15,520	25.72	Catalysis and Surface/Interface Chemistry	176	11,470	22.95
Physical Chemistry	316	20,353	26.51	Chemical Theory and Mechanism	116	7,561	22.22
Analytical Chemistry	169	10,884	25.72	Chemical Metrology	159	10,363	22.18
Macromolecular Science	143	9,211	26.58	Materials Chemistry and Energy Chemistry	293	19,099	21.40
Environmental Chemistry	199	12,818	26.46	Environmental Chemistry	214	13,948	22.02
Chemical Biology	79	5,095	27.43	Chemical Biology	134	8,734	22.04
Chemical Engineering and Industrial Chemistry	324	20,866	22.18	Chemical Engineering and Industrial Chemistry	344	22,421	21.92
Total or average	1,671	107,630	25.41	Total or average	1,737	113,180	22.24
Direct cost per project	64.14			Direct cost per project	65.16		

In 2018, new discipline codes were employed to conduct funding and management in the Department. 7,811 proposals for General Program were received by the Department (1,234 proposals and 8.76% more than that of 2017). 1,737 proposals were funded with a success rate of 22.24% and an average funding intensity of 651,600 yuan per project. In 2018, the success rate decreased by 3.17% compared with that of 2017 to guarantee the funding intensity by the Department. The proposals received and funded as well as their ratios in the main research orientations of chemistry and chemical engineering were almost at the same level to that of 2017. There was an increase in the received proposals related to the overlapping research areas such as materials and energy, life health and environmental resources.

The Department will continue to support high quality research in the cutting edge fields, lay stress on in-depth and systematic research work, give priority to interdisciplinary research projects, and emphasize the diversity of research ideas, methods and contents to avoid the convergence and homogenization. In addition, the Department will take effective measures to support original, creative and risky research, so as to foster the breakthrough innovation, unblock the bottleneck of chemical research in China and achieve the transition from high-quantity to high-quality research. In the review process, scientific merit will always be the core concept, and the balancing, coordinating and sustainable development of all related disciplines will be thoroughly considered as well. In 2019, the average funding intensity per project will be at the same level as that of 2018.

In 2019, the Department selected General Program for all the disciplines to

conduct classified application and review. For detailed information, please refer to "2019 NSFC Reform Initiatives" in this *Guide*.

Division I of Chemistry

The Division supports research in the field of synthetic chemistry.

Synthetic Chemistry

Synthetic chemistry is the science of studying the methods of material transformation and synthesis, which involves the synthesis and assembly of inorganic, organic, and polymeric materials. By controlling selectivity in the process of molecular creation and substance transformation, synthetic chemistry gradually realizes the precise preparation and application of new substances with specific properties and functions. As the basis and core of chemistry, synthetic chemistry actively expands the cross-integration with related disciplines and fields, promotes the solution of major scientific problems and boosts the national economic and social development.

Synthetic chemistry is oriented to the demand for new substances, new materials and new devices in chemical science and engineering, life sciences and health, materials sciences and engineering, information sciences and applications, energy and environmental sciences and engineering. The research focuses on the theoretical design, structural control, reaction process, synthesis and assembly methodologies with high efficiency and selectivity of function-oriented substances. The tasks include but are not limited to: (1) to synthesize various of compounds with specific structures and functions; (2) to learn from the biosynthesis and transformation process of living systems; (3) to develop new synthesis strategies by combining research methods and technologies of disciplines such as Physics; (4) to explore the mechanism and essential rules of the synthesis reaction and substance conversion process; (5) to establish relevant theoretical systems and experiment foundations. Synthetic chemistry takes green, economic, efficient and highly selective way as a goal, and makes the synthesis of new substances to be more precise and environmentally friendly. The development of synthetic chemistry will follow this trend and will pay more attention to human health, effective utilization of environmental resources and the sustainable development of society. The following directions are preferred: (1) synthetic chemistry driven by new reagents, new reactions, new concepts, new strategies and new theory; (2) synthetic methodology of atomic economy, green sustainability and precise control; (3) biological and biomimetic synthesis driven by chemical principles; (4) synthetic chemistry under unconventional and extreme conditions; (5) non-covalent synthesis based on intermolecular interactions; (6) molecular design and synthesis of novel function-oriented materials; (7) controllable synthesis and functionalization of macromolecules; (8) construction and function research of new compounds.

Synthetic chemistry sparkplugs the collaborative innovation of traditional disciplines such as polymer science, inorganic and organic chemistry. Original breakthroughs of basic research focusing on molecular creation and material transformation are encouraged in synthetic chemistry, as well as the original contributions to industrial applications.

In 2019, General Program of this Division was selected to conduct classified

application and review. For detailed information, please refer to "2019 NSFC Reform Initiatives" in this *Guide*.

Division II of Chemistry

The Division supports the research in the field of catalysis and surface/interface chemistry and chemical theory and mechanism.

Catalysis and Surface/Interface Chemistry

Catalysis and surface/interface chemistry is intended to study catalytic process and the structure and properties of the surface/interface and reveal the physical and chemical basic rules of catalysis and the surface/interface.

The areas funded by catalysis and surface/interface chemistry include chemical catalysis, surface chemistry, colloids and interfacial chemistry and electrochemistry. These areas involve surfaces, gas-solid interfaces, gas-liquid interfaces, liquid-liquid interfaces, liquid-solid interfaces and solid-solid interfaces and gas-liquid-solid multi-phase interfaces.

Supports in the field of chemical catalysis are focused on developing new concepts and catalytic theory, discovering new catalytic reactions, creating new catalytic materials, promoting the cross-over and fusion between multiphase, homogeneous and biological catalysis, fostering the rational design and regulation of catalytic active sites, developing new catalytic characterization methods and technologies with the features of in-situ, dynamic and high temporal-spatial resolution, and the coupling and integration during the catalytic reaction.

Surface chemistry mainly supports research on chemical and physical processes related to solid surface interfaces, as well as their correlative characterization techniques and methods. Encouraged research orientations include: solid surface/interface structure, performance and control; dynamics and energy transfer theory in the assembly and reaction at surface/interface; the new characteristic methods for physical and chemical process at surface/interface.

Colloid and interface chemistry supports the research on the following directions: (1) the usage of theoretical and computational methods, and advanced experimental techniques to reveal the essences of colloids and interface chemistry; (2) the design and synthesis of new surfactants and the construction of aggregation; the development of new dispersion systems; the understanding of assembly processes, interface adsorption and infiltration behaviors; (3) construction of a colloidal material with self-healing and outfield responsiveness; (4) the enhancement of basic research for application of colloid and interface chemistry in the fields of material, life science and environment science.

Electrochemistry mainly supports the following research: (1) the construction and characterization of electrochemical interface systems; the methods of in situ electrochemical spectroscopy with spatial and temporal resolution and the theory and simulation methods of electrochemical systems (2) surface/interface process in the manufacture of high-end electronics; (3) recognition and control of electric charge transfer, mass transport and conversion in electrochemical interface; (4) design, synthesis and characterization methods for electrocatalysts; (5) reveal of problems in the fields of electrochemical energy

conversion and storage, electrochemical synthesis, bioelectrochemistry and photocatalytic and electrochemical engineering.

Chemical Theory and Mechanism

Chemical theory and mechanism aims to establish and develop new chemical theory and experimental methods to reveal the mechanism and basic rules of chemical reaction and its related processes.

The areas supported by chemical theory and mechanics include theoretical and computational chemistry, chemical thermodynamics, chemical kinetics, structural chemistry, photochemistry and spectroscopy, chemical reaction mechanisms, polymer physics and polymer physical chemistry, and chemical informatics.

Theoretical and computational chemistry focuses on the new methods of electronic structure theory, dynamics and statistical mechanics, conducting theoretical design and computational simulation of complex systems such as material system and biology system, and the development of computational chemistry software. For chemical thermodynamics, there is a need to develop theory and experimental method that are applicable to complex systems, to reveal the intrinsic relationship between the thermodynamic properties and microstructure of the system, and to focus on the interdisciplinary study of the application of chemical thermodynamics in important fields. Research in chemical kinetics focuses on the development and utilization of new experimental and theoretical methods to explore the substantive characteristics of the chemical reaction and the non-adiabatic process during the reaction as well as the chemical kinetics in extreme conditions. Applicants are encouraged to conduct research employing advanced coherent light source and the work of ultrafast dynamics, microstructure and mechanisms of condensed phase. Applicants of structural chemistry are encouraged to focus on the study of structural characteristic methods, controllable synthesis and assembly, dynamic bonding and transformation. Research of photochemistry and spectroscopy should pay attention to develop spatial resolved, time-resolved and energy-resolved new technologies and their new assembly methods, and to the exploration of photochemistry mechanisms of new material system. The research of chemical reaction mechanism will be focused on exploring microscopic mechanism and basic rules of chemical reaction by means of theoretical chemistry, computational chemistry and experimental strategies, and illuminating mechanisms of molecule polarization, electron coupling and spin transition. Polymer physics and polymer physical chemistry mainly focus on the chain behavior and interaction of macromolecules, the evolution mechanism and control over different scales of the structure, the essence of the connection between microstructure and macroscopic properties. For chemical informatics, it is encouraged to develop new algorithms for the storage, retrieval, transformation and data mining of molecular structure information based on system principle by integrating with big data and artificial intelligence.

In 2019, General Program of the Division was selected to conduct classified application and review. For detailed information, please refer to "2019 NSFC Reform Initiatives" in this *Guide*.

Division III of Chemistry

The Division supports research in the field of materials chemistry and energy chemistry.

Materials Chemistry

Materials chemistry is to study the design, preparation, structure, property and application of materials. It is a bridge between chemistry and materials, energy, environment, life, medicine and information science. Material chemistry is the science basis of new material systems. Principles and methods of chemical sciences are used to design new materials at atomic and molecular levels and to develop preparation techniques and study the structure-activity relationships of materials. The preferred areas include: (1) to realize the control over the materials' micro/meso/macro-scopic properties by means of structure function transfer, integration and coordination at multi-scale and multi-level; (2) to study the creation of new high-performance and multi-functional materials as well as their applications in the fields of energy, health, environment and information.

Materials chemistry pays attention to the precise preparation of new materials with specific functions, accurate construction and control over the structure and properties of materials, the crossover and integration of multi-disciplinary, the correlation between structure and properties, and the investigation of the molecular basis of material systems using various characterization techniques. Material chemistry faces the major national needs and focuses on the deep utilization of characteristic resources in our country.

Study of material chemistry should focus on the development of functional materials, that have the characteristics of electricity, optics, magnetism, acoustics and thermology, and those related to biology, medicine and pharmacy. Attention should be paid to the optimization of structure design of new advanced materials as well as their preparation process using artificial intelligence. And there is a need to develop material chemistry methods and principles in the processing of advanced materials.

Energetic material chemistry should focus on the basic problems in storage, release and application of high-density chemical energy, and developing methods in the design and preparation of novel energetic materials such as materials of all-nitrogen structure, ionic type and coordination type.

Energy Chemistry

Energy chemistry is a science focusing on energy conversion, transmission, storage and utilization with chemical principles and methods. Its basic task is to investigate new energy conversion and storage mechanisms, design new materials, establish new theories and methods, develop new systems, and construct new devices to achieve efficient and clean utilization of chemical energy.

Energy Chemistry pays attention to clean and efficient utilization of fossil resources, and strengthens the investigation on preparation chemistry of clean energies such as non-fossil liquid fuels and hydrogen energy, storage materials and their efficient energy conversion. Electrochemical energy focuses on various batteries with power and energy storage which pays attention to the innovative research of electrolytes, battery separators

and electrode materials, and to the design and preparation of highly efficient solar cell materials, device assembly and integration. In this area, it needs to develop materials of wearable devices and microelectronic system devices. Energy Chemistry pays attention to developing materials of energy conversion and storage and optimizing phase-change energy storage materials. Basic chemistry problems in important energy conversion processes such as photochemical energy, thermoelectricity, photoelectricity and optothermal as well as the conversion of biomass into energies and resources should also be paid attention to. The utilization of biomass should be focused on catalytic pyrolysis and conversion to high quality liquid fuels.

In 2019, General Program of the Division was selected to conduct classified application and review. For detailed information, please refer to "2019 NSFC Reform Initiatives" in this *Guide*.

Division IV of Chemistry

The Division supports research in the field of chemical metrology, environmental chemistry and chemical biology.

Chemical Metrology

Chemical metrology aims to develop chemistry-related measurement and analysis theories, principles, methods and techniques, and to develop related instruments, devices and software to obtain the variation rules of the matter's composition, distribution, structure, properties and interactions.

The studies of chemical metrology emphasize interdisciplinarity, and focus on methodological research, instrumental creation based on new principles and development of key technologies. The funding scope of chemical metrology ranges from macroscopic detection and analysis to microscopic systems with high throughput, high sensitivity and high specificity, aiming at establishing new theories, principles, methods and technologies, and broadening the application of existing technologies in important scientific fields. The research includes theory innovation, sample treatment and separation, spectroscopic methodologies and applications, chemical and biological sensing, chemical imaging, creation of instruments and the development of key technologies.

The priority funding areas for chemical metrology include: (1) processing, separation and identification methods for complex sample; (2) space-time resolved spectroscopy and chemical imaging; new spectroscopic principles and technology; (3) precise measurement of single atom, single molecule, single cell and single particle; (4) micro/nano analysis and devices; (5) structural and functional analysis of biological macromolecules; (6) in-vivo and real-time detection of living organisms; omics analysis; biomolecular recognition and probes; analysis technology for major diseases diagnosis; (7) early warning, screening and traceability of public safety; (8) creation of miniature instruments and devices; chemical measurements based on big facilities.

Environmental Chemistry

Environmental chemistry is to study the principles and methods of the existence, characteristics, behaviors, effects and pollution control of chemical substances in environment. It is an important branch of chemical science and a core area of environmental science.

Major funding fields of environmental chemistry cover the following branches: environmental pollution and analysis, pollution control and remediation chemistry, environmental toxicology and health, theoretical environmental chemistry, radiochemistry and radiation chemistry, chemistry safety and security chemistry.

The applicants are encouraged to refine the key scientific issues targeting the major problems in the protection of ecological environments. Applicants are also expected to study environmental chemical behaviors, ecological and health effects, and the principles of control technology of pollutants through combining the laboratory study, field experiment and theoretical simulation and developing new technologies and methods. Research orientations encouraged include: (1) characterization and analysis of pollutants in complex environmental media; (2) tracing and behaviors of emerging contaminants on multi-media interface; (3) forming mechanism and control techniques of atmospheric combined pollution; (4) control, remediation and the mechanisms of soil contamination and water pollution; (5) environmental exposure and health effects of new toxic pollutants; (6) environmental behaviors and toxicology of micro- or nano-materials; (7) formation and control of antibiotic resistance of microorganisms; (8) big data analysis of environmental pollutions; (9) prevention and control of radioactive pollution and recycling of radioactive nuclides; (10) key scientific issues of chemistry in the prevention and control over dangerous chemical and radiation.

Chemical Biology

Chemical biology accurately modifies and manipulates biological systems at the molecular level by means of exogenous chemical substance, interventional chemical methods or pathways. It not only develops new reactive technologies and molecular tools, but also provides new thoughts and concepts for research in the area of life science. It is playing an increasingly important role in the research of visual, controllable and creatable life processes (or function).

Chemical biology focuses on the processes and dynamic rules of important molecular events in life science, and gives full play to the characteristics and creativity of chemical science. The study focuses on: (1) to achieve, explore and regulate the living action in real-time, in-situ and in quantitative analysis by means of the construction and discovery of molecular probe; (2) to achieve modification and labelling of biological molecules by means of the orthogonal and coupling technology and study the biological functions of biological macromolecules, such as protein, nucleic acid, polysaccharide, lipid compounds, as well as active molecular and ions; (3) to establish and optimize small molecule compounds library and high-throughput screening technology to detect and interfere the biological process in cell, thereby to reveal unknown pathways and new life activities of interaction of biological molecules, promote the study of signal transduction and gene transcription based on active small molecules, and realize the identification of drug targets and the discovery and development of leading compounds; (4) to reveal the

bio-function of active molecular; (5) to analyze the biosynthesis mechanisms of substance in life activities, and to synthesize target molecule or complete special chemical reaction by using biosystem and/or basic parts; (6) on the basis of creating and developing innovative chemical tools and techniques, to develop new theory for chemical biology, carry out chemical assembly and simulation of complex living system, reveal chemical essence of life activities.

Chemical biology encourages original innovation and preferentially supports the themes as follows: (1) the discovery and construction of chemical molecular probe as well as its application on the study of molecular mechanism and functional regulation of important biological events and serious diseases; (2) research of solving biological and medical events by use of chemical means and methods; (3) basic research on the chemical reaction mechanism and theory of living systems for promoting intercross and cooperation between chemistry discipline, and biology and medicine. Proposals without discipline intercross will not be supported.

In 2019, General Program of the Division was selected to conduct classified application and review. For detailed information, please refer to "2019 NSFC Reform Initiatives" in this *Guide*.

Division V of Chemistry

The Division supports research in the field of chemical engineering and industrial chemistry.

Chemical Engineering and Industrial Chemistry

Chemical engineering and industrial chemistry studies the motion, transfer, reaction and interrelation in the conversion processes of matter. The tasks include: (1) to recognize the transfer and reaction phenomena, rules in the conversion processes of matter, its mechanism on the process efficiency and properties of products; (2) to study the theories, methods and technologies for the green and high effective conversion of substances; (3) and to develop new technologies, new flow chart and new equipment suitable for industrial production. Chemical engineering emphasizes the research on "engineering science" and the intercross with other disciplines such as chemistry, material, biology and information. Chemical engineering provides scientific basis for national major demands such as modern manufacturing industries, strategic emerging industries and life and health.

Major funding fields of chemical engineering and industrial chemistry cover chemical thermodynamics, transfer process, reaction engineering, separation engineering, chemical equipment and process enhancement, systems engineering and chemical safety, biochemical engineering and light chemical, fine chemical and green manufacturing, chemical engineering of materials and products engineering, energy chemical, resources and environmental chemical engineering. In recent years, it has become a major trend to study the key scientific issues in application and new theories, methods and technologies in science and their intercross. New research directions are listed as follows: (1) the research is more focused on the regulation, measurement and simulation in micro-/meso-structure, interface and mesoscales, and great attention is paid to the reinforcement of processes and

scale-up rules; (2) the research pays more attention to the uncommon and extreme processes as well as the relevant information and intellectualization research; (3) the research further expands from chemical engineering to the product engineering and intercrosses with new fields such as life and health, ocean, electronic information and new energies.

Special and innovative research will be preferentially supported: spatial and temporal dynamic structure at mesoscale; systems, synthetic and engineering methods; chemical big data and intelligent processes; system security in chemical engineering; transfer and reaction processes under unconventional conditions; green chemical engineering; product engineering as well as chemical science related to energy, resources, environment and health.

In 2019, General Program of the Division was selected to conduct classified application and review. For detailed information, please refer to "2019 NSFC Reform Initiatives" in this *Guide*.

Department of Life Sciences

The funding of the Department covers a broad spectrum including biology, agricultural sciences and basic medicine, which extends to various fields of resources, environment, ecology, population and health, etc. In recent years, with the support from NSFC and other funding sources, together with the unremitting efforts made by Chinese scientists, research in life sciences has achieved extraordinary progress in China. Not only the number of authentic research articles published by Chinese scientists in international authoritative journals is climbing, but the quality of research is improving rapidly.

In 2018 the Department received 12,664 proposals, of which, 12,436 were accepted for General Program and 3,048 projects were funded, including projects of Small Fund for Exploratory Studies, with a success rate of 24.07% (accounted by the accepted proposals, and all the data bellow are also calculated by the number of accepted proposals). The average direct cost is 582,300 yuan per project. 2,928 projects were funded as 4-year General Program projects, the success rate of which is 23.12% and the average funding intensity is 595,900 yuan per project. In 2019, the average direct cost of funding will be roughly the same as that in 2018.

The Department encourages researchers to carry out original study with innovative academic ideas, as well as novel technology and approaches, particularly for those playing a pivotal role of promoting the development of related disciplines with authentic ideas. Emphasis will be put on proposals with novel theories, firm hypotheses and the interdisciplinary importance based on previous research over a long period of time. The Department will pay attention to important frontiers and new emerging fields in life sciences in the future, while keeping a balanced and harmonious development among various disciplines. In line with the principles of "encouraging exploration, highlighting originality; focusing on the frontier, creating novelty; demand promoted, breaking through bottlenecks; common orientation, cross-disciplines", scientists are encouraged to aim at basic scientific issues both in the frontier of science and the major national needs. It is especially encouraged to deliver research on major basic scientific issues in the field of agriculture and environmental ecology.

The Department encourages scientists to carry out systematic and original research on fundamental and systematic scientific problems. The Department implements the funding policy depending on the performance of previous funded project, and gives preferential consideration to applicants with good performance in their previous projects under equivalent conditions. **Moreover, considering the problems commonly occurred during the application and peer review processes in recent years, the Department reminds applicants to pay special attention to the following points when writing proposals:**

(1) In the explanation part of the *Guide* of the Department, as well as of all the disciplines, the funding scope is emphasized and the categories that will not be accepted have been clearly noted. Therefore applicants should read carefully according to their subject of application. It should be emphasized, that **the categories not to be funded by the disciplines in the General Program apply to other types of programs within the same discipline.**

(2) Concerning applications related to operation with highly pathogenic microbe, applicants should abide by national regulations concerned, and perform under bio-safety qualified conditions.

(3) The signature of both the applicant and all participants should be in regular script, and the signature should be the same as the one in printed form in the application.

(4) The applicants should note that the fund is filled in the unit of 10,000 yuan. Misfiling will cause errors in the budget, leading to a decline.

(5) Please fill in the research period according to the notes requirement for application in this *Guide*. The research plan listed in the application should be consistent with the funding period. Otherwise, the grant will be declined.

(6) The application code should be specified to the final level. Applications fail to provide the detailed code will be declined. Please refer to the discipline guides for specific requirements on application codes.

In addition, the Department has made the following requirements for ethics-related research applications in biomedical research:

(1) To carry out research in the field of biomedicine, researchers must abide by the relevant provisions of the state, respect internationally recognized bioethical norms, and abide by the relevant requirements of the state for ethical research.

(2) Biomedical research involving human beings must provide the review opinions of the supporting unit ethics committees or that of their superior departments in the application form.

(3) Applications involving multi-unit participation in ethical research should be supported by certification documents examined and approved by each participating unit or the ethics committee of the competent department at a higher level.

(4) When overseas institutions or individuals cooperate with domestic medical and health institutions to carry out research and declaration fund projects involving ethics, they shall issue certification documents for examination and approval by Ethics Committees provided by domestic relying units.

(5) For Research projects that need to sign informed consent, the process and procedure of signing informed consent should be described in the application form.

(6) If the ethics-related project is approved and the research plan is changed during the implementation period, the review opinion certificate of the ethics committee after the

change of the research plan shall be submitted to the fund committee again in accordance with the above requirements.

Applicants should follow the requirement of the *Guide* and the application syllabus when writing their proposals. Otherwise, the proposals will be rejected or not funded.

Funding for General Program Projects in Department of Life Sciences in 2017 and 2018

Unit: 10,000 yuan

Divisions		2017			2018		
		Projects	Direct cost	Success rate+ (%)	Projects	Direct cost	Success rate+ (%)
I of Biology	Microbiology	187+7*	11,209+175*	26.15	192+7*	11,438+175*	25.91
	Botany	199+7*	11,931+175*	28.41	209+7*	12,452+175*	26.77
	Zoology	142+5*	8,552+125*	34.59	142+5*	8,462+125*	32.89
II of Biology	Genetics and bioinformatics	141+6*	8,456+150*	28.77	141+5*	8,392+125*	26.35
	Cell biology	94+5*	5,622+125*	34.86	108+5*	6,435+125*	31.92
	Developmental biology and reproductive biology	80+4*	4,820+100*	31.94	80+4*	4,740+100*	30.00
Biomedicine	Immunology	76+4*	4,567+100*	32.65	80+4*	4,762+100*	26.84
	Neurosciences and Psychology	138+9*	8,296+225*	24.96	144+9*	8,591+225*	25.76
	Physiology & integrative biology	80+4*	4,806+100*	32.56	85+4*	5,088+100*	29.28
Interdisciplinary Research	Biophysics/Biochemistry/Molecular biology	155+5*	9,311+125*	34.48	157+6*	9,383+150*	28.85
	Biomaterials/ Imaging/tissue engineering	93+5*	5,587+125*	25.00	97+5*	5,795+125*	24.58
Environment and Ecology	Ecology	179+7*	10,764+175*	26.76	188+7*	11,177+175*	24.28
	Forestry and grassland science	199+8*	11,923+200*	23.90	219+8*	13,074+200*	21.35
Agriculture and Food Science	Agriculture and crop sciences	214+8*	12,817+200*	23.39	232+8*	13,800+200*	21.13
	Food science	201+8*	12,068+200*	22.00	211+8*	12,594+200*	19.55
Agricultural Environment and Horticulture	Plant protection	141+6*	8,485+150*	23.60	150+6*	8,932+150*	21.25
	Horticulture and plant nutrition	151+6*	9,089+150*	24.49	160+6*	9,541+150*	21.64
Agriculture Animal	Animal husbandry	105+5*	6,318+125*	23.16	114+5*	6,763+125*	20.66
	Veterinary medicine	129+6*	7,721+150*	23.52	136+6*	8,093+150*	22.26
	Aquaculture	78+5*	4,688+125*	23.25	83+5*	4,958+125*	20.61
Total or average		2,782+ 120	2,782+120*	167,030 +3,000*	26.31	2,928+120*	174,470 +3,000*
Direct cost per project		37.99			58.59 (60.04**)		

Note: * Pilot projects of Small Fund for Exploratory Studies; ** Average funding for General Program project excluding Small Fund for Exploratory Studies; + Funding rate including projects of Small Fund for Exploratory Studies

Division I of Biology

The funding scope of the Division covers three disciplines, namely microbiology, botany and zoology.

Microbiology

The Discipline supports basic research in the area of microbes, including fungus, bacteria, achaea, virus, prion and other microbes.

There is an obvious lack of balanced development of different branches in microbiology, observed based on previous years of grant application and funding situation. The number of proposals aiming at study on mycoplasma, rickettsia, chlamydia, spiroplasma, phage, prion, etc., is relatively small, indicating that the related research team needs to be augmented and intensified. The Discipline encourages researchers to carry out fundamental and authentic studies on resources, diversity as well as biological relevance in the fields listed above.

In 2019, the Discipline will continue to encourage studies with a combinational use of genome and big data and other modern technology together with traditional methods. Preferential funding will be given to areas in the taxonomy of microbes, especially rare and difficult to cultivate microorganisms. The Discipline will continue to promote the study of classification and phylogenetic taxonomy, as well as strengthening talent training.

The Discipline encourages the exploration of novel techniques and methodologies applied to basic research of microbiology, and especially welcomes scientists in mathematics, physics, chemistry, and information sciences to carry out interdisciplinary studies related to microbiology; encourages research based on single microbe cell, structural compositional research of microbe, basic research in pathogenic microbe and marine microorganism, and functional research on microbe in complex system; systematic research on mechanisms of frontiers in life sciences applying microbe as model system is preferentially encouraged.

In order to promote the development of microbial research on the new technology and novel method, to converge multi-field academic thoughts, research methods and technical tools as well as to break the traditional disciplinary barriers for solving of complex scientific problems, the integration of mathematics, physics, chemistry and microbiology, information technology and engineering and other related disciplines is encouraged.

Botany

The Discipline supports basic and part of applied basic researches on plants.

It can be seen from the applications accepted and funded in recent years that the development of each branching field within the Discipline is unbalanced. There are relatively more applications in areas such as plant phylogeny, plant hormone, growth and development, and resistance physiology, and therefore the research quality is relatively high. Systematic and creative research combined with structural biology, system biology and computational biology should be further strengthened henceforth. On the other hand, there are fewer applications in the fields such as paleobotany, biological nitrogen fixation, mineral elements and the metabolism, organic synthesize and transportation, hydrophytes

and ocean plant and resources, etc. Applications that have research basis in the above-mentioned subjects are encouraged.

The Discipline will pay close attention to natural variation and domestication mechanism of plants, environmental adaptation mechanism of plants, simulation of plant life processes and functions. Applicants are also encouraged to carry out their studies in the fields of Phytosystematics, invasive plant biology, introduction and plant germplasm conservation, plant cell totipotency, molecular basis of plant important traits, interaction between plants and other organisms, and plant response to environmental changes.

The Discipline will continue to give preferential support to plant taxonomy in 2019, especially to strengthen the support to young taxonomists. The Discipline encourages applicants to carry out research on species revision of certain families and genus on the world wide range and plant resources research in key areas and special environment.

The interdisciplinary studies of botany with other related fields will be strongly encouraged, especially with mathematics, physics, chemistry, geosciences, and ecology, genetics, genomics, proteomics, metabonomics, phenomics, bioinformatics and computer science, etc. Applicants are encouraged to raise unique scientific questions based on their own strengths and research foundations. Development of new model plants with important evolutionary positions is encouraged in order to explore special biological phenomena. In order to achieve better use of local advantages, resources advantages, and talent training, the Discipline will encourage collaborations among applicants with institutions or groups having unique special advantages.

Special notice for applicants: projects accepted under the plant-other-organism interaction code do not include applications for research related to crops and other cash crops.

Zoology

Zoology studies the life phenomena and principles in animal morphology, taxonomy, physiology, behavior, ecology, evolution and genetics. The effective application of theory and techniques has greatly enriched the research contents of zoology. Studies on animal diversity, ontogeny and phylogeny, co-evolution and phenotypic evolution, animal behavior and adaptability have become cutting-edge research areas; whereas research on animal taxonomy, zoogeography and animal resource utilization, and conservation biology has been deepened and integrated continuously. Laboratory animal science has acquired more and more recognition.

Applications accepted by the Discipline in recent years have demonstrated that researches in some subjects have already formed their own features and acquired significant international impact. It can be also observed that not only the formulation of scientific problems as well as rationality of designs, but also the creativeness of academic thoughts of the proposals are greatly improved. However some problems still exist, for example, the excessive pursuit of hotspots without solid research basis, and the lack of justification for proposed research and feasibility of technical routes; insufficient experimental accumulation was provided by some of applications, or the description of detailed research progress and contents; some proposals were lack of scientific problem or hypothesis with explicit definition, or overstating research objectives; the budget for research is impractical in some proposals; repetitive applications still exist on a small scale.

In the future, the identification and description of unknown species of animals, and revised study of known species of animals will remain the key funding areas by the branching field of taxonomy. Taxonomy of ocean animals should also be highly valued. Key research areas currently focus on animal phylogeny and zoogeography, as well as the life history around the evolution. The Discipline will encourage researches on animal physiology, animal behavior, and the establishment of model animals, etc. Support will be strengthened for researches on conservation biology for endangered animals, the sustainable utilization of important resource animals, and related biological researches for important alien invasive species and bio-safety. Basic research of zoology for specific species in China and fragility of western and remote areas will be continually encouraged. In addition, the Discipline will pay more attention to basic research on zoology; encourage original studies and exploration based on animal resources and regional features in China and the application of new theory and technologies. Interdisciplinary studies will be encouraged.

Special notice for applicants: this Discipline will not accept grants for clinical diagnosis and treatment as well as with model organisms as study materials.

Division II of Biology

The funding scope of the Division covers the following three disciplines: genetics and bioinformatics; cell biology; and developmental biology and reproductive biology.

Genetics and Bioinformatics

Genetics is to study the inheritance and variation of organisms on various levels of molecules, cells, individuals and populations. Bioinformatics is an interdisciplinary field of biology and computing science, aiming at the exploration and improvement of methods and means to obtain, store, manage and analyze biological data.

The Discipline will give priority support to the following fields: the study of genomic variation and evolution law of complex biological characteristics, including the identification, analysis of key genetic function and its regulating rules; genetic diversity; the correlation between phenotype and genotype; the genotype in analysis and the express prediction of complex traits and complex diseases; the evolution model and mechanisms of genetic variation for important populations; studies on the genetic and molecular basis of genetic disease of single gene and complex diseases of multi-genes, including identification of genomic function variation, recognition and prediction of disease genes, and molecular signal route concerned; study on basic genetic laws and the molecular mechanisms of gene expression and regulation by using model organisms; the establishment of genetic operating system, new methods and technologies of phenomics and genetic breeding; basic researches on the genetic law of typical resources, major agriculture crops, microbe, etc.; and the molecular basis of genetics and variation of organisms under extreme or special environment; novel genetic fields such as genetic editing, chemical genetics, photo-genetics, phenotype-nomics, 3D/4D genomics, algorisms and methodology in biological big data, etc.

In 2018, the numbers of applications received in areas of animal genetics, microbe genetics, cellular genetics, population genetics, behavior genetics, evolution genetics, network model of biological system and simulation and construction of biological loop were

relatively small, whereas those fields are pivotal concepts in classical genetics research. The Discipline will prioritize proposals with solid previous studies and novel scientific questions in the above branches. In 2019, the Discipline continues to encourage original studies on genetic mechanisms and basis, as well as research on epigenetic rules.

As for bioinformatics, focus will be on the following fields: developing new theories, algorithms and analytical techniques of bioinformatics and computational biology; genomics and epigenomics, transcriptome and epigenomics, phenomics; integrating genomics data and system biology analysis; research on methods of integration, standardization and visualization of large biological data; machine learning and in-depth learning of biological data; curation; virtual Reality display of biological data; design and synthesis of molecular modules and networks; research of biological networks, etc. Combination of bioinformatics analysis and bio-experimental verification is encouraged. In the future, the Discipline will continue to support and encourage new theories, methods and cross-disciplinary research in genetics and bioinformatics, and continue to support and encourage the acquisition, standard monitoring, quality control, storage and acquisition, analysis and mining of large biological data.

Cell Biology

Cell biology studies the principles and mechanisms of life activity. Cell biology is mainly aimed at revealing the structure, function, phenotypes and regulation mechanism at molecular, cellular and individual levels within organisms, as well as studies on cytological mechanisms of phenotype and functional abnormal occurrence of organisms.

Studies on the structure and function of cells have been the major aspects supported by the Discipline. Applicants are encouraged to carry out integrated studies on the mechanisms of synthesis, modification, degradation, localization, and translocation of protein with the aggregation, dissociation, location of its components, and the activity diversification with time and space of protein complex during the process of cell signal transduction with dynamic change mechanisms of life activities of cells. Highlight will be given to endeavors on solving important problems in basic cell biology upon using cell models or model systems, in combination with techniques and methods of genetics, developmental biology, chemical biology, and cell imaging technologies, etc.

Among the applications accepted in 2018, there were fewer applications in areas of cell growth and multiplication, extra cellular matrix, establishment of cell polarity, cell substance transportation, cell metabolism, plant cell biology and research of new methods, whereas the above areas are pivotal in cell biology and have foundations in related researches in China. The Discipline will prioritize funding to applicants who present their proposals with scientific issues from their solid research background on these aspects.

In 2019, the Discipline will continue to emphasize on functional and mechanism issues, highlighting the utilization of various novel research technologies and methodologies in cell biology. The Discipline will actively promote the development of techniques in cell in situ and real time, dynamic and high-resolution analysis, and highly value integrated researches from molecular to cellular and individual levels, so as to reveal different molecular mechanisms closely linked with cell function and biological effect and regulation network.

In 2019, the Discipline has been selected as the pilot in the Department for classified

application and evaluation. Please refer to the "2019 NSFC Reform Initiatives" in this *Guide*.

Developmental Biology and Reproductive Biology

Developmental biology and reproductive biology studies the basic biological laws in the process of formation, development, growth and aging of multicellular individuals.

This Discipline focuses on the basic laws of gametogenesis, fertilization, embryonic development, organogenesis, homeostasis, aging, damage repair and regeneration, identification, establishment, reprogramming, pluripotent stem cell induction and other important biological processes of human, animal and plant.

Among the proposals received in 2018, studies in organogenesis and development as well as the stem cell field could aim at the international forefront with relatively high starting point; studies in the field of reproductive biology are closely combined with the important scientific problems in the field of human reproductive medicine. Research in both basic and applied research reflects the trend of transformation of basic research to clinical medicine. In the future, the Discipline will continue to encourage applicants in the field of developmental biology and stem cell biology to carry out cutting-edge research. Basic research closely related with human needs for reproductive medicine is encouraged and preferential funding in reproductive biology will be delivered.

Modern developmental biology and reproductive biology emphasize on the continuity of development and dynamic process of change, emphasize the collaborative function of multi-cells and multi-genes, value the relationship of development and diseases, and encourage the exploration of molecular regulating mechanisms of development and reproduction by using model organisms. Applications will be encouraged on the creative development of research methods and systems, as well as the establishment of model diseases concerning development and reproduction, so as to provide basis for clinical transformation. In the field of plant development and reproduction, applications of basic research which may provide theoretical guidance for modern molecular breeding will be encouraged.

Division of Biomedicine

The Division covers the following three disciplines: Immunology, Neurosciences &Psychology, and Physiology & integrative biology.

Immunology

Immunology studies the structure and function of immune system. It has been a frontier and leading discipline, bridging biology to clinical medicine.

The Discipline mainly supports basic research aiming at the structure, development, function and abnormal mechanisms of immune molecules, cells, tissues, organs, and immune systems. The core funding areas include: (i) gene expression and regulation, structure and function of immune molecules; structure basis of immune recognition; recognition, activation and effects of innate immunology; molecular mechanisms of antigen

presentation; structure, function and immune-pathogenic of cytokines and chemokines; (ii) the differentiation, development, migration, tissue distribution of immune cells and sub-cells and their functional modulation, evolution and comparative immunity; (iii) identification, response and regulation of innate and adaptive immune; infectious immunity; tumor immunity; self-immunity; hypersensitivity; initiation, progression and elimination of inflammation; mechanisms and intervention of non-infectious diseases; (iv) cell and molecular mechanisms of immune tolerance; malfunction of immune tolerance; mechanisms of transplant immune tolerance; abnormal immune response and immunodeficiency; (v) molecular and cellular mechanisms of immune regulation; abnormal of immune regulation; nerve-endocrine-immune network; immune metabolism; (vi) immune heredity; genetic basis of immune-related diseases; epi-genetic regulation of immune response; (vii) immunological mechanisms of reproduction and pregnancy; cross-interaction between reproductive endocrine and immune system; (viii) the function and mechanisms of mucosal immunity and local immunity; (ix) basic immunology problems during the manufacture of vaccine; (x) studies of antibody engineering, including scientific problems on the establishment of new techniques and methods and new research system of immunity.

It is clearly demonstrated from the applications in 2018 that there is a rapid progress of immunological research in China, with the proposals covering a wide range of subjects, and the quality of research contents improved obviously. Most of the proposals were based on solid background and pre-studies; some applications analyzed the possibilities of technical failures and were able to provide alternative resolutions as backup plans; a few proposals were carrying out systematic cutting-edge studies based on novel hypothesis. However, there are problems such as lack of substantial subject intercrossing, etc.

In 2019, the Discipline will support applications with creative academic thoughts; encourage applicants to concentrate scientific problems from their former research and practice to carry out in-depth exploration of mechanisms targeting at specific scientific target; encourage the establishment of typical research system and techniques platform, and highlight the setting-up and application of various novel methods and techniques in immunological studies; encourage study in areas of systems immunology, immunomics and computational immunology; encourage basic research relating to the structure of immune system and abnormal function, and the close cooperation of scientists working in basic and clinic studies.

Neuroscience and Psychology

The funding scope of this Discipline includes neuroscience, psychology and cognitive science. The key scientific question of neuroscience research is to analyze the essence of human nervous activity, from primary sensation and instinctive behavior to advanced language, learning, memory, attention, consciousness, thinking and decision-making, etc. Psychology is the science of studying human psychology and behavior, aiming at clarifying law and mechanism of occurrence, development, expression and function of psychological phenomena such as personality, cognition, emotion, motivation, thinking, consciousness, and decision-making. Cognitive science studies the nature and law of cognition and intelligence including cognitive and intellectual activities at all levels and aspects including perception, attention, memory, reasoning, choice,

consciousness and even emotional motivation.

In 2018, the largest number of the proposals submitted and projects funded are focused on molecular neurobiology, cellular neurobiology, developmental psychology, medical psychology, social psychology, educational psychology, cognitive psychology, cognitive brain structure and neural basis, whereas there are fewer applications under the applying code of tactile neurobiology, chemosensory neurobiology, computational neurobiology, neuroinformatics, and cognitive simulation.

In 2019, the Discipline will continue to encourage the exploration of the neurobiological basis of cognition and behavior, through analysis at different scales, such as micro, mesoscopic and macro scales. Interdisciplinary studies will be encouraged to clarify the occurrence, development and mechanism of nervous system diseases at the molecular, cellular and body levels. Cross-species neuroscience research is encouraged to perform research or develop novel technologies and methods to solve bottleneck problems. For psychology and cognitive sciences, the dominant areas will be continually supported, while interdisciplinary integration, using modern neuroimaging, genomics, deep brain stimulation, big data analysis, longitudinal tracking, computational models and other technologies and methods to promote in-depth research on psychological activities and cognitive processes and their material basis, and the development of new theories, technologies and models are encouraged.

Physiology and Integrative Biology

Physiology and integrated biology are the basic disciplines of biomedicine, which study the phenomena, laws and regulation of organism's life activities. The scope of funding includes the functions of various systems in physiological state and mechanism of their homeostasis maintenance, the structural, metabolic and functional imbalance of cells, tissues and organs in pathophysiological state, and innovative research on the interaction and functional integration of cells, tissues, organs and systems. The Discipline also encourages research on mechanisms of stress, adaptation and compensation for organisms in special environments or diseases.

In 2018, amount of applications under the code of system physiology, sports physiology, integrated physiology and nutrition physiology is relatively large. Funding for circulation physiology is mainly for researches on blood pressure regulation, blood vessel malfunction and system, arrhythmia, and myocardial remodeling and function renovation; proposals funded in the area of respiratory physiology focus on respiratory dynamics; structure, function, regulation and abnormal in respiratory system; lung injury and repair; respiratory centers and respiratory regulation; pulmonary vascular smooth muscle and pulmonary arterial hypertension. The area of digestive physiology covers investigation on the function of stomach, intestinal, liver, gallbladder, pancreas and body’s protection mechanisms upon damage. Proposals funded in the area of urinary physiology cover regulation and control mechanisms of water-salt metabolize of kidney, renal fibrosis, and functional regulation of ladder. Most of the applications supported in the area of reproductive physiology cover researches on the occurrence and fertilizing of germ cells, implantation of embryo, and the regulation and control mechanism of the placenta function. Most of the applications in neurosystem concentrate their researches on the hypoxic-ischemic encephalopathy, neurodegeneration, injured nerve repair, brain and

cognitive behavioral, etc. Most of the applications in the area of exercise physiology mainly focus their researches on the physiology mechanisms of the health by exercise, and the prevention and treatment of diseases. Most of the applications in the area of human anatomy concern about basic research of applied anatomy. The embryology, which covers regulation mechanisms of embryo development, tissue damaging and regeneration, is the major funding area as well. Moreover, endocrine, and glucose metabolism, lipid metabolism, insulin resistance, trace elements (include calcium and phosphorus metabolism) nutrition, senescence, and biological rhythm as well as hemopathology are the key funding areas as well. The Discipline will continue to encourage innovative researches on aging and biorhythms, as well as studies on the functional integrative and regulative mechanisms between different systems.

Please note in particular that applications concerning researches about plants, traditional Chinese medicine, wild animals (except comparative physiology) and livestock are not accepted in this Discipline.

Division of Interdisciplinary Research

The Division covers disciplines as follows: biophysics and biochemistry, molecular biology and biotechnology; and biomaterials, imaging and tissue engineering.

Biophysics and Biochemistry

Biophysics is a cross discipline to investigate mechanisms of biological problems and phenomena, applying the theory and method of physics; Biochemistry is a discipline to study chemical composition of living organisms as well as chemical changes during the process of life, and to research the life phenomena and activities of life process at the level of biological molecules.

Considering the contents of applications received in recent years, fields with more applications as well as more approved grants are the following: structure and function of protein complexes, interaction between macromolecules. Structural biology is an important research field in this Discipline, among which X-ray crystallography is still the most commonly used research method; due to the continuous improvement of cryoelectronic microscopy technology in recent years, the number and quality of applications in the field of Cry-EM have increased significantly; the application and research of biological macromolecular structure by using nuclear magnetic resonance spectroscopy and other methods were less funded; there are more and more higher quality applications on protein interactions and regulatory mechanisms; ribonucleotide-related applications represented by circular RNA and long-chain non-coding RNA are on the rise in quantity and quality; Proteomics-related projects are declining; Environmental biophysics projects including acoustic, photobiophysics and environmental biophysics are relatively less competitive. The number of applications for research projects in space biology is relatively small. The research of new methods of biophysics and biochemistry covers a wide range, but still lacks pioneering or cutting-edge methods.

The Discipline encourages cross-disciplinary research on biophysics and biochemistry, especially the application of real-time, dynamic and micro-detection of

biological molecules, ultra-high resolution microscopy, single-molecule imaging, non-fluorescence imaging, monitoring of spatial and temporal dynamics of subcellular organelles in cells and quantitative systems of living molecules in vivo and in vitro. Due to rapid development of Space Science in China, the Discipline will also consider on research closely related to environmental biophysics and space biology. Meantime, free exploration and basic research aiming at solving major urgent national problems are also encouraged.

Molecular Biology and Biotechnology

The development of life sciences has always been inseparable from the innovation of technology and methods. Nowadays, science depends more and more on breakthroughs in experimental technology, development in tools and improvement of methods. Biotechnology is not only conducive to bringing forth pivotal theories, but also providing novel ideas for solving important scientific problems. At present, the research of technology and methodology in life science is interdisciplinary. The funding scope of this Discipline includes but is not limited to the following areas.

(1) New theory, new method, new technology and new system in molecular biology.

(2) Synthetic biology: in order to enhance the biological functions of organisms and realize new biological functions that have not yet evolved naturally, artificial life is designed and manufactured through synthetic biotechnology, the artificial design and optimization of transformation pathways of substances and energy of living organisms.

(3) Biomics technology: The cross-study of multi-groups has become a major trend of biomics research. The Discipline encourages research to establish the quality control system and standards of biomics data, in order to develop a number of biological targets and biomarkers, achieving comprehensive application of biomics technology and bioinformatics technology in many fields.

(4) Biomolecule detection technology: applying optical, electrical, spectroscopy and other technologies and methods to achieve specific target molecule location and tracing, meanwhile focusing on in situ identification and concentration determination of target molecules and determination of the primary structure of biological macromolecules.

(5) Gene editing and biological macromolecule manipulation: developing or improving genome editors and biological macromolecule manipulation tools, investigating on the mechanism of transporting manipulation tools in vivo, and developing molecular manipulation “toolkits”.

(6) Protein and vaccine engineering: undertaking the excavation and design of novel functional proteins, discovering and improving new antibodies and adjuvants, and creating a series of functional molecules and new designed molecules for large-scale biosynthesis.

(7) Single molecule and single cell technology: developing single molecule and single cell precisely manipulation and control technology, focusing on dynamic imaging and tracing technology for single molecule or living cells, dynamic imaging technology for unlabeled chemical components, etc. The Discipline emphasizes on the application and promotion of integrated microfluidic technology in non-destructive isolation of mammals, especially in human single cells.

(8) Stem cells and tissue engineering technology: establishing the technology of obtaining, proliferating and differentiating pluripotent stem cells with high efficiency of heterozygous chimerism to achieve the reconstruction and reconstruction of tissues and

organs; simulating the main structural and functional characteristics of different human tissues and organs and complex organ-to-organ connections in vitro to predict human response to drugs or different external stimuli.

(9) Bioimaging technology: achieving ultra-high spatial and temporal resolution detection of molecular events in living cells through various probes and labeling technologies, improving the process of information collection, manipulation and analysis of biological images.

(10) Artificial intelligence and computational biotechnology: developing and optimizing the analysis and calculation methods of artificial intelligence, developing new theories and countermeasures for the representation, organization, management, analysis, mining and utilization of biological big data, and establishing systematic technology for the formation of biological big data from generation to application.

(11) Applied biotechnology: medical biotechnology, industrial biotechnology, agricultural biotechnology, environmental biotechnology, biotechnology of biological resources, biotechnology of biosafety, etc.

(12) Other important biotechnologies, such as artificial culture of special types of cells and microorganisms, marine "dark ecosystem" research technology, the discovery of "dark matter" on microbial chromosomes, etc.

Biomaterials, imaging and tissue engineering

This Discipline is a branch intercrossing of life science with other research areas. The funding scope covers biomechanics and biorheology, biomaterials, tissue engineering, biomedical electronics, bionics and nano-biology.

According to applications in recent years, there is an imbalanced development among the above five sub-disciplines. The field of biomaterials is a relatively mature branch field. Most applications in 2018 still focused on implantation, interventional biomaterials, genes, drug carrier biomaterials, material surface interface, biocompatibility, safety, etc. In tissue engineering field, most projects focused on bone and cartilage tissue engineering, oral tissue engineering, stem cell transplantation and tissue regeneration, but there was lack of proposals on other important organ tissue engineering, as well as novel methodology. In 2018, in the sub-discipline of biomechanics, projects were mostly in such fields as biomechanics of cellular and molecular biomechanics, bone and other tissues and organs of the movement, while biomechanics studies on other organs were rare. In the biological image and bioelectronics devices sub-discipline, there was a lack of study on biomedical signal detection and analysis, biomedical sensing, biomedical detection and system applications. In the field of nano biology, only a few studies were proposed on nano-bio safety evaluation. Overall most of the proposals funded in 2018 showed solid research basis and provided clear scientific questions with novelty. The main weakness of applications was a lack of original ideas, or lack of substantial interdisciplinary collaboration.

In 2019, the Discipline will continue to encourage applications to carry out systematic multidisciplinary research in fields of biomaterials, tissue engineering, biomechanics and biorheology, bioimaging and biomonitoring, biomedical electronics, bionics and nano-biology. Researches should aim at key scientific issues in the process of important tissue/organ reconstruct engineering, as well as interdisciplinary studies, especially long-term, systematic and in-depth study in tissue/organ replacement and repair,

engineering reconstruct and transformation of regeneration. In particular, the Discipline encourages and supports the basic research in tissue biomechanics basis and the practical application, other than bone/joint motion system, and cardiovascular system; study on interaction mechanisms and new effect features between biological materials and the body; the novel methods and new technology of tissue engineering (such as 3D printing, biological manufacturing); studies on bioelectronics and biological systems related to the study of bionics, and nano biodetection, nanometer biological safety evaluation and application of ethics.

Special notes for applicants: biomaterial and bionic research other than biology/biomedical applications is excluded in this Discipline.

Division of Environment and Ecology

The Division supports researches in areas of ecology and forestry and grassland science.

Ecology

Ecology studies the interaction between organisms or between organisms and the environment. It plays a pivotal role in solving the national ecological problems that are getting increasingly important.

In recent years, significant progress has been achieved in ecological study in China. Ecology in China has made important progress in the fields of system construction and monitoring of field observation stations and experimental platforms, ecosystem response to global change, evolution of important biological groups and conservation biology, whereas traceability research is still common and the overall quality of fundamental ecology needs to be improved. In 2018 scientific questions of some applications are not clear enough. In a small portion of applications, there is a lack of innovative ideas.

In 2019 the Discipline will strengthen its support to applications with strong innovative ideas, multidisciplinary research and cutting-edge growing subjects, give priority support to proposals focusing on the basic research frontier of international ecology, closely connected with the national ecological and environmental issues, give preference to researches with possibility of making breakthrough in new theory and novel method, and strengthen basic research with long-term observation and experiment of field work, and encourage researches perform study on landscape and regional scale. It is encouraged to perform research on theoretical ecology, species evolution and adaptation mechanisms, biodiversity and ecosystem functions. The Discipline also prefers to support research on ecological models, ecological prediction and evolutionary biology, and support basic ecological research on the protection, restoration and sustainable development of natural ecosystems.

The content of research proposal should focus on key points with clear definition of scientific issues, and special attention should be paid to scientific aspect and feasibility of the research route and methods. Proposals regarding to the multidisciplinary and macro research should put enough emphasis on the combination of the theoretical study with the national need.

Forestry and Grassland Science

Forestry and grassland science is to reveal the essence and mechanisms of the biological phenomena by taking forest and grassland as its research objects, in order to carry out the cultivation, protection, management, and utilization of forest and grassland resources.

In recent years, there is a tendency of rapid growth of basic research on forest, but the unbalanced development among sub-disciplines remains the key issue. The number of proposals submitted to branches such as wood physics and the chemistry of forest products is large, while there are much fewer applications to the more classical sub-disciplines like silviculture, forest soil science and forest management, indicating a trend of shrinking. The proposals failed to focus on important basic scientific issues in some important fields, such as silviculture and non-wood product forestry. Some applications in the field of forest genetic breeding on homologous gene cloning and function verification failed to carry out the research from the angle of biological characteristics of trees, as well as lack of close relation with forestry production.

In order to meet the needs of national strategic development, basic research on forestry and grassland science should focus on identifying and concreting key scientific issues in the practice of forestry and grassland industry. Most of the research objects of forestry science are woody plants, and the research period is relatively long, therefore it is particularly important to carry out continuous and systematic research. In the future, the Discipline will continue to support basic research in the fields of forest and grass cultivation, forest and grass health and forest and grass resource utilization, focusing on the major needs of the country. The Discipline will encourage under-forest resource cultivation, basic characteristics of timber and forest products, physiological ecology of important afforestation tree species and forage grass, forest nutrition, impact of forest soil on forest productivity, forest degradation and restoration mechanism, formation and maintenance mechanism of mixed forests, afforestation measures and timber properties, provenance selection and tree adaptation mechanism under climate change, disaster regularity and prevention of major forest disasters Control, exploitation and innovation of forest germplasm resources, formation mechanism of special traits of trees, genetic transformation of potential model tree species and verification system of gene function, conventional forest genetic breeding, degradation mechanism of economic forest varieties and biological basis of cultivation, garden plants and application, and efficient production and utilization of forage were explored.

There are two major features in basic research of forestry. The first one is to meet the national needs for forestry development. Therefore applicants should pay close attention to formulating the important and key scientific questions from the forestry industry. The second is to carry out continuous and in-depth studies regarding to perennial woody plants for a relatively long period of time. In the future, the Discipline will continue to prioritize to support basic research in such core fields like silviculture, the health care, the efficient utilization of forest resources, etc. The Discipline will encourage researchers to carry out investigation in fields of advanced generation tree breeding theory and methods, multi-service function of forest and management, forming mechanism of wood superior traits, the analysis of the specific growth, silviculture, forest soil science, forest management, garden planning and landscape architecture and development mechanisms of trees, which

meet the national strategic needs at the international frontier research fields.

In 2019, applicants should pay close attention to the following: (1) the discipline of forestry will not accept proposals on pharmaceutical functional verification of effective components targeting at animals; (2) the discipline of forestry will not accept research and development projects for forestry machinery, wood cutting tools, road and bridge design, forest engineering machinery and equipment, forest engineering and civil construction in forest areas; (3) projects in the forest product chemistry field without forest biomass research will not accept.

Starting from 2019, tea tree science related projects should apply to horticulture and plant nutrition discipline.

Division of Agriculture and Food Sciences

The Division covers two disciplines: basic agriculture and crop science, and food sciences.

Basic Agriculture and Crop Science

The discipline of basic agriculture and crop sciences mainly supports basic and applied basic research on crops and their growing environment.

It is reflected from the applications in 2018 that there was an increasing number of proposals with basic issues on topics meeting the national demand of agriculture, an obvious increase in interdisciplinary studies around basic agricultural issues. However, major problems remain as the following: (i) researches on crop genome are generally concerned, but more attention is yet to pay on further exploration of mechanisms of physiology and genetics; (ii) following-up work with the international frontier is increasing, but it should be performed in close combination with practical issues of national agricultural production, so that to provide potent support of basic research to applied research; (iii) some of the applications are lack of systematic and sustainable studies; (iv) there are more applications in agricultural information, utilizing physical methods (such as spectrum, infrared, remote sensing, 3D photography, etc.) to acquire agricultural information, but there is a lack of in-depth theoretical study, and difficulty exists on actual utilization; (v) some of the proposals are not standardized with inaccurate information, such as untrue or incorrect contents in the resume part, especially in the order of authors for publications, or the list failed to present the real contribution of the applicant and others.

This Discipline encourages applicants to condense scientific issues from the reality of agricultural production in China, aiming at the frontier of the Discipline and the major needs of national agriculture; encourages the development of basic research by combining modern biotechnology with Crop Agronomic Traits improvement; encourages the development of germplasm resources mining and innovative research by using new technologies and methods; and encourages the development of high-yield, light cultivation and resources around crops; encourage crop cultivation regulation and tillage system based on efficient utilization; encourage research on characteristic small crops.

Applications to this Discipline should take crops and crop products as their research objects, and the interdisciplinary studies with other subjects should not

depart from the principal object; otherwise proposals will be rejected. The Discipline does not accept applications with research objects of agricultural animals, animal products, microbe, forest, vegetable, traditional Chinese medicine, algae, woods, and model plants of Arabidopsis thaliana.

Food Sciences

Food science studies basic research on food and food materials.

In 2018, the number of applications was relatively large under the following four application codes: food safety and quality control, food biochemistry, biological basis of food processing, food fermentation and brewing, while the number under the application codes of food storage and preservation, food nutrition and food raw materials was smaller. Generally speaking, most projects had innovative topics, clear scientific issues are and in-depth research contents, but major problems existing in proposals accepted in 2018 include: (i) a small number of proposals excessively emphasized on the technology and product development; (ii) Incorrect or incomplete application code; (iii) the writing of proposals is not up to the required standards, especially with untrue or unprecise CV contents; (iv) lack of continuity for some of the applicants; (v) loose research contents, failing to concisely demonstrate their key scientific issues, etc.; (vi) some proposals were tracking up study, lack of novelty or in-depth research.

In 2019, the Discipline continues to encourage projects addressing the major strategic needs of the country, bases on the scope of funding, with condensed scientific issues from the actual food production, especially the key technical issues that restrict the food industry in China. It is encouraged to adhere to the guidance of scientific issues, closely focus on the actual food production, and attach importance to traditional Chinese food, special food and food quality and safety. Applicants are encouraged to focus on interdisciplinary research with food science as the main body, integrate new theories, methods and technologies of other related disciplines, and analyze key scientific issues of food science; encouraged to carry out original, continuous and systematic basic research and applied basic research on the basis of their previous work.

The Discipline will not accept proposals in the following areas: (i) prevention and treatment of human diseases by food and food ingredients; (ii) research related to health products; (iii) research on the development of drugs or their components; (iv) the preliminary clinical trials to human body; (v) projects involving the growth, metabolism of growth and metabolic physiology of plants; (vi) research on food machinery, packaging materials, food processing technology, product development and food chemical modification.

Division of Agricultural Environment and Horticulture

The funding scope of the Division covers two disciplines: plant protection, horticulture and plant nutrition.

Plant Protection

The Discipline covers plant pathology, agricultural entomology, agricultural weeds, agricultural rats and other pest, plant chemical protection, biological prevention and cure, quarantine of agricultural pests, invasion biology, and biological techniques of plant protection, etc. Recently, the theory and technologies of genomics, proteomics, metabolic and molecular genetics are widely applied in the innovation of theory and techniques of pest control. However, basic research of plant protection in China is relatively weak, and especially there is a large gap between China and developed countries in the basic research on functional genomics of the interaction of important pests and crops, mechanisms of pest's virulence and crop resistance (sensibility), law of pest disaster, production and safe utilization of new pesticides with high efficiency, low poison, and environment-friendly property, etc.

The following problems exist in the 2018 applications: (i) for some of the researches, emphasis was not to the field study and verification; (ii) some applications simply traced or imitated researches related at home and abroad, or grafted one research method (or material) to another material (or method), with a lack of original ideas; (iii) too much attention was paid to the research under laboratory simulation conditions, whereas insufficient attention to the verification research under field conditions; (iv) in some of the applications, the research topics were over broadly laid out, with a lack of concrete of scientific problems, and the research contents were not precise, lack of in-depth studies and substantive subject intercrossing; (v) some of the grants are inadequate of working basis and lack of systematic continuity.

In 2019, the Discipline will continue to encourage researches focusing on the national security of agricultural production, quality safety of agricultural products, and eco-environmental safety. Researches should focus on scientific issues concreted from practice of agricultural production, and put more emphasis on the innovation of new theory and methodology in plant conservation, and on the original creativeness of research. As for research contents, it is encouraged to carry out explorations of the reciprocity mechanisms of crop-pest-environment (biotic and abiotic) at either microscopic or macroscopic level; principles of disaster of hazardous organisms; monitoring, forecast, prevention and control of pests; and the basic and applied basic research of pesticide toxicology and its safe utilization. Special attention should be paid to new scientific issues, combining with the factors of the national crop of ecological features of different regions, to study the adjustment of industrial structure, improvement of cultivation measures, and the global climate change, etc. On the research approaches, emphasis should be put on the combination of new theory and new technologies with traditional methods, as well as integration of laboratory work with field experiment. For interdisciplinary studies, the specific aim of solving major scientific questions in the plant protection field should be elaborated. Preferential support will be given to continuous and systematic research. Excellent proposals will be prioritized funded in the field of agriculture weed, farm rats and diseases and pest forecasting of agricultural crops, etc., in order to promote the balanced development of different branches in plant conservation.

Applications taking woods or model organisms such as Arabidopsis and Drosophila as main research objects will not be accepted.

Horticulture and Plant Nutrition

The funding scope of this discipline covers two research subjects, namely horticulture and plant nutrition.

The funding scope of horticulture covers pomology, olericulture and fruit science, ornamental horticulture, horticultural facilities, post-harvest biology of garden crops and food mycology. In recent years, there has been a rapid development of basic research in horticulture in China. The quality and activity of research work have been much improved in the field of horticulture: the research objects have been broadened and diversified, and research approach has been gradually transferred from traditional organism level and cell level to molecular level; studies based on -omics have been actively carried out in horticulture. Great achievement has been made in the study on basis of trait formation of horticulture crops, regulating measures, gene mining and function identifying, germplasm excavations and innovation, mechanisms and control of quality formation, response mechanisms to adversity, mechanisms of rootstock-scion interaction, the formation and regulation of unfavorable components of horticultural products.

The funding scope of plant nutrition covers the heredity of plant nutrition, physiology of plant nutrition, manure and fertilizer science, nutrient resources and recycling, crop-soil interaction and regulation, etc. Based on the frontier of the Discipline and the national demands on agricultural resource environment, plant nutrition has been focusing its basic research on the interdisciplinary study of the plant-soil-microbe interactions, especially on root microbe-omics and regulation so as to reveal the coupling mechanism of high efficiency use of plant nutrition elements and water resources; studies on the functional genomics, genetics and physiology of plant nutrition, which are formed by the combination of plant nutrition with modern biotechnology; quantitative study in the process of soil-crop system in the combination of plant nutrition with information techniques, etc.; researches on the new theory and methodology in manure and fertilizer science; and the exploration and sublimation of modern plant nutrition theory from practice of traditional agricultural production.

In 2018, major problems in the application for horticulture were the following: (i) the research content in some of the applications was too broad and lack of the precise layout of basic technique requirement for research approach and method, indicating low level of feasibility to achieve proposed research goals; (ii) there were a large number of proposals pertaining to copying and tracing research, but only a few demonstrated original creative and systematic study; some applications concentrated their researches on practical problems of horticulture, but lacked of sufficient scientific issues; (iii) some of the grants were inadequate of working basis and lack of systematic continuity. Main problems in the applications for plant nutrition were as follows: (i) there is a lack of scientific problems raised and condensed according to the production problems of plant nutrition, fertilizer and fertilization in China and the needs of industrial development; (ii) many applications put their study emphasis on molecular biology of plant nutrition, without in-depth study on mechanisms on the physiology and genetics aspects of plant nutrition; (iii) most studies were on large elements of N, P and K, while less studies on medium and trace elements, and there was a lack of coordination and interaction of elements; (iv) there was a lack of substantial interdisciplinary studies among crop-soil-microbe, and in-depth study on the efficient nutrient utilization under intensification conditions; (v) lack of basic researches on

nutrient resources and fertilizing science.

In 2019, the Discipline will continue to encourage endeavors on scientific issues based on national agricultural practice and agricultural industry development, with a close combination of new approaches with traditional methods. Priority funding will be given to original, continuous and systematic and distinctive research. The discipline of horticulture will support proposals which take horticultural crops as their research objects, and address scientific problems on the features of horticulture crops, and production yield, quality, fastness, and constancy. Proposals originated from the assessment, extravagant and utilize of germplasm resources of the nation or wild garden crops will be strongly encouraged. Research on specific biological problems, such as winter dormancy of horticulture crops, flowering phase, scion interaction and organ formation and development, is especially encouraged. As for applications in facility horticultural studies, proposals should emphasize on the substantial combination of facility gardening environment and its regulation with biological problems of garden crops. Studies on the genetic, physiologic and molecular mechanisms of nutrient utilization of high efficiency, interaction between crop, soil and microbe and its control, and the coupling mechanisms of soil water and fertilizer, and its effectiveness to crops will be prioritized in funding. It is especially encouraged to apply for the experimental testification of laboratory research in the field and excellent proposals in "manure and fertilizer science". Researches on the nutrient mechanisms of middle and trace elements will also be encouraged for an active promotion of healthy development of all branches in plant nutrition.

Applications using forest or model plant like Arabidopsis as its research objects will be not accepted by the Division.

Division of Agriculture Animal

The funding scope of the Division covers three disciplines: animal husbandry, veterinary science and aquatic science.

Animal Husbandry

Animal husbandry is a science that studies the germplasm resources, genetic breeding and reproduction, growth and development, nutrition and feed of livestock and poultry (including special economic animals).

Applications accepted and funded in 2018 covered all branches of this discipline, among which, the majority of applications focused their studies on mining excellent genes of typical excellent domestic animals of the country and their functional genome, molecular genetically breeding, reproduction and development model, molecular mechanisms of regulation, new theory and methods related to molecular nutrition, and the development of fine grass germplasm resources and fine variety cultivation, the livestock of low emission, and the interaction of animal husbandry development and its environment. Quite a few studies in the above fields have formed their features in many aspects. Moreover, researchers started to pay close attention to international and domestic cooperation and exchange, and endeavors have been put to the research which may acquire independent intellectual property rights.

In 2019, the Discipline will give more priority to studies on excellent gene mining of typical livestock, poultry, grass, silkworm and bees of China, and cultivation of fine species; encourage basic research on nutrition of domestic animals, prolificacy of live stocks, and the genetic breeding of grazing; and the high efficiency utilization of feedstuff and forage resources. The Discipline will also give moderate preference to researches on the environment of domestic animals and pollution, behavior and welfare, mechanisms of the physiological adaptation of productivity, and grassland pasture, sericulture and apiculture, etc.

In 2019, the Discipline will continue to encourage research on the discovery of excellent genes, regulation mechanism and important scientific issues related to breeding of good breeds in livestock, poultry, silkworm and bee resources; encourage the basic research on Germplasm resources, genetic breeding, reproduction, nutrition and feed of livestock and poultry. Appropriate support should be given to the research on environment and pollution of livestock and poultry, facilities and equipment of livestock and poultry and bee and silkworm breeding, behavior and welfare, sericulture and apiculture. Applicants are encouraged to carry out original, systematic and continuous research on the basis of their previous work, and to give preference to the high quality of the completion of the pre-scientific fund projects.

Special notes for applicants are the following: (i) study object of the research should be livestock, poultry, grass, silkworm, or bee; interdisciplinary studies with other subjects are not allowed to depart from the main research aspect above; otherwise the proposal will be not funded; (ii) for research topic selection, please grasp the essence of key scientific issues in related fields, instead of simply following up the new research progress at home and abroad.

From 2019, projects in grassland science should be submitted to the discipline of forestry and grassland science.

Veterinary Science

Veterinary science is to study the occurrence, development, diagnosis, prevention and cure of animal diseases. The Discipline covers the following branching: animal diseases, zoonoses, public hygiene, laboratory animals, veterinary medicinal industry, etc., as well as other related novel interdisciplinary research areas. The Discipline supports basic researches taking animal diseases as major objects on animal infectious diseases, zoonoses, most common diseases and comparative medicine.

Proposals accepted and funded in 2018 covered all subjects of this discipline. Among them, the majority of applications were focused on veterinary immunology, veterinary epidemiology, basic veterinary, clinical veterinary. Some of them were able to aim at the international frontiers, highlight the creativeness in the selection of their research themes, and actively prompt the international standard of research work. However, problems still exist as demonstrated here: some of the applications paid much attention on the international hotspot, but were lacking of enough concentration of scientific issues; basic research on topics such as traditional Chinese veterinary and animal (veterinary) pathology were yet to be concerned.

The Discipline will continue to encourage studies on the epidemiology, pathogenic biology, mechanisms of pathogenic infection and immunity about important animal

epidemic diseases and zoonoses, meanwhile, strengthen researches on the basic veterinary immunology, the non-infectious disease of animal mass populations, food safety of animal source, and related research, and give moderate preferential support to studies on traditional Chinese veterinary, and animal (veterinary) pathology, etc.

In 2019, the Discipline requests applicants to take animal diseases as their main research objects and interdisciplinary studies should not deviate from the research objects. This Discipline encourages research for the development of national animal husbandry and veterinary science, aiming at defeating new and recurrent animal diseases.

Special note to applicants: when involving highly pathogenic microbes, the operation of the project must strictly abide by the relevant provisions of the state, with the biological safety of the appropriate conditions.

This Discipline does not accept research on animals, bees, silkworms.

Aquatic Science

Aquatic science is to study basic rules of the development, growth, breeding, genetics, physiology and immunology of aquatic organisms and their breeding ecology, breeding engineering, nutrition and foodstuff, control of diseases and pests, and the protection and utilization of aquatic resources, etc.

In 2018, most of proposals accepted and funded were in areas of immunity and control of diseases and pests of aquatic organisms, aquatic basic biology, genetic breeding of aquatic organisms, as well as aquatic resources and conservation, etc. Relatively in-depth studies were conducted on important economic traits of aquatic animals, molecular characters of important pathogens and their pathogenesis, etc., and some of studies have formed their own research features and superiority in some aspects. It can be seen from peer review and panel meetings that the creativity of academic thoughts of proposals were obviously improved. However, only a small portion of applications were able to propose original research on the important scientific issues of aquiculture, whereas for most of the studies, concentration of specific scientific issues was yet to be improved.

In 2019, the Discipline will request applicants to focus their studies on research fields of aquatic science, and aim at the frontier and important demands of production. The interdisciplinary study on aquaculture subjectively with other disciplines will be encouraged. It will be strengthened to support proposals with original ideas. Applicants should choose topics based on new development of subjects concerned at home and abroad, and their research background, aim at scientific problems, focus on original innovation, and avoid over emphasizing on R&D for technology while lacking of key scientific issues. Research on model organisms should be based on aquaculture science. The Discipline will encourage cooperation of applicants with superior units and teams, so as to fully exert regional and resource priority, and enforce cultivation of talents. The Division will prioritize applications in the following areas: genetic rules and gene function of economic traits of important breeding organisms; epidemiology and pathogenesis of important aquatic organisms; host immunity and diseases prevention and treatment; molecular basis and regulation mechanisms of breeding and development of important aquatic organisms; regulation mechanisms of the utilization as well as metabolism of nutrient stuffs for aquatic animals. Moderate support will be provided in the following areas: basic research of aquatic breeding and interaction with eco-environment, conservation of aquatic resource, new model and

new techniques of breeding, etc.

Department of Earth Sciences

Earth sciences study the origin and evolution of the planet earth system, including geography, geology, geochemistry, geophysics and space physics, atmospheric and oceanic sciences, as well as environmental earth science and other related interdisciplinary research among these disciplines.

The above sub-disciplines of earth sciences are the core and foundation for the development of the earth sciences. The General Program aims to promote the balanced, synchronized and sustainable development for all disciplines of earth sciences, facilitate original innovation and expend the frontier of research, and hence to establish a robust basis for the development of the earth science. In 2018, the Department received 7,111 proposals for the General Program submitted from 741 institutions, among which, 1,895 were funded with a total award of 1.1721 billion yuan (direct expenses, and hereinafter), with a success rate of 26.65% and an average funding of 618,500 yuan per project. Among the funded projects from the General Program in 2018, 1,158 (61.11%) were applied from universities and 707 (37.31%) from research institutes. The PIs of 1,376 projects (72.61%) were younger than 45 years old. There were 296 inter-department project funded, and 446 projects supported by different divisions inside the Department. Small Fund for Exploratory Studies with 1-year research was designed for highly exploratory, innovative and high-risk projects or projects with uncertainties. Altogether, 10 proposals were approved as the Small Fund for Exploratory Studies projects in 2018 and 2 million yuan were allocated.

The criteria for the selection of General Program projects in 2019 are still as follows: (1) Innovation and academic value of the overall research approach; (2) Research capability of the applicants; (3) Clearly-stated scientific issues and well-defined ideas; (4) Availability of necessary research background and conditions. During the selection and review process of the proposals, the Department pays close attention to the importance of the basic or traditional disciplines, maintain the international status of the privileged discipline or fields in China, promote the disciplines which are still weak or even “endangered” in China yet predominant in the world, encourage the intercrossing, integration, infiltration and synthesis among disciplines, improve the development of the frontier and basic sub-disciplines, foster the development of the sub-disciplines closely related to experiment, observation, data integration and simulation, and recognize the importance of the intercrossing of the earth science and other disciplines. While advocating innovations, the accumulation of research work should be emphasized. Under the same condition, preferential support will be given to those applicants who have a good accumulation of previous studies and high-quality results obtained from their recent completed projects, as well as who apply to continue their studies. Applicants are required to address the relation between the proposed research work and their accomplished projects. In regard to the exploratory, unforeseeable and long-term running for basic research, special attention will be paid to the high risk, interdisciplinary and frontier research. Scientists will be encouraged to face the great challenging scientific issues and to carry out risky and exploratory research. In 2019, the average allocation per project in the General Program is expected to stay the same as that of the previous year.

Funding for General Program Projects in Department of Earth Sciences in 2017 and 2018

Unit: 10,000 yuan

Divisions		2017			2018		
		Projects	Direct cost	Success rate+ (%)	Projects	Direct cost	Success rate+ (%)
I	Geography	573+3*	36,780	24.17	382+2*	22,394	23.32
II	Geology	390+2*	27,634	26.96	255+2*	16,746	28.02
	Geochemistry	148+1*	10,145	31.63	76+1*	4,810	38.58
III	Geophysics and space physics	194+1*	13,355	29.15	218+1*	13,692	29.90
	Environmental earth science	—	—	—	549+2*	33,679	25.11
IV	Marine science	204+1*	13,902	27.89	231+1*	14,378	26.80
V	Atmospheric science	165+1*	11,254	29.64	184+1*	11,511	31.24
Total or average		1674+9*	113,070	26.83	1895+10*	117,210	26.65
Direct cost per project		67.18 (67.44**)			61.85 (62.07**)		

Notes: *The number of projects of Small Fund for Exploratory Studies for 1 year; **Average amount for individual general projects with a full term; +Funding rates include the projects of Small Funds for Exploratory Studies. The statistics of this table in 2017 was made according to the former sub-disciplines in the Department.

In 2019, the Department selected the General Projects in Division V of Earth Sciences (Atmospheric Science) to initiate categorized application and review. For detailed information, please refer to "2019 NSFC Reform Initiatives" in this *Guide*.

Division I of Earth Sciences

Geography

The scope of funding: physical geography, human geography, landscape geography, natural resource management, regional sustainable development, remote sensing, geographic information science.

Geography is a subject to explore spatial distribution, time evolution and regional characteristics of natural and human elements or geographical complexes. The core of geography is the human-land relationship and interaction mechanism of land surface system. Geography owns the comprehensive, intersectional and regional characteristics, and focuses on the systematic research from the perspective of multi-dimension and dynamic, the perspective always depends on tempo-spatial scale.

Geography concentrates mainly on the interaction relationships, spatial variation rules and evolution processes of natural environment elements (such as water, soil, atmosphere, biology, and so on), landscape and geographical complexes at different tempo-spatial scales; the natural and culture background of human civilization development; as well as the evolution mechanism of the human-land relationship. Geography concerns the spatial structure and evolution process of human elements (including the economy, society

and culture elements, etc.), and its natural background, historical evolution and driving mechanism. Geography focuses on the sustainable development mechanism and strategy of the interaction process between human and environment; the ecosystem functions, processes and services, sustainable natural resource utilization and management; soil and water process and its disaster effect; the interaction mechanism between environmental quality and economic development; human-land relationship system simulation, and so on. Geography explores the mechanisms and methods of remote sensing; the theories and methods of geographic information science and remote sensing geo-analysis; the applications of remote sensing, geographic information system and global navigation satellite system on modern geographic comprehensive application and geographic interpretation, especially the service of tempo-spatial big data. Geography focuses attention not only on understanding the past, but also on giving service to the present and predicting the future.

In 2019, the comprehensive, exploratory and prospective application will be continuously supported. Special encourage will be given to the land surface process studies which use the theories, method and technology of mathematics, physics, chemistry, biology and informatics. The simulation and prediction of complex human-land system and sustainable development system will be priority research subject. More funding opportunities will also be given to interdisciplinary research concerned on the key areas (such as urbanization, globalization, climate change, environmental change, ecological security, disaster prevention and reduction, sustainable development, environmental archaeology, geographic intelligence system), which aimed at the national demand such as the ecological civilization construction, the Belt and Road Initiative and rural revitalization. Related researches on geopolitics and geoeconomics are also encouraged.

Division II of Earth Sciences

Geology

The scope of funding: geology.

Geology is the knowledge about the composition, structure and evolution of the Earth. The aims of modern geology are to disclose the structure and composition of the Earth, to explain the mechanism controlling the transition of Earth materials, to elucidate the Earth's environment and life evolution recorded in these materials, to reveal the agents and processes which modify the Earth's surface, and to apply the knowledge of geology to explore the utilizable energy, mineral and water resources, to uncover the relationship between geological processes, life evolution and human activities, to protect the Earth environment, and to prevent (or give early warning) and mitigate geo-hazards.

The development of geology is based on the advancement of fundamental theory and cutting-edge technology. The introduction to plate tectonic theory has brought about revolutionary changes to the understanding of the Earth. The disclosing of complexity of continental dynamics and the tectonic schemes predating the plate systems are raising new themes for the advancement of plate tectonic theory. Due to the emerging new framework of Earth system science, the correlation between deep processes and surface impacts of the

Earth has become the frontier for geological sciences. The enhancement of abilities to obtain and to analyze data has become a major driving force for promoting the development of geological sciences. The implementation of high precision, in-situ and real-time analytical methods for the composition and structure of Earth materials has enhanced the capability to constrain the composition and evolution of the Earth. The development of geophysical exploration, space-based observation, and geological drilling technology has increased the integrity and accuracy for the understanding of the Earth's structure. New high-tech approaches such as information system, internet of things and photoelectron technology have helped to realize real-time monitoring of crustal movements, earthquakes and volcanic activities. The reproduction and predication of important geological processes have been made possible through the development of computer simulation and high-temperature/high-pressure experiments. This geological program encourages characterized proposals of basic research on fundamental theory based on field and site observations by using of the abundant materials and data recently acquired and accumulated by geology-related agencies and institutions. Multidisciplinary approaches, such as the application of theory, technology and methodology of mathematics, physics, chemistry, bioscience and computer science, are encouraged to study geological issues. International collaboration is also advocated for promoting geological researches and theory advancement with a global scientific view.

Geochemistry

Geochemistry is the discipline that investigates the chemical composition, chemical process and chemical evolution of the epigeosphere, earth interior, celestial bodies and cosmic matter, etc. It applies primarily elements and isotopes tracing, analysis of macroscopic and microscopic structure, analysis of organic matter and biology, isotope and chemical dating, etc. Geochemistry focuses mainly on substances evolution and interaction of different geospheres in the Earth's history. Also, it emphasizes the distribution, state, migration, transformation, cycle and fate of the substances of the earth surface system under human activities stress and natural state.

Geochemistry is not only the basic discipline to cognize the earth and cosmos but also the applied discipline to solve the problems such as natural resources, ecological environment, geologic hazard faced by people to survive and develop There are three aspects to promote jointly the further development of geochemical basic theory and applications: the development of planetary science, earth system science, interdisciplinary, the progress of analysis technology, the needs of human sustainable development demanding on mineral resources and fossil fuels, ecological safety and environmental protection. The geochemical research area covers all aspects of chemical composition, chemical process and chemical evolution of rock, soil, water, atmosphere, volatile matter of earth interior and organism etc.

The characteristics of modern geochemical studies include the following: (1) In the solid geochemistry field, the research hotspots have shifted from the material composition and chemical reactions of the interior Earth to the interactions of different geospheres and their boundaries. It gives full play to advantages of geochemical microprobe in situ analysis with high-resolution, high-precision and high-sensitivity. It pays more attention to geochemical processes and composition structure of Earth's layers. It emphasizes the

integration of plate tectonics evolution and global change research. (2) Research methods and techniques have shifted from statically semi-quantitative description to dynamically quantitative simulation, focusing more on the research of four-dimensional space-time evolution. (3) It pays attention not only to the reconstruction of ancient geologic events on long time scales, but also to the description of physical, chemical and biological processes on short time scales, and the prediction and simulation of environment changes in the future.

Division III of Earth Sciences

Geophysics and Space Physics

The scope of funding: geophysics, space physics and geodesy.

Geophysics, space physics and geodesy are disciplines which based on the theories and methods of physics and related disciplines, and combining observation and experimental means, to understand the basic laws of the space structure and evolution of the Earth and planets, to explore the internal resources of the Earth and planets, and to reveal the characteristics of natural disasters in the Earth and space environment.

Geophysics, through direct observation and theoretical studies on the basic physical fields of the Earth and planets, for instance, gravity, magnetic field, electric field, stress field, heat flow, seismic, is to reveal the internal structures of the Earth and planets and their components and dynamic processes, to effectively understand the mechanism of earthquake and other natural disaster, and to develop the foundation of new methods and technology development of resource exploration.

Space Physics is based on space borne or ground-based detection and study of space physics, to understand physical phenomena of upper atmosphere, ionosphere, magnetosphere of the Earth and planets, and interactions of solar atmosphere, heliosphere and interplanetary space, to provide scientific support for astronautic activities, communication and navigation.

Geodesy is based on the development of the ground- and space-based observation system and theories, to determine the precise location of the surface of the earth and its outer space point, to obtain the shape and deformation filed and gravity field of the Earth and planets, to understand the mechanisms of crustal deformation field and gravity which provide space, time and gravity datum for the national economy and national defense.

Geophysics and space physics attach importance to basic theoretical research, continuous support to fundamental research, more efforts will also be given to new growth and pioneering studies. According to the development trend of earth science and space science, encourage will be focused on studies which belong to the deep cross-integration with other disciplines. In order to well use of new technologies and methods to deepen research on core scientific issues, attention will be given to encourage the independent development and application of detection instruments.

Environmental Geosciences

The scope of funding: environmental geosciences.

With the continuous advancement of industrialization and urbanization and the rapid development of the economy and society, environmental problems such as shortage of water and land resources, increased environmental pollution, degraded ecosystems, and frequent natural disasters are becoming more and more serious, threatening the safety of the ecological environment and the sustainable development of human society. How to scientifically address these resources, environmental, ecological and disaster issues, which brings new challenges to the research and development of environmental geosciences.

Taking the Earth's surface system as the study object, environmental geosciences study the physical, chemical, and biological evolution processes of pedosphere, hydrosphere, surface lithosphere, atmosphere and biosphere, as well as the interaction between the spheres and the biogeochemical cycle of material, using the theories, methods, and means of geoscience; reveal and construct the occurrence and development rules and the risk assessment theory of various geological and environmental disasters under the influence of nature and human activities; explore the basic scientific issues of repair and restoration of various polluted environments and degraded ecosystems.

Specific funding areas for environmental geosciences include: soil science, environmental water science, environmental atmospheric science, environmental biology, environment and disaster in engineering geology, environmental geology, environmental geochemistry, behavioral processes and environmental effects of pollutants, quaternary environment, environmental change and forecast, and regional environmental quality and safety.

For national strategic needs, this Discipline encourages the consolidating of scientific issues in cross-cutting and frontier areas, and conducts basic research work; encourages the creative application of new theories, new ideas, new methods, and new technologies in this discipline, and cultivates new discipline growth points; encourages systematic scientific research for sustainable development, and leads breakthrough in major achievements.

Division IV of Earth Sciences

Marine Science

The scope of funding: marine science and polar science.

Marine science is a discipline studying sea water and seabed, and various processes at interfaces between ocean and atmosphere, and between sea water and coastal estuaries, including physical oceanography, marine geology and geophysics, marine chemistry, biological oceanography, marine environmental science, coastal estuaries, marine engineering, marine monitoring and survey techniques, marine remote sensing, integrated coastal zone management and other branches. Basic sciences, such as mathematics, mechanics, physics, chemistry and biology have been continuously applied to marine science. Meanwhile, new and high technologies, such as space technology, information technology, biotechnology and deep-diving technology, have been continuously applied to marine science. These have opened a new frontier in marine science. Research within this new frontier is also encouraged by the Division.

Marine science is a comprehensive research, characterized by the accumulation of observational and experimental data, the application of new and high technologies, the development of simulation models, and the tendency towards globalization and internationalization. The advance of marine science can make social and economic development achieve sustained benefits from ocean resources, which is an important measure of national scientific and technological strength. The current strategic position of marine science has been leveled up greatly with a tendency toward "global change" and "deep-sea research", forming a new pattern extending from the shore to the interior ocean and from the shallow water to the deep ocean.

Marine science is a science essentially based on observation. The promotion of its academic thoughts and research abilities depends on long-term observation and data accumulation. To meet the demands of research projects in ocean observation, NSFC initiated the pilot Ship-time Sharing Project. Scientists are encouraged to participate in the NSFC Open Research Cruise (NORC) to obtain more continuous, systematic and comprehensive data. The program aims at encouraging scientists to conduct in-situ observation and laboratory analysis using new technologies and methods focused on the scientific issues to be investigated, and provide technical support for exploiting new research fields and new results. In order to promote a balanced development of marine science in China, it is also encouraged that scientists may join in existing cruise plans carried out by other agencies to do research on the deep ocean. To aim at the integrated development of marine sciences, the scientists are encouraged to conduct researches related to physical oceanography, marine chemistry, marine geology and biological oceanography on different spatial and temporal scales.

For those who want to participate in the NORC, it is required to describe the necessity, contents and expected data outputs of the proposed observations in the proposal. Applicants are suggested to pay close attention to the related bulletin and announcements for cruise timing.

Polar science is a discipline studying various natural phenomena, including the processes and changing rules peculiarly in polar region as well as its interaction with other components of the Earth system. It is a comprehensive discipline consisting of several sub-disciplines including polar biology and ecology, polar oceanography, polar space physics, polar atmosphere science and climatology, polar geology, geophysics and geochemistry, Antarctic astrolithology, polar glaciology, polar mapping and remote sensing science, polar management and information science, polar observation and engineering technology, etc.

For the past few years, significant progress has been achieved in international polar research. However, it is still the weakest area in earth science. Comprehensive and interdisciplinary study is the current trend in polar science, which is focused on the key scientific issues on global change and sustainable development for carrying out research on large-scale interactions of the five spheres in the polar region as well as their interactions with the middle and low latitudes. Polar science in China should develop research by focusing on key scientific issues such as global change and sustainable development based on the accumulation of the previous studies.

Division V of Earth Sciences

Atmospheric Science

The scope of funding: meteorology, atmospheric physics, and atmospheric chemistry.

Atmospheric science is to study various phenomena and their changing regulations occurring in the atmosphere so as to serve the mankind. The atmosphere is one of the most active spheres in the Earth system. Its changes are affected and controlled by other spheres in the system and celestial bodies such as the Sun; at the same time the response of the atmosphere to the changes simultaneously results in direct impact on the ocean, terrestrial surface, ice and snow, as well as the ecosystem on the Earth. The atmosphere plays an important role in the interaction among different spheres of the Earth system, and regulates the whole behavior of the Earth system with the interaction of other spheres. Therefore, beside the study of dynamical-physical-chemical process within the atmosphere, atmospheric science currently focuses on the comprehensive researches on the essence of the atmospheric change in terms of the interaction among hydrosphere, lithosphere, cryosphere, biosphere, human activities and global climate, the regulation of weather, climate system and theories and methods of climate change prediction, the regulating technology and measures affecting weather and climate, the impact of human activities on weather, climate and environment system, and the influence of weather, climate and environment system change on human society. Atmospheric science deepens the study on its various sub-directions, and meanwhile, pay attention to the mechanism of the disastrous events occurrence and development of the weather, climate and environment, as well as the forecast and prediction; study on issues of global climate and environment change, and its impacts, adaptation and mitigation; the comprehensive, integrated, modeling and systematical studies on various processes; the interdisciplinary study which could provide the scientific basis for the livelihood and the sustainable development of society.

In 2019, the Division will continually encourage proposals for exploratory, original and prospective basic studies in areas as follows: the various phenomena, processes and mechanism in atmosphere, and the physical-chemical-biological processes of the substance, energy and momentum interaction between the atmosphere and other spheres by applying new ideas, methods, advanced equipment and technologies; applications regarding to synoptic meteorology, atmospheric dynamics, hydrometeorology, atmospheric physics, atmospheric chemistry, atmospheric environment, atmospheric detection and remote sensing, boundary layer, stratosphere and mesosphere; the climatic change and its relevant extreme synoptic and climatic events; new theories and methods for weather forecasting, climate prediction and related complex disaster estimation; new theories and methods for numerical model and data assimilation; basic research on the satellite and radar meteorology; analysis and applied research on the data received from the large scientific experiments and science plans being initiated, conducted or already completed, as well as large observation network established in China and aboard; research on the principle and method for meteorological observation, data analysis and applications; interdisciplinary research concerned on the key areas such as national defense, agriculture, energy, transportation, forestry, hydrology,

health, economy, ecology, etc., as well as the national demand such as the Belt and Road Initiatives and major engineering support, to serve the livelihood and the sustainable development of society.

In 2019, the Division will carry out the classified application and review as reform experimentation. For detailed information, please refer to the "2019 NSFC Reform Initiatives" in this *Guide*.

Department of Engineering and Materials Sciences

Engineering and materials sciences deliver scientific and technical supports to national security, the improvement of people's living standard and the sustainable development of the society and economy. Aiming at cutting-edge areas and meeting the national strategic demands of the social and economic development as well, and committed to discoveries, inventions and innovations concerned, researches in engineering and materials sciences should pay full attention to scientific creativity and innovation, especially original creativity and innovation with independent intellectual properties, promotion of the sustainable development of interdisciplinary integration, so as to achieve a higher level of sustainable development and broad international impact in the field of engineering and materials.

The Department will continue to support interdisciplinary and cutting-edge researches, especially the researches with such great significance that new knowledge could be formed, industrial development could be promoted and international competitiveness could be raised. Researchers are encouraged to focus on original and integrated innovation and to pay more attention to key scientific issues coming from application and propose related research contents. Priority is given to researches that can lead the development of disciplines, and have the potential to obtain independent intellectual properties, especially those combined with national conditions.

The Department encourages various projects with distinctive characteristics of basic research and high technology. Applicants should pay attention to the following priority areas and put forward idea-driven proposals. The areas include microstructure and deformation mechanism of metastable metallic materials, preparation, processing, and property tailoring of high performance light metal materials, low dimensional carbon materials, new inorganic functional materials, new theories and methods of polymer materials processing, carrier materials for biological active materials controlled release/delivery system, theories of efficient development of fossil energy and disaster prevention/control, green metallurgical processes toward resource saving, highly efficient metallurgical extraction and processing, preparation and processing of high performance materials, mechanical surface and interface behaviors and regulation, technology foundation for additive material manufacturing, heat and mass transfer and advanced thermal system, regulation of combustion reaction, new generation energy power system, foundation of high efficiency high quality motor system, design theory for whole-life overall reliability of

structures under multiple disasters, design theory and principles of green buildings, life cycle periodic performance evolution performance major dam and ocean platform, etc.

Funding for General Program Projects in Department of Engineering and Materials Sciences in 2017 and 2018

Unit: 10,000 yuan

Divisions		2017			2018		
		Projects	Direct cost	Success rate (%)	Projects	Direct cost	Success rate (%)
Materials Sciences I	Metallic materials	238	14,284	21.02	250	14,989	18.23
	Polymer materials	231	13,845	21.51	240	14,374	19.26
Materials Sciences II	Inorganic non-metallic materials	339	20,355	21.23	341	20,473	19.77
Engineering Sciences I	Metallurgy and mining science	344	20,624	20.66	372	22,364	18.40
Engineering Sciences II	Mechanics and mechanical manufacturing	565	33,965	21.41	586	35,158	19.04
Engineering Sciences III	Engineering thermophysics and energy utilization	228	13,680	21.67	226	13,548	20.04
Engineering Sciences IV	Architecture, environmental and civil engineering	643	38,564	20.64	676	40,590	18.80
Engineering Sciences V	Electrical science and engineering	217	12,993	19.87	216	13,028	18.91
	Hydrology and marine engineering	280	16,810	20.91	292	17,564	18.78
Total or average		3,085	185,120	20.98	3,199	192,088	18.97
Direct cost per project		60.01			60.05		

In 2018, the Department received 16,863 proposals (364 rejected), increased by 14.67% in comparison with that in 2017, and among them 3,199 were supported with a total direct cost of 1,920 million yuan. The average direct cost is 600,500 yuan per project and the success rate is 18.97% (20.98% in 2017). In 2019, the average funding per project for General Program is expected to be basically the same as in 2018.

Applicants should pay full attention to the following:

(1) The Department will support preferentially basic research with scientific merits and applicable prospects, with considerations to practical conditions and resource characteristics of China, which can either give an impetus to the development of relevant sciences or lead to independent intellectual properties. Proposals that meet the needs of national economy and sustainable development of the society will be encouraged.

(2) Interdisciplinary researches will be encouraged so as to promote the progress of the cross disciplines involved. Applicants should put forward new conceptions and ideas as creative as possible with specific scientific issues.

(3) The fundamentality and innovation should be fully discussed in proposals. Applicants should pay attention to proposing key scientific issues, concentrating research contents and highlighting research focus. For different types of projects, please refer to the

relevant project administrative policies, and put forward proposals according to the requirements.

(4) When applicable, applicants are required to provide the research achievements of the previous completed project(s), and list the scientific papers published in domestic or foreign academic journals. The provided information must be objective and accurate; otherwise it will be treated as a research integrity issue.

(5) Please refer to the funding amount of different projects, and put forward proposals with a reasonable budget plan according to actual demands of various expenses.

Division I of Materials Sciences

The Division supports fundamental research on metallic materials and organic polymer materials.

Metallic Materials

Research proposals should present the merits of the proposed fundamental research clearly, including clear objectives and scientific significance of the project, and the suitability of the methods to be employed. Proposals should target either to advance the materials science in cutting-edge areas or to promote development in the relevant areas that meet the national demands. The funding scope of the Division covers compositions, microstructures, phases, surfaces and interfaces, scales effect, impurities and defects in metals, alloys, metal matrix composites, inter metallic compounds, metal-like materials and metamaterials, and their influence on mechanical, physical and chemical properties and performance; basic issues in the preparation and processing of metallic materials, including heat treatment, casting, forging, welding and cutting; basic issues in the strengthening and toughening, deformation and fracture, phase transformation and alloy design; fundamentals in energy materials, environment-friendly materials, biomaterials, and materials in transportation, aeronautic and astronautic industries; interaction mechanisms of metallic materials and environment, damage, functional degradation and consequent failure mechanism, recycling mechanism and relevant fundamentals; theoretical fundamentals on metallic materials; development of theoretical methods, calculating methods, modern analysis and test methods, big data analysis and processing methods incorporating basic and applied basic researches of metallic materials.

In 2018, the Division received 1,371 proposals for the General Program, increased by 21.11% in comparison with that in 2017. Totally, 250 projects were granted with an average funding intensity of 599,600 yuan per project and a success rate of 18.23%.

It is noticed that the areas of metastable metals and alloys, functional materials and surface engineering kept the leading place in term of the amount of proposals. It is hoped that researchers should pay attention not only to the frontiers and the hot areas, but also to other fundamental issues with scientific merits and creative ideas, especially those common key issues beyond materials systems. In addition, attention should be paid to the new understanding of classical issues in basic materials. Applications in the field of composites and surface engineering should focus on scientific aspects and proposing unique ideas. Applications with a cross-disciplinary background should focus on issues within the

funding spectrum of the Division.

Organic Polymer Materials

The Division mainly supports the following areas in the field of organic and polymeric materials science: preparation chemistry of organic and polymeric materials; theory and method for the characterization of polymeric materials; processing of polymeric materials; the surface and interface of polymeric materials; the implementation of high performance and functional properties of general polymer materials; polymer-based composite/hybrid materials; functional organic and polymeric materials and organic solid materials; biomedical polymer materials; smart and biomimetic polymer materials; special polymer materials; organic and polymeric materials related to energy, transport, ecological environment and resource utilization.

In 2018, the Division received 1,246 proposals for the General Program, with an increase of 16.01% compared with that in 2017. Finally, 240 applications were granted with an average funding amount of 598,900 yuan per project and a success rate of 19.26%. Quite a few applications were involved in the following areas: polymer blend and composite materials, biomedical polymer materials, functional inorganic/organic composite materials, photo, electro, magnetic functional materials, environment-related polymer materials, and structure-property relationships of polymeric materials, etc.

The Division encourages interdisciplinary basic and applied basic researches involved with mathematics, chemistry, physics, life science, medical science, information science, energy, environment, mechanical and manufacturing science, transport and aerospace science, and oceanography, etc., which lead to creativity and innovation. To be specific, the researches in the following areas are encouraged: scientific issues in the preparation of polymeric materials, including high efficient and controllable synthetic methods of polymeric materials, synthetic chemistry of polymer materials with high performance, including new monomers, new routes and new technologies, the preparation of functional polymer materials, new method and theory in polymer processing, the relationship between the aggregation structures and the properties of polymeric materials and their composite materials; the method and theory in the implementation of the high performance and functional properties of general polymer materials; low-cost and green method in the preparation of functional organic and polymeric materials, the structure-property relationship and the implementation of their stability; performance-directed biomedical polymer materials and the evaluation method of their application; new concept in the design theory and preparation method of smart and biomimetic polymer materials; the controllable preparation and assembly methods of supramolecules and polymer materials with multilevel structures and their functionalization, eco-environmental polymer materials, including the structures, properties and efficient utilization of natural polymers, as well as the design theory and preparation method of environment-friendly polymer materials, the recycling and utilization of polymeric materials; polymeric materials for environmental control and improvement in water, soil and air pollution, and the stability and aging of polymeric materials. The Division also encourages enhancing the design of polymer materials with the guidance of theories; basic research aiming at the difficult problems existing in the preparation, modification and processing of the main assortments of domestic polymer materials; basic research aiming at

new organic and polymeric materials and new technologies in polymer processing for the national strategical objective; synthesis and preparation of polymeric materials by non-petroleum routes.

Division II of Materials Sciences

The Division supports the fundamental and applied basic researches on various inorganic non-metallic materials. Along with the development of material basic theories and the innovation in fabrication technologies, lots of new inorganic non-metallic materials have continually emerged, including two-dimensional materials, smart materials, biomaterials, new energy materials, etc. The researches on inorganic non-metallic materials are becoming more and more active. At present, in the researches of inorganic non-metallic materials, functional materials are developing in the direction of high efficiency, high reliability, high sensitivity, smartness, and functional integration; and structural materials tend to possess toughening, functionalization, extreme environment endurance, eco-friendly fabrication, and high reliability. While developing new materials, conventional inorganic non-metallic materials are constantly being remolded, upgraded, and developed as well. More attention are given to the applications of inorganic non-metallic materials in various engineering science and technologies including information technology, life science, energy and environmental science, aerospace technology, and so on.

In 2018, 1,725 proposals for the General Program were received, increased by 8.02% compared with that last year, and 341 projects were funded with an average funding of 600,400 yuan per project. The success rate was 19.77%.

From the proposals submitted in the past 3 years, the researches on inorganic non-metallic materials involve various areas with a broad interdisciplinary range, and the number of applications has been increasing year by year. 63.48% of the proposals is for the researches on functional materials, which is the most active field and thus forms many subject hotspots including energy conversion and storage materials, low-dimensional carbon and two-dimensional materials, multiferroic and lead-free piezoelectric materials, photoelectric information functional materials, multi-functional composite materials, biomedical materials, and so on. Among them, proposals regarding energy conversion and storage materials (about 23.27% of the total in the year 2018) ranked above all the others. There were still many proposals in photoelectric information functional materials, low-dimensional carbon and two-dimensional materials, biomedical materials, in which the innovations need to be further improved. The proposals in structural materials were relatively concentrated among a few institutions, and the number of proposals accounted for 5.71% of the total. There are also a large number of proposals for composite materials based on inorganic non-metallic materials, among which the number of the proposals on functional composite materials has increased compared with the past. However, in terms of the quality, quite a number of them were of follow-up, low-level repetition, lack of innovation ideas and features, lack of basic issues and research contents in inorganic non-metallic materials.

The Division supports the innovative researches, as well as substantive interdisciplinary researches of inorganic non-metallic materials cross-cutting with other

related disciplines. The Division encourages and supports: exploration of new inorganic non-metallic material systems based on domestic resource status; new fabrication sciences and technologies, including new theories, effects, characterization technologies and methods; applied basic researches on novel inorganic functional materials and smartness materials, advanced structural materials, photoelectric information functional materials, low-dimensional carbon and two-dimensional materials, biomedical materials, novel energy materials, eco-environmental materials, etc.; researches on the surface, interface, and composite design of materials; basic researches on "structure-function" integrated composite materials; and applied basic researches on the improvement and remolding of conventional inorganic non-metallic materials using new theories, techniques, and processes.

Division I of Engineering Sciences

The Division supports the fundamental researches on Mining and Metallurgical Engineering, which are mainly involved in natural resource exploitation, safety science and engineering, mineral engineering and separation science of substances, physical chemistry of materials and metallurgy, ferrous and nonferrous metallurgy, materials preparation and processing, ecology of mining and metallurgy, and resource recycling and utilization, etc.

The Division received 2,022 research proposals in its general program in 2018, with an increase of 21.44%. 372 of the proposals were granted, with an average funding of 601,200 yuan per project, and the success rate was 18.40%.

In recent years, benefited by continuous financial supports, and driven by major national needs, Mining and Metallurgy Engineering science in China have obtained great progresses through continuous innovations. The research capability has improved, and some researches have reached international frontiers. Many significant research results have been achieved. The main developmental trends of the Discipline include: (1) Discipline differentiation and extension. The theory of the Discipline is much deepened and improved by continuously assimilating novel methods and techniques from other disciplines during the transition from macro scales to micro scales. (2) Interdisciplinary and integration. The more disciplines are subdivided, the more their integrations are strengthened. New research areas have emerged one after another due to further development of interdisciplinary. (3) Relationship between fundamental research and application is getting closer. The applications, such as mining and metallurgical equipment, system monitoring and control, metallurgical reaction engineering and systems engineering, and ecological technology of metallurgy, etc., heavily depend on theoretical innovation of the fundamental researches. The obvious characteristics include process integration, technology integration and disciplinary integration. Therefore, it is getting faster and faster in integration, interaction and transformation of science and technology. Science and technology have also been integrated. At present, the Discipline is in the focal point of resource, energy and environment. Due to gap between demand and development, upgrading of traditional industries and improvement of ecological environment, the developmental concepts including innovation, coordination, green, open, and sharing should be put into practice in upgrading traditional industries and improving ecosystem to fulfill new meaning of

industrial upgrading promoted by the fundamental research.

Hot research topics of the Division include oil and natural gas exploitation, metal and nonmetal mining, safety science and engineering, metal materials preparation and processing, mineral processing and utilization engineering, metallurgical engineering.

Focusing on engineering science, the Division emphasizes on quality sustainability rather than guarantee of quantity. The Division will continuously enhance interdisciplinary research, explore new methods, pay close attention to new theory, concepts and methods, and their creative applications. The aim is to enhance the levels of basic research on promoting the core competitiveness in China's petroleum, mining industry, metallurgy, and materials preparation and processing by providing problem-oriented solutions to meet the major national needs. In the aspect of natural resources exploitation, research emphases will be placed on the engineering and scientific issues relative to recovering, safety and environmental friendliness. In the aspect of techniques, process, and equipment, emphases will be placed on structure optimization and adjustment, process intensification, and the scientific law of Engineering. Researchers are encouraged to conduct long-term research and boldly put forward their own hypotheses to form their own research features. In terms of selecting research topics, priority should be given to the funding of the basic researches that can meet the major national needs, have great theoretical significance, have potential applications and foresights, and are likely to become the growth point of new knowledge, and especially to the funding of youth scientific research projects with original ideas, and with cooperation at home and abroad.

The following research fields are encouraged: (1) new theory and method to enhance recovery of oil and natural gas; (2) theory of safe and efficient development in drilling, production, transportation and storage for complex oil and gas resources in deeper formation and deeper sea; (3) theory of gas hydrate and geothermal exploitation; (4) mining theory of mineral resource; (5) mechanical behavior of rock under multiple fields (6) theory of material green separation; (7) clean and efficient extraction and application of mineral resources; (8) thermodynamic basis and metallurgical theory for the production of high quality metal materials; (9) formation, transportation and control of pollutants produced in the metallurgical process; (10) preparation of high performance materials under the action of multi-fields and near-net-shape forming; (11) compact process fabrication and fine forming of metals; (12) information acquisition and data processing of mining and metallurgy; (13) accident prevention and system evaluation of hazardous chemicals; (14) prevention of major natural disaster and emergency rescue.

Division II of Engineering Sciences

The Division supports fundamental research in the fields of mechanical and manufacturing science.

Mechanical science is a fundamental technological discipline that involves the study of functional synthesis, quantitative representation, and performance control for various mechanical products, and the development of novel design theories and methodologies by applying related knowledge and technologies regarding mechanical systems. It mainly includes mechanism and robotics, transmission mechanics, mechanical system dynamics, strength theory for mechanical structures, mechanical tribology and surface technology,

mechanical design, and mechanical bionics. Manufacturing science primarily involves studying theories, methods, technologies, processes, equipment, and systems concerned with production manufacturing of high-efficiency, low-cost, intelligent, and high-performance. It mainly includes component forming and machining, manufacturing systems and automation, mechanical measurement and test theory, and micro/ nanomechanical systems.

In 2018, 3077 research proposals for standard grants were received, a 16.60% increase from the previous year. A total of 586 proposals were funded, the average direct cost of funding was 600,000 yuan per project and the funding rate was 19.04%.

The particular focuses of support from the Division are (1) fundamental research concerning national strategic priorities, developing the frontiers of disciplines, and realizing potentials for industrial applications; (2) research aimed at the environmentally friendly, resource-saving, and energy-efficient integration of sustainable design and manufacturing; (3) research concerning innovative design, new manufacturing principles, and measurement theories for ultrahigh-precision, high-tech, and, in particular, large or heavy equipment and instruments, including processing mechanisms, prototyping theories, and technologies; (4) methodologies for designing and manufacturing under extreme working conditions involving, for instance, parameters ranging from conventional to extraordinary or extreme conditions, and scale ranging from macroscale to mesoscale, microscale, nanoscale, and multiscale.

Based on the basic tasks of mechanical engineering discipline, the Division will continue to support research in emphasizing fundamentals, frontiers, explorations, and innovations by encouraging continual in-depth research in specific fields and high-risk exploratory research for original breakthroughs and disruptive innovation. The Division will preferentially support research that has yielded innovative achievements and is expected to achieve major breakthroughs; moreover, the Division will preferentially support substantial and profound interdisciplinary research, especially in topics involving multi-disciplinary areas such as electronics, information technology, biology, materials, and medical science, with the primary objective of resolving scientific problems in the field of mechanical engineering provided that applications do not deviate from the funding scope of the Division. In 2019, substantial financial support will be provided by the General Program Groups in two areas, Basic Scientific Problems of Dynamics in Power Machinery and Mesoscale manufacturing fundamentals and technical methods. If you apply for such a project, please indicate the project group in the first line of application text.

The PIs of current projects are suggested to focus on these ongoing projects rather than applying for new short-term projects. Junior researchers are advised to choose research topics combining their own specialized expertise and background, but not to participate in proposals that are irrelevant to their own research fields.

Division III of Engineering Sciences

The Division supports fundamental research in fields of engineering thermo-physics and energy utilization that involves in engineering thermodynamics, refrigeration and cryogenics and dynamic characteristics of thermodynamic systems, aerothermodynamics,

heat and mass transfer, multi-phase flow, combustion, thermo-physical properties and measurement, and renewable energy utilization, as well as other fundamental and innovative researches related to engineering thermo-physics and energy utilization.

In 2018, the Division received 1,128 proposals for the General Program, increased by 7.22% compared with that in 2017. Totally, 226 were supported with an average funding intensity of 599,500 yuan per project and a success rate of 20.04%.

The main development trends of the Discipline are as follows: (i) research on the basic issues has been deepen from macro-level to meso-level and micro/nano-level, from isolated studies to coupled studies, from common parameters to parameters under ultra- or extreme conditions, from routine thermo-physical problems to random, unsteady, multi-dimension, multi-phase and complicated thermo-physical problems and intercrossing research in the discipline; moreover, research becomes more quantitative and precise; (ii) research themes have been crossed over traditional disciplinary borders and integrated with related disciplines, for example, physics, chemistry, life science, information science, materials science, environment and safety. Researches in the following areas are active: the mechanism of new type thermodynamic cycles and non-equilibrium thermal dynamics, refrigeration and low temperature engineering, dynamics, optimization and control of complicated systems, turbulence properties of internal flows and properties and control of unsteady flows, porous media and micro-scale heat and mass transfer, radiation and heat exchange by phase transformation, clean, supersonic and micro-scale combustion, thermo-physical problems in the prevention of disasters, mechanism of interaction between phases and thermo-physical model in multi-phase flow, new principles and methods in thermo-physical measurement, and new thermo-physical principles in energy conservation, renewable energy transformation and utilization, energy and environment. In 2019, encouraged research areas are fundamental issues on renewable energy utilization and fundamental issues on energy transformation and utilization under extreme conditions. If they are interested in these areas applicants should focus the research on one of the above encouraged research areas in their proposals.

The Division will give priority to fundamental researches with theoretical importance, potential application and prior prospect, which might be the new fields for knowledge production, continuously promote interdisciplinary studies and the exploration of novel methods, and encourage original ideas and creations. The Division will continue supporting the researches with interdisciplinary nature, or international cooperation background or good achievements got in the completed projects.

Division IV of Engineering Sciences

The Division’s funding scope mainly covers architecture, environmental engineering and civil engineering. The development trend of architecture is to study the development of region, city and building, and the innovation of construction techniques from the viewpoint of human-environment relationship, as well as the basic theory, methods of planning and design, and construction technology innovation based on sustainable development strategy. The environmental engineering research is focused on the water or air pollution control and quality amelioration, as well as theories and methods for the treatment, resourcelized and

harmless disposal of various pollutants and wastes. Civil engineering stresses that studies should be closely combined with engineering practice to investigate basic theoretical issues and solve foresight key technological issues arising from engineering construction. The interdisciplinary interaction, application of advanced experiment and information technologies and adoption of new materials, new structures and new technologies are the major features in the development of these research fields.

In 2018, the Division received 3,595 proposals for the General Program, increased by 15.37% in comparison with those in 2017. Totally, 676 proposals were supported with an average funding intensity of 600,400 yuan each and a success rate of 18.80%.

In the area of architecture, emphasis will be given to new scientific issues arising from urban construction, scientific method in urban planning and building design, and the exploration and innovation of new technologies and new methods. Research on environmental engineering will emphasize key scientific issues related to new theories and technical bases of new high-efficiency and low-consumption technologies, which include water purification, wastewater treatment and utilization, municipal water supply and drainage system, urban refuse disposal and utilization, air cleaning and air pollution control and renovation of the polluted water environment. Municipal sewage regeneration and resourcezation are priority areas for grant. In the area of civil engineering, more attention should be paid to innovative research on design theories and methods of complex structures. Key scientific issues on the following topics are encouraged: new structure systems and performance design theories, disaster effect and civil infrastructure failure mechanism and performance control, modern structure experiment, on-spot measurement and digital simulation technology. In the area of geo-technical engineering, researchers should focus their attention on the engineering properties of soil under complex conditions, and invalidation mechanism and control methods of geotechnical engineering.

Division V of Engineering Sciences

The Division mainly supports researches in electrical science and engineering, hydro-science and water research, hydraulic engineering and ocean engineering.

Electrical Science and Engineering

The subject of electrical engineering includes two main parts: electric (magnetic) energy science and the interaction between electromagnetic fields and materials, and common basic areas: electric network theory, electromagnetic field theory, and electromagnetic measurement. The related research fields mainly include the electrical energy conversion (power conversion of new type renewable energy, mutual conversion and substitution between electric power and other kinds of energy), electric machine and its control, electrical apparatus, power system, power electronics device and system, superconducting technology, pulse power technology, high voltage and electrical insulation technology, advanced electrical engineering materials, discharge and plasma technology, electromagnetic biological technology, electromagnetic compatibility, environmental electro-technology, electric sensing and measurement, electric drive and motion control, communication and information of power system, new technology of electric energy storage

and power saving, etc.

In 2018, 1,142 proposals were received for the General Program, increased by 4.58% in comparison with that in 2017. Totally, 216 proposals were funded with an average funding intensity of 603,100 yuan per project and a success rate of 18.91%.

As for electric (magnetic) energy science, the priority is given to new theory, new technology and new equipment related to high efficiency, flexibility, safety and reliability, and eco-friendly electrical (magnetic) energy conversion, transmission and utilization. The research fields mainly include power generation of new energy and renewable energy, smart gird, wireless power transfer, high efficient conversion and utilization of electric energy, electric machine system (including electric motor drive and control in robot, servo system, etc.), electric drive and motion control (including electric vehicle, railway traffic, ship and aircraft), superconducting electrical technologies, pulse power technology, efficient power consumption and also the involved information technology, control theory and method for electrical engineering.

As to the interaction between electromagnetic fields and materials, the priority is given to investigation on new phenomena, exploration of new principles, and the establishment of new models and discovery of new applications, such as the safety and reliability related to power apparatus, novel high power electronic devices, advanced electrical materials, measurement of electromagnetic characteristics, coupling between electromagnetic pulsed energy and its applied objects, discharge theory and high active plasma generation, and electric energy storage. The proposals are highly encouraged for investigations mainly based on electromagnetic science for the interaction between electromagnetic field and biomatter, extracting and utilization of biologic electromagnetic information.

Hydro-Science and Water Research, Hydraulic Engineering and Ocean Engineering

The Division supports basic researches in three areas, including hydro-science and hydraulic engineering, geotechnical engineering and hydro-power engineering, and coastal and ocean engineering. The research themes include hydrology and water resources, agricultural soil/water and biological system engineering, water environment and water ecology, river and coastal dynamics and sediment research, soil and rock mechanics and geotechnical engineering, hydraulics, hydro-machinery and systems, hydraulic structures and materials, coastal and offshore engineering, ship engineering, ocean engineering, ocean technology. Among them, the field of water environment accepts applications with open water and soil as the main research objects. The field of soil/rock mechanics and geotechnical engineering accepts applications for common scientific problems in this field and applications with the characteristics of this discipline. Hydro-machinery engineering accepts engineering science and engineering technology studies on ship power plant and ship-engine-propeller system, and does not support researches on engine combustion, fuel cell, electric power and other disciplines. Applicants should carefully understand the scope of funding in this field, and do not apply to this subject again on the basis of having applied for (or funded) in this field.

In 2018, 1,555 proposals were received for the General Program, increased by 16.13% in comparison with that in 2017. Among them, 292 proposals were finally granted

with an average funding intensity of 601,500 yuan per project and a success rate of 18.78%.

According to application and funding statistics in recent years, there is a growing trend of interdisciplinary research in proposals of hydro-science and ocean engineering, and both the number of proposals and the number of grants are increasing. In 2018, areas with more applications and grants included ocean engineering (E0910), water environment and ecological hydraulics (E0903), and soil and rock mechanics and geotechnical engineering (E0907). Areas with less applications and grants included coastal engineering (E0909) and hydro-machinery and systems (E0906).

In 2019, encouraged research areas are (1) processes of material transport and transformation in river basins and their effects on ecological environment; and (2) new theories and methods of ocean engineering and ocean technology. Those who are interested in these two areas should indicate in the first line of the main body of the application that this application belongs to the "research area of encouragement" in the General Program Guidelines, in order to remind the reviewers to pay attention to it.

Researches in the field of hydrology and water resources are mainly focused on the hydrological cycling and evolution, prediction, prevention and mitigation of extreme flood and drought disaster in changing environment, the fine allocation of watershed/region water resources and comprehensive regulation of quantity, energy and quality. Researches in the field of agricultural soil/water and biological system engineering are mainly focused on the coupling effect of water, fertilizer, gas, heat, and chemical and biological processes in farmland, the mechanism of green and high-efficient water use for crops, irrigation and drainage engineering technology and models, and their ecological and environmental effects. Researches in the field of water environment and water ecology are emphasized on physical, chemical and biological processes related to water environment, and the ecological and environmental effects of major projects and the theory of regulation and control. Since water resources are closely related with economy, society, environment and energy, the interdisciplinary and integrated research is encouraged in fields of water resources, water environment and water ecology. Researches in the area of river and coast dynamics and sediment research should give their focuses on basic theory of sediment transport, estuary evolution, sediment problems related to large projects and utilization of sediment resources, and the theory and technology of intellectualized dynamic regulation of water and sediment in river basins; the basic research of hydraulics from macro to micro, from engineering to river basins, and the exploration of new methods of hydro-informatics are encouraged; and the in-depth study of transient process of hydraulic machinery and anti-wear technology are also encouraged. Hot research topics in the field of soil and rock mechanics and geotechnical engineering include the constitutive relationship of geo-materials, multi-fields and multi-phases coupling, deformation and failure mechanism and underwater foundation construction technology. Research trends in the field of hydraulic structural materials are the new structures, environment-friendly and function-based design under complex conditions. Hot research topics in the field of coastal engineering include port and waterway engineering and underwater engineering, offshore resources and energy exploitation and environmental protection, disaster prevention and mitigation in extreme cases. Hot topics in the field of ocean engineering and ocean technology include the basic theory of motions and response of ship and marine structures subjected to complex marine conditions, new hull forms and innovative design methodology, and the basic theories in exploitation of deep-sea resources; Unmanned vehicle technology, big data based optimization of ship energy

efficiency and navigation safety technology, deep-sea exploration technology, multi-functional underwater sensing and environmental monitoring technology, new underwater acoustic and energy transition and communication theory, numerical and physical experiment technology, ship safety and early warning, ship intelligence and information technology.

Department of Information Sciences

The Department funds researches in areas of the generation of signals, acquisition, storage, transmission, processing and utilization of information. Based on the trends of disciplinary development and social progress, the following priorities are set for funding: new generation of mobile communication theory and technology, air land and sea coordination theory and technology, marine information acquisition, high performance detection imaging and identification, interactions of electromagnetic wave and complex targets, information security, cyber space security, new system software design method, social media big data analysis and processing, new types of storage and computation, analysis and control of complex system modeling, advanced navigation technology and system, intelligent robot theory, technology and system, intelligent optimal manufacture theory and technology, automation using artificial intelligence, semiconductor photoelectric devices, integrated circuits, inferred and tetra hertz technology, quantum information, new types of laser, cognitive science and artificial intelligent, etc. Preferential support will be given to basic researches that meet national demands and have far-reaching importance in promoting the national economic and disciplinary development.

Scientific and technical issues in information sciences are increasingly interdisciplinary in nature. Therefore, the Department pays great attention to proposals for interdisciplinary researches between information science and mathematics, physics, chemistry, life sciences, medical sciences, materials sciences, engineering, geosciences and management sciences, and so on. The Department encourages cooperative research among scientists with different backgrounds and knowledge to put forward cross-disciplinary research proposals in smart city, health and service sciences. It also encourages scientists to combine theory with practice and explore basic theory and key technical issues that have important application potentials for national economy and security. Encourage research on basic theory and key technology driven by national need, and promote deep integration of industry and research. The Department will continue to encourage scientists to conduct substantial international cooperative research with scientists abroad in frontier areas of information sciences.

Please select the correct code, research directions and key words when submitting applications.

In 2018, the Department received 10,558 applications for General Program, increasing 19.07% from that in 2017, and funded 2,007 projects with a total direct cost funding of 1.20037 billion yuan. The average direct cost funding is 598,100 yuan per project. Some projects are related to interdisciplinary areas with mathematics and education. In 2018, 140 applications for the projects of interdisciplinary research between Information Sciences and Mathematical Sciences were received and 29 projects were funded with

average direct cost funding of 500,000 yuan per project and a funding rate of 20.71%. 484 applications for the projects of education information sciences and technology were received and 38 projects were funded with average direct cost funding of 453,700 yuan per project and the funding rate of 7.85%.

In 2018, we funded 122 small grants in the General Program, with a total direct funding of 19.52 million yuan, and an average funding per project of 160,000 yuan.

In 2019, the Department encourages creative basic research that is different from traditional research ideas, and welcomes researchers conduct discussions and studies on new concepts, new theories, new methods and new technologies. The PIs of those projects making important progress will be given preferential support towards their new applications. The average direction cost funding will be about the same as last year.

Funding for General Program Projects in Department of Information Sciences in 2017 and 2018

Unit: 10,000 yuan

Divisions		2017			2018		
		Projects	Direct cost	Success rate (%)	Projects	Direct cost	Success rate (%)
I	Electronics and technology	176	10,656	21.20	182	11,040	20.04
	Information and communication system	181	10,724	21.47	158	9,477	20.15
	Information acquisition and Processing	143	8,463	21.34	138	8,237	19.91
II	Theoretical computer science, computer software and hardware	128	7,609	21.77	122	7,231	21.11
	Computer applications	285	17,039	21.74	174	10,411	21.14
	Network and information security	163	9,762	21.91	164	9,893	20.97
III	Control theory and control engineering	416	24,499	21.98	363	21,939	19.78
	Systems science and system engineering	—	—	—	231	13,908	17.47
	Artificial intelligence and intelligent systems	—	—	—	38	1,724	7.85
IV	Semiconductor science and information devices	175	10,482	21.63	179	10,719	18.76
	Information optics and photoelectric devices	120	7,182	21.78	116	6,940	18.77
	Laser and technical optics	125	7,464	21.82	142	8,518	18.64
Total or average		1,912	113,880	21.56	2,007	120,037	19.01
Direct cost per project		59.56			59.81		

In 2019, the Divisions of Semiconductor science and information devices and Information optics and photoelectric devices will use experiment on new method of application and evaluation. For detailed information, please refer to "2019 NSFC Reform Initiatives" in this *Guide*.

Division I of Information Sciences

The Division mainly funds basic research in areas of electronic science and technology, information and information system, information acquisition and processing and related interdisciplinary areas.

Researches funded include areas of circuit and system, electronic science and technology, magnetic field and wave, as well as electronics and applications. Funding areas mainly cover the design, test and verification of circuits and system, diagnosis, reliability, micro-nano circuit and system design theory, methods and technology and low energy consumption design method, power, radio electronic circuit and system design theory and method, circuit and network theory, electromagnetic theory and computational methods in electromagnetic fields and waves, characteristics of electromagnetic field and waves in new types of media, scattering and back-scattering, mechanism of interaction between electromagnetic field and wave and objects, electromagnetic compatibility and electromagnetic environment, theory and technology of millimeter wave and micro wave, acquisition and transport of electromagnetic energy, electronic wave transmission and antenna, micro wave optics, tera hertz science and technology, transient electromagnetic field theory and application, vacuum electronics, surface and membrane electronics, superconducting electronics, quantum electronic theory and device, plasma electronics, molecular and nano electronics in physical electronics, electromagnetic effect in bioelectronics, biochips, medical imaging, medical information detection and processing, medical imaging navigation and key medical instrument technology; information processing and analysis in bio informatics, analysis of bio big data, detection and identification of cell and bio molecular information, information network and analysis in bio systems, modeling and simulation of bio system functions, methods and technology of bionic information processing; sensitive electronics and physical, chemical, bio and bio chemical sensors, wearable sensors, properties of new types of sensitive materials and sensors, and sensor theory and technology.

Researches funded also include the theory and key technologies for information transmission, exchange and application in fields of communication and information. The main funding areas include informatics, signal coding, channel coding, network service theory and technology, information system modeling and simulation, information system and communication network security, wireless connection security, cognitive wireless in information theory and information system; wireless, spatial, underwater, multimedia, optical, quantum, computational, transducer network communication theory and technology, body network, new network access technology, mobile wireless internet technology, and basic mobile communication theory and network, future information network theory and transmission mechanism, network communication theory and system, etc.

Researches funded as well include information acquisition and processing related to the theory, methods and applied technology of information sensing, acquisition and processing. The main funding areas include signal theory and signal processing, the processing of multidimensional signals and array signals, and processing of radar, sonar, remote sensing and voice signals; mathematical theory and methods in information acquisition and processing, and information acquisition mechanism and technology, weak

signal detecting and processing, detection and imaging system in information detection and processing, image processing and interpretation, integration of multi-detector signals, multimedia information processing and presentation, space information acquisition and processing, marine information acquisition and processing, disaster information acquisition and processing, and applied basic research in mobile network big data, etc.

Interdisciplinary research between electronic communication and mathematics will be supported in the Division. Please select application code F070201.

In 2018, the Division received 2,401 proposals for General Program, and funded 478 projects. The funding rate is 20.04% and the average direct cost funding intensity is 601,500 yuan per project.

In 2019, the Division will continue to support researches in areas of basic theory and key technologies that are significant to the national security in areas of new method of circuit and system design, millimeter wave antenna and system integration, acquisition and transport of electromagnetic energy, micro wave photon radar, new sensor mechanism and design method, bio data analysis, medical image processing, space, sea and land information network, mobile internet, vehicle internet, positioning of outdoor targets, optical communication, communication system security and wireless connection security, underwater communication and sensor network, electromagnetic vortex communication, new principle and method of radar, detection and imaging, remote sensing image processing, multimedia information processing, space information acquisition and processing, underwater information acquisition and processing. The innovative and cross-disciplinary research and exploratory studies with good prospects will be supported that may have some risk and are non-consensus, preferential funding will be given to the projects which have scored outstanding achievements in previous research. Preferential support will be given and encouraged to the projects which could open and share their research results, and research on the design of software and hardware on the opening data base; it is encouraged the combination of theory and practice to focus on innovation and to study and solve basic problems in important application areas, so as to improve China's research capabilities in this discipline.

Division II of Information Sciences

The Division mainly funds researches in areas of basic theories, basic methods and key techniques related to computer science and technology and relevant interdisciplinary areas.

Computer science and technology is one of the most active, fast-growing and widely influential areas in information sciences. The important trend of computer science and technology development is to obtain super speed, large storage, high performance, high reliability, easy interaction, intelligent, networking, universal and mobile applicability. Applicants are recommended to pay attention to these new features in this Division.

The Division supports researches on the theory of computer science, software theory and engineering, architecture and system software, parallel and distributed computation, new types of storage, imbedded system, computer graphs and virtual reality, image and audio video processing, bio data processing and analysis, man machine interaction and

coordination, information security, computer network and security, mobile and universal computation. The Division also stress on funding of studies on theoretical method of information security, network security, new system and software design method, social media big data analysis and processing, man machine interaction and coordination.

Interdisciplinary research between computer science and mathematics will be supported in the Division. Please select application code F070202.

In 2018, the Division received 2,182 proposals for General Program, and funded 460 projects. The success rate is 21.08% and the average direct cost funding is 598,600 yuan per project

It should be noted that such problems as lack of creative ideas, lack of clear scientific topics, too many research contents, lack of specific research scheme, lack of reviews on existing research results, lack of clear research goals and preparations still existed in proposals received in 2018. We suggest applicants do better in preparing proposals, and select more meaningful, creative and reasonable topic of research to conduct original, basic, farsighted and interdisciplinary research.

The Division will continue to support collaborations with researchers in areas of life sciences, medical sciences, mathematics, management and economics and social sciences to make joint explorations on new theories, new method and technology in interdisciplinary areas so as to promote the mutual development of computer science and other sciences. The Division especially encourages and support scientists to focus on strategic national goals and address those basic issues that are well known internationally for their complexity and significance and of strong exploratory nature, so as to increase the level and international impact of computer science research in China.

Division III of Information Sciences

The Division mainly funds basic research and far-sighted research for the national economy and national security in areas of automation, artificial intelligence, and information science in interdisciplinary areas. Artificial intelligence (F06) and information science in interdisciplinary areas (F07) are newly added with application codes in 2018.

Research funded in the area of automation (F03) includes control theory and technology, control system, system modeling and emulation, system engineering theory and technology, bio system analysis and control, detection techniques and devices, navigation, guidance and control, smart manufacturing and automation system theory and technology, robotics and robot technology, and automation driven by AI technology.

In 2018, under this application code the Division received 1,835 proposals for General Program, and funded 363 projects. The success rate is 19.78% and the average direct cost funding intensity is 632,800 yuan per project.

The AI area (F06) will focus on key scientific issues and technology in AI research, encouraging original, fundamental, far-sighted and interdisciplinary research. We encourage research on basics of AI, machine learning, machine sensing and pattern recognition, natural language processing, knowledge representation and processing, AI system and application, cognitive and neural science induced issues. We support close cooperation between AI researchers and those in other disciplines and humanities and social sciences to explore new

concepts, theory, method and technology. We especially encourage researches to explore basic issues of great difficulties and great impacts.

In 2018, the Division received 1,322 proposals for General Program under this application code, and funded 231 projects. The success rate is 14.47% and the average direct cost funding intensity is 626,100 yuan per project.

The information science in interdisciplinary areas (F07) promotes information science inter-crossing with other disciplines and fosters research teams, we use this application code to receive applications in related areas.

We have two parts in this application code, namely, F0701 for education information science and technology, and F0702 for interdisciplinary problems in information and mathematics. We encourage using F0701 and F0702 for applications.

For education information science and technology F0,701, we focus on knowledge generation, cognition laws and learning development, and original, fundamental, far-sighted and interdisciplinary research, encourage research on basic theory and method of AI driven education, online and mobile learning environment, virtual and enhanced reality learning, visual representation of knowledge education cognition tools, education robot, education AI bodies, education big data analysis and application, learning analysis and evaluation and self-adaptive personalized learning assistance, etc. Explore new concept, theory, method and technology to solve education problems in China.

In 2018, the Division received 484 proposals for General Program under this application code, and funded 38 projects. The success rate is 7.85% and the average direct cost funding intensity is 453,700 yuan per project. In 2019, we shall increase the success rate.

The interdisciplinary problems in information and mathematics (F0702) support research requiring integration of information and mathematics, such as theory and method in electronic communication and mathematics, computer and mathematics, automation and mathematics, AI and mathematics, semiconductor and mathematics, and optics and mathematics, and exploration in theory and method of representation of scientific problems in related basic issues. Priority is given to exploratory research, so as to promote development of inter-crossing of information and mathematics.

Applications using code F0702 will be received by various divisions, and F070203 and F070204 belongs to Division III. Please select correctly when submitting applications.

Division IV of Information Sciences

The funding scope of the Division covers semiconductor science and information devices, and optics and photo-electronics.

The main scope of funding for semiconductor science and information devices includes semiconductor material, design of integrated circuits, semiconductor photo electric devices and integration, semiconductor devices and integration, semiconductor physics, integrated circuit devices, fabrication and packaging, micro and nano mechanical and electrical devices and control system, and new types of information devices including nano, molecular, super conducting, quantum functional information devices.

The main funding scope for optics and photo-electronics includes two parts, namely,

information optics and photoelectric devices, and laser technology and technical optics. The information optics and photoelectric devices mainly support optical information acquisition, display and processing, photon and photoelectric devices, transmission and exchange photonics, inferred and tetra-hertz physics and technology, photon integration technology and devices. The laser technology and technical optics mainly support nonlinear optics and quantum optics, laser, spectrum technology, applied optics, optics and photoelectric materials, space optics, atmospheric and marine and environmental optics, biomedical photonics and photonics, energy and lighting photonics, micro nano photonics and interdisciplinary issues in astronomy and advanced manufacturing,

Research on interdisciplinary problems in semiconductor (F070205) and optics and mathematics (F070206) should be submitted to the Division. Please select correct application code when applying.

In 2018, the Division received 2,334 proposals, and funded 437 projects with a funding rate of 18.72% and an average direct cost funding intensity of 599,000 yuan per project.

In recent years, along with the development of information sciences, the above areas are now having more and more interactions with physics, chemistry, materials sciences and life sciences and medical sciences, and many new research directions are emerging. Among the major branch areas, applications remained the same in the following areas: semiconductor photoelectric devices, IC design and test, semiconductor materials, photon and photoelectric devices, transmission and exchange photonics, optical information acquisition and processing, nonlinear optics and quantum optics, laser and applied optics, etc. Applications are increasing in such areas as semiconductor electronic devices, semiconductor micro nano mechanical electronic devices and system, IC manufacturing and packaging, semiconductor physics, inferred physics and technology, biomedical photonics, optics and photoelectric materials, spectroscopic technology, etc.

The Division will give priority to researches on high performance light source, low power consumption integrated circuit and radio frequency chips, new types of sensor materials and devices and technology, tera hertz devices, micro and nano device and technology, new types of optical field control technology and devices, quantum optics and quantum devices, quantum communication and quantum computation, optical information processing and display technology, photon electronic devices and photonic integration, wide gap semiconductor materials and devices, semiconductor integrated circuit system, energy photonics, new types of laser technology and devices, new optical imaging method and technology, biomedical optics, new spectrum technology, and space and astronomical optics, environment and marine optics, etc. In order to solve the bottleneck issues of devices in various fields in China, the Division will encourage studies to improve device performance (both yield and reliability) including scientific issues in device physics, structure and technology development.

In 2019, semiconductor science and information devices, and optics and photo-electronics of the Division will use experiment on new method of application and evaluation. For detailed information, please refer to "2019 NSFC Reform Initiatives" in this *Guide*.

Department of Management Sciences

Management is an interdisciplinary science which aims at revealing and applying the basic laws of various management activities. The research findings can be used to optimize the utilization of limited resources. The Department consists of three divisions, handling proposals of four disciplines, which are Management Science and Engineering, Business Administration, Economic Sciences, and Macro-Management and Policy.

During the 13th Five-Year Plan, the Department will pay more attention to the scientific issues derived from demands, give preference to proposals of discovering universal scientific issues based on Chinese management practices to explore these issues, and enrich the knowledge of human management sciences. The department will further encourage innovative studies and those focusing on the frontiers of sciences in unique ways.

The Department emphasizes applying "scientific methods" to explore the objective laws of management sciences, and therefore ordinary management research will not be supported. The Department supports experimental research that observes and discovers the new management phenomena based on data obtained from experiments, observations, and measurements, etc. The Department also supports theoretical research that aims at addressing management issues by analyzing and explaining management phenomena through modeling, computation, induction and deduction. The Department will offer higher funding support than the average funding level for experimental research projects that do need long-term and large-scale data collection, data processing, and field investigation, and high performance computing and experiments.

The Department encourages and supports scientists from diverse academic backgrounds to take an active role in management science research and contribute to the development of management science, a comprehensive interdisciplinary science. However, applications focusing on social science and humanities, as well as those within the funding scope of other scientific departments of NSFC, will not be accepted by the Department. Applicants are advised to propose their research topics from the perspective of management science research.

General requirements for applications in 2019 are as follows:

1. No repetitive funding with the National Social Science Fund

To optimize the allocation of the National Natural Science Fund and to ensure that project leaders invest adequate time and energy in their on-going national projects, the Department will decline proposals by the following applicants in 2019 (except for the applications of National Science Fund for Distinguished Young Scholars):

(1) Applicants who were supported by the National Social Science Fund as a project leader within the past 5 years (from January 1, 2014), and have not yet got the project completion certificate awarded by the National Planning Office of Philosophy and Social Science until the deadline of this year's fund application.

Note: if an applicant has gained the project completion certificate from the National Planning Office of Philosophy and Social Science, and is applying for an NSFC project with the application code starting with G in 2019, he/she must provide a copy of the certificate with an official signature and seal of his/her home institution.

(2) Applicants who apply for National Social Science Fund as a project leader in the

year of 2019.

2. Accuracy and integrality of information

Applicants are responsible for the accuracy, integrality, and reliability of the contents of their applications, and their home institutions are obligated to undertake serious check on the relevant information. The following requirements should be complied with when applicants prepare and submit the project proposals:

(1) Applicants are required to give a detailed description on their previous research work related to the proposed work, as well as the publications published for previous work. For publications that are accepted and waiting to be published, a copy of the acceptance notice should be provided in the proposal.

(2) The Department treats it unacceptable that applicants submit the same proposals to more than one science funding agency. Applicants who propose new research topics based on their previous NSFC projects are required to describe the progress of the previous NSFC project and clarify the relations and differences between the newly submitted proposals and the previous ones. For applicants who are undertaking projects funded by other agencies, such as MOST, NSSF or local science funding organizations, they are required to clarify the similarities and differences between their on-going projects and the new proposals submitted to NSFC.

3. Special requirements for project leaders starting NSFC projects in recent years

To ensure that project leaders invest adequate time and energy in their on-going projects, the applicants in 2019 who gained any kind of NSFC projects as a project leader in 2017 or 2018 will be reviewed and assessed through stricter procedures.

4. Consideration of the performance of accomplished projects

The Department conducts performance evaluation for all General Program projects, Young Scientists Fund projects, and Fund for Less Developed Regions projects one year after these projects were completed. The evaluation results will be released to the public on the NSFC website. Researchers with good performance evaluation results will be given priority for funding when they apply for new projects. However, researchers with poor performance evaluation results will undergo stricter review procedures when they apply for new projects.

In 2019, the average funding intensity for direct expenses of General Program projects will be the same as that in 2018.

Funding for General Program Projects in Department of Management Sciences in recent two years

Unit: 10,000 yuan

Divisions		2017			2018		
		Projects	Direct cost	Success rate (%)	Projects	Direct cost	Success rate (%)
I	Management science and engineering	224	10,752	20.59	235	11280	19.90
II	Business administration	196	9,408	19.20	200	9600	18.57
III	Economic Sciences	153	7,344	17.09	153	7344	16.28
	Macro-management and policy	182	8,736	17.04	215	10320	16.28
Total or average		755	36,240	18.54	803	38544	17.77
Direct cost per project		48.00			48.00		

Division I of Management Sciences

The Division mainly supports the fundamental research in the areas of management sciences and engineering discipline.

The Division mainly supports research associated with theories, methods and techniques in the field of management science, which includes management theory and research method, operations management, decision-making theory and method, game theory and method, evaluation theory and method, forecast theory and method, management statistics theory and method, management psychology and behaviors, management system engineering, industrial engineering and management, logistics and supply chain management, service science and engineering, system reliability and management, information system and management, knowledge management, risk management, financial engineering, engineering management, and transportation management, etc.

The Division emphasizes basic theories and frontier areas, and innovative research on management theory and method integrated with China's management practices, management philosophy, and cultural characteristics. The Division encourages interdisciplinary research and international frontier research.

In 2018, the Division received a total of 1181 applications for General Program and funded 235 projects. The funding rate was 19.90%.

For the past few years, the discipline of management science and engineering has experienced rapid development in China. The discourse power in the international scientific society has been improved in many research areas. However, the number of application and funded applications varied significantly across the research areas. The application amount of Transportation management, logistics and supply chain management, information system and management, optimization and management, and financial management was relatively large, while the number of applications in the fields of game theory and method, management theory and research method, decision-making theory and method, forecast theory and method, management statistics theory and method, management psychology and behaviors was small.

In 2019, the Division will continue to encourage and support innovative studies combined with China's management practices, the studies integrated with other natural science disciplines, as well as the studies aiming to explore the frontiers of management sciences. The Division will provide strong support for scientific thoughts and points of views derived from management practices, encourage scientists to integrate theories and methods with practical issues to solve the issues generated from management practices in China, and to form the management theory and methods for China. The Division also encourages integrations of management sciences with mathematics, economics, behavior sciences, information sciences, engineering sciences, as well as other disciplines, and supports studies of seeking breakthroughs of theory, methods, and practices though multi-interdisciplinary. Through interdisciplinary research, the Division wishes to seek development advantages for this discipline in theory, method and technology. Researchers are encouraged to focus on international frontier scientific issues and frontier theories, to gain innovative, systematic and leading findings that have important international influences and guiding significance for management practical departments.

Division II of Management Sciences

The Division mainly supports the fundamental research in the areas of business administration.

The discipline of business administration mainly supports fundamental research and applied fundamental research on management theories and new management techniques and methodologies, taking micro-level organizations (all types of industries, enterprises, institutions, and nonprofit organizations) as research objects. The funding areas of the Division include 14 disciplines, which are strategic management, organization theory and organization behaviors, enterprise technology innovation and innovation management, human resource management, financial management, accounting and audit management, marketing, production and quality management, enterprise information management, e-commerce, operation management, project management, entrepreneurship management, international business and multi-culture management, etc.

In 2018, the Division received a total of 1,077 applications for General Program and funded 200 projects, with a success rate of 18.57%.

In 2018, the number of applications in the fields of financial management, marketing, enterprise technology innovation and innovation management, operating management accounting, audit management, and organization theory and organization behaviors was relatively high, and correspondingly, the number of funded projects in these fields was larger than that in other fields. On the other hand, the number of applications in the fields of project management, production and quality management, international business and multi-culture management, and enterprise information management was small, and the number of funded projects in these fields was relatively low. In general, the proposals aiming at new methods and technologies have shown some innovation, and the number of applications focusing on new issues and China's practical needs was increasing. From a perspective of funding structure, a balanced distribution of funding areas has been formed.

In 2019, the Division will continue to support innovative and frontier research, encourage theory innovation and new knowledge discovery and creation, encourage scientific accumulation and discovery research by integrating empirical analysis, case studies, and observation experiments, encourage those focusing on scientific issues derived from China's management practices that have potential social application values, and those research with substantial international cooperation. The Division advocates scientific spirits, encourages exploration, and supports original fundamental research.

In order to promote the balance within the discipline, the Division will give priorities to fundamental research frontier in areas of strategic management, organization theory and organization behaviors, enterprise technology innovation, human resource management, financial management, accounting and audit management, marketing, enterprise information management, e-commerce, and operation management. Preference will be given to areas of international business and multi-culture management, project management, entrepreneurship management, service management, as well as e-commerce and business intelligence. Meantime, the Division will strengthen the support for theory innovation research based on Chinese management practice.

Division III of Management Sciences

The Division supports two fundamental research areas: Economic Sciences and Macro-Management and Policy.

Economic Sciences

The Discipline mainly supports the fundamental research of revealing development rules of economic activities, explaining economic development phenomena, and discovering economic theories by using scientific research methods such as empirical study, quantitative study, and behavior study. The funding areas of the economic sciences discipline include game theory and information economy, behavioral economy and experimental economy, quantitative economics and economic calculation, economy development and trade, monetary, fiscal, and tax policy, financial management, environment economy and labor economy, agriculture and forestry economics management, spatial economy and industry economy, etc.

In 2018, the discipline received a total of 940 applications for General Program and funded 153 projects. The funding rate was 16.28%.

In 2018, the number of applications in the fields of agriculture and forestry economics management, financial management, and economy development and trade was relatively higher. The total number of application associated with game theory and information economy, and quantitative economics and economic calculation were not very large, but was increased significantly compared to that in 2017. Many applicants concentrated on hot topics associated with China’s economy development and growth, and submitted high-quality research proposals.

In 2019, the Discipline will pay more attention to those research proposals that are based on China's actual situations in the fields of macro-economic models, econometrics and experimental economy theory and method, international trade, and public finance. Special preference will be given to the research areas focusing on China's economic structure adjustment, international macro-economy policy coordination mechanism, international economy governance structure, technology innovation and productivity, monetary policy, population and labor, and income distribution.

Macro-Management and Policy

The Discipline is a group of disciplines that study the behaviors of all levels of governments and related public sectors in formulating macro policies and implementing comprehensive management policies, in order to achieve the social and economic development goals. It covers public administration, non-profit organization management, technology management and policy, innovation management, health management and policy, education management and policy, public security and crisis management, culture and leisure industry management, social welfare management, environment and ecology management, resource management and policy, regional development management, information resources management, etc.

In 2018, the Discipline received a total of 1,321 applications for General Program and funded 215 projects. The funding rate was 16.28%.

In 2018, applications focusing on the areas of public health management and policy, resource and the environment management, environment and ecology management, regional development management, education management and policy, and innovation management are relatively more than other areas, of which the growth rate of applications in the field of public health management was the highest. The number of applications in the areas of public security and crisis management, and information resource management increased rapidly. any applicants concentrated on hot topics associated with macro-management and policy practices in China, and submitted high-quality research proposals.

In 2019, the Discipline will pay more attention to research proposals in the fields of government function transform, regional innovation ecologic system, public health risk, food security, natural resource asset, pollution prevention, urban energy system, rural economic transform, and science ethics and integrity.

Through funding research projects, the Division aims to facilitate discipline development, promote academic innovation, and support talent scientists and research teams. In particular, the Division encourages researchers to provide scientific support and evidences for macro policy makers while developing theories and methods. The applications should take China's practical management issues as the main research objects, and bring up scientific theoretical issues from the research objects accurately. Special attention should be paid to the scientificity and normativeness of the research methods. Applicants are advised to differentiate between management science research and actual management work, and between an NSFC project and a humanity and social science project in terms of research methods. The scope of the research topic needs to be appropriate, the research goal should be concentrated, and the research content should be specific and concrete. The research method and technology roadmap, as well as how to address the key scientific issues, need to be clearly clarified in the application.

Department of Health Sciences

The objective of the funding for General Program in the Department is to support basic research on issues concerned with disease prevention, disease control and disease treatment in China. For the purpose of improving the scientific research in medical science, this program mainly supports basic research (including clinical-related basic research) in the following areas: the structural, functional, developmental, genetic and immune abnormalities of human body, the occurrence, development, outcome, diagnosis, treatment and prevention of diseases.

The Department encourages research areas as follows:

Innovative theoretical and methodological research aimed at the scientific issues emerging from medical practices; systematic and indigenous study on key scientific issues emerging from medical disciplines; translational medicine through combination of basic research and clinical research; integrative medical research on the occurrence, development and regression of diseases at various levels from molecular, cellular, tissue to organ, individual and population level by using new multidisciplinary and comprehensive techniques or methods; in-depth systematic and innovative study based on existing

accumulated researches; interdisciplinary medical research crosscutting with other scientific fields; the development of new animal models of human diseases; substantive international joint research and exchange. The Department will give priority to basic research on major key diseases closely related to the national welfare, human livelihood, major emergency event of public health, and common or frequently encountered diseases that severely affect human health. Meanwhile, the Department will also highlight research on rare diseases based on existing accumulated research work and other weak research areas in an effort to keep the balance and coordinative development of various disciplines.

Funding for General Program Projects in Department of Health Sciences in 2017 and 2018

Unit: 10,000 yuan

Divisions		2017			2018		
		Projects	Direct cost	Success rate+ (%)	Projects	Direct cost	Success rate+ (%)
I	Respiratory system, circulatory system, blood system	487＋22*	27204＋550*	20.54	490＋22*	28,045＋550*	18.13
II	Digestive system, urinary system, endocrine system/metabolism and nutrition support, ophthalmology, otorhinolaryngology head and neck science, oral and craniomaxillo-facial Science	594＋24*	33,188＋600*	20.57	603＋24*	34,470＋600*	17.88
III	Neurological and psychiatric diseases, gerontology	382＋13*	21,316＋325*	20.65	388＋13*	22,152＋325*	17.73
IV	Reproductive system/ perinatology/neonatology, medical immunology	251＋11*	13,980＋275*	22.30	255＋11*	14,584＋275*	19.11
V	Medical imaging and biomedical engineering, special medicine, forensic sciences	239＋11*	13,234＋275*	19.17	244＋12*	13,929＋300*	15.97
VI	Medical pathogenic microorganisms and infection, orthopedics and sports medicine, emergency and intensive care medicine/trauma/ burns/laboratory medicine/plastic surgery/ rehabilitation medicine	401＋21*	22,223＋525*	18.65	411＋21*	23,476＋525*	16.46
VII	Oncology (leukemia not included)	819＋29*	45,562＋725*	18.28	826＋29*	47,160＋725*	16.48
VIII	Skin and appendages, preventive medicine, endemiology, occupational medicine, radiology	241＋10*	13,341＋250*	24.18	246＋10*	14,127＋250*	22.24
IX	Materia medica and pharmacology	262＋11*	14,534＋275*	21.28	262＋11*	14,925＋275*	18.81
X	Chinese medicine, Chinese materia medica, integrated Chinese and western medicine	599＋28*	33,058＋700*	16.22	610＋27*	34,752＋675*	14.00
Total or average		4,275＋180*	237,640＋4,500*	19.40	4,335+180*	247,620＋4,500*	17.00
Direct cost per project		54.35 (55.59**)			55.84 (57.12**)		

Note: *One year program; ** One year program not included; + One year program included

1. Specific instructions for applicants

(1) Applicants are encouraged to carry out in-depth basic research toward scientific issues, especially the original research. Applications with unique academic ideas or solid

previously accumulated research work are encouraged to carry out further systematic research. Simply descriptive or observant applications and those tracking others' without innovative scientific ideas, or applications merely pursuing new high-technology rather than scientific novelty will not be in consideration for grant.

(2) Applicants are expected to elaborate the scientific values and potential clinical applications of the anticipated research results in detail. Applicants are suggested to propose a defined scientific issue or a specific hypothesis based on analysis of the relevant latest literatures and research progress in the field. Furthermore, elucidation of theoretical as well as applicable value of the research is needed.

(3) Applicants are expected to elaborate whether the proposed research will possibly solve the specific scientific problems or verify the hypothesis, and the proposed research is supposed to be specific, feasible and logical. Furthermore, applicants are expected to propose adequate research contents, detailed research design, clear research methods and reasonable budget.

(4) Applicants are expected to provide detailed information about relevant previous research. In case of extensive applications of previously funded project, the innovative ideas and further scientific problems of the research are expected to be elaborate in detail. Besides, all the relevant published papers are expected to be listed, and relevant unpublished results including experimental data, tables and graphics, etc., are suggested to be provided.

(5) Applicants are expected to provide true and accurate information in their applications, including the CVs and major participants (both education and working experience are expected to be included, in chronological order with exact months and years, keeping the timeline consistent), previous grant information and relevant publications. Patents and awards should also be listed according to the guideline.

Applicants are requested to pay special attention to: for publications, please write it in accordance with the instructions and guidelines of the application form and the writing outline, in the meantime to refer to the requirements of "implementing the evaluation system of the representative work" in "2019 NSFC Reform Initiatives" in this *Guide*, as well as the requirements of scientific integrity in the guidance notes. Detailed information including the names of all authors (in the same order in which they appeared in the publication), the article and journal title, book title, volume number, page number, and year of publication (abstracts or meeting proceedings should be specified) are supposed to be included. The first authors and corresponding authors should be noted in accordance with the instructions and guidelines of application form. Accepted manuscripts should be listed along with an attached acceptance letter or online publication link, unaccepted submitted manuscripts or manuscripts in preparation should not be included. Conference papers shall be listed separately. Applications with incorrect ranking and labeling of authors will be submitted to the meeting review panel due to the scientific integrity.

(6) Applicants are expected to provide a signed written institutional certification or approval (the scanning copy should be attached to the electronic proposal) to meet the related ethical or informed consent requirement if applications involve special medical research objects such as human subjects.

(7) Applicants are expected to follow all appropriate guidelines for the use and handling of pathogenic microorganisms, including the guideline "Bio-safety Administrative Rules of Pathogenic Microorganism in Lab" released by the State Council of China and the

ethical and bio-safety regulations by other governmental agencies. If applications involve human genetic resources, applicants should follow related regulation on Interim Measures for the management of human genetic resources. Additionally, a commitment letter to guarantee bio-safety should be provided by the research institutions when applications are involving highly pathogenic microorganisms.

(8) Applicants with good performance records in their previous grants will be given preference on equal conditions.

(9) Applicants are expected to notice that: in 2019 the Department will generally not give further funding to applicants who either have got high funding intensity in 2018 from NSFC (such as Key Program, Major Program, Major International and Regional Joint Research Program, etc.), or are applying for repetitive or similar research to their on-going national scientific projects funded by other agencies.

(10) **Applicants are expected to provide PDF copies of no more than 5 representative papers (PI's papers only) in their electronic applications.**

(11) Applicants are expected to refer to the specific requirements for various programs via the website of the Department (http: //health.nsfc.gov.cn).

2. General overview of applications in the Department in recent years and instructions to research institutions

The number of applications has been increasing in the Department ever since its establishment. In 2017, the number of applications was 57,454(from 1039 research institutions), accounting for 28.45% of the total applications in NSFC, including 22,965 of General Programs which account for 28.60% of the total applications of General Program in NSFC. In 2018, the number was 64,415 (from 1,062 research institutions), accounting for 28.60% of the total applications in NSFC, including 26,552 for General Program which account for 28.67% of the total applications for General Program in NSFC.

To enable the rapid and healthy development of both scientific fund and medical research in China, the research institutions are expected to further strengthen their management in the process of NSFC grant applications, and to make an effort to further improve the scientific quality of applications (rather than increase the number of applications) under the guidance of "Requirements of NSFC for Institutions to Improve Management of Scientific Projects".

3. Specific explanations on application codes

Peer review activities of the applications in the Department are organized according to the application codes attached to this *Guide*. The application codes of the Department are composed of 31 primary application codes (H01 to H31) and many relevant secondary codes. The basic characteristics of the application codes are as following: (i) the primary application codes, which are mainly arranged in the order of organs or systems, include research areas relevant to both basic and clinical research, in an effort to ensure that applications on similar scientific issues from different disciplines are reviewed in the same reviewing system; (ii) the secondary application codes, which are arranged in the order from basic to clinical research and from structural, functional and developmental abnormalities to diseases, cover both basic and clinical research relevant to the given organ or system.

The applicants are expected to carefully choose the primary application code and the relevant secondary one. For the details, please refer to the following contents in the *Guide* of each division of the Department. **Special instructions for applicants are as follows:**

The Department sets up the oncology discipline separately. Please select the

corresponding secondary application code under Oncology (H16) for all kinds of tumor-related medical scientific researches except for hematological tumor, tumor epidemiology, oncological pharmacology, tumor imaging medicine and tumor traditional Chinese medicine. The proposals on hematological tumor should be submitted to the corresponding secondary application code under Hematological System(H08); the proposals on tumor epidemiology should be submitted to the Epidemiology of Noncommunicable Diseases (H2610); the proposals on oncological pharmacology should be submitted to anti-tumor pharmacology (H3105); the proposals on medical imaging and biomedical engineering of tumor should be submitted to the corresponding secondary application code under Medical imaging and Biomedical Engineering (H18); the proposals on radiation oncology should be submitted to Tumor Physiotherapy (H1610) under Oncology (H16); in addition, the proposals on traditional Chinese medicine tumor research should be submitted to Traditional Chinese Medicine (H27), Chinese Materia Medica(H28), or Integrated Chinese and Western Medicine (H29).

The funding scope under Radiology (H22) is given to basic research in radiation damage and repair, radiation toxicology and pathology, radiological hygiene and protection, and radiological therapy for non-tumor disease. The Division of Radiology (H22) does not support applications for cancer radiotherapy or radiodiagnosis, the latter of which should be submitted to Medical Imaging and Biomedical Engineering (H18).

The funding scope under Gerontology (H25) mainly covers studies focused on the pathophysiological mechanisms of aging and aging-related diseases. Applications that focus on age-associated diseases that do not involve pathophysiological mechanisms of aging should be submitted to other proper divisions.

Applications that focus on neonatal diseases should be submitted to Reproductive System/Perinatology/Neonatology (H04).

Applications that focus on sexually transmitted diseases should be submitted to Medical Pathogens and Infection (H19).

Traditional Chinese medicine (H27), Chinese Materia Medica (H28) and Integrated Traditional Chinese and Western Medicine (H29) only support the research carried out under the theoretical guidance of traditional Chinese medicine (including the medicine of the Han nationality and ethnic minorities, the same below). Please select other application codes for the application that has nothing to do with the theory of traditional Chinese medicine.

4. Special Projects under General Programs and relevant policies

(1) Etiology and prevention study of human rare diseases

The Department will continuously give special support to research aimed at studying the development and prevention of human rare diseases. The rare diseases are defined by WHO as diseases accounting for 0.65‰ to 1‰ of the total population. Applicants are expected to take the advantage of rich genetic resources in China, and to carry out in-depth research on prevention, diagnosis, and drug development of rare diseases, making achievement with own proprietary intellectual properties, and high international impacts. Meanwhile, case studies of major key rare diseases are highlighted in an effort to advance the understanding of pathogenesis underlying the development of major key diseases, thus providing theoretical bases for their novel diagnostic and therapeutic strategies. **The applicants are expected to choose the proper secondary application code attached to the primary application codes (H01 to H31), and to write "Mechanism**

underlying rare diseases (including case studies) and their prevention and treatment" on the annotation column of the application form.

(2) The development and function of lymphatic system

The Department will also give special support to research aimed at the development and function of lymphatic system. Research aimed at the regulation mechanism underlying the generation, maturation and homeostasis of the lymphatic system, the relationship between lymph and blood, the roles of lymphatic system on lipid metabolism, the immune defense function of lymphatic system, and the pathogenesis of major key diseases related to lymphatic system, are all encouraged. **The applicants are expected to choose the proper secondary application code attached to the primary application codes (H01 to H31), and to write "Mechanism underlying rare diseases (including case studies) and their prevention and treatment" on the annotation column of the application form.**

Specific annotation of the above Special Projects should be specified in the annotated column of the application form. Otherwise, these applications would not be treated as Special Projects. The Special Projects above are limited to General Program.

5. Funding plan and budget for General Program in 2019

The funding intensity of direct cost for each project of the General Program in the Department is expected to be the same as that in 2018, and the duration will still be four years. Doubled funding will possibly be given to excellent innovative research built upon previous strong background in some specific areas (please see every division section of this *Guide*). Applicants are expected to request the adequate budget for their proposed work by filling out the budget form with detailed justification. The support research areas of each division, and an overview of the award number, funding, and success rate of the General Program in 2017 and 2018 in the Department are listed in the table below.

Division I of Health Sciences

The Division supports basic and clinical-related basic research on the diseases of respiratory, circulatory, and hematological systems.

Respiratory System (H01)

The Division mainly supports the basic and clinical basic translational research that focus on pathogenesis, pathophysiological changes and treatment strategies of diseases such as lung, airway, pulmonary circulation, mediastinum, pleura, thoracic cage, and diaphragm. The funding areas involve the studies on lung and airway structure, function and developmental abnormalities, immunology and transplantation of lung and airway, alveoli and air-blood barrier, lung fluid transport and pulmonary edema, abnormalities in respiratory regulation, respiratory infections and host-pathogens interactions, sleep-disordered breathing (SDB), airway inflammation and asthma, chronic obstructive pulmonary diseases, pulmonary diseases and coagulation-fibrinolysis, lung injury-repair and remodeling, pulmonary circulation and pulmonary vascular diseases, interstitial lung diseases, atypical hyperplasia and pulmonary nodules, granuloma, sarcoidosis, pleural diseases, new methods and animal models of the respiratory system diseases.

In present, proposals received and funded in the respiratory system mainly focus on the areas of respiratory inflammation and infection, asthma, chronic obstructive pulmonary diseases, pulmonary circulation and pulmonary vascular diseases, interstitial lung diseases, lung injury- repair and remodeling, sleep-disordered breathing. The number of application in other areas is relatively low. The following studies are encouraged in the areas of lung injury, infection and immunology of respiratory system, host-pathogens interactions, chronic cough, atypical hyperplasia and pulmonary nodules. In recent years, public attention has focused on the discussion of respiratory emerging infectious diseases and ambient particulate matter (e.g., haze, cigarette smoking etc.) on human health. Therefore, it is also encouraged to carry out studies on the basic and translational researches related to: (i) environmental pollution and/or pathogen-induced respiratory system damage and immune system dysfunction,(ii) inflammatory microenvironment regulation, tissue damage repair and pulmonary fibrosis, which share scientific similarities,(iii) bronchial or alveolar epithelial cell dysplasia and nodular lesions,(iv) lung stem cells and lung regeneration studies,(v) the pathogenesis and treatment strategies of rare and endemic diseases,(vi) the studies on animal models, especially humanized animal models, and (vii) establish new technologies and methods for respiratory research.

At the same time, it is encouraged based on the preliminary work in the following fields: (i) extra-pulmonary organ damage related to sleep-disordered breathing,(ii) biological treatment of respiratory diseases (iii) new methods of precise medicine,(iv) potential molecular markers and treatment targets.

Circulatory System (H02)

The Division mainly supports the basic researches in cardiac and vascular (including lymphatic vessels) diseases, as well as microcirculation and shock. In recent years, most proposals were focused on cardiac/vascular injury and protection, and followed on atherosclerosis, coronary heart diseases, arrhythmia and heart failure, etc. Additionally, there were many applications in the fields of non-coded RNA, but the innovation and its own characteristics were insufficient. Applicants are encouraged to carry out original basic research, working together with clinicians, developmental biologists and genetic biologists, regenerative medicine specialists and other related disciplines to study on the mechanisms of cardiovascular diseases development and the therapeutic strategy. In the cutting-edge fields of cardiovascular diseases, researchers are encouraged to establish international collaborations, to propose innovational hypothesis based on their own research data, and eventually gain achievements with independent intellectual properties. Researches on the biological and pathological effects of the biological active substances on the heart and vessels are encouraged, and further screening the potential biomarkers for diagnosis, therapeutic targets and innovative treatment technologies. Studies on the molecular etiology, regulation network and intervention targets of the metabolic disorder related cardiovascular diseases are encouraged, and the effects of other system diseases on the cardiovascular system are also encouraged. Research and applications of new techniques, new methods and new materials in the cardiovascular field are encouraged. Pericardial diseases, infective endocarditis, infectious cardiovascular disease, immune related circulatory system diseases and lymphatic circulatory diseases are still the relative weak fields in cardiovascular system, and the basic and applied basic research are encouraged. Applicants are encouraged to

conduct the study on the cardiovascular diseases in children. The basic and applied basic applicants on important clinical issues in the circulatory device implantation and peri-operative period of cardio-vascular surgery are encouraged.

Hematological System (H08)

The Division mainly supports original basic research in the areas of hematopoietic cell/organ development and formation, hematopoietic stem/progenitor cell and bone marrow microenvironment and hematopoiesis regulation, erythrocyte and its related diseases, leukocyte and its related diseases, platelet and its related diseases, aplastic anemia and bone marrow failure, myelodysplastic syndromes, myeloproliferative diseases, blood infection and its treatment, bleeding, coagulation and thrombosis, leukemia, hematopoietic stem cell transplantation and its complications, Basic research on hematological mesenchymal stem cells and its related applications blood typing and blood transfusion, blood products, hereditary hematologic diseases, lymphoma, and lymphoproliferative diseases, myeloma, and plasma cell diseases, research related to new technologies and methods for diagnosis and treatment of hematological diseases.

Currently, most applications and funding are concentrated in the fields of leukemia, lymphoma, myeloma, stem cell transplantation and hematopoiesis regulation. Applications in other fields are relatively low in number, especially in the areas of structure and function abnormality of hematopoiesis related organs (liver/spleen/thymus), hematological infectious diseases. It is encouraged to carry out studies in the fields of: (1) correlation between hematopoietic microenvironment and disease occurrence, (2) clonal evolution in hematologic malignancies from the perspective of cellular heterogeneity, (3) precise medicine, (4) initiate biotherapy-related study, including HSC transplantation, immunotherapy, gene therapy, especially focusing on basic and applied basic research using gene editing and new immunology technologies, (5) initiate clinical-based basic research and propose basic research projects from clinical perspective (including translational research fully utilizing clinical resource).

At the same time, it is encouraged to do research based on the preliminary work in the following fields: (1) hematopoiesis regulation and hematopoietic cell reprogramming, (2) interaction between hematopoietic cells and leukemic cells and their microenvironment under the disease condition, (3) immune surveillance inhibition of hematological tumor cells, (4) hematopoietic stem cell transplantation and its biological and immunological issues, (5) hematological disease omics, hematologic biomarkers and their functional validation, (6) the mechanism for leukemic stem cell maintenance and its clinical correlation, (7) drug resistance and molecular targeted therapies for hematological diseases, (8) in vitro differentiation of pluripotent stem cells to hemogenic cells and amplification, (9) the interaction and mechanisms of platelets, blood vessel and coagulation factors.

Please refer to the general description of the Department for non-hematologic malignancies applications. As for the applications related to pulmonary circulation and pulmonary vasculature studies, applicants should choose the application codes of either respiratory system (H01) or circulatory system (H02), depending on their specific scientific questions.

Division II of Health Sciences

The Division mainly supports basic researches on digestive system, urinary system, endocrine system/metabolism and nutrition support, ophthalmology, otorhinolaryngology, head and neck science, as well as oral and craniomaxillo-facial science.

Digestive System (H03)

The funding scope mainly covers basic research on various non-infectious and non-cancerous diseases of the digestive system. In 2018, the total number of application increased by 13.57% comparing to the year of 2017. The applications on liver diseases, such as liver fibrosis, cirrhosis and portal hypertension, are still the most dominant research areas in the Division (accounts for 12.87% of all applications). Other research topics in hepatology include liver regeneration, hepato-protection, liver failure and artificial extracorporeal liver support (10.45%), metabolic liver disease (9.73%), and inflammatory and infectious liver diseases (6.08%). In the field of gastrointestinal diseases, applications on mechanisms of immune-related diseases of gastrointestinal tract (10.04%), internal environment disturbance of gastrointestinal tract, intestinal mucosal barrier impairment and related diseases (9.94%), and abnormal gastrointestinal motility and gastrointestinal functional disorders (5.15%) are among the primary focuses. The number of applications on the endocrine and neuro-humoral regulation of digestive system, structure and functional impairment of abdominal wall/peritoneum, acid-related diseases and vascular circulation abnormalities, and vascular/circulation disorders of digestive system is relatively low (together account for 5.77% of all applications), which warrants further attention.

Prevalence of inflammatory bowel disease (IBD) keeps increasing in China. Studies of IBD pathogenesis have made several breakthroughs in recent years. However, a number of research gaps of its diagnosis and therapy need further investigations. Effects of gut microbiota on human health attract attention of various research groups. A great number of studies have proved the close association between the structural/functions alterations of gut homeostasis and the progression of metabolic, inflammatory, neuronal and neoplastic diseases. China has the majority of viral hepatitis patients in the world. Thanks to the great efforts of Chinese government in controlling viral hepatitis (e.g., the universal HBV immunization program from 1992), its prevalence is decreasing in most parts of China. Since many viral hepatitis patients have progressed into the hepatic fibrotic and cirrhotic stages, applications on those topics are changing from viral hepatitis to liver fibrosis and cirrhosis in recent years. On the other hand, applications of metabolic diseases, such as non-alcoholic fatty liver disease, are increasing with the elevation of people's life in China. The researches focusing on these aforementioned important areas, particularly end-stage liver diseases, alcoholic liver disease, biliary tract disease, and pancreatic disease, as well as studies on the patho-physiology of pre-clinical phase of these diseases and the mechanisms of functional disorders, crosstalk among different digestive organs in the pathogenesis of digestive diseases are encouraged.

Urinary System (H05)

This section is to focus on the structural and functional disorders of the kidney,

ureter, bladder, prostate and urethra, not including tumor research. The number of applications received in 2018 increased by 11.54% compared with that in 2017. Popular research topics are still in areas of the prevention and treatment of acute kidney injury and chronic kidney diseases, under the code of H0503 (the injury and repair of the urinary system, 23.40%), followed by H0510 (the secondary renal diseases, 16.11%), H0511 (the renal failure, 11.66%), and H0509 (the primary kidney disease, 8.82%). The number of proposals related to kidney transplantation, urinary urolithiasis and urodynamics in 2018 was similar to that in 2017.The research on urinary tract infection, dysfunction of renal substance transportation and renal endocrine function is less and deserves more attention. The NSFC will support the continuous and innovative research in these fields.

Endocrine System, Metabolism, and Nutrition (H07)

This section mainly supports studies on endocrine organ structure and/or function under normal or pathological conditions and on non-tumor endocrine diseases. Supported areas include classical or non-classical endocrine tissue function and pathogenesis, metabolic disorders, clinical malnutrition, and therapeutic treatment for endocrine diseases. The total application number increases by 13.08% in 2018 relative to 2017, but the distributions of major research areas remain unchanged. The majority of the proposals (45.49%) are still centered on diabetes and diabetes-related diseases, followed by the projects investigating energy metabolism/obesity (15.10%), bone disease (10.38%) and thyroid diseases (5.48%). In contrast, there are few proposals on water/electrolyte metabolic disorders, acid-base imbalance, amino acid metabolic abnormality, aberrant adrenal gland development and/or structures, thyroid or parathyroid transplantations, or dysregulation of calcium-phosphorus metabolism. These minor areas will continue to be emphasized and considered preferentially for funding in the future. Similarly, research on clinical discoveries, new clinical questions, and innovative approaches/designs will be encouraged.

Ophthalmology (H12), Otorhinolaryngology Head and Neck Science (H13), Oral and Craniomaxillo-Facial Science (H14)

This section mainly supports non-neoplasm diseases of related fields. Ophthalmology mainly supports researchers that focus on inflammatory, immune related, hereditary, as well as degenerative and neo-vascularized eye diseases. Among the proposals received in 2018, fundus diseases remained to be the most concentrated area, accounting for 34.5% of all applications, followed by corneal diseases (15.9%), glaucoma, optic nerve and visual pathway related diseases (13.4%) and optometry diseases (10.9%). Diabetic retinopathy, retinal/choroidal neovascular diseases, refractive error and age-related macular degeneration remain to be the hot topics of ophthalmic research. Most grant application proposals in the field of Otorhinolaryngology Head and Neck Science focused on hearing abnormality and balance disorders (53.1%), diseases of the anterior skull base (26.09%), the olfactory system and the nose (8.39%) in 2018. The number of the applications received in 2018 increased by 22.20% compared with that in 2017. Hearing related diseases and balance disorders as well as their therapeutic interventions will continue to be key issues in otology, which include genetic and molecular mechanisms underlying the pathogenesis for various types of deafness and the signal pathways related to hearing impairments. Pathogenesis of rhinitis and sinusitis, and its immunotherapy will be hotspots in the field of

rhinology. Proposals focusing on respiration disorders, pararthria and functional repair will be encouraged. Proposals for throat diseases will be encouraged to focus on laryngopharyngeal reflux. Pathogenesis and interventional treatments for tinnitus, hyperacusis and dizziness, and for immune-disturbance of nasal mucosa will be the important research directions, which will favorably be funded. In addition, interdisciplinary studies with artificial intelligence, imaging, biomaterials, mechanics and mathematical algorithms have also attracted much attention.

In areas of oral and craniomaxillo-facial science, there were more proposals on the periodontal and oral mucosa diseases, accounted for 18.59% of total proposals in 2018, followed by tooth defects, anodontia, repair and correction of dentognathic deformities (15.75%), as well as dental pulp and periapical diseases (13.73%). The studies in osteogenesis, applications and mechanisms of odontogenic stem cells and exosomes, tissue biomechanics and biomaterials were hot fields.

Division II does not support researches on drug design or pharmacology. Please submit the related proposals to Division IX of Health Sciences (H30, H31). Proposals on the male reproductive system and male sexual dysfunction are not included in code H05, so please submit related proposals to Division IV (H04). It is specially noted that the proposals on teeth repair and implant material should use code H1409, and the proposals on craniofacial bone, cartilage tissue in the field of oral medicine should use code H1402. Other proposals related with characters of oral orthodontic and repair should submit to code H1408. Division II does not support cancer research. All applications on cancer research in those areas please refer to the General Description section of proposal guidance from the Department.

Division III of Health Sciences

The Division provides financial support primarily for basic research in the fields of neurological diseases, psychiatric disorders, and diseases associated with aging.

Neurological Diseases and Psychiatric Disorders (H09)

Under this code, the Division offers a wide range of funding opportunities that provide support for both basic and applied research investigating the pathogenesis, mechanism, diagnosis, treatment, and prevention of various non-neoplastic nervous system diseases.

The Division provides research funding for common neurological disorders (e.g., cerebrovascular diseases, cognitive dysfunction, injury and repair of brain and spinal cord, neurodegenerative disorders, epilepsy, pain and analgesia), as well as rare nervous system diseases. The Division supports for diagnostic and mechanism studies on inherited metabolic diseases, and pathogenic and therapeutic research on autoimmune and infectious diseases of the nervous system. In addition, the Division encourages research aiming at etiology and clinical investigations on comorbidity of neurological diseases and psychiatric disorders.

In recent years, funded projects in the field of neurology were predominantly focused on cerebrovascular diseases, injury and repair of brain and spinal cord, pain and

analgesia, and cognitive dysfunction. In 2018, there have been significant increases in the number of applications for research on glia, RNA, autophagy, and exosomes in neurological diseases. However, most of the applications were follow-up studies and/or lacked originality. In 2019, the Division will continue to fund studies on rare neurological hereditary diseases using genetic techniques, especially studies of individualized diagnosis and treatment based on molecular typing and its mechanism research. At the same time, studies using animal models such as non-human primates, Drosophila, and Zebrafish, etc. will be encouraged. Studies in cerebrovascular diseases will highlight basic research around clinical concerns, including etiology, genetic background, hemorrhagic transformation, cognitive dysfunction, early intervention for neurovascular injury, revascularization, functional recovery, and application and effects of precise diagnosis and treatment in acute stroke and neurotraumatic patients. Research on the mechanisms underlying pain, especially the mechanisms of chronic pain, need to be strengthened through the collaboration of basic and clinical studies. Research on neurological and psychiatric diseases and disorders of the nervous system in children has been an ongoing concern of the Division, but the research in this field in China is relatively weak. In 2019, two or three high-intensity general projects will be given in the research related to epilepsy, neurodevelopmental disorders, and emotional disorders of children, combined with defining the characteristics of the children's developing nervous system. These projects will be generously funded to increase the pace of knowledge acquisition and encourage research in this vitally important field. In addition, the Division will work to balance its support among applications from neurology, neurosurgery, and psychiatry, as well as related fields such as pediatrics and anesthesiology. Clinicians and researchers in basic neuroscience are encouraged to apply jointly for collaborative funding to carry out significant multifaceted investigations.

One of the defining characteristics in the spectrum of modern human disease is the rapidly increasing prevalence of psychological and psychiatric diseases. In order to achieve early detection, objective diagnosis, and targeted treatment, the core problem in these fields is to identify and/or classify the biological bases associated with specific disorders, and to elucidate the etiology and pathogenesis. Applications submitted within this scope are considered to be among the highest funding priorities for the Division. Compared with research funding requests from previous years, most of the applications in 2018 remained focused on depression disorders and schizophrenia, though there has been a mild increase in applications for studies of psychiatric disorders in children and adolescents, neurosis and stress-related disorders, organic mental disorders, sleep disorders, rhythm regulation, and psychological measurement and evaluation of mental illness, etc. Yet, despite the growing need, the number of applications that focus on personality disorders and psychosocial treatment, and psychotherapy remained very low. In order to reduce the incidence of mental disorders in our population, attention should be paid to the basic research of non-pharmaceutical and non-physical treatment of children, the study of psychotherapy processes, mechanisms and side effects, and the study of long-term brain damage in chronic mental disorders. More attention need to be paid to study the role of interaction between genetic and environmental factors in the development of mental disorders, discover potential causes and intervention targets, establish in vivo biomarkers to monitor the occurrence, development and prognosis of mental disorders, optimize psychological and behavioral examination techniques, and achieve early detection and diagnosis of mental disorders. Much more attention should to be paid to early intervention and treatment

through medicinal or non-pharmacological means.

Gerontology (H25)

The funding scope under this code mainly covers studies on the pathophysiological mechanisms of aging and aging-related diseases. The Division encourages research on pathophysiological changes during aging and their effects on organs, tissues and cells. Common mechanisms of various diseases related to the aging process are also encouraged. Of particular interest are studies exploring the effects of factors such as genetics, metabolism, damage, stress, and inflammation on organ and tissue aging and occurrence of aging-related diseases, regulation of stem cell senescence and its association with organ function and maintenance; new techniques and methods in aging study, and molecular mechanism of anti-aging approaches for healthy aging including calorie restriction, exercise, and small molecule drugs, etc.

The Division does not provide funding for research concerning tumors. Applications on age-associated diseases that do not involve pathophysiological mechanisms of aging will not be funded. Please refer to the General Description section of proposal guidance from the Department.

Division IV of Health Sciences

The Division mainly supports basic, translational, and clinical research in the areas of Reproductive System/Perinatal Medicine/Neonatal and Medical Immunology.

Reproductive System/Perinatal Medicine/Neonatology (H04)

Major supporting research projects include but are not limited to: basic research on the structure/function/development abnormalities of the reproductive system, injury and repair, inflammation and infection, the endocrine abnormalities and related disease, hereditary reproductive diseases and other non-neoplastic reproductive system related diseases, germ cell occurrence and fertilization, embryo implantation and fetal development, prenatal diagnosis, placental structure/function and development abnormalities, pregnancy and pregnancy related diseases, neonatal related diseases, mammary gland structure/function and development abnormalities, contraceptive/birth control and termination of pregnancy, female infertility and assisted reproduction, reproductive engineering and the related research about developing new diagnosis/treatment technologies in the areas of reproductive system/perinatal medicine/neonatal related diseases.

Major supporting research projects include but are not limited to: establishing new characteristic research systems and multidisciplinary technology platform (i.e., targeted molecular therapies, in vivo tracking therapies and primate/other large animal models) to study the molecule and cell basic of human genetic and developmental diseases, the gametogenesis and the regulation of reduction division, the regular rule and abnormalities of human sperm-ovum recognition and fertilization, the regular rule and abnormalities of embryonic stem cells and early embryo development, the physiology regulation of pregnancy establishment/maintenance and the pathomechanism of related diseases, fertility

preserve, the remodeling of germ cells, reproductive tissues, organs, including artificial gametes, uterus and placenta; exploring the new mechanisms of dysgenesis diseases; the study about pathogenesis and early diagnosis/treatment of congenital malformation, congenital metabolic diseases, single/poly gene genetic diseases and chromosomal disorders based on the superiority of Chinese genetic and disease resources; the research about assisted reproduction and related safety evaluations based on novel advances in biomedicine; the basic and applied basic research for treatment of reproductive system diseases using the novel techniques such as stem cell cultivate and directional differentiation, and the novel advances in tissue materials engineering etc.; the research about environment in/out utero affect the pregnancy outcome and descendant health; the basic/applied basic research and translational clinical studies on reproductive system/ perinatal medicine/ neonatology related areas using real-time imaging techniques, advanced sequencing and histology new technology etc.

In 2018, the proposal and funded projects were more focused on neonatal related diseases (H0422), pregnancy and pregnancy associated diseases (H0420), the female reproductive endocrine abnormalities and related diseases (H0404), sperm abnormalities and male infertility (H0424), embryo implantation and early embryo dysplasia (H0417), etc. Some other branch area is relatively weak. More attention should be paid in the future for the following research directions: in the reproductive system related areas, it is recommended to focus on the puberty onset, the physiology and pathogenesis change of menopause and the occurrence of related diseases, hereditary diseases of male and female reproductive system, female sexual dysfunction, male reproductive system inflammation and infection, the abnormal of breast development or perinatal breast structure/function disorders, reproductive system aging, reproductive system transplantation, etc.; in the assisted reproduction and reproductive medical engineering related areas: it is recommended to focus on developing new assisted reproductive technologies and reproductive medical engineering methods such as in vitro gamete induced differentiation technology; in the perinatal medicine areas, it is recommended to focus on the study of the interactions between maternal nutrition/environmental/genetic factors and maternal diseases on pregnancy outcomes and descendant health, focus on the etiology and related mechanisms of recurrent pregnancy loss, focus on the mechanisms of parturition, focus on the normal development of fetal organ systems and mechanisms of abnormal fetal organ defects as well as early diagnosis and treatment of congenital defects; in the neonatology related areas, it is encouraged to focus on the research of neonatal critical care, focus on the neonatal chronic organ damage related diseases, etc.

Reproductive system/Perinatal medicine/Neonatology (H04) does not support the tumor-related research project.

Medical Immunology (H10)

It mainly supports the basic research and applied basic research on the morphological, structural, functional and developmental abnormalities of immune cells, tissues, organs and systems, as well as the immunopathological mechanism, immune regulation and immune tolerance mechanism, immune prevention, immune diagnosis and immunotherapy of various diseases. Priority directions and areas include: the new immune cells and immune molecules subtype and its signal transduction pathway and disease, stem

cells and immune, differentiation of immune cells in vitro and preparation, epigenetic modification effect on immune cell differentiation and function, metabolism and the immune adjustment, the respiratory tract/digestive tract/urinary tract, micro ecology and mutual regulation of the immune system, regional immunization and disease, extracellular body and immune related diseases, differentiation and function of the immune cells and disease, immune recognition-response-effect mechanism with diseases, infectious diseases/inflammatory disease/ hypersensitivity disease/autoimmune disease/organization injury and repair /immunodeficiency disease/transplant immunology and organ transplantation (such as long-term survival of organ transplant patients with immune status and immuno-suppression-related diseases) and related basic and clinical research, new biological agents and carriers for immunotherapy, and the mechanism of action of vaccines and adjuvants, etc.

In 2018, the Division received 1,218 project applications, which are mainly concentrated in autoimmune diseases (514), inflammation, infection and immunity (200), organ transplantation and the transplantation immunity (90), immune related factors and the body's immune response to diseases (79), immune recognition/tolerance/immune dysregulation (59), vaccine and adjuvant research/vaccination/immune prevention (59), and other research fields. It is suggested that the applicant should pay more attention to the related researches on genetic defects and phenotypic changes of primary immunodeficiency disease, rare autoimmune diseases, neuro-endocrine immune regulatory mechanism, mucosal immune system structure and function, mucosal immune tolerance and regulatory mechanism in the future; the research on the common laws of human immune-related diseases through the establishment of distinctive research systems and targeted technology platforms (such as the search for targeted molecular technology, the establishment of unique cell models and animal models); the interdisciplinary study of systematic immunology, and in-depth studies on the immune informatics, immunomics, immunocyte library and computational immunology, so as to comprehensively understand the characteristics of disease spectrum based on immunology; the close cooperation between basic and clinical immunology personnel, making full use of China's advantages in disease resources and genetic resources, and medical immunology research based on clinical practice; the research on disease-related immune systems and immune response processes using new technologies such as high-resolution magnetic resonance imaging, real-time dynamic imaging, mass spectrometry and flow cytometry, and single-cell sequencing.

Division V of Health Sciences

The Division mainly supports basic research and basic clinical research in the fields of medical imaging, biomedical engineering, special medicine, and forensic medicine.

Medical Imaging and Biomedical Engineering (H18)

Medical Imaging and Biomedical Engineering are characterized by interdisciplinary work between multiple subject areas, such as that between medicine and mathematics, physics, chemistry, information sciences, materials sciences, engineering, life sciences, and so forth. The Division supports research in the areas of medical imaging and biomedical

engineering.

In the field of Medical Imaging, the Division mainly supports the research of medical imaging and its application to solve scientific problems related to medicine, including radiology (magnetic resonance imaging, X-ray imaging and computed tomography imaging), ultrasound in medicine, nuclear medicine, interventional medicine, and so forth. Meanwhile, explorative interdisciplinary studies in the scientific forefront of these fields, including the areas of multimodal imaging, molecular imaging, functional imaging, computer-aided diagnosis and artificial intelligence-based imaging (radiomics), precision interventional medicine, theranostics, and translational medicine are also encouraged. In addition, the researches of new imaging technology which can be applied in early diagnosis/treatment, prognosis, and the therapeutic effect evaluation of various diseases are also supported.

In the field of biomedical engineering, the Division mainly funds the basic research related to medical Electronic engineering, regenerative medicine and nanomedicine associated with disease prevention and early-warning, disease detection and diagnosis, disease treatment and rehabilitation, including processing/analysis of biomedical signals and images, biomedical sensors, biomedical photonics, chips and micro-nano systems, biomedical system modeling/simulation, medical information system, rehabilitation engineering, neural engineering and brain-computer interface, treatment planning and navigation technology, robotics-assisted therapy, biomedical instruments and medical equipment, gene/drug delivery materials and transport systems, medical biomaterials, tissue engineering, regenerative medicine, artificial organ, and so on. Researches on neural interface/regulation technology, bioMEMS, 3D-printing and tissue/organ construction, medical virtual reality and augmented reality, cell therapy, bioreactor, micro-tissue/organ construction and application, medical artificial intelligence and big data mining in healthcare are particularly encouraged.

Special Medicine (H21)

Special Medicine is aimed at the special health care for the population under different special circumstances, to solve various special medical problems, so as to provide theoretical and technological support for major national strategic needs. These studies will aim at understanding the physiological and pathological changes and related mechanisms, on the level of molecules, cells, tissues, organs and the entire human body. In this area, the Division mainly supports research on the analysis of pathophysiological phenomena and the prevention/cure of diseases under special circumstances, such as hypoxia, overweight, weightlessness, radiation, hyperthermia, high humidity, high-cold and other special or extreme conditions. The Division encourages the applications in medicine, physics, chemistry, biology, and modern engineering technologies to perform thorough and systematic research on specific medical issues and explore new technologies and methods to maintain and enhance cognition and physical function of the body under special environmental conditions. Interdisciplinary work within special medicine, interdisciplinary work between special medicine and biomedical engineering or other natural sciences are also encouraged.

Forensic Medicine (H23)

In the field of Forensic Medicine, the Division mainly funds the research on resolving the medical problems in the judicial practice with the studies of human body and other relevant human biological samples. The funding fields mainly include the identification of cause of death, the estimation of postmortem interval; the pathophysiological changes caused by abuse of and dependence on drugs and poisons, in vivo metabolism of poisons, detection technologies for poisons and their metabolites; the forensic evidence associated with the mechanism of injury and damage, the evaluation of the degree of injury and damage, the estimation of wound age, the identification of the level of disability and loss of the working ability; the objective evaluation of the legal capacity of persons with mental disorders; the determination of individual characteristics (age, height, appearance, etc.), individual identification from difficult samples, paternity identification, identification of the tissue origin and ethnic origin. Systematic research in the above aspects using the theories and techniques of physics, chemistry, biology, medicine, legal science and informatics, and so forth, is strongly encouraged. Interdisciplinary studies between forensic medicine and medical imaging, biomedical engineering, and other disciplines are also strongly supported.

The development of medical imaging, biomedical engineering, special medicine and forensic medicine has been accelerated by multidisciplinary studies. In 2018 there were in total 1,603 applications in the areas of medical imaging, biomedical engineering, special medicine and forensic medicine, of which 256 applications (including low-intensity funding) were funded, with a success rate of 15.97%. There was a significant increase(more than 20%)in the number of applications in Medical Imaging, Biomedical Engineering, Special Medicine, while the Forensic Medicine has 18% increase in the number of applications. To further promote the rapid development of medical imaging, biomedical engineering, special medicine and forensic medicine disciplines, the Division will continue to encourage multidisciplinary research and cooperation between scientists with different scientific backgrounds aiming at the above scientific frontiers. At the same time, preferential supports will be provided to young investigators.

The Division does not accept applications on radiation oncology or radiation prevention, which should be submitted to Division VII (H16) or Division VIII (H22) in the Department. The applications on pharmacology and drug administration should be submitted to Division IX (H30, H31) in the Department.

Division VI of Health Sciences

The funding scope of the Division covers basic researches in the fields of abnormalities and diseases of locomotor system, emergency and critical care medicine, trauma, burns, frostbite, plastic surgery, rehabilitation medicine, laboratory medicine and biological characteristics and infection of bacteria, fungi, viruses, parasites and other pathogenic organisms.

Abnormalities and Diseases of Locomotor System (H06)

The Division mainly supports the research on the abnormalities in structure, function and development of the bone, joint, muscle and ligament, and the research in the etiology, pathogenesis, diagnosis, prevention and cure of the musculoskeletal diseases including the genetic diseases, the immune-related diseases, inflammation and infection, injury and repair, grafting and reconstruction, fatigue and recuperation, degenerative disorders, sports injury, deformity and correction, and non-neoplastic diseases. Meanwhile, the researches on the emerging scientific issues such as precise medicine and medical biomaterials development in musculoskeletal fields are highly encouraged. In 2018, the submitted proposals were mainly focused on the research fields in the musculoskeletal damage and repair (H0605), and the degenerative diseases of bone, joint and soft tissue (H0609). Research projects on intervertebral disc degenerative disease, osteoarthritis and biomaterials have been hot spots in this field. In contrast, research applications in musculoskeletal fatigue and recuperation filed (H0608) were still at quite low volume. Research projects focusing on the biological mechanisms in the interaction between locomotor system and other organ systems based on the emerging medical phenomena and clinical problems are preferentially encouraged.

Emergency and Critical Care Medicine/Trauma/Burns/Plastic Surgery (H15)

Focus on scientific problems includes the pathophysiology, pathogenesis, diagnosis, treatment and prevention in the field of emergency and critical care medicine, trauma, burns, and plastic surgery. Key funding areas of emergency and critical care medicine include early identification, diagnosis and treatment, as well as organ function support, protection and reconstruction. Key funding areas of trauma and burns include pathogenesis of injury, treatment and prevention of complication, tissue repair, as well as functional reconstruction. Key funding areas of plastic surgery include wound healing and scar management, repair, regeneration and reconstruction against malformation and defect of surface tissue and organ. According to the projects received and funded in recent years, the research on organ injury and dysfunction, wound healing and regeneration, the mechanism of emergency and critical care medicine are hot topics in this field. The research team is large with high level.

Rehabilitation Medicine (H17)

The Division mainly supports researches on the mechanisms, evaluation, therapy, engineering and prevention of the rehabilitation in dyskinesia and injuries including sports, sensation, cognition, speech and swallowing dysfunction caused by the diseases of musculoskeletal system, nervous system or other relevant organ/systems. At the same time, attention is paid to the mechanisms of physical factors on the body and the basic research of artificial intelligence. The basic and the applied basic researches of dysfunction on multidisciplinary cross-cutting, original and breakthrough innovation are encouraged.

Medical Pathogens and Infection (H19)

The Division mainly supports the research for medical microbiology and parasites, including etiology, pathogenic biology, pathogenic mechanism of pathogens, mechanism of drug resistance and host immune response, epidemic characteristics of nosocomial infection,

discovery and biological characteristics of pathogenic vectors, and so on. The genetic variation and evolutionary processes, drug resistance and the interaction with the host of the pathogen are the important scientific issues and research hot topics in pathogenic biology and infectious disease. The Division encourages innovation of basic research on the above scientific issues, and encourages the development of related biomedical research on new and neglected pathogens.

Laboratory Medicine (H20)

The Division mainly supports researches on new theory, new technology, new methods and new markers for prediction, diagnosis, monitoring and prognosis of all kinds of diseases, as well as reference systems and standardized studies for important clinical trials. Key funding field include the development of early, rapid and accurate detection techniques, the discovery and identification of new biomarkers, detection and diagnosis of rare and hereditary diseases. Laboratory medicine is a new and rapidly developing discipline, which runs through the whole process of disease prevention, occurrence, development and outcome. Laboratory medicine is a field of interdisciplinary research in medicine, life sciences and other disciplines. It serves clinical laboratory medicine but is not equal to clinical laboratory medicine. The Division will pay more attention to the development of laboratory medicine.

The Division does not support the tumor-related applications; please refer to the General Description section of proposal guidance from the Department**. The applications on therapeutic drugs and pharmacology should be submitted to Division IX (H30, H31) or Division X (H28). Pathogenic mechanism of molecules and temporal and spatial expression and regulation of genes should not be sent to laboratory medicine, please apply it in other appropriate divisions. Researches on drug-resistant pathogens should choose the code of Variation of Pathogen and Drug-Resistance (H1908). Researches that are not involved in the mechanism, evaluation and therapy of rehabilitation should not submit to rehabilitation medicine, please apply it in other appropriate divisions. Please refer to the general description of the Department for the applications involving highly pathogenic microorganism and tumor.**

Division VII of Health Sciences

The Division mainly funds basic research and translational research in oncology.

Oncology (H16)

The Division provides major funding for the basic research on tumor initiation, development and outcome, including the etiology, pathogenesis, diagnosis, treatment and prevention of various tumors. The funding covers the following research areas: tumor etiology, tumor initiation, tumor genetics and epigenetics, tumor immunology, tumor prevention, tumor recurrence and metastasis, tumor stem cells, tumor diagnosis, tumor chemotherapy, tumor physiotherapy, tumor biotherapy, comprehensive treatment of tumors, tumor rehabilitation (including psychosocial rehabilitation) and new techniques for the

tumor research system, as well as tumors in various systems/organs (except the hematologic and lymphatic systems) covering respiratory system, digestive system, nervous system (including special receptors), genitourinary system, breast and endocrine system, bone and soft tissue, head and neck and maxillofacial region, together with skin, body surface and other parts of the human body.

Cancer research involves different tissues and organs. On the one hand, it emphasizes basic research on the unsolved common problems of tumors, focusing on the molecular basis of tumor biologic behaviors such as cell proliferation, differentiation, metastasis, autophagy and apoptosis, aimed at exploring the mechanism and laws of tumorigenesis, tumor development, metastasis and recurrence, thus laying the foundation for tumor diagnosis, treatment and prevention. On the other hand, it highlights the distinct characteristics of tumors from various systems and organs, aiming to conduct the clinical practice of tumor management by carrying out translational research based on the observation and analysis of clinical phenomena as well as problems raised in clinical practice.

Proposals related to the common scientific questions of tumor should select corresponding application codes for tumor etiology, tumor initiation, tumor genetics and epigenetics, tumor immunology, tumor prevention, tumor recurrence and metastasis, tumor stem cells, tumor diagnosis, tumor chemotherapy, tumor physiotherapy, tumor biotherapy, comprehensive treatment of tumors, tumor rehabilitation (including psychosocial rehabilitation) and new techniques for the tumor research system (application code: H1601 to H1614). Proposals related to the distinct characteristics of tumors from specific systems/organs should choose application codes of corresponding systems/organs (application code: H1615 to H1626). Application codes should be carefully selected in accordance with the scientific fields.

Oncology research is one of the most active fields in medical sciences. With the rapid development and integration of cell biology, developmental biology, genetics and immunology, cancer research has been focused on tumor epigenetics, tumor stem cells, tumor immunology, and tumor systems biology. Recently, research on cancer epigenetics has emerged as a rapid increasing field, especially the studies on RNA-involved epigenetic regulation in tumorigenesis and tumor progression. In the field of tumor microenvironment, studies on the interaction between tumor cells and the surrounding microenvironment have gained increasing attention, for it emphasizes not only the regulation of tumor cells' biological characteristics by the tumor microenvironment, but also the modification of microenvironment by tumor cells per se and various cancer therapies. As for studies on tumor metabolism, special interests have been aroused in the mechanisms of metabolic reprogramming of cancer cells and microenvironment, the association between specific metabolic patterns of tumor cells and their biological behaviors, the roles of metabolites, metabolic enzymes, and metabolic-associated molecules in tumorigenesis and tumor development, the crosstalk among different signaling molecules and its effects on tumor microenvironment and tumor immunity. The other proposals have also stressed the translational values of metabolic factors in regulating tumor biological characteristics. For example, studies exploring the effects and mechanisms of some agents regulating the metabolism of glucose, lipids and nuclear acids in tumor cells may provide experimental evidence for the new application of traditional drugs in cancer treatment. Additionally, the exploration of tumor stem cells is deepening and interpenetrating with other frontiers fields,

which include molecular mechanisms underlying the stemness maintenance of tumor stem cells, abnormal metabolism of tumor stem cells, relationship between epithelial-mesenchymal transition (EMT) and tumor stem cells, formation and mechanisms of vascular mimicry, interaction between microenvironment and tumor stem cells, tumor dormancy, tumor heterogeneity, and therapy resistance, etc., Meanwhile, tumor chemoprevention has aroused increasing attention. By screening natural or synthetic compounds, new targets for cancer prevention were identified, which is of great significance to reduce the incidence of cancer and improve the survival chances of cancer patients. Moreover, psychological impact on tumor development has become a wide concerned issue. The immunological and neuroendocrine alterations caused by mental stress may play a role in the processes of tumor metastasis and therapy resistance. It could also be an important etiological factor in tumorigenesis. The development of new technologies and methods for cancer research, for example, the establishment of organoid models and related techniques, is also encouraged.

In recent years, the quality of proposals in the field of oncology research has been significantly improved, which is manifested by the solid preliminary experimental data, the well-reasoned scientific hypothesis, as well as the complete and thorough research contents. Proposals derived merely from literature reviewing without preliminary experimental data, or descriptive and correlative studies lacking in-depth mechanism exploration are declining each year, and are also uncompetitive in gaining the approval of reviewers.

Applicants are encouraged to discover and refine scientific questions from preliminary research and clinical practice, and to systemically investigate the mechanisms of malignant tumors for translational research and clinical improvement of cancer diagnosis and treatment, as well as to develop new technologies and methods for cancer research. Integrated research proposals taking advantage of the clinical resources in China and studies focusing on common and frequently-occurring tumors in Chinese population are also encouraged.

Applicants should note that the proposals on tumor epidemiology should be submitted to the Division VIII of Health Sciences (application code: H26), and proposals on hematologic and lymphatic system tumors should be submitted to the Division I of Health Sciences (application code: H0818, H0819). Proposals related to the distinctiveness of tumor from specific systems/organs should carefully choose the application codes of corresponding systems/organs. Proposals submitted with the wrong application codes would be objected.

Division VIII of Health Sciences

The Division provides funding for basic researches in fields of skin and its appendages, radiology, endemiology, occupational medicine, and preventive medicine.

Skin and its Appendages (H11)

The funding scope mainly covers the basic research in the abnormality of structure, function and development of skin and its appendages, as well as hereditary, immune-mediated and inflammatory skin diseases.

Radiology (H22)

The funding supports basic research in radiation-induced damage, radiation toxicology, radiological hygiene and protection, and radiological therapy for non-tumor diseases.

Endemiology (H2401)

This field provides funding to basic research regarding to the natural focal diseases, biogeochemical diseases and special diseases related to occupation or life style.

Occupational Medicine (H2402)

This field provides funding to basic research concerning diseases due to exposure to occupational hazards.

Preventive Medicine (H26)

The funding scope covers the basic research in environmental health, occupational health, human nutrition, food hygiene and safety, maternal and child health care, children and adolescent health, toxicology, hygienical analytical chemistry, infectious disease epidemiology, epidemiology of non-communicable disease, epidemiological methods and medical statistics.

Funding for radiology, endemiology, occupational medicine and preventive medicine is mainly focused on research in discovering new theory and developing advanced technology and methods for disease prevention and control. Projects with important scientific value and original innovation are highly preferred. Investigators are recommended to focus on population-based studies according to the actual need of public health and disease prevention. Reasonable application of integrated advance technology is encouraged. Combined laboratory experiment and human trial is also encouraged. Applicants should pay more attention to the multidisciplinary method and new idea. To reflect Chinese characteristics and have an international position, it is prerequisite to seek a novel research direction and to make great efforts in prospective studies. Basic data accumulation and medical specimen collection will be encouraged for in-depth, systematic studies. The basic research in epidemiological cohort studies is highly encouraged. Studies on environmental pollution and health scope should be intensively supported.

In the scope of skin and its appendages (H11), oncology-related researches are not accepted, which should be applied to Division VII (H16); researches on sexually-transmitted disease are not supported as well, and applicants may refer to categories under Division VI (H19). Applications involved in cancer radiotherapy are not accepted in Radiology (H22), and may refer to categories under Division VII (H16); applications for medical imaging and radiological diagnosis also are not included, and may refer to categories under Division V (H18). Applications of hereditary disease without geographical features are not accepted under the category of Endemiology (H2401). These applications are suggested to refer to corresponding category depending on the systems of human body. Food hygiene (H2604) does not support the study only on food processing and relevant divisions of the Department of Life Sciences are recommended. Applications for studying gynecologic diseases and

pediatric diseases are not accepted in the field of maternal and child health care (H2605), and children and adolescent health (H2606). The former may refer to categories under Division IV (H04), and the latter depends on the classification of body system. Applications on drug toxicology are not supported by Toxicology (H2607), and applicants may refer to categories under Division IX (H31). Researches on clinical test are not included in the category of hygienical analytical chemistry (H2608). Applicants may refer to categories under Division VI (H20). Pharmaceutical analyses are also excluded from H2608 and applicants may refer to Division IX (H30). Research only involved in laboratory research is not accepted under the category of epidemiology (H2609/H2610). Epidemiology of non-communicable disease (H2610) and other issues in preventive medicine (H2612) do not accept applications for health economics and policy, hospital administration and health management. Applicants may refer to related categories under the Department. In addition, applications for pathogen biology, including its pathogeny, pathogenesis, diagnosis, treatment and prognosis are not supported by field of infectious disease epidemiology (H2609) and other issues in preventive medicine (H2612). Applicants may refer to categories under Division VI (H19).

Division IX of Health Sciences

The Division mainly supports basic researches in the discipline of materia medica and pharmacology.

Materia Medica (H30)

Funding scope of materia medica in the Division covers research areas or sub-disciplines including synthetic medicinal chemistry, medicinal chemistry of natural products, microbial drugs, biotechnological drugs, marine drugs, special drugs, drug design and drug informatics, pharmaceutics, pharmaceutical materials, pharmaceutical analysis, drug resources, etc.

The Discipline puts emphasis on interdisciplinary researches, basic researches of innovative drugs and druggability. Funding in synthetic medicinal chemistry focuses on the research of active molecules based on new targets, new mechanisms or new structures, and generally does not support the simple optimization research of active compounds for known targets. Funding in medicinal chemistry of natural products and microbial drugs mainly provides to innovative theories, technologies and approaches for drug discovery from plants, animals and microorganisms. Funding in biotechnological drugs mainly supports researches on innovative biotechnologies or approaches to obtain biotechnological drugs including therapeutic antibodies, vaccines, proteins, nucleic acid and cells, etc.; meanwhile, exploratory researches on new types of expression systems and large scale cultural techniques will also be supported rationally. Funding in marine drugs mainly supports chemical, pharmaceutical and ecological researches of rare marine creature and marine microorganism from deep sea. Funding in special drugs supports drug researches involved in aeronautics, astronautics, deep sea, radiations, militaries, special environments, etc. Funding in drug design and drug informatics mainly supports researches on innovative

theories or approaches for drug design and druggability prediction, and meanwhile, on the discovery and structural optimization of completely new chemical structures of hit molecules. Funding in pharmaceutics mainly supports researches on innovative theories, technologies and methods, which are associated with physical pharmacy, biopharmaceutics, molecular pharmaceutics, industrial pharmaceutics, novel drug delivery systems and pharmaceutical dosage forms. Funding in pharmaceutical materials mainly supports basic researches on establishment and safety evaluation of new pharmaceutical excipients and carriers, which should have owned prominent features in pharmaceutical functions and structures and can be distinguished from researches in the area of pharmaceutics. Funding in pharmaceutical Analysis mainly supports basic researches on establishment and development of innovative approaches and techniques for analysis of the pharmaceutical molecules, drug targets or biofunctional molecules, especially, the in vivo effector molecules and the interaction between drug molecules and target molecules or effector molecules to solve key scientific problems in the fields of materia medica and pharmacology, and supports integrated investigations on the novel techniques for multi-omics with the important scientific problems of drug targets and biomarkers. As for drug resources, the Division mainly supports researches on key scientific problems associated with discovery, exploration, sustainable utilization and protection of new pharmaceutical resources.

Pharmacology (H31)

Funding in the discipline of pharmacology supports researches on target discovery and validation, drug action mechanism or drug resistance mechanism, target validation, drug metabolism and pharmacokinetics, clinical pharmacology and drug toxicology, etc. The involved drugs should be therapeutic drugs or drug candidates or bioactive substances with advantages in treatment of diseases.

The Discipline puts emphasis on in-depth study of action mechanism of drugs or bioactive products and their target, including exploring the basic rule of life and the pathologic mechanism of disease by using drug molecules as probes. In-depth and systematic studies should be strengthened in proposals related with research fields as below: discovery and validation of new target, disease-specific and sensitive biomarker, discovery of new pharmacological actions of drugs or bioactive compounds and elucidation of their action mechanism, strategies and methods to effectively overcome multi-drug resistance, new targets, novel drugs and new strategies of drug combination based on pharmacogenomics, epigenetics, systematic biology, etc. Basic research should be strengthened in proposals as below: molecular regulatory network of complex disease and mechanism of drug intervention, individualized drug therapy and new treatment approaches, translational medicine, innovative pharmacological models, techniques and approaches. In the sub-discipline of drug metabolism and pharmacokinetics, new approaches and new models should be constructed and developed to strengthen the integrated researches on the drug target, pharmacodynamics, toxicology, clinical medication and drug intervention, and the regulation mechanism researches on the drug-metabolizing enzymes and transporters. In the sub-discipline of clinical pharmacology, the researches should focus on the exploratory research of individualized medication and the interaction between drugs and human body, and lay more emphasis on rational administration of special community such as children,

pregnant women and the highest-risk population, etc. In the sub-discipline of drug toxicology, researches should be strengthened in the research fields as below: molecular mechanism, intervention strategy to drug toxicity, mechanism on metabolite toxicity, novel models and approaches for drug safety evaluation.

In recent years, a large proportion of proposals in materia medica were from the sub-disciplines of pharmaceutics, synthetic medicinal chemistry, and medicinal chemistry of natural products. Many proposals from sub-disciplines of pharmaceutics and synthetic medicinal chemistry were involved in antitumor drug researches. Even though the proportion of these proposals in General Program basically tended to be balanced in 2018, it was still excessively large in Young Scientists Fund. Therefore, disease types and new ideas should be further expanded and interdisciplinary research between chemistry and biology should be further strengthened. The researches also should be emphasized on the discovery of original innovative drugs and key scientific problems of druggability. In the sub-discipline of pharmaceutics, researches on multi-functional delivery systems should focus on evaluation of druggability and rationality of combinational design.

In the discipline of pharmacology, most proposals have mainly focused on the action or the resistance mechanism of a certain sorts of drug. Some featured projects based on long-term accumulation and an increasing proportion of the projects focusing on the new target discovery and new molecular mechanism could be found. Some proposals with good research idea failed to be approved due to insufficient evidences, inadequate data, incomplete scientific logic, ambiguous research objects oversized research plan and insufficient study in depth, etc. A considerable number of proposals were not granted due to the lack of obvious innovation or over simple application that lacks depth and preliminary data.

Innovative fundamental research and continuous in-depth projects will be granted in priority. Because translational medicine is of far reaching significance in improving clinical application value of basic research, laboratory basic research on discoveries of new drug, clinical therapeutics and diagnostics will be strengthened to reveal new targets for drug therapy, new biomarkers for disease diagnostic in the course of exploring the mechanisms on occurrence and development of disease, furthermore, to lay theoretical and experimental foundation for developing innovative drugs and diagnostic reagents with independent intellectual property.

The scope of funding at Division IX does not cover conventional researches for drug development for new drug approval such as pharmaceutical process and general pharmacology. To the innovative basic research with a great prospect for new drug development, the entire chemical structures or backbone of compounds should usually be provided in application, but the applicants should pay special attention to the protection of intellectual property and carefully handle the relationships between application and secrecy. Confidentially core contents or techniques, which are not suitable to be illustrated or described in proposals such as chemical structures, should be sent directly to the office of Division IX by confidential letters and explained in proposals. Applicant of young scholar should get the consent of applicant's supervisor and Letter of Authorization signed by applicant's supervisor should be attached with proposal, if research proposal is similar with or closely related to applicant's supervisor research work.

Division X of Health Sciences

The Division identifies its role as advancing the theories of Traditional Chinese Medicine (TCM) while highlighting advantages of the heritage. It provides funds to basic research and clinic-based research programs in TCM, Chinese Materia Medica (CMM) and Integrated Chinese and Western Medicine (IM).

Traditional Chinese Medicine (H27)

Funding areas: (i) fundamental theories of TCM: essence of viscera, qi-blood-body fluid, body constitutions, etiology and pathogenesis, basis of TCM syndromes, therapeutic principles and methods, prescriptions and diagnostics in TCM; (ii) basic research in clinical medicine: internal medicine, surgery, orthopedics and traumatology, gynecology, pediatrics, ophthalmology, otorhinolaryngology, stomatology, geriatrics, and health preservation and rehabilitation in TCM; (iii) acupuncture and moxibustion, Tuina and massage: meridians, collaterals, and acupoints, acupuncture, moxibustion and Tuina and massage; (iv) other ethnomedicine.

Chinese Materia Medica (H28)

Funding areas: (i) Chinese materia medica: resourceology, identificology, pharmacodynamics substance, quality evaluation, processing, pharmaceutics of CMM, and theories in the properties of Chinese herbs; (ii) pharmacology: neuropsychopharmacology, cardiovascular and cerebrovascular pharmacology, anti-tumor pharmacology, endocrine and metabolic pharmacology, anti-inflammatory and immune pharmacology, antiviral and anti-infective pharmacology, respiratory pharmacology, digestive pharmacology, urinary and reproductive pharmacology, pharmacokinetics, and toxicology in CMM; (iii) ethnopharmacology.

Integrated Chinese and Western Medicine (H29)

Funding areas: (i) fundamental theories of IM; (ii) basic clinical research of IM; (iii) methodological or technical innovations in TCM research.

In recent years, the funded projects in the field of TCM, CMM, and IM have exhibited the following features: (1) based on TCM theories and clinical effects of TCM, and conducted from both macroscopic and microcosmic levels, the projects explored the holistic rules of human life and the integrating regulatory effects of TCM; (2) through introducing cutting-edge theories, methods and techniques exerted in the modern medical science and other sciences, incessant innovation of research thoughts and methods, dynamic integration of TCM and new emerging disciplines, the projects have particularly been promoting the TCM development; (3) these projects have also paid more attention to the clinic-based research of functional disorders, age-associated diseases, metabolic diseases, immunological disorders, and viral infectious diseases treated by TCM and/or ethnomedicine and to identify underlying mechanisms.

The Division’s top priority is to support the best projects that discover the key scientific problems of TCM, the inner-connections between TCM and biomedical science.

The Division will continue to encourage the integration of different disciplines, focus on matters of science in this field and particularly emphasize interdisciplinary research using multidisciplinary concepts, methods, techniques and approaches under the guidance of TCM and thus promote the inheritance, development, and innovation of TCM fundamental theories.

In light of the current TCM research, the Division in 2019 will continue to value and support researches on the followings: visceral manifestation theory, etiology and pathogenesis, TCM syndromes, therapeutic principles and methods, detoxification and compatibility in classical formulas, relationship between classical formulas and TCM syndromes, mechanisms for therapeutic effects of TCM on preponderant diseases and the preventive effects on major and refractory diseases, methodology in clinical therapeutic evaluation of TCM, mechanisms underlying the therapeutic and preventive effects of acupuncture on diseases and the theories of meridians and acupoints, theoretical and clinical basis for integrated TCM and western medicine, innovative techniques and methods in TCM research, CMM resources; CMM identification, CMM processing and preparation, CMM properties, material basis for effects, physiological disposition and the related regulation, pharmacological effects and mechanism of CMM, CMM toxicity, correlation between toxicology and toxicity-effect, ethnomedicine such as Mongolian medicine, Tibetan medicine, Uyghur Medicine and so on.

The Division will not support any proposal which is not associated with TCM and Ethnomedicine. Any pharmaceutical proposal without the guidance of TCM theories or Ethnomedicine theories should be submitted to Materia Medica (H30) or pharmacology divisions (H31). Medical proposals without the guidance of TCM or Ethnomedicine theories should be submitted to other medical divisions (H01 to H26). Any proposal containing TCM or acupoints formulas which cannot be shown openly should be sent to the Division directly by confidential mails, and specifically explained in the proposal, or it will not be accepted.

Key Program

The Key Program supports researchers to conduct in-depth, systematic and innovative research in directions with sound research basis or where new growth points of scientific disciplines might emerge, so as to promote disciplinary development and breakthroughs in important areas or scientific frontiers.

Key Program projects should follow the principle of limited objectives, limited research scope and focused goals, pay attention to intercrossing disciplines, make effective use of existing major scientific research bases at national and ministerial levels, and conduct substantive international cooperation and exchange.

Applicants should have the following qualifications:

(1) Experience of undertaking basic research projects;

(2) Senior academic position (title).

Post-doctors, postgraduate students and the people with no host institution or whose institutions are not registered at NSFC are not qualified for application. Key Program projects set research areas or directions and announce in the *Guide*. Applicants should follow the guidelines to prepare proposals, be concise and specific in content within the research fields and directions, choose project title according to research content, and avoid using research area as project title.

In general, one Key Program project is conducted by only one research institution. If necessary, two institutions at maximum are allowed to work as collaborators. The funding period of a Key Program project is 5 years.

Special reminder to the applicants:

(1) In 2019, NSFC will implement the pilot application and review for the Key Program based on 4 natures of science topics. When preparing the application for Key Program, the applicant should select the nature of science topic based on the key scientific problems to be solved and the research content, and clarify the reasons for choosing the science nature concerned. In the case of multiple science natures, the applicant should choose the science nature that best matches and summarizes the application. NSFC shall organize respective review by experts based on the science nature the applicant chooses.

(2) In 2019, for Key Programs, pilot paperless applications are carried out. In process of the submission, the supporting institution shall only confirm the online application and the attachments, without having to submit a paper form application. Once approved, the signature and seal page (A4) of the application form should be submitted at the time of submitting the project plan. The signature and seal information should be consistent with that of the electronic application.

In 2018, NSFC funded 701 projects under the Key Program, with a total funding of 2.05442 billion yuan, and the average funding for direct costs is 2.9307 million yuan per project.

Funding of the Key Program Projects in 2018

Unit: 10,000 yuan

Departments	No. of applications	Awards				Success rate (%)
		No. of awards	Funding for direct costs	Average funding for direct costs	Share of NSFC total funding for direct costs (%)	
Mathematical and Physical Sciences	311	80	24,000	300.00	11.68	25.72
Chemical Sciences	277	62	19,500	314.52	9.49	22.38
Life Sciences	621	113	32,300	285.54	15.72	18.20
Earth Sciences	509	92	27,780	301.96	13.52	18.07
Engineering and Materials Sciences	476	102	30,600	300.00	14.89	21.43
Information Sciences	347	98	28,000	285.71	13.63	28.24
Management Sciences	138	34	7,992	235.06	3.89	24.64
Health Sciences	685	120	35,270	293.92	17.17	17.52
Total or average	3,364	701	205,442	293.07	100.00	20.84

Please refer to the respective sections in each department for research areas and orientations of the Key Program projects.

Department of Mathematical and Physical Sciences

In 2018, the Department announced 119 areas for Key Programs, and received 311 applications. 80 projects were funded with direct cost funding of 240 million yuan and about 3 million yuan per project. The success rate was 25.72%.

In 2019, the Department plans to fund about 80 Key Program projects. The average direct cost funding will be more than 2.6 million yuan per project for mathematics, and 3.4 million yuan for mechanics, astronomy, physics I and physics II. The funding will be 5 years. Please provide with the proper application code when applying.

To ensure the high quality of projects, applicants are required to have held national projects, with relatively large research teams.

Please give the title of the proposed research directions in the note section of the application form, otherwise the application will be not accepted. Please provide with the specific application code when applying.

In 2019, the Department selected Key Program to conduct classified application and review. For detailed information, please refer to "2019 NSFC Reform Initiatives" in this *Guide*.

In 2019, the main research directions are as follows:

1. Grid code problems

2. Associative algebra derivative domain and homological hypothesis

3. Infinite-dimensional Lie theory and applications

4. Non-commutative algebraic geometry

5. Atiyah-Singer indicator theory

6. Finsler geometry

7. Convex geometry and integration geometry

8. Geometry and topology on 3D manifold

9. Non-commutative and non-associative several complex variables theory

10. Modern variation and its applications

11. Non-commutative analysis and application

12. Integrability and non-integrability of finite-dimensional dynamical system

13. Qualitative theory of differential equations and bifurcation problems

14. Periodical probability and periodic property of time lag differential equations and bifurcation analysis

15. Stochastic dynamical system and its application

16. High Reynolds number problem of fluid dynamic equations

17. Multi-scale fluid equation and its mathematical theory of coupling models

18. Elliptical partical differential equation

19. Singular limit problems of quasi-linear parabolic partical differential equations

20. Discrete integrable systems

21. Dirichlet form theory and Markov process and its applications

22. Stochastic and dynamic game theory and applications

23. Distributive statistic algorithm and system for big data mining

24. Semi parameter integration and regression inference

25. Statistic theory and method of functional data

26. Optimization theory and algorithm in machine learning

27. Theory and computation of data driven matrix optimization

28. Stochastic optimization and emulation optimization

29. Combinational optimization algorithm in network and bio data analysis

30. Control theory for stochastic distributed parameter systems

31. Modeling and theoretical analysis of fluid coupling and multi-phase flow interactions

32. Mathematical method and theory of smart diagnosis by medical images

33. Theory and algorithm data analysis for single cell sequencing

34. Multi-data driven network epidemic dynamics and prediction

35. Algebraic method of discrete structure

36. Maximum graph theory and applications

37. Multi-parameter inversion method based on wave propagation and diffusion

38. High order algorithm and application of fraction order differential equation

39. Computation method and theory of electromagnetic field in non-conventional materials

40. Multi-scale modeling and computation method in transport process

41. Theory and method of physical mechanics

42. Theory and experiments of multi-degree of freedom nonlinear system dynamics

43. Modeling, analysis and control of complex system dynamics

44. Vibration characteristics of complex structures and advanced control method

45. Fracture, fatigue, buckling and strength of materials and structures

46. Solid deformation and constitutive relations

47. Mechanical theory and experimental method of multi-field coupled mechanical response for new materials and structures

48. Dynamical response and structural optimization of complex structures

49. Light material and structure mechanics and theory and method of multi-functional design

50. Unsteady complex flow mechanism and control

51. Hydro dynamics of marine vessels and structures

52. Aerodynamics and thermodynamics of aircraft

53 Theory and method of bionic fluid dynamics

54. Biomechanical problems in human health and medicine

55. Multi-scale multi-field coupled mechanical bio problems

56. Mechanical behavior of materials and structures in large dynamic loading conditions

57. Mechanism of energy release and damage in energy containing material explosion

58. Methods and high performance computation software

59. New methods and technology in experimental mechanics

60. Theory and method of fluid solid coupling mechanics

61. Key mechanical problems in environmental evolution and catastrophe

62. Key mechanical problems in advanced manufacturing

63. Key mechanical problems in high end manufacturing

64. Key mechanical problems in extreme conditions

65. Key mechanical problems in new energy and resources areas

66. Basic mechanical problems in propulsion system

67. Nature of dark matter and dark energy and physical process in evolution of cosmos

(1) Dark matter and dark energy and physical process in early period of cosmos

(2) Large scale cosmic structures

68. Galaxy evolution and impact of surrounding environment

(1) Detection of medium high red shift celestial bodies and formation and evolution of galaxies

(2) Galaxies and relations with surrounding dark matter and interstellar media

69. Structure, formation and evolution of large mass black holes and active galaxies

(1) Structure and radiation of active galaxy cores

(2) Formation and evolution of large mass black holes and mutual evolution with the galaxies

70. Structure, composition, integration and evolution of the Galaxy

(1) Galaxy structure, distribution dynamics and long term evolution of star groups

(2) Basic parameters and matter distribution (including dark matter) of the Galaxy

71. Formation of molecular cloud and stars, internal structure and evolution of stars and high energy process of dense celestial bodies

(1) Formation of stars, molecular cloud, interstellar matter circulation

(2) Internal structure and evolution of stars and star systems

(3) Birth, explosion, gravitational wave and high energy process of dense celestial bodies

(4) Discovery, time measurement and radiation mechanism of pulsars

72. Planet system formation, exploration and dynamics

(1) Exploration of solar system and outer planets, and dynamics of planetary system

(2) Atmospheric property and internal dynamics of planets

(3) Formation and original star disk and planetary system

73. Solar atmosphere, magnetic field and activities

(1) Structure and dynamics of solar atmosphere, fine structure of solar magnetic field, origin and evolution of solar magnetic field

(2) Solar eruption and its origin and evolution, forecast of solar activities

74. High precision astronomical measurement and time frequency

(1) Micro angular second frame celestial sphere, high precision earth reference frame and astronomical earth dynamics

(2) Precision time generation and transmission

75. Solar system dynamics and stability

(1) Stability of solar system and orbit diffusion

(2) Discovery of small celestial bodies in solar system and its origin dynamics

(3) Physical and chemical properties of small celestial bodies in solar system

76. Measurement, determination of precise orbit and dynamics of fast moving

celestial bodies

(1) Design and measurement of deep space probes and precision satellite navigation and positioning

(2) Monitor and dynamics of fast moving celestial bodies

77. Optical and inferred key technology

(1) Key technologies for extremely large optical and inferred telescopes

(2) Wide field view, high resolution, high contrast imaging and detection technology

(3) Optical and inferred detection technology

78. Key technology of radio astronomy

(1) Key technology of low noise, super wide band, array receiver

(2) Key technology digital signal processing

(3) Single array interference imaging and VLBI technology

79. Key technology for space astronomy

(1) Key technologies of X-ray, ultra violet and inferred space telescopes

(2) Key technologies for high resolution cosmic ray, X-ray, inferred and ultra violet space detectors

80. Solid quantum information and quantum computation

81. Physics of advanced functional materials and devices

82. Surface and interface physics

83. Physics of confined quantum systems

84. Strong correlated system and superconductivity

85. Physics of soft matter and biophysics

86. Computation and design of new materials

87. Topological matter state and related physics

88. Solid magnetism and multi-field regulation

89. Physic in extreme conditions

90. Artificial intelligence and solid state physics

91. Structure and impact dynamics of atoms and molecules

92. Physics of atoms and molecules in outer field

93. Cold atoms and molecules

94. Precision spectroscopy and precision measurement

95. Ultra-fast, ultra-strong light physics

96. Quantum optics and quantum information physics

97. Optical field regulation and interference control

98. New effect and new mechanism in photo electric, photo thermo and photo acoustic conversion process

99. Photonics and optical physics in meso scale and complex media

100. Phononics, acoustic field regulation and acoustic physics in complex media

101. Acoustic field and optical field in the sea

102. Key problems in acoustic and biomedical and information sciences

103. Frontier problems in basic theory of quantum physics

104. Frontier problems in basic theory of statistical physics and physical systems

105. Frontier problems in theory of gravitation, cosmology and dark matter

106. Precision verification of standard models and new physics

107. New method in quantum field, high precision computation and

measurement in partical physics

108. Studies on the internal structure of hadron and strong interactions

109. Quantum chromo dynamics and quark gluon plasma

110. Novel structure and decay spectroscopy of unstable nuclei

111. Studies on reaction of non-steady nuclei, nuclear astrophysics and laser nuclear physics

112. New techniques of neutron physics, reactors and scattering

113. Applied basic research in the application of nuclear technology in new materials and energy

114. Basic research on nuclear technology and applications in life and environmental sciences

115. Studies on key problems in radiation physics and radiation protection

116. Accelerator physics and its advanced technology

117. Mechanism, method and technology of radiation detection (including radiation energy spectrum)

118. Particle detection mechanism and method based on large facilities

119. Technology and method of nuclear electronics

120. Frontier problems of strong laser plasma and inertia confined fusion physics

121. Magnetic confined fusion plasma physics and advanced experimental and diagnosis technology

122. Basic research on low temperature plasma physics and advanced technology and new methods

123. Studies on advanced technologies and experimental methods of synchrotron radiation and free electron laser

Department of Chemical Sciences

In 2018, the Department funded 62 Key Program projects with 195 million yuan and 3.145 million yuan of average funding intensity per project (direct cost). The duration of each project is 5 years.

In 2019, the Department announces guidelines for Key Program projects and accepts proposals in 78 research areas, and the average direct funding intensity will vary from 2.5 to 3.5 million yuan for each project. In principle, no more than 2 projects will be funded expect for the Key Program projects group. In order to further improve the quality of projects, proposals from those groups and teams with excellent research resources and innovative ideas are preferred, and proposals for interdisciplinary cooperative research carried out by teams which have strong background are encouraged.

When filling in the application form, the applicants must indicate the selected research area in "the column of note", and select the proper discipline code marked in brackets of the research area.

In 2019, the Department selected Key Program to conduct classified application and review. For detailed information, please refer to "2019 NSFC Reform Initiatives" in this *Guide*.

In 2019, the research areas for Key Program projects funded by the Department are listed as follows:

1. New methodologies of inorganic synthesis (B01)

2. Inorganic solid state synthesis (B01)

3. Synthesis of cluster compounds (B01)

4. Synthesis and application of organo-metallic/organo-elementary compounds (B01)

5. New reactions and new reagents in organic synthesis (B01)

6. Light-induced reaction and radical chemistry (B01)

7. Novel synthetic strategies for natural products and complex pharmaceutical molecules (B01)

8. New methodologies for polymer synthesis (B01)

9. Synthesis of polymers with novel topological structures (B01)

10. New strategies for coordination polymers (B01)

11. New building block-based supermolecular systems and functional self-assemblies (B01)

12. Theoretical research of surface/interface in catalytic process and its dynamic characterization (B02)

13. New methods and new concepts for construction of specific structural and functional catalytic materials (B02)

14. Selective activation of chemical bond on surface (B02)

15. New theories and methods of colloid and interface chemistry (B02)

16. In situ dynamic method and process research of electrochemical interface (B02)

17. Interface problem of photoelectrochemical system (B02)

18. Theory and methods of electronic structure (B03)

19. Theoretical simulation of dynamic structures and interactions of biological macromolecules (B03)

20. Ultrafast dynamics study of condensed phase (B03)

21. Molecular reaction dynamics in excited state (B03)

22. Theory and mechanism of chemical reactions (B03)

23. Theoretical calculation and simulation of non-equilibrium polymer system (B03)

24. New theory and mechanism of chemical metrology (B04)

25. Chemical metrology based on modern analytical methods and technologies (B04)

26. Separation and analysis of complex systems (B04)

27. Single molecule, single particle and single cell analysis (B04)

28. In-vivo chemical metrology (B04)

29. Intelligent sensing and measurement (B04)

30. Micro-nano chemical metrology (B04)

31. New chemical imaging methods (B04)

32. Material chemistry of new solid-state battery (B05)

33. Biomedical material chemistry (B05)

34. Material chemistry of opto-electronic functional organic/polymeric systems (B05)

35. Material chemistry of polyolefin system (B05)

36. Material chemistry in biomass conversion and utilization (B05)

37. Porous functional material chemistry (B05)

38. Material chemistry of biomimetic and intelligent composite material (B05)

39. Material chemistry of ion exchange membrane for energy conversion (B05)

40. Photo/electro-catalytic conversion of small molecule fuels (B05)

41. Exploration of new photovoltaic system (B05)

42. New battery system based on metal cathode (B05)

43. Material chemistry of thermoelectric conversion (B05)

44. New techniques and methods for pollutant detection in complex environmental media (B06)

45. Identification and detection of intermediates in the process of pollutant transformation (B06)

46. Migration, transformation, micro-interface behavior of pollutants in multiple media and its regulation (B06)

47. Fundamental chemistry of new functional materials in polluted environment remediation (B06)

48. New methods for water pollution control based on the cycle of transition metal elements (B06)

49. Environmental spread and health effects of antibiotics resistant genes (B06)

50. Exposure and toxicity research on environmental endocrine disruptors (B06)

51. Environmental chemical behaviors and biological effects of micro-nano materials (B06)

52. In-situ, real-time biological probe discovery and biological imaging (B07)

53. Discovery and functional research of new skeleton natural products with important bioactivities (B07)

54. Chemical biology of metals and trace elements (B07)

55. Small molecule recognition and regulation of biomacromolecule functions (B07)

56. Discovery of small molecular compounds acting on mitochondria and their functions (B07)

57. Discovery and function of new targets based on small molecule (B07)

58. Design and application of novel artificial enzymes (B07)

59. Precise measurement and simulation of essential data for chemical engineering (B08)

60. Chemical reaction engineering and reactor (B08)

61. New methods and technologies for chemical separation (B08)

62. Methods and technologies for enhancing chemical engineering process (B08)

63. Big data of chemical engineering and intelligent process (B08)

64. Synthetic biotechnology and biorefinery processes (B08)

65. Chemical engineering basis of high purity chemicals and materials of information electronics (B08)

66. Preparation and accurate property regulation of new materials for chemical engineering (B08)

67. Chemical engineering foundation for clean and efficient utilization of fossil

energy (B08)

68. Chemical engineering and key technologies of new energy system (B08)

69. Process basis and equipment technology of ocean chemical engineering (B08)

70. Chemical engineering basis and key technologies of efficient utilization of biomass (B08)

71. Green chemical engineering process and key technologies (B08)

72. Fundamentals and application of environmental chemical engineering (B08)

73. Molecule chemical reaction and mechanism under extreme conditions (B0X)

74. Nonclassical aromatic chemistry (B0X)

75. Near-infrared luminescent nanomaterials for multichannel time-resolved imaging and detection (B0X)

76. Efficient ammonia synthesis under mild conditions (B0X)

77. Database and data mining of chemical energetics (B0X)

78. Precise measurement and molecular mechanism of single molecule behavior (B0X)

The research guides from 73th to 78th listed above are the Key Program projects/Key Program project group driven by the disciplinary frontier. Applicants may organize collaborative research teams to apply for one of them accordingly. When filling in the application form, the applicants should select the corresponding code based on the research contents (for code B0X, please select code from B01 to B08). The General Office of the Department will accept and handle the proposals.

Department of Life Sciences

The research fields funded by the Department cover biology, basic medicine and agricultural sciences. According to the orientation of Key Program, funding is carried out in line with the principle of "limited objectives, limited scale and prominent focus". In 2018, the Department received 621 applications, among which 597 projects were accepted. There were 113 projects funded with a funding rate of 18.2%.

In 2019, the Department will follow principles of "encouraging exploration, highlighting originality; focusing on the frontier, creating new paths; demand traction, breaking through bottlenecks; common orientation, cross-linking". After carefully untangling of the frontier directions of various disciplines with close attention to the scientific problems in the major needs of the country, Key Program areas in 2019 are proposed to encourage scientists to aim at the frontier of science, select fundamental and global scientific problems and carry out systematic innovative work, form Key Program groups in important research directions of disciplines, and promote the development of fields.

In order to apply for the Key Program, applicants should read the application requirements, special notes, and the funding plan of the Department in this chapter carefully. Moreover, since the research areas in the Department cover a broad spectrum from fundamental biological sciences and basic medicine to agricultural science, the designated areas of Key Program in each discipline is closely correlated with the funding areas of the

discipline. **Please note that applicants should correctly apply for the Key Program according to the funding areas. Those categories, which are not within funding areas as described in the General Program part of this *Guide*, are not applicable to Key Program.**

The requirements for application to the Key Program projects of the Department are as follows:

(1) Applicants should propose research topics and compose every parts of the proposal following the guidelines of designated areas issued by the Department in 2019. In the column of Annotations on the basic information table of the application form, applicant should fill in the applied research area; with the corresponding application code lined out in each discipline's designated areas correctly. **Please note that the designation of application codes for the Key Program projects is set for efficient project management, whereas the application codes appointed may not include all the research contents of the designated areas, therefore applicants should not be restricted by the application codes appointed in ascertaining their research themes according to the relevant contents of designated areas.**

(2) Applicants for the Key Program of the Department are required to attach the first pages of five representative research articles (published in the recent five years) closely related to the proposal (upload as attachment with application).

In 2019, based on the overall arrangement for the Key Program of NSFC, the Department will arrange a total direct cost budget of 300 million yuan, to support the same number of Key Program projects as that of 2018. The funding intensity is roughly the same as that in 2018. Applicants should put forward reasonable budget according to the actual financial needs of their research. The duration of the Key Program project is 5 years.

In 2019, Key program is the pilot for classified application and evaluation. For detailed information, please refer to "2019 NSFC Reform Initiatives" in this *Guide*.

The designated areas of each division in the Department in 2019 are as follows:

1. Interaction between microorganism and environment and its metabolic regulation (C0105)

2. Analysis, design and construction of microbial pivotal life processes (C0102)

3. Adaptation and evolution of plant to environmental (C0203)

4. Regulation of plant growth and development (C0204)

5. Animal diversity and animal resources (C0409)

6. Biological basis of animal adaptation (C0401)

7. Theoretical and application study on bioinformatics and biological big data (C0607)

8. Analysis, function and mechanisms of genetic and epigenetic regulation to important traits (C0606)

9. Molecular regulation of important activities and plasticity to cell life (C0706)

10. Subcellular structure, function and dynamic regulation (C0701)

11. Molecular mechanisms of germ cell generation, fertilization and embryo development (C1202)

12. Regulation mechanism of organogenesis, homeostasis and stem cell regeneration (C1201)

13. Recognition and new discovery of immune organs, cells and molecules (C0803)

14. Immune recognition, response, regulation mechanisms in diseases (C0804)

15. Neurobiological mechanisms of sensation and behavior (C0901)

16. Development, degeneration and plasticity of nervous system (C0901)

17. Psychological and brain mechanisms of cognition (including social cognition) and emotion (C0902)

18. Maintenance and regulation of body structure and physiological function (C11)

19. Tissue and organ remodeling and molecular regulation in pathophysiological processes (C11)

20. Dynamic regulation and function of bio-membrane (C0502)

21. Synthesis, modification and activity regulation of biomacromolecules and bimolecular complexes (C0506)

22. Design of new functional proteins and large-scale biosynthesis (C2106)

23. High spatiotemporal resolution molecular event detection (C2109)

24. Mechanisms of tissue repair and regeneration (C1003)

25. Advanced technology research on biomaterials and drug delivery (C1002)

26. Formation, evolution and maintenance mechanism of biodiversity (C0312)

27. Response and adaptation of ecosystems to global change and human activities (C0308)

28. Basic research on high efficiency cultivation and utilization of forest resources and grassland (C1607)

29. Analysis of important tree characters (C1610)

30. Exploitation and utilization of excellent crop germplasm resources (C1304)

31. Mechanism of crop yield, quality formation and resistance to abiotic stress (C1302)

32. Biological studies in food storage, processing and biomanufacturing (C20)

33. Basic research on food quality, nutrition and food safety control (C20)

34. Interaction mechanism between crops and harmful organisms (C1409)

35. Harmful mechanism and regulation of crop pests (C1401)

36. Biological basis and regulation mechanisms of excellent characters formation in horticultural crops (C1502)

37. Nutrient requirement rules of crops and the mechanism of effective utilization of nutrient elements (C1508)

38. Genetic basis and breeding regulation of good traits of livestock, poultry and bee silkworm (C1703)

39. Biological basis of healthy livestock and poultry breeding (C1705)

40. Pathogenesis and host resistance of important diseases in livestock and poultry (C1805)

41. The mechanism and control of mutation and drug resistance of important pathogens in livestock and poultry (C1807)

42. Mechanisms of nutritional metabolism of important aquatic products and pathogenesis of diseases (C1904)

43. Formation mechanism of economic characters of important aquatic products (C1902)

Moreover, considering common problems in the past years, the Department particularly reminds applicants of avoiding the following listed mistakes. Otherwise,

proposals may be rejected during the preliminary checking procedure:

(1) Applications that have not specified the title of designated research areas in the column of "Annotations" on the basic information table in main body of the application text;

(2) Applications that have not filled in the corresponding application code specified by this *Guide*;

(3) Applications without submitting the 5 representative publications within 5 years (since 2014) as first author or corresponding author;

(4) Applications indicating the designated areas in the "Annotation" column, without the actual research contents matching the scope of funding;

(5) Applications submitted by applicants who are still holding a full time position abroad, or who cannot ensure necessary time and efforts for implementing the proposed research in China.

For other issues to be noted for proposal preparation, please refer to the *Guide* to the General Program projects of the Department.

Department of Earth Sciences

As one branch of fundamental sciences, the research object of earth sciences is the complex planet of the Earth. The challenges emerging from the research in the past, present and future of the earth system and its habitability have gone well beyond the capability of any single traditional discipline. Interdisciplinary research has become the fertilizer for innovative ideas and original innovation. It is expected that scientists from various disciplines of earth sciences and scientists from other research areas such as mathematics, physics, chemistry, biology, materials and engineering sciences, information sciences and management sciences jointly submit proposals for the Key Program in the Department. The application codes for interdisciplinary study should be filled in the application form.

The relevance and academic contribution to the specific priority area must be stated in the proposals. To avoid duplication in funding, applicants shall state clearly the relations and differences between the research and related projects funded by other national agencies.

The application codes for key project proposal should be filled in the application form upon the applicant's selection.

In 2018, the Department received 509 proposals for the Key Program, and 92 were funded with a total of 277.80 million yuan as direct expenses. The successful rate was 18.07% and the average funding amount was 3.0196 million yuan. In 2019, 89 projects will be funded, with a preferred range of 3 to 3.5 million yuan for each project. The required research period of a Key Program project is 5 years.

In 2019, the Key Program supported by the Department will initiate categorized application and review. For detailed information, please refer to "2019 NSFC Reform Initiatives" in this *Guide*.

Special notes for applicants: In 2019, titles of the 12 themes to accept proposals for the Key Program in the Department are as follows:

(1) New theories, techniques and methods of earth observation and information extraction;

(2) Deep earth processes and dynamics;

(3) Environmental evolution and biological processes on the planet earth;

(4) Formation mechanism and the application of detection methods for mineral resources and fossil energy;

(5) Ocean processes and their impacts on resource, environment and climate;

(6) Changing processes and effects of terrestrial surface environment;

(7) Evolution and sustainable utilization of water and soil resources;

(8) Process and function of the critical zone;

(9) Process, change and mechanism of weather, climate and atmospheric environment;

(10) Sun-Earth space environment and space weather;

(11) Global environmental change and interactions among different spheres of the Earth;

(12) Impacts of human activity on environment and disaster.

In regard to the problems emerged when applying for Key Program projects, applicants must fill in "Annotations" in the proposal sheet with one of the above 12 titles of the themes. Proposals with incorrect "Annotations" or without "Annotations" will not be accepted.

For example, if applying to Theme 1 "New theories, techniques and methods of earth observation and information extraction", the title "New theories, techniques and methods of earth observation and information extraction" must be correctly listed in the Annotations in the proposal. Please do not change the title of the theme or fill with any detailed research directions.

The applicants may decide the title, content, and research plan for their own proposals according to the key issues listed in the research themes based on the previous research work and new scientific problems, as well as new research approaches.

1. New theories, techniques and methods of earth observation and information extraction

Scientific objectives: Earth science is based on mathematics, physics, chemistry theory and its observation, exploration methods and experimental research. The application of new theories, new technologies and new methods has led to great changes in earth science research methods and ways of thinking, which has promoted the progress of earth science and is the core of the earth science in the future. The scientific goal in this field is to develop new theories, new techniques and new methods for the basic theory, experimental simulation, observation and related information extraction of earth science research for the frontiers of earth sciences, and to provide theory and means of research for a breakthrough and deep-going development for earth science in China and such major issues as resources, energy, disaster prevention and mitigation and environmental protection that are facing the national economy construction and sustainable development.

Key scientific issues: experimental technologies of physical and chemical properties and processes of the Earth's matter; theory and technology of deep earth exploration and surface observation; trace, micro-area and high-precision and high sensitivity experimental analysis technology; theory and technology of earth system basic information collection and application; deep space, deep land, deep time, deep sea exploration theory and method; geography big data assimilation, fusion, sharing and analysis technology; remote sensing

quantitative research of earth system science system; observation system and multi-source data fusion; earth system science numerical computation and simulation techniques.

Preferred research themes in 2019:

(1) Theoretical and experimental studies of the earth's mass and dynamics processes;

(2) High temperature and high pressure experimental theory and technology;

(3) Micro-area element and high-resolution isotope analysis technology;

(4) Geophysical methods of detecting the deep structure of the earth;

(5) Geophysical methods and technologies for the earth subsurface environment;

(6) High resolution stratum profiling technology;

(7) Joint inversion technique of gravity, magnetism, electricity and earthquake;

(8) Research on coupled mechanisms using satellite low-frequency electromagnetic wave;

(9) New principles and new methods of earth surface observation;

(10) High-precision, high-resolution integrated detection and analysis of different circles;

(11) New methods and technologies for atmosphere-ocean detection;

(12) New technologies for the detection of fluxes (energy, momentum and composition) of land-sea, land-sea and sea-air interfaces;

(13) Data applicability and information mining in China’s satellite remote sensing data;

(14) New theories and methods of quantitative remote sensing modeling and parameter inversion;

(15) Theory and method on earth big data artificial intelligence and data assimilation;

(16) Earth system numerical methods and simulation techniques;

(17) Global observation information vectorization theory and spatial and temporal intelligent methods.

2. Deep Earth processes and dynamics

Scientific objectives: to decipher how the solid Earth operates, to characterize the interactions among multiple spheres of the Earth, to disclose the coupling relationship between the deep Earth and the surficial processes, and to provide theoretical support for natural hazard mitigation and mineral resource exploration. To promote development and innovation in Solid Earth science, the researches of this field should dedicate to accurate description of tempo-spatial trajectory of continental materials, characterization and comparison of lithospheric structure, tectonics and dynamics of typical regions that include overseas key regions, construction of architecture and evolution of continents in a global scale, elucidation of origin and evolution of the Earth and their impacts on natural sources, geohazards and environment.

Key scientific issues: structure, composition and status of the crust and the mantle; origin, rejuvenation and evolution of continental lithosphere; plate convergence and orogenic dynamics; deep Earth fluids and volatiles; processes of plate interface and subduction zone; coupling of deep and surficial Earth processes; tectonic scheme and composition of the early Earth; seismogenic processes and mechanisms for hazard generation; mechanisms for continental volcanic activities and their geohazard and environmental impacts.

Preferred research themes in 2019:

(1) Early Earth evolution and the formation, growth and reconstruction of continents;
(2) Processes and dynamics of continent assembly and breakup;
(3) Earth's deep structure and the interactions between its multiple spheres;
(4) Crustal and upper-mantle anisotropies and deep-Earth dynamics;
(5) Orogenic processes and basin and range system evolution;
(6) Origin and evolution of mantle plume;
(7) Ocean-continent transition process and mechanism;
(8) Multiple-scale geodynamic experiment and simulation;
(9) Coupling of deep and surficial Earth processes;
(10) Metamorphism and its mechanisms;
(11) Magmatism and geothermal activities;
(12) Deep Earth fluids and water-rock interaction;
(13) Rock rheology and continental deformation;
(14) Active tectonics, seismogenic process and mechanism of geohazards;
(15) Comparison and interaction between the Earth and terrestrial planets;
(16) Other important fundamental innovative researches related to this field.

3. Environmental evolution and biological processes on planet Earth

Scientific objectives: as the only known habitable planet, Earth is a complex interactive system, comprising the lithosphere, hydrosphere, atmosphere and biosphere. China has a very complete rock and fossil archive, which plays a very important role in this research field. Establishing a high-resolution stratigraphic framework will enable interdisciplinary research to be conducted between paleontology, anthropology, archaeology, stratigraphy, sedimentology, mineralogy, structural geology, geochemistry, geobiology and evolutionary biology, which together will elucidate our understanding of the co-evolution between the physical environment and life. This multidisciplinary cooperation aims to make new scientific findings, strengthen traditionally advantageous research directions and gradually gain a globally leading role in some directions in these fields towards achieving significant scientific breakthroughs and theoretical innovations.

Key scientific issues: systematic paleontology of major fossil groups and reconstruction of the tree of life; evolutionary principles that underpin deep-time biodiversity; early Earth evolution and the origin of life; high-resolution integrated stratigraphy towards establishing a precise global timescale; geomicrobiological processes and environmental evolution; biological processes in extreme environments; major environmental events and their causal mechanisms; human origins and their relationship with environmental change; origin and evolution of the terrestrial planets.

Preferred research themes in 2019:

(1) Origin and evolution of major groups of organisms, and their environmental context;
(2) Evolution of biodiversity and major co-evolutionary (life/environment) events in geologic time;
(3) Evolution of terrestrial ecosystems in geologic time;
(4) Evolution of marine ecosystems in geologic time;
(5) Origin and evolution of humans, and their environmental context;
(6) Early history of agriculture and its adaptivity with environment;
(7) Origin and evolution of civilization, its impact on, or response to climate change;
(8) High-resolution chronostratigraphy and geochronology;

(9) Geomicrobiological processes and environmental evolution;

(10) Biogeochemical processes, mechanisms and environmental evolution;

(11) Evolution of sedimentary systems and relevance for natural resources and environment;

(12) Biological and mineralogical interactions and their environmental effects;

(13) Application and development of new technologies and methods in earth environment and life research.

4. Formation mechanism and the application of detection methods for mineral resources and fossil energy

Scientific objectives: to reveal the coupling between the mineralization and the geodynamic system evolution, and constraints of the structure deep and process on the mineralization of the important metallogenic belt; to establish genesis model of ore deposit, ore deposit model, theory of ore genesis; to explore the dynamics of large basin and the law of oil and gas accumulation, the accumulation conditions and distribution law of deep oil-gas reservoirs, and mechanism of formation and evolution of unconventional oil and gas reservoirs; to improve oil and gas geological system theory which is suitable to the complex geological conditions in China; to establish and improve the geophysical and geochemical exploration methods and theories of concealed ore deposits, deep oil-gas reservoirs and unconventional oil and gas reservoirs; to improve the speed, precision and depth of exploration; to reveal the formation and evolution mechanism of groundwater dynamic field and chemical field in different geographical units and in different geological media under the effects of humankind activities and natural factors.

Key scientific issues: the occurrence and exploration of resources and energy in the deep earth; plate convergence, lithospheric reconstruction and mineralization; enrichment and mineralization of special elements; the dynamics of sedimentary basins and hydrocarbon accumulation; formation conditions and distribution of dense oil and gas and exploration; groundwater circulation and sustainable utilization; metallogenic models, metallogenic system and mineralization mechanisms.

Preferred research themes in 2019:

(1) Metallogenesis and metallogenic laws in different geodynamic environments;

(2) Massive enrichment mechanism of metallogenic materials in magmatic system;

(3) Metallogenesis and metallogenetic laws of strategic mineral resources (REE, rare, scattered and radioactive metals);

(4) Formation, occurrence and enrichment mechanisms of natural gas hydrates in land and marine domains;

(5) Occurrence, migration and enrichment mechanisms of coalbed methane, shale oil and gas, tight oil and gas;

(6) Formation, circulation and spatial distribution of groundwater resources in different scales;

(7) Genesis and distribution of geothermal resources in large geothermal fields, high-T geothermal systems and oil fields;

(8) Theory and methods of geophysical and geochemical explorations for deep concealed mineral deposits;

(9) Characteristics, structural models and principles and methods of metallogenic information extraction for different metallogenic systems;

(10) Formation mechanisms of mineral resources on near-Earth planets and theories and methods of geophysical and geochemical explorations.

5. Ocean processes and their impacts on resource, environment and climate

Scientific objectives: applications should be focused on the scientific problems closely related to the key national demands and international research frontiers. The marginal sea along the Asia continent as well as the adjacent open ocean should be the key regions to be studied. By studying the oceanic physical, chemical, geological and biological processes as well as the interactions among them on different timescales and spatial scales, the researches should enhance the understanding on the oceanic processes and mechanisms, promote the fundamental research on oceanology in China and extend ocean researches in China from marginal seas to deep oceans.

Key scientific issues: multi-scale ocean processes and their effects on climate system; oceanic ecosystem and biological diversity; ocean biogeochemical process and eco-environment; formation and evolution of marginal seas in East Asia and island arc and mid-ocean ridge system; ocean-continent transitional zone: structure, tectonics and their interactions; environmental change and related oceanic process in the polar regions; process and mechanism of multi-spherical interaction in the ocean.

Preferred research themes in 2019:

(1) Ocean dynamics and its environmental and climate effect;

(2) Marine geological processes and submarine energy and mineral resources;

(3) Paleo-ocean and its environment and climate evolution mechanisms;

(4) Ocean-continent interaction and watershed evolution;

(5) Marine ecological processes and biogeochemical cycles;

(6) Marine biodiversity and biological resources;

(7) Marine renewable energy and resources;

(8) Marine disaster process, disaster prevention and mitigation;

(9) Sustainable development of coastal zone and island;

(10) Polar change process and its resource, environment and climate effects;

(11) Observation, detection and simulation in the ocean and polar;

(12) Extreme environment and life processes in the deep sea and polar regions;

(13) Ocean and polar engineering and its environmental effects;

(14) Coordinated development of marine resources, environment and economy, and spatial planning and utilization;

(15) Marine rights and global governance.

6. Change processes and effects of terrestrial surface environment

Scientific objectives: This field mainly focuses on the interaction and interfacial processes of key components of the terrestrial surface and the relationship with human activities, and primarily analyzes the typical processes and the typical regions on the terrestrial surface. The scientific objectives are to reveal formation characteristics and mechanisms of surface environment, to elucidate change processes and effects of surface environment, to develop the methods of change-monitoring and effect-evaluating in terrestrial surface system, to expand theory and methodology of system science for terrestrial surface study, and finally to provide the scientific basis for the application of spatial administration and human-nature coordinated development under the background of global change and globalization.

Key scientific issues: processes of terrestrial surface system, response mechanism

and feedback of surface processes on environmental change, soil processes and its biogeochemical cycle, comprehensive study on surface processes in typical regions.

Preferred research themes in 2019:

(1) Interaction mechanisms between patterns and processes of terrestrial surface system;

(2) Biogeochemical cycles and their spatial differentiation in typical regions;

(3) Interactions between climate, hydrology and landform, and their environmental and disaster effects;

(4) Processes and effects of cryosphere;

(5) Interactions between soil and vegetation, and their spatial heterogeneity;

(6) Mechanisms of ecosystem degradation and restoration strategies;

(7) Ecosystem processes and services;

(8) Evolution of rural regional systems and its resources and environmental effects;

(9) Surface processes and eco-environmental effects of city and urban agglomeration;

(10) Surface environmental changes and the effect evaluation on public health;

(11) Effects and responses of human processes on the evolution of terrestrial surface system;

(12) Spatial evolution processes and its simulation of human-nature compound system;

(13) Uncertainty of spatial information and spatial analysis;

(13) Uncertainty of geography spatial information and its process and analysis;

(14) Expression, analysis and visualization of terrestrial surface features;

(15) Synthetical integration and simulation of terrestrial surface system processes;

(16) Spatial governance path based on human-land coupling.

(17) The tempo-spatio process and monitoring mechanisms of 2030 sustainable development goals (SDG)

7. Evolution and sustainable utilization of water and soil resources

Scientific objectives: this field mainly focuses on the formation, evolution and the ecological and environmental effects of soil and water driven by natural and human activities, and primarily analyzes the coupling mechanisms and processes of soil and water in the different scales. The scientific objectives of this field are to elucidate the evolution processes of water and soil and their coupling mechanisms, to reveal the principles of formation and evolution of water and soil resources, and to propose the approaches to rational exploitation, scientific allocation, efficient utilization and integrated management of water and soil resources.

Key scientific issues: soil processes and evolution, soil quality and resource effect, watershed hydrological processes and their ecological effects, formation mechanisms of regional water cycle and water resources, coupling of regional water and soil resources and their sustainable utilization, ecological function and environmental effect of soil biology, and eco-hydrological processes and ecosystem services.

Preferred research themes in 2019:

(1) Soil biodiversity and its function;

(2) Interaction mechanisms and effects of soil processes;

(3) Mechanisms and effect of soil degradation and soil remediation;

(4) Water cycle and hydrological Processes under environmental change;

(5) Formation, transformation mechanism and safety of regional water resources;

(6) Soil and water quality and safety of agricultural products;

(7) Regional soil erosion and soil and water conservation;

(8) Tempo-spatial variation of soil properties and informatization of soil and water elements;

(9) Evaluation of soil-water resources on regional carrying capacity and ecological compensation.

8. Process and function of the earth critical zone

Scientific objectives: Critical zone is a complex system of the thin layer of the Earth's surface and near-surface terrestrial environment, where strongest interactions occur among rock, soil, air, water, life, and anthropogenic force. The critical zone is the nexus of the mass and energy cycle not only connecting the deep Earth, surficial processes and the climate system, but also controlling the ecological environment and sustaining the inhabitability of life on the Earth. With the application of geology, geochemistry, pedology, hydrology and ecology, as well as other interdisciplinary approaches, the characteristics, process and evolution, with relations to social sustainable development, will be explored. The research work will dedicate to the development of transformative research approach and theory on the critical zone, construction of model for the critical zone system processes, prediction of evolution of the ecosystem and environment on multiple tempo-spatial scales, as well as the service to the societal sustainable development.

Key scientific issues: structure, formation and evolution of the critical zone; mass, energy and gene transformation and interactions of the critical zone; service function and sustainable development of the critical zone; modeling and systematical simulation of the critical zone. Critical zone science is the system science based on the multidisciplinary and integrated research on the near-surface Earth system. From this rationality, multiple-disciplinary and systematic observation, experiments and theoretical modeling based on long term observation and research platforms are especially encourage.

Preferred research themes in 2019:

(1) New theory, technology and methodology of the critical zone observatory network;

(2) Multiscale modeling and intercomparison of the structure, process and function evolution of the critical zone at profile, catchment, regional and global scales;

(3) Critical zone structure and its impact and regulation on earth system process and eco-function;

(4) Controlling mechanism of geological, climatic, hydrological and biological factors for the formation and evolution of the critical zone;

(5) The characteristics, processes and regulation mechanism of mass and energy cycles in the critical zone;

(6) The mechanism of contaminant migration, transformation and purification in the critical zone;

(7) Prediction and controlling mechanism of the impacts of the environmental change on the structure and processes of the critical zone;

(8) Evolution and prediction of structure, processes and ecosystem functioning of the critical zone;

(9) Capacity and resilience of the critical zone.

9. Process, change and mechanism of weather, climate and atmospheric

environment

Scientific objectives: to investigate various physical, chemical and biological processes of weather, climate and atmospheric environment, to understand their spatial and temporal characteristics, mutual relations and interactions mechanisms, to develop and improve the theory of modeling and prediction for weather, climate system and atmospheric environment, to provide a scientific foundation for the requirement of the high resolution, timing, fix point, and quantitative forecast of disastrous weather and atmospheric environment, as well as the improvement of the weather and climate prediction.

Key scientific issues: dynamical mechanism and predictability of the weather and climate change; predication of the climatic interdecadal variability; processes of atmospheric physics and atmospheric chemistry, as well as the mechanism of their mutual influences; interactions among weather variations, climate change and atmospheric environment in Asia; exchange and cycling between substance and energy in climate system; frequency and amplitude of the extreme climate events.

Preferred research themes in 2019:

(1) Interactions among aerosols, clouds and precipitation as well as radiation;

(2) Interaction among atmospheric boundary layer, atmospheric pollution and climate system;

(3) Variations of the middle and upper atmosphere and interactions with troposphere;

(4) Coupling mechanism of the atmospheric physical and chemical processes, as well as related simulation;

(5) Development of high resolution weather forecast model, cloud model and atmospheric chemistry climate model;

(6) Integrated sounding technology of dynamics-micro physics-electric processes in thunderstorm and weather modification;

(7) Occurrence, development and evolution of the disastrous weather and climate events, as well as theories and methods of the refined weather prediction;

(8) Dynamical mechanisms of climate and climate change;

(9) Causes and predictability of atmospheric sub-seasonal (10-90 days) variations;

(10) Prediction of atmospheric seasonal, interannual and interdecadal variations;

(11) Exchange and cycling between substance and energy between subsystems of climate system;

(12) Interactions among regional extreme weather, climate, environment and global climate;

(13) Implementation and application of the new theories and methods in critical atmospheric variables detection;

(14) Data assimilation for coupled model;

(15) Land-air and air-sea interactions.

10. Sun-Earth space environment and space weather

Scientific objectives: to form a theoretical frame of the global cause-effect chain of space weather processes so to achieve new original knowledge based on the study of space weather processes among the different layers of the solar-terrestrial system; to establish the cause-effect chain model of the space events and develop the integrated method for prediction based on physics to provide basic data for the safety of astronautic activities and the space-to-earth survey; to develop new concept and method in space explorations and new schemes of space weather satellite series for a new era of space weather study; to

conduct the interdisciplinary research with mathematics, physics, information, material and life sciences on the exploration of the mechanism of space weather effects on human activities for providing scientific basis in the policy making of administrations; to encourage fundamental research on space weather combined with national key projects; to encourage analysis, theoretical and simulation study based on the newest space borne or ground-based data from both home and abroad; to encourage studies on the space weather by using data from the Meridian Project observations; to encourage the related basic researches on space geodesy; to encourage the interdisciplinary study between space weather and space geodesy especially.

Key scientific issues include: frontiers of basic physical processes in space weather science; the coupling processes among solar-terrestrial space; space weather modeling and integrated modeling method; the mechanism and countermeasure of space weather on human activities; the influence of solar activity on space weather; the theory, method and technology of space and ocean geodesy, and its application in geosciences.

Research orientations in 2019:

(1) Solar driving source of space weather, related physical mechanisms and activities during the solar cycle;

(2) Multi-scaled spatial and temporal structures in solar wind, magnetosphere, ionosphere and upper atmosphere; their evolution and couplings;

(3) Fundamental physical process in space weather and Sun-Earth connection;

(4) Prediction model and method in space weather, early warning of hazardous space weather;

(5) Effects of space weather on astronautics, telecommunication, navigation, materials and human health;

(6) New concept, principle, method and technique in space weather exploration, project pre-research in space exploration;

(7) New theory, principle, method and technique for space geodetic observation;

(8) Theory of geodetic survey, and the process and mechanism of mass transport of the earth theory of multi-source geodetic data fusion and its applications;

(9) New theory and methodology for time-variable geodesy and theory of geodetic inversion;

(10) Deep space exploration and planetary science;

(11) Deep-sea geodesy and detection;

(12) Scientific studies in the disaster mitigation and prevention based on geodetic method and technology.

11. Global environmental change and interactions among different spheres of the Earth

Scientific objectives: Under the background of global environmental change, this field aims to improve the understanding of global warming and its changing trends in the future through the investigation of key scientific issues in the ocean-atmosphere interactions, in particular for the Asian climate change, and to provide scientific and technical supports for addressing the enormous environmental stresses and challenges faced by human society.

Key scientific issues: processes and mechanisms of global warming hiatus; ocean-atmosphere interactions and the Asian climate change; global climate change and hydrologic cycle; biogeochemical cycle and climate change; past global warming and its effects during the Cenozoic era; interactions among different spheres and Earth system

simulations.

Preferred research themes in 2019:

(1) Regional hydrologic cycle and its linkage to climate change;

(2) Biogeochemical cycle and climate change;

(3) Global change and ecosystem mutation;

(4) Evolution and mechanism on multi-scale monsoon and atmospheric circulation;

(5) Multi-scale sea-air interaction and its climatic effects;

(6) Sea-land interaction and global change;

(7) Extreme climate and disaster processes and disaster prevention and mitigation;

(8) Simulations, recent forecasts and long-term projections of global climate change;

(9) Marine multi-scale process and high-resolution mode development;

(10) Observations and attributions of global or regional climate change;

(11) Big data analysis and data mining in global change;

(12) Response and feedback of the polar process to global change;

(13) The evolution and correlation of the three poles in the Antarctic, Arctic and Qinghai-Tibet Plateau;

(14) The impact of urbanization on global and regional climate;

(15) Global climate change and human health;

(16) Climate change mitigation and adaptation.

12. Impacts of human activities on environment and disaster

Scientific objectives: this field follows the scientific development concept, which will devote to maintaining harmonious relationship between human and nature; this field will focus on the development phase and needs of economy and society in China, and consider the actual condition and advantage of resources and environment and its change, and continue to support multidisciplinary and interdisciplinary researches between natural science, engineering technology, and social science, which will attempt to reveal interaction effects, mechanism and process during the industrial and agricultural production activities, engineering construction of major infrastructures, exploitation of resources and energy, urbanization and other human activities, and investigate threatening impact of human activities on the earth's environment and disaster mechanism, and understand the mechanism of action due to the human activities and its possibly negative effects and disastrous consequences of the human activities on the earth system during the earth's environment and regional environmental evolution. This will be helpful to provide scientific basis to protect regional environment, reduce disaster risk, adjust and control the adverse environmental evolution, realize harmony relationship between human and nature, and promote sustainable economic and social development.

Key scientific issues: characteristics, interaction and security disposal of industrial and urban solid waste; impact of large-scale human engineering activities on environment and its hazard mechanism; ecological and environment effects caused by mineral resources utilization; evolution process, influencing factor and mechanism of geological disasters (such as landslide and debris flow); impact of human activities on forming process of combined atmospheric pollutions; impact of human activities on regional and global environment; regional environmental process and control; regional sustainable development; multi-medium interface process, effect and control of environmental pollutants; coupling interaction between regional human activity and resources & environment; effects of urbanization and environment & resources.

Preferred research themes in 2019:

(1) Environmental impacts and disposal of radioactive waste;
(2) Environmental effects and restoration of mine;
(3) Pollution mechanism and treatment of e-waste;
(4) Pollution process and environmental restoration of groundwater;
(5) Multi-interface processes and effects of environmental pollutants;
(6) Regional development and spatial restructure;
(7) Urbanization and rural sustainable development;
(8) Early identification and warning of geological hazard;
(9) Disaster mechanism and prevention of major projects;
(10) Formation mechanism and prevention of atmospheric combined pollution.

Department of Engineering and Materials Sciences

In 2018, the Department received 476 proposals for the Key Program, and among them, 102 proposals were funded in 91 fields with a success rate of 21.43%. The total direct cost was 306 million yuan and the average direct cost was 3 million yuan per project for five years.

In 2019 about 100 projects will be supported in 89 fields with an average direct cost of 3 million yuan per project for five years.

In 2019, the Department selected Key Program to conduct classified application and review. For detailed information, please refer to "2019 NSFC Reform Initiatives" in this *Guide*.

Key priority funding areas of the Department:

The Department plans to fund a Key Program Cluster in the research field of "Key scientific issues in the design and construction of large wind tunnels" in 2019, including 4 projects, with direct expense of 3 million yuan per project and a time span of 3 years.

The Key Program Cluster is aiming at the new requirements and challenges of high-performance manufacturing, intelligent control and measurement and testing techniques for wind tunnel installations in large wind tunnel tests, promoting fundamental research and technical breakthrough in the design, manufacture and construction of large-scale wind tunnels, for early completion of a world-class aerodynamic test equipment system. The application teams are encouraged to conduct joint research with the China Aerodynamics Research and Development Center.

The applications to the following four research fields should be labeled "Key scientific issues in the design and construction of large wind tunnels" in the Annotation area of the front cover. The General Office of the Department is responsible for the administration process.

(1) Toughening mechanism, evolution of microstructure and properties and life evaluation of composites (E01);

(2) Friction and wear mechanism and bearing service performance of self-lubricating materials under low temperature and heavy load condition (E05);

(3) Integrated design and manufacture of high temperature wind tunnel materials and structures in extreme environments (E05);

(4) Noise mechanism, numerical simulation analysis and noise reduction technology of high performance wind tunnel compressors (E06).

Other Key priority funding areas of the Department

Applications of Key Program should be aiming at the needs for supporting the socio-economy, human society and national security, strengthening the ability to refine core scientific issues from the critical needs of the country and the "bottlenecks" of technology, with clear objectives, focused direction, centralized content, and emphasis on the development trend of AI and green technology, to promote the application of basic research results.

1. Key issues in the design, manufacture, processing and application of ferrous metals (E0101, E0109, E0113)

2. Key issues in the design, manufacture, processing and application of non-ferrous metals (E0101, E0109, E0113)

3. High temperature alloys, intermetallic compounds and metal matrix composite materials (E0101, E0102)

4. Metastable and nano-structured metallic materials (E0103, E0104, E0105)

5. Energy and catalytic metallic materials (E0105)

6. Biomedical, intelligent and biomimetic metallic materials (E0105)

7. Magnetic and information metallic materials (E0105)

8. New phases, new functions in metals and new materials with metallic properties (E0104, E0105, E0106, E0114)

9. Characterization of structure, surface and interface of metallic materials (E0107, E0110)

10. Mechanical properties and service behavior of metallic materials (E0108, E0111, E0112)

11. Detector materials with broadband from ultraviolet to far infrared (E0204)

12. New fabrication technique and fundamental research on silicon nitride based porous ceramics (E0203)

13. Free proposition for solving key bottlenecks in major national needs (E02)

14. Free proposition in the frontier of inorganic non-metallic materials (E02)

15. Structure/property directed chemistry of polymeric materials (E03)

16. Manipulation of the aggregation structure of polymeric materials and its influence on properties (E0314)

17. New theories and methods for the processing (including micro-nano processing and additive manufacturing) of polymeric materials (E0315)

18. Basic issues on biomedical polymeric materials (E0310)

19. Basic issues on optoelectronic organic polymeric materials and devices with high performance (E0309)

20. Basic research on polymeric materials related to energy, ecological environment and resources (E0313)

21. Basic research on structure/function design, preparation and properties of polymer composites (E0307)

22. Basic research on the major problems &challenges existing in the fields of polymer materials those fulfill the requirements for the national strategical objective (E03)

23. Basic research on theory, simulation and characterization method and technology of polymeric materials (E0314)

24. Safe and efficient mining technology of coal under weakly cemented strata (E0402)

25. Controllable theory of hydraulic fracture propagation (E0403)

26. Fundamentals of safe and efficient recovery of natural gas hydrate (E0403, E0404)

27. Basic research in dynamic loading effect of mine support (E0408, E0409)

28. Risk forecast, prevention and control of major and complex natural disaster (E0410)

29. Fundamentals of safety science and key technologies in metallurgical, petroleum and mining fields (E0410)

30. Key technologies for green and efficient utilization of salt lake resources (E0411)

31. Scientific issues on complex interfacial interactions of microbial metallurgy (E0412)

32. Fundamentals of non-equilibrium physical chemistry in metallurgical process (E0412, E0415)

33. Fundamentals of metallurgical and chemical reactor engineering (E0413)

34. Fundamental issues of monitoring and integrated control in continuous casting process (E0414)

35. Technical basis for high-level recycling of secondary resources (E0419, (E0422)

36. Technical basis for remediation and control of heavy metal contamination (E0420)

37. Innovative design methodologies for efficient manufacturing (E0501)

38. New principles and methodologies for precision drive/transmission systems (E0502)

39. Mechanical system dynamics and vibration control for service safety (E0503)

40. Failure mechanisms and life design for the components/structures/ mechanisms of mechanical equipment (E0504)

41. Functional design and performance regulation for mechanical surfaces and interfaces (E0505)

42. Forward design theories and methodologies for complex equipment (E0506)

43. New principles and methods for bio and bionic design and manufacturing (E0507)

44. Novel principles and methods for integrated manufacturing with precisely formed and high-performance complex components (E0508)

45. Theories, technologies, and methods for high-efficiency and ultraprecision machining (E0509)

46. Novel principles and methods for high-energy-density beam and nontraditional energy-field-based manufacturing (E0508, E0509)

47. New principles, operation modes, systems, and equipment for intelligent manufacturing (E0510)

48. Measurement and testing theories, methods, and technologies under extreme conditions (E0511)

49. Non-silicon-based micro/nano devices and systems (E0512)

50. Thermodynamic system analysis, control and optimization for energy conservation and environmental protection (E0601)

51. Turbulent flow mechanism and flow control in fluid machinery (E0602)

52. Fundamentals on mass and heat transfer in energy conversion and utilization (E0603)

53. Combustion theory and combustion new technique of gas and liquid fuel (E0604)

54. Mechanism of combustion, pollution and emission reduction of solid fuel (E0604)

55. Fundamentals on multi-phase flow in power systems (E0605)

56. New principles and methods of measurement for complex thermo-physical quantity and field (E0606)

57. Key thermo-physical issues on the utilization of new energy and renewable energy (E0607)

58. Interdisciplinary research of thermo-physical area with mechanics, materials, environment and life science, etc. (E0608)

59. Fundamental theory and key technology on the high efficiency high quality electric machine system and its control (E0707)

60. Fundamental theory and key technology on the integrated energy power system new energy system (E0704, E0706)

61. Fundamental theory and key technology for advanced electrical material, equipment and system (E0705, E0702, E0703)

62. Fundamental theory and key technology on power electronic devices, equipment and system (E0706)

63. Applied fundamental theory research on electromagnetic-biological interaction and medical application (E0712)

64. Fundamental theory and key technology on the pulse power and discharge plasma (generation, control and application) (E0708, E0709)

65. Fundamental theory and key technology on high efficiency, low cost and large scale storage of electric energy (E0713, E0702)

66. Fundamental theory and key technology on the advanced electric-magnetic energy transmission (E0701, E0706)

67. Research on the theories and methods of the protection and development of Chinese traditional villages (E0801, E0802)

68. Theory and approach of intelligent optimization design for building green performance (E0801)

69. Research on coupled heat and mass transfer for building energy saving in hot and humid climate (E0803)

70. New technological principles of resource-oriented urban treatment for

municipal wastewater (E0804)

71. Fundamental scientific issues of ecological storage and recycle for the reclaimed water (E0804)

72. Pollution-free emission reduction of industrial wastewater and novel technological principles of high risk substance control (E0804)

73. Advanced control of multiple pollutants in industrial flue gas (E0804)

74. Regeneration of civil engineering materials and the application in structural engineering (E0805)

75. High-performance composite structural system and the disaster prevention and mitigation (E0805, E0808)

76. Theory and method of construction and operation safety control in urban underground engineering (E0806)

77. Research on theory and method of performance-based blast resistant design of building structures (E0808)

78. Theory and method of urban infrastructure resilience improvement (E0808)

79. Key scientific problems of hydrology and water resources under green development (E0901)

80. Key scientific problems of green and high-efficient water use in agriculture (E0902)

81. Evolution law and regulation technology of soil and water environment in watershed (E0903)

82. Ecological water conservancy and health of water ecology in watershed (E0903)

83. Mechanism and prevention technology for hydraulic hazards in nature or engineering (E0905)

84. Damage and protection of hydraulic equipment with sediment-laden inner flow (E0906)

85. Soil mechanics problems in marine development or environmental protection (E0907)

86. Performance and disaster prevention of concrete or granular dams (E0908)

87. Key technologies of marine autonomous vehicles (E0910)

88. Safety or stealth of new marine structures (E0910)

89. Underwater sensor technology and ocean environmental monitoring (E0910)

Department of Information Sciences

In 2018, the Department announced 95 areas including 1 priority funding area for the application of Key Programs, and received 347 applications (241 in the specified areas and 106 not in the specified areas), of which, 98 projects were funded with direct cost funding total of 280 million yuan, and average direct cost funding intensity of 2.8571 million yuan per project. The success rate is 28.24%.

In 2019, the Department will publish 99 areas for Key Program projects.

In 2019, the Department will fund 85 Key Program projects with average direct cost funding of about 3 million yuan per project for 5 years. Applicant should follow the

guidelines for research directions in relevant areas, in accordance to the trend of development in the research area and basis of their research team and the actual research object or process, propose key scientific problems and conduct systematic and in-depth theoretical studies or experimental verifications. Apart from high level papers, research results should be verified in experimental system or in practical applications.

In 2019, the Department will continue to accept free application for Key Program project on a trial basis, in areas of marine information acquisition and transmission, social media big data analysis, system software design theory and method, unmanned system control and cooperation, AI, IC design and super wide band gap semiconductor information devices. In 2018, the Department plans to fund about 15 free application type Key Program projects in areas of major need, with funding of 3 million yuan per project for 5 years.

Please provide proper application code in the application form. Please see NSFC's website (http://www.nsfc.gov.cn/) for details.

The deadline for proposing areas of Key Program for 2020 is April 30, 2019; please see the department website (http://www.nsfc.gov.cn/cen/oo/kxb/xx/tztg.htm).

In 2019, the Department will use experiment on new method of application and evaluation. For detailed information, please refer to "2019 NSFC Reform Initiatives" in this *Guide*.

Key areas funded by Department are as follows:

1. Smart monitoring and management of vehicle internet securities

2. Smart network of large scale drone group

3. Dense connection for fast mobile network

4. Low power consumption mass connection of internet of things

5. Integrated space to ground smart network flow rate theory and technology

6. Time variation graph theory and time variant network group method

7. Smart coding for 3D video

8. Basic theory and method for high frequency wide band signal processing in total light and time frequencies

9. Key technology for wireless signals penetrating caves

10. Basic theory of frequency controlled matrix and signal processing

11. Multi-lighting source passive radar network information processing

12. Multi-base radar celestial detection and imaging based on radio telescopes

13. Multi-layer media detection mechanism and information extraction by millimeter wave radar on satellite

14. Multi-dimensional coordinated all optical computation imaging for bird monitoring in seaside wetland

15. Terminal cloud coordinated video smart computation method and chip architecture studies

16. High dimensional dense optical field data compression and reconfiguration theory and technology

17. Code videoing theory and method for front end merging

18. 5G millimeter wave super wide band phase controlled front end chips studies

19. High speed terahertz direct modulation on chips

20. Millimeter wave self-adaptive high efficiency wireless energy transmission

21. Surface resonance high spectrum imaging of biochemical detection

22. Online measurement of micro nano optical sensors for multi-component trace in polluted gas

23. Mechanism of pulsatile tinnitus based multi-mode imaging information

24. Smart positioning of epileptic seizure

25. Complexity analysis and efficient computation of large scale graphs

26. Coordinated software modeling and evolution based on collective intelligence

27. Data driven testing method and technology for intelligent software system

28. Application driven large graph modeling theory and algorithm

29. Coordinated design theory and method for software and hardware for embedded multi-core real time systems

30. Theory and system design of physical system for secured and key vehicle information

31. Non-volatile storage system structure and key technology for cloud margin and terminal integration

32. Generation, coding and transmission of dynamic panorama video

33. Visual computation theory and method for enhanced reality

34. Audio synthesis and sketch for virtual reality

35. Key theory and method of smart comprehension and question and answering between different media

36. Theory and method of micro biome data processing

37. Efficient processing of electronic microscope data

38. Visual analysis of deep neural network

39. Public key and complexity theory in quantum computation environment

40. Privacy and secured sharing of mobile social media big data

41. Security technology for internet of things based on block chain

42. Counter theory and spreading mechanism in network cyberspace

43. Large scale mass intelligent coordinated computation theory and technology

44. Efficient sensing of internet of things

45. High precision antenna servo control system

46. Optical fiber sensor matrix for deep ocean parameter detection

47. Smart flight control of round trip spacecrafts

48. Coordinated optimal control of information and physical system in new battery material industry

49. Bio control and operation and information detection based on micro nano robots

50. Wearable sensor network based on ubiquitous energy

51. Management and control of integrated physical information system

52. Multi-mode brain image information integration analysis and application

53. Key technology of animal robot

54. Modelling and reliable control of dynamic pointing guidance drilling system

55. Control and stability of electronic grid

56. Smart optimal theory and method for integrated energy systems

57. Distributive margin sensing and coordinated control of industrial network

systems

58. Multi-time scale coordination and optimization and security measures for smart grid

59. Quantitative diagnosis and stability control in complex industrial process

60. Fast on site check method for drug and chemicals based on micro nano optical electronic sensor arrays

61. Total monitoring and dispatching system for equipment network

62. Solid atom self-spin quantum sensing and precision measurement theory and technology

63. Smart quantum coding and error tolerant computation

64. Key theory and key technology of interpretation of deep learning

65. Cognitive mechanism and computational modeling for language understanding

66. Smart cognition and understanding of old Chinese literature using digital method

67. Brain image analysis based on deep learning

68. Integrated storage and computation architecture with dynamic reconstruction inspired by the brain

69. New types of computational structure model and algorithm for automatic driving

70. Deep analysis and decision making for cross mode social media

71. Basic theory and key technology of smart block chain

72. Smart analysis of video behavior for efficient mobile margin computation

73. Generation, evolution, realization and application of man-like emotions

74. Data driven personal learning and smart education services

75. Large size Si-based high-Al content AlGaN ultraviolet photoelectric materials and devices

76. Interconnection and storage of hetero cores chips

77. Quantum devices of 2D material with energy valley self-spins

78. Microwave passive circuit integration technology based on silicon hole

79. Key scientific problems related to GaN based digital circuit

80. Key technology related to internal computation of new principle storage device

81. Micro millimeter wave array transmission chips

82. Key technology of silicon based laser radar chips

83. Trouble shooting and error tolerance technology of sensor network chips

84. Radiation resistant high performance empty core micro structure optical fiber and devices

85. Reverse design algorithm of integrated photon devices

86. High dimensional high order coding geometric forming technology in high speed optical communication

87. Efficient and stable non lead calcium titanium solar cell devices

88. Mid-infrared low-loss optical fiber preparation and photon functional devices

89. Terahertz fast interference layer imaging mechanism and technology

90. Integrating photon functional devices on pseudosurface plasmon wide band

terahertz chips

91. Super low noise optical amplification in modulus division multiplexing systems

92. Enhancing mechanism and quantitative detection of light sensitive single line state oxygen

93. Bionic eye using photoelectric integration

94. Basic research on high light output and high energy resolution flashing materials

95. Optical imaging method and technology for cancer treatment

96. Basic problem and key technology of electric pump Calcium Titanium laser

97. Basic research on new types of micro nano photon devices

98. High energy super short pulse medium inferred laser

99. Time resolution optical bio detection and imaging

Department of Management Sciences

In 2018, the Department received a total of 138 Key Program applications, and funded 34 projects. The average funding for direct expenses was 2.3506 million yuan per project.

During the 13th Five-Year Plan period, the Department will release funding fields of key programs annually, and release funding fields of key program clusters and database construction timely. The Key Programs should be focused on (1) scientific frontier issues that can promote discipline development, obtain great innovative achievement, and generate international impacts; (2) important theoretical and application issues regarding economy construction, society development, reform and opening-up, and the improvement of China's comprehensive competitiveness, which need to be addressed immediately, and are possible to be addressed; (3) systematic and in-depth innovative research, which explores management theories and laws for China and has sound research background or good potential for discipline development.

The funding priority areas described in this *Guide* outline the main contents and scopes. Please note that the title of application is not required to be exactly the same as the area titles of the following listed Key Programs. Applicants are required to possess solid research experiences and abilities in the areas that they are applying for. Applicants are encouraged to exploit their full advantages, present deep academic thoughts in their applications, make the research goals clear and concrete, emphasize the key points of research, focus on one or several key points of the research and actually address them, and have theoretical breakthroughs. In addition, applications are required to apply theories to practice, discover key scientific issues from important practical management issues from a perspective of China's situations and conduct in-depth research, and try to provide new approaches to address practical management issues. Applicants should focus on scientific methodologies, emphasize on the application of scientific approaches, take real data and actual cases as the fundamental information of their research, and make sure not to be subjective.

Note that the requirements given in the general description section of the

General Program of the Department in this *Guide* are also applicable to the Key Programs. Please read these items carefully.

The key programs of the Department will be pilot programs for the new policy of classified application and evaluation. For detailed information, please refer to "2019 NSFC Reform Initiatives" in this *Guide*.

Key priority areas of Key Program in 2019

Applicants who apply for Key Program of the Department should choose the codes noted after the areas of the Key Program in this *Guide* as the first application code, and fill the name of the corresponding areas in the Appendix of the application. Applications that fail to do so will not be accepted.

In 2019, the Department proposes 35 priority areas for Key Program and plans to support 30 projects. The funding for direct expenses will be 2.2-2.8 million yuan per project, and the implementation period of the projects will be 5 years.

1. Operational management theory and method of new retail modes (G0111)

2. Experimental research on evolution and management of game behavior (G0104)

3. Management theory and method of intelligent factory production and operation (G0110)

4. High efficiency service modes and mechanism of medical space resources and key equipment (G0109)

5. Cooperative operation and optimal decision-making of energy and transportation Systems (G0109)

6. Theory and method of complex data analysis towards economic management (G0107)

7. Operational management theory and methods of shared transportation (G0102)

8. Life-cycle quality engineering theory and methods (G0113)

9. Simulation modeling and management optimization of new mixed traffic flow in mobile internet and automatic pilot driving environment (G0119)

10. Optimization theory and methods of data-driven service product design (G0119)

11. Overseas social responsibility decision-making mechanism, behaviors, and international influence of China's enterprises along the Belt and Road (G0201, G0214)

12. Low-carbon sustainable development behavioral characteristic and driven strategies of enterprises (G020201)

13. Innovation system and development modes of enterprise technology standard alliance driven by data (G0203)

14. Mechanism and modes of high-tech industry innovation breakthrough (G0203)

15. Audit institution governance mechanism and audit quality research (G0206)

16. Financial modes of intelligent supply chain based on network ecology (G021101, G0205)

17. Theory and methods of operation management under the internet plus big data environment (G021101)

18. Quality science management and control methods for intelligent

manufacturing system in the context of industrial big data (G0208)

19. Enterprise strategic management theory in the age of intelligent manufacturing (G0201)

20. Business intelligence system construction based on big data fusion (G0210)

21. Theory, methods, and application of big data modeling in the economy sciences (G0303)

22. International economic structure changes and China's international trade Strategy (G0304)

23. Historical econometric research on China's economic development and theoretical evolution (G0304)

24. Research on China's macro-coordination system (G0304)

25. Development strategy of human resource in China in the new era (G0307)

26. Agricultural market cultivation and opening in Western China (G0308)

27. Relationship between the government and market and associated coordination mechanism in the process of rural rejuvenation (G0308)

28. Policy mechanisms and impacts of changes in government functions (G0401)

29. Integration mechanism and evolution law of regional new innovation ecosystem in the context of internet (G0405)

30. Public health risk prevention and mode innovation under the background of the Belt and Road (G0406)

31. Evolution of food supply and demand patterns and food security in China (G0409)

32. Coordination mechanism and strategy of natural resources assets, economic growth and economic security (G0409)

33. Comprehensive assessment and innovative measures of air pollution control effects (G0411)

34. Driving mechanism and policies of low carbon transition in urban energy system (G0412)

35. Pathways and regular patterns of rural economic transition in the process of rural revitalization (G0413)

Department of Health Sciences

In 2018, 685 applications for the Key Program in 40 thematic areas were accepted, 120 of them were funded, with a total funding of 352.7 million yuan (direct cost) and an average funding of 2.9392 million yuan (direct cost as well) per project. **In 2019, approximately 95 applications in the listed areas and 20 applications outside the listed areas for the Key Program will be awarded by the Department; the funding intensity of direct cost is expected to be 3 million yuan per project, and the duration is 5 years.**

According to the discipline development strategy and priority funding direction in the field of medical science, 40 thematic areas for solicited Key Program were determined by the Department in 2019 through extensive research and expert discussion. Please see the following for details. To apply for the Key Program in the thematic areas listed by the Department, applicants are expected to give their own specific project titles, research

contents and research plans according to the listed areas. Application code 1 shall be selected as indicated after the name of thematic areas for Key Program in this *Guide*, the funding category shall be selected as Key Program, and the notes shall be filled in the corresponding field name published in this *Guide*. Applications selected or filled incorrectly in above content will not be accepted.

In 2019, the Department will try to accept a small number of free applications for Key Program in non-listed areas of occurrence, development, outcome, diagnosis, treatment and prevention of major diseases according to the major needs of the state while accepting applications for Key Program in thematic areas. **Applicants who have made original discoveries or important progress in the above areas and are in urgent need of funding but the research contents are not within the listed areas of Key Program published by the Department this year are encouraged to select the research direction freely to apply for the Key Program according to the major strategic needs of national development and the frontier of basic science research.** To apply for the Key Program in non-listed areas, **application code 1 shall be chosen according to the research content,** the funding category shall be selected as Key Program, and **the notes shall be filled in "Application for the Non-Listed Area". Applications that filled incorrectly above or filled with "Application for the Non-listed Area" but the research content are in the following listed areas for Key Program in this year will not be accepted. In addition to writing the application in accordance with the conventional requirements for Key Program, an 800-word "Statement of the Important and Innovative Progress" should be added before the body of the application for the Key Program in non-listed areas. Applications without "Statement" will not be accepted.**

Detailed requirements for applications for the Key Program are described in the general requirement for the Key Program of NSFC in this *Guide*. Special attention should be given to the following requirements:

(1) **Applicants are expected to refer to the requirement for General Program in the Department in this *Guide***, and to pay special attention to the following: in 2019 the Department will generally not give further funding to applicants who either have got intensive funding in 2018 from NSFC (such as Key Program, Major Program, Major International and Regional Joint Research Program, etc.), or are applying for repetitive or similar research to their ongoing national scientific projects funded by other governmental agencies. Due to the limited funding resources, it is not recommended that researchers with two Key Program projects under development apply for the Key Program project in 2019.

(2) Applicants are required to attach PDF copies of 5 relevant representative papers of the PI to the electronic proposals.

(3) Applicants are expected to fill in the budget form with detailed justification.

It will be unacceptable if applicants fail to follow the above requirements.

The Key Program in the Department will be reviewed by classification in 2019. For detailed information, please refer to "2019 NSFC Reform Initiatives" in this *Guide*.

The thematic areas for solicited Key Program in 2019:

1. The mechanism and intervention of lung injury and repair (H01)

The studies will explore the inflammatory microenvironment and its regulatory

mechanisms in the pathogenesis of acute and chronic lung injury and pulmonary vascular disease, focus on the interactions between different lung cells, such as structural cells, inflammatory cells (including microvesicles, etc.), and their mechanisms in the process of lung injury-repair and remodeling, and explore the new treatment targets and application value based on this research.

2. Immune regulation and intervention of vascular diseases (H02)

The priority research areas will focus on the key role of immune homeostasis imbalance (such as natural immunity) in vascular injury and dysfunction, the interaction between immune microenvironment and vascular parietal cells, and the vascular damage-related immune imbalance as the entry point to elucidate the pathogenesis and prevention of important vascular diseases.

3. The key role and regulatory mechanisms of cardiomyocytes fate changes in myocardium injury and repair (H02)

During the myocardial injury, the priority research areas will focus on cardiomyocytes fate change (proliferation, senescence, apoptosis and necrosis, pyroptosis or phenotypic changes of cardiac myocytes and non-cardiac myocytes), in cardiac structure and function maintain, as well as regulatory mechanism of myocardial injury and repair, to elucidate the molecular network of cardiomyocytes fate changes in myocardial injury and repair, and provide the new intervention targets for myocardial repair.

4. Pathogenesis and intervention of end-stage liver diseases (H03)

Studies should focus on liver ischemia-reperfusion injury, metabolic homeostasis imbalance, immune-microenvironment and gut microbiota in patients with end-stage liver diseases, clarify their influences on liver function recovery or hepatic regeneration, determine the regulatory networks and key molecules, and elucidate the molecular mechanism of critical complications such as hepatic insufficiency, graft dysfunction, metabolic disease and ischemic cholangiopathy after treatment of end-stage liver diseases. It is expected to identify molecular markers for precise diagnosis and interventional targets.

5. The mechanism of immune influence on pregnancy establishment and maintenance and intervention strategy (H04)

The research focuses on the mechanism of abnormal autoimmune response affecting the development of germ cells, the molecular mechanism of immune regulation during embryo implantation, and the immune regulation mechanism of maternal and fetal microenvironment during pregnancy maintenance and its intervention strategies.

6. The mechanism and intervention strategy of fetal dysplasia (H04)

The research focuses on the maternal-fetal interaction mechanism, maternal-fetal transport pathway and mechanism of important metabolites, and the histological regulation network of fetal intrauterine development, etc., so as to explore the key factors, early prediction markers and interventions at various stages of fetal development.

7. The mechanism and intervention of urinary dysfunction (H05)

The studies focus on the mechanism of urinary dysfunctions caused by non-neoplastic lower urinary tract disorders, including polyuria, urgency, urge incontinence and dysuria, elucidate the pathogenesis of the lower urinary tract dysfunctions caused by genetic factors, immune disorders, tissue hyperplasia, outflow obstruction, abnormal neuromodulation, and disorders of pacing and excitation of the bladder and the urethra, and provide new potential interventions such as drugs, stem cells, minimally invasions and surgeries.

8. Injury, regeneration and rehabilitation of the locomotor system (H06)

The studies focus on the microenvironment changes of musculoskeletal tissue and organ after injury, as well as the therapeutic mechanisms with tissue engineering and regenerative medicine, and also on exploring the rehabilitation methods and the related mechanisms after musculoskeletal injury.

9. The role of gastroenterological hormones and metabolic products in metabolic diseases (H07)

The studies investigate the regulatory role of gastroenterological hormones and metabolic products in metabolic diseases, and in particular explore the association and mechanism of gut hormones, such as glucagon like peptide-1 (GLP-1) and metabolic products, such as bile acids with metabolic diseases, and further develop the potential treatment targets and pathway for metabolic diseases.

10. The mechanisms and intervention on immunosurveillance inhibitory effect from hematological malignant cells (H08)

The studies focus on the negative regulatory mechanisms of specific tumor cellular subsets (such as cancer stem cells and certain differentiated subpopulations) on host endogenous immunosurveillance or/and adoptive immunotherapeutic components during the pathogenesis and treatment of hematological malignancies (including leukemia), and their involvement in tumorigenesis, treatment resistance, and relapse. The studies may also focus on establishing systematic research methods and models for monitoring and analyzing cellular and molecular regulatory networks among tumor cells and discrete immune cell types, so as to reveal and identify novel crucial factors and underlying mechanisms, and provide a theoretical basis for bettering the development of immunotherapy against hematologic malignancies.

11. Effects and mechanisms of energy metabolism in neuropsychiatric diseases (H09)

The research highlights energy metabolism changes in nervous system including inherited skeletal muscle metabolic diseases and neurodegenerative diseases. Priority will be given to studies that comprehensively analyze the regulatory network of energy metabolism between nervous system and its related organs, explore the re-programming of energy metabolism on the occurrence, development and prognosis of neurodegenerative and inherited metabolic diseases, seek the key molecular signals in the re-programming regulatory network, and explore its therapeutic prospects on neurodegenerative and inherited metabolic diseases.

12. Effects and mechanisms of immune system in central nervous system diseases (H09)

The research focuses on the role and mechanism of peripheral immune system in the occurrence of central nervous system diseases and psychiatric disorders; influence of abnormal peripheral immune system on internal environment homeostasis of central nervous system; effects of key ingredients in peripheral immune system (such as immune cells and immune active substances) on the structure and function of disease-specific neural circuits; and the role and mechanism of peripheral immune system in the pathogenic process of systemic factors (such as aging, emotional changes, stress, intestinal flora disturbance), aiming at exploring key diagnostic markers and intervention targets.

13. Characteristics of mucosal immunity and its impact on related diseases (H10)

This study focuses on the characteristics of the immune response of the mucosal tissue system widely distributed in the respiratory system, digestive system, urogenital system, etc., as well as the effects of the mucosal immune response on infectious diseases, inflammation and allergic diseases, including the role and mechanism of new innate immune cells in the occurrence of related diseases.

14. Effects of metabolic pathways of immune cells and their metabolites on related diseases (H10)

The research focuses on the mechanism of immune cells' metabolism of sugar, fat and choledochol in pathogenic microbial infections, tumors, autoimmune diseases and other diseases, including the effect of key enzymes or products regulating metabolism of sugar, fat and cholesterol of immune cells in pathogenic microbial infections, tumors, autoimmune diseases and other diseases, including the effect of key processes or products regulating the metabolism of sugar, fat and cholesterol on the function of immune cells, targeted immune cell metabolism, blocked the new pathogenesis or exploring new target of severe infection, tumor and autoimmune disease.

15. Function, regulation and translation of Keratinocytes in skin disease (H11)

The studies focus on the biological function and regulatory mechanism of Keratinocytes, find biomarker and therapeutic target of related diseases and investigate possible translation using the methods of clinic cases, animal models, biochemistry, pharmacology, genetics and immunology.

16. Immunopathological study in eye disease (H12)

The studies focus on mechanism of the interaction among genetic factors, immune responses and ocular/systemic microenvironment in blind-causing diseases, explore the role of immune responses to environmental factors in eye diseases, to investigate genetic factors in the “environment-immunity-disease” pathway, and elucidate their roles in disease phenotype, therapeutic effect, and prognosis.

17. The biological effect and mechanism of stem cells and scaffold materials in dental and maxillofacial restoration and regeneration (H14)

The studies focus on the mechanism of the stemness maintenance and directed differentiation of dental and maxillofacial mesenchymal stem cells, and identify the key factors that promote tissue repair and regeneration, the biological effect of scaffold materials and its interaction mechanism with the host, using lineage differentiation map as well as other updated techniques. The translational potential of the studies should be explored by using in vitro and in vivo models.

18. The mechanism of organ injury and repair in emergency and critical care medicine (H15)

The research is to study the key molecular mechanism and control strategy for organ injury and repair in emergency and critical care medicine to provide new ideas for the intervention of organ dysfunction in emergency and critical care medicine and the treatment for related diseases.

19. The metabolites and their sensors with tumorigenesis and development (H16)

The research will discover and identify the key metabolites and metabolic sensors involved in tumorigenesis and development, and investigate the effects and mechanisms of key metabolites and their sensors on tumorigenesis and development, as well as their effects on the reprogramming of tumor microenvironment.

20. The effects and mechanisms of tumor microenvironment on tumor immunotherapy response (H16)

The research will discover the key factors of tumor microenvironment involved in the regulation of tumor immunotherapy response, and investigate the effects and mechanisms of the factors in tumor microenvironment, including inflammatory factors, extracellular signals and interactions between interstitial cells, on tumor immunotherapy response and tumor immunotherapy curative effects.

21. The effects and mechanisms of mitotic catastrophe in tumor therapy (H16)

The research will discover the key factors that regulate mitotic catastrophe in tumor cells and the underlying associated mechanisms, evaluate the anti-tumor potential and therapeutic outcomes by targeting these regulatory factors, and explore therapeutic effects of induction of mitotic catastrophe combined with radiochemotherapy.

22. Tumor stromal heterogeneity and its relationship with tumorigenesis and development (H16)

The research will investigate the heterogeneity of tumor stromal cells which has close relationship with tumorigenesis and development, study the effects and mechanisms of the activation of inflammatory signals and the release of inflammatory mediators caused by tumor stromal heterogeneity on tumorigenesis and development, and discover the molecular mechanisms involving in the formation and maintenance of the phenotype and function of tumor stromal heterogeneity.

23. Multimodal imaging study of tissue microcirculatory disorders in ischemic diseases (H18)

Tissue microcirculatory dysfunction after ischemia is an important cause of organ failure. In-vivo imaging and quantitative evaluation of tissue microcirculatory dysfunction is a key scientific issue guiding early treatment. The research will apply multimodal imaging technology, focus on the study of in-vivo imaging and dynamic monitoring regarding tissue microcirculation in ischemic diseases, evaluate tissue microcirculation from tissue blood flow, reservation, metabolism and endothelial cell molecular function; reflect hemodynamic changes in the physiological and pathophysiological conditions of tissue and organ, obtain microcirculation information of ischemic diseases; explore mechanisms of tissue ischemia and microvascular dysfunction; identify in-vivo biomarkers of microcirculation and use them in early detection and diagnosis of disease, efficacy assessment and prognosis.

24. Construction of new biomaterials for tissue regeneration and its interaction with the immune system (H18)

It is an important scientific issue in tissue engineering how to use biomaterials to effectively induce the construction of engineered tissues and how they respond to the human body's immune response and regulate immunity after transplantation. The research will focus on disease treatment and tissue regeneration integrated functional biomaterials and new biohydrogels with high biocompatibility; explore the interaction mechanism between implanted cells, materials and engineered tissues and the human body's immune system, evaluate the effects of release factors and material degradation products on immunity, detect the mobilization, recruitment and homing effects of stem cells and immune cells, and reveal the mechanism of biological immunity induced by biomaterials on disease treatment and engineered tissues.

25. Molecular basis of human virus infection and pathogenicity (H19)

The studies focus on the molecular basis of etiology, infection and immunology for the occurrence and development of viral diseases, which provides a new theory and target for the prevention and treatment of infectious diseases.

26. Laboratory medical research on biomarkers of major diseases (H20)

The studies focus on the molecular basis of the different stages of occurrence, development and outcome of major diseases, searching and verifying relevant biomarkers and establishing reliable detection methods, in order to provide new indicators with potential application value for disease prevention and early diagnosis, treatment and prognosis.

27. Rapid adaptation, risk prediction and confrontation protection of the human body in extreme environments (H21)

The studies focus on the rapid adaptation mechanism of the body to special or extreme environments such as aerospace, aviation, navigation, diving, plateau, polar, etc., and analyze the molecular medical basis of the body to quickly adapt to the environment, identify key regulatory molecules or signal pathways, and target them to carry out corresponding research of human body confrontation and protection; use cutting-edge technologies such as gene editing and omics to reveal the incidence characteristics and development rules of the body's susceptible diseases under special environmental or operating conditions, and develop a new method for risk assessment and early warning of the body health status based on new markers.

28. Molecular mechanism of irradiation-induced tissue damage and genetic effects (H22)

The studies focus on the underlying mechanism behind irradiation-induced chronic damage to stem cells of normal tissue, and delayed effect of radiation in distal histiocyte, genetics influence of offspring and predisposing genes, key signaling molecule and intervention methods.

29. New techniques and methods for traceability of forensic biological and physical evidence (H23)

All kinds of biological samples left in the crime scene are important physical evidence for case investigation and fixed evidence. The precise traceability of the physical evidence is a key scientific issue in forensic science. The studies focus on different forensic biophysical evidence (blood spots, fine spots, saliva spots, etc.) in the special environment of degradation, mixing and other special ways to achieve individual traceability, explore a new strategy based on forensic genomics, forensic microbiology, forensic botany and other omics techniques applied to the traceability, develop a new method based on artificial intelligence for the traceability, and establish an intelligent analysis system of the traceability of forensic biological and physical evidence.

30. Mechanisms of metabolic aging in degenerative diseases (H25)

Based on multi-systemic and multi-disciplinary studies, the research is to elucidate the general (gonad, thyroid, parathyroid, islet, adrenal gland, etc.) and local (metabolism regulatory factors of aging organs and cell itself) mechanisms of metabolic aging (except heart and brain related diseases), establish early warning and evaluation system, and explore precise intervention strategies and methods for degenerative diseases.

31. Health hazard of environmental and occupational toxicants and underlying new mechanism (H26)

The studies will assess the exposure level of environmental and occupational

toxicants (excluding air pollution) among Chinese population, focusing on the studying action and mechanism of harmful factors for health damage, screening exposure and responsive biomarkers and evaluating healthy risk under low level exposure.

32. Environmental and genetic factors and healthy risk behaviors in children and adolescents (H26)

The studies will investigate the effect of environmental, material and genetic factors on healthy risk behaviors (aggressive behavior, addictive behavior, self-harm and suicide behaviors, safe behavior, unhealthy dietary and sports behaviors) and its mechanism of genetics and neurophysiology using large-scale, multicenter cross-sectional study and prospective cohort design.

33. Relationship between tumor microenvironment and TCM syndromes, and the biological basis of the corresponding therapeutic principles and methods (H27)

Under the guidance of tumor pathogenesis theory in TCM, the research will focus on the relationship between tumor microenvironment and the syndromes, pathogenesis in TCM, and thus explore the biological mechanisms underlying the tumor microenvironment regulations, and changes of the tumor recurrence and metastasis by the corresponding therapeutic principle and methods.

34. Biological mechanisms underlying the prevention of degenerative osteoarthropathy based on the theory of "tendon injury" in TCM (H27)

In term of the core concept of bone constraint and joint lubrication in muscle meridian theory of TCM, the research will focus on homeostasis of tendon and bones, specifically investigate the pathologic basis of degenerative osteoarthropathy, prevention and treatment strategy of "tendon injury" and the underlying mechanisms.

35. Mechanism of TCM in the treatment of drug-resistant infectious diseases (H28)

The studies focus on the interventions of TCM in infectious diseases, especially the function and mechanism of these interventions in drug-resistant bacterial/viral diseases, clarify the characteristics and advantages of TCM in drug-resistant infectious diseases, and provide clear evidence for the clinical application of TCM in infectious diseases.

36. Mechanism for the prevention and treatment for cardiovascular diseases by integration of traditional Chinese and Western medicine (H29)

The studies focus on clinically effective Chinese medicine preparations and specifically aim to elucidate the mechanism of these preparations for the prevention and treatment of cardiovascular diseases, targeting key pathogenesis of cardiovascular diseases, to provide a new strategy for translational research via integrating TCM and Western medicine.

37. Novel theories and methods for the design, construction, synthesis and evaluation of drug molecules (H30)

The studies focus on the novel theories, techniques and methods for the design, synthesis and evaluation of drug molecules, developing target discovery and drug design based on big-data analytics and artificial intelligence technologies, developing novel high efficient synthetic techniques for constructing lead compound libraries of structural diversity, wide variety and high druggability, discovering potential drug targets and validating their action mechanisms based on novel theories and techniques, as well as exploring targeting lead compounds.

38. Fundamental researches on drug rediscovery based on new mechanisms,

targets or disease indications (H30, H31)

The studies focus on the correlation between the characteristic profiles of omics (e.g., genomics, proteomics, DNA methylomics, metabolomics, transcriptomics, etc.) of a specific disease and the characteristic omics profiles (biological effects) of the drugs (including Chinese herbal medicine) commercially available or in clinical trials, investigating and discovering new acting features of drugs above by using mixed research methods, including system biology, molecular pharmacology and bid data analytics in bioinformatics, validating new mechanisms, targets and indications of drugs to propose and validate new treatment concepts with drugs, identifying novel lead compounds and further optimizing structures.

39. Structures and functions of bioactive polysaccharides (H31, H30)

The studies focus on the structure-function relationships and action mechanisms of natural polysaccharides (including oligosaccharides), developing novel techniques and methods for separation and purification, structure elucidation, chemical synthesis, biological preparation, and structure modifications of polysaccharides, as well as biological and pharmacokinetics studies in line with the characteristics of polysaccharides, leading to breakthroughs in polysaccharide research techniques, elucidating pharmacological characteristics and mechanisms of several biologically active polysaccharides, as well as exploring their bioactive domains and structure-activity relationships.

40. Identification of novel targets and discovery of novel drugs based on emerging mechanisms of metabolic disorders in major diseases (H31)

The studies focus on new molecular mechanisms of metabolic disorders of carbohydrates, lipids and amino acids; elucidation of structures and functions of key signal regulators; confirmation of the association of mechanisms above with the occurrence and progression of critical diseases, such as diabetes, nonalcoholic steatohepatitis, tumor and neurodegenerative diseases; identification of novel drug targets, introduction of new targeting concepts and proposal of high selective and active lead compounds as new drug candidates for treatment of relevant diseases.

Major Program

Major program serves the major needs of the scientific frontiers, national economic, social and S&T development and national security, deploys in advance, conducts multidisciplinary research, and plays the supporting and guiding role of improving the capability of indigenous innovation in China's basic research.

Major Program projects will be implemented by unified planning and research projects will be supported in batches. Research areas and guidance for Major Program will be determined on the basis of the development plan, priority areas, evaluation reports on funding and opinions from the expert consulting committees of NSFC's scientific departments.

NSFC only accepts integrated applications for each Major Program, which should include both the overall application for the Program and proposals for research projects. Proposals involving only part of the research areas or one of the research projects indicated in the *Guide* on Major Program will not be accepted.

Each Major Program application can contain no more than 5 projects. The applicant for the program must also be the PI for one of the projects. Each project application should have no more than 2 collaborative research institutions. The total number of Host Institute and Collaborative units may not exceed 5 for one overall application. (For those programs with special research design and number on Collaborative units, please refer to the *Guide* on Major Programs.)

Applicants should have the following qualifications:

(1) Have experience of undertaking basic research projects;

(2) Have senior academic position (title).

Post-docs, graduate students and those without host institutions are not qualified to apply.

Applicants should have excellent academic accomplishments, with considerable influence and team ability.

The duration for Major Program is 5 years. When writing the proposal, the applicant should type in: from January 1, 2020 to December 31, 2,024, in the column for duration.

The Major Program applicant should first fill in the overall application form in the submission system and authorize all the project applicants. Unauthorized applicants cannot submit in NSFC's information system.

Applicants should compose the application based on the Major Program Composition Outline, select "Major Program" in the funding category, "Overall application" or "Project application" in the subclass introduction, select the relevant major program title in "annotation" and select the correct application code according to the research content (for those with specific requirements on application codes, please do as required by the guidance).

Overall application and project application should be submitted through the host institutions. The project application must be submitted prior to the overall application, which should be submitted after all project applications are successfully submitted and then the produced overall budget forms are confirmed.

In 2019, *the Third Group of One Major Program Guide for the 13th Five-Year Plan* is released. Applicants should follow the guidelines when writing proposals, focus on key scientific issues with strategic and fundamental significance, put forward clear, concentrated and interdisciplinary scientific targets, avoid simply putting everything together, and pay attention to coordination and links with other national S&T programs. The research team should have good accumulation of research work, sufficient research conditions, the ability to do innovative work and a number of high level academic leaders.

The Fourth Group of Major Program Guide for the 13th Five-Year Plan will be released online on the NSFC website.

Market Design: Theory and Experiment

The core issue in economic system reform is to properly handle the relationship between government and market so as to let the market play a decisive role in resource allocation and the government play a better role. It is thus essential to carry out systematic and in-depth research on the theories and experiments of market design in China's economic practice. This major project expects productive research on market mechanism based on China's development practice under the dynamic of economic transition, optimization of economic structure, and shift of driving forces of economic growth in China. Centered on the key issues of improving socialist market economic system and faced with scarce public and social resources, an intensive research on the fundamental theories of market design should be conducted in light of China's economic practice, while multiple experimental methods including laboratory experiments, field experiments and simulation experiments should be applied therein.

1. Research Objectives

The project aims to bring elements of market economy with Chinese characteristics into the theoretical system, enrich the fundamental theory of market design in the international academia, and build an internationally influential research team in this field. Meanwhile, it is expected to provide theoretical foundation, scientific support, and policy implications for the government to better handle its relationship with market and deepen the reform of market economic system.

2. Research Contents

2.1 Theoretical Research on Market Design

In the actual economic context of China, the research should analyze how markets, allocation mechanisms and market participants interact, by applying mechanism design, auction theory and matching theory. The research also includes topics that study how market mechanisms incentivize the market participants, as well as the fundamental theory of optimal allocation mechanism that aims to maximize equity or efficiency. The research should develop applied theories to optimally allocate public resources controlled by the government. Examples include government procurement, transactions or construction projects with regard to state property and assets, allocation of commodities and public services.

2.2 Laboratory Experiments in Market Design

The parameters in the laboratory experiments should be chosen in consideration of the potential failure of current market mechanism theories. The research topics include the laboratory implementation of the optimal resource allocation mechanisms, the role of social norms and true preferences of market participants in resource allocation, the impacts of risk and ambiguity in the trading environment upon decisions of market participants, and the role of information transmission among market participants in resource allocation.

2.3 Field Experiments in Market Design

To accurately evaluate the implementation of market mechanisms, the sampling methods and design of proper field experiments should be carefully studied. Field

experiments in market mechanism design theory should be conducted to investigate the impacts of policy interventions upon the behavior and decisions of market participants, the average policy effects and the heterogeneity among different subjects, as well as the external validity and the cost-benefit of experimental policies. Specifically, it can focus on effect assessment of major public policies and analysis of social welfare to provide feasible policy options for decision-making government departments.

2.4 Computer Simulation Experiments in Market Design

Based on computational economics, evolutionary game theory, evolutionary dynamics, and system complexity theory, this research should focus on the general theory and methods for the application of computer simulation to market design, including building models and algorithms of market mechanism design and developing related simulation software and platforms. This research is expected to combine simulation with market design to study the application scope, dependence on external environment, sensitivity and robustness, and policy effects of market design theory in the actual economic environment of China, so as to facilitate efficient, applicable, and scientific market design.

2.5 Market Design with Applications in China

To address market failures in major economic issues in China, the research should employ game theory, experimental economics and empirical analytical methods to design the allocation and trading mechanism aiming to establish an efficient market. It should also investigate the scope, extent, forms, and methods of effective government participation in market design, and study efficient mechanisms and policies of resource allocation under various market failures.

3. Application Notes

(1) For application form note, select “Market Design: Theory and Experiment”; for application code 1, select **G0301 (wrong choice or blank will lead to invalid application)**.

(2) The direct expense budget should not exceed 15 million yuan.

(3) Applications of this project should be submitted to the Department of Management Sciences.

(4) **The requirements listed in the General Program overview also apply to the Major Program application, so please read carefully before submitting proposals.**

Major Research Plan

The Major Research Plan focuses on key basic scientific issues with strategic importance to the nation and major frontier areas and gives high priority identified on the basis of the capability and advantages in the country. Rather than individual project, the Major Research Plan is designed to be a program cluster which contains a number of projects with relatively identical objectives for innovative research resources integrity in order to explore the possible breakthroughs in the identified areas.

The Major Research Plan follows the principle of "definite objective, stable support, integration and refinement and leap-forward development". The funding period for Major Research Plan projects is 8 years in general.

Applicants should meet the following eligibilities:

(1) Having experience of undertaking basic research projects;

(2) Bearing a senior academic position (title).

Post-doctors in station and graduate students are not eligible to apply. Researchers without affiliation to a research institution or whose host institutions have not been registered at NSFC cannot apply as the Principle Investigator.

One applicant may submit no more than one application in the same year (excluding Integrated Program and Strategic Research Program); and grantees of the Major Research Plan program are not allowed to apply for this kind of programs in the following year.

The Major Research Plan is framed with the types of programs, namely, the Fostering Program, Key Program and Integrated Program, of which each one is open to application. Proposals shall be prepared in accordance with the requirement for the Major Research Plan and outlines for proposal preparation, featuring interdisciplinary research, emphasizing on the contributions to solving key scientific issues and fulfilling the overall goals of the Major Research Plan. Applicants should select "Major Research Plan" for the column of the funding type in the application form of proposal, and Fostering Program, Key Program, or Integrated Program for the column of sub-type, and input the title of the Major Research Plan in the annotation.

Generally, duration for Fostering Program project is 3 years, for Key

Program project is 4 years, and that for Integrated Program project is determined by the Steering Committee of each Major Research Plan according to the actual need. For Fostering Program project and Key Program project, the collaborative organizations involved may not exceed 2 in number. The number of collaborative organizations involved in one Integrated Program project may not exceed 4. The main participants must be the actual contributor to the Integrated Program project, and total number of main participants may not exceed 9.

Regulations on sharing of data and information should be observed in order to achieve the overall scientific objectives and multi-disciplinary integration of the Major Research Plan. During the implantation period, attention should be paid to the supporting relationship among various programs.

Each Major Research Plan should hold an academic workshop or seminar once a year on related areas so as to strengthen academic exchange and achieve the overall scientific objectives and integration of disciplines. The PIs of the granted projects are required to participate in these activities.

For details of each Major Research Plan, please refer to the relevant sections of introductions on Major Research Plan in this *Guide*.

Other Major Research Plan Program Guidances will be released online on the NSFC website.

Physics and Application of New Optical Field Regulation

This major research plan aims at obtaining new type of optical field with specific multi-dimensional time space structures (polarization, phase, frequency, and pulse width and module field) by precise control of the physical process of the interaction of optical field and matter, studying the regulation of systems such as atomic, molecular, electron and artificial nano micro structures by the new type of optical field, discovering new phenomena and physics, and promoting application of optics in information science, chemistry, live sciences and material sciences.

I. Scientific Target

Main target of this major research plan is to study the construction, propagation, measurement and phase interference of new types of optical field, explore new physical concepts and related method of multi-dimensional optical field regulation required in research in physics, information processing and communications, materials, chemistry and life sciences, discover new phenomenon and effects through research in the interaction of new types of optical field and matter, develop related new techniques, and by implementing this research plan, meet the need of national importance, provide knowledge for sustainable development and national security, foster high level research team and leading scientists of international importance.

II. Key Scientific Problem

This major research plan mainly funds research focusing on multi-dimensional regulation physics and application of new types of optical field, multi-dimensional precision configuration, regulation and characterization of new type of optical field, and key problems in new physics, new effect and new applications related to the interaction of new type of optical field and matter.

III. Funding for 2018

In 2018, we received 109 applications, among them, 36 for Key Projects, and 73 for Fostering Projects. After evaluation, we funded 9 Key Projects, and 21 Fostering Projects. The total funding was 50 million yuan.

IV. Funding Plan for 2019

In 2019, we plan to fund 20 Fostering Projects with strong emphasis on exploration. The funding will be 800,000 yuan per project for 3 years. We also plan to fund 7 to 8 Key Projects for applications with good research background and potential to make breakthrough. The funding will be 4 million yuan per project for 4 years.

V. Funding Areas for 2019

In 2019, we encourage developing research method using interdisciplinary studies.

Research contents include multi-dimensional construction, regulation and characterization of new types of optical field, the generation and regulation of ultra-fast optical field, interaction of light and mass beyond the diffraction limit, etc. Key areas of support are:

1. Novel principles, technology and application of optical field regulation;

2. Generation and application of attosecond light pulses at hundred nano-joule level;

3. Application of ultra-fast spectrum in life, chemistry and photoelectric functional materials;

4. Principles, technology and devices for optical field regulation of high speed Tbit/s and low energy consumption 10fJ/bit at nano scale;

5. Micro nano photoelectric integrated chips for new generation of information and biomedical technologies;

6. Far field and wide field non marker dynamics high resolution imaging;

7. Non marker 3D super high resolution imaging (hundred nanometer resolution, and micrometer in vertical).

VI. Principles of Selection

All application should focus on new principles of new types of optical field regulation, focusing on 1 or 2 key problems.

1. Exploration in frontier areas is encouraged; and priority will be given to original research;

2. Research focusing on discovering new phenomena, new physics, novel technologies and potential of applications is encouraged;

3. Interdisciplinary research, especially intercrossing with information, chemistry, life and materials sciences is encourages;

4. Integration of theory and experiment is encouraged.

Generation and Evolution of Turbulent Structures and Mechanism of Its Effect

This major research plan, the generation and evolution of turbulent structures and mechanism of its effect, is needed in research in aeronautics, space, navigation and atmospheric science, and related disciplines in turbulent research. Based on turbulence structural dynamic theories, using numerical method, experimental measurement and data processing and analysis, this research plan studies the generation and evolution of turbulent structures and mechanism of its effect under various conditions. We encourage combining physical mechanism and applied research, encourage new ideas, new theories, new method and new technologies, developing high precision numerical method and fine measurement technology, revealing the generation, evolution and interaction mechanism, developing turbulent model theory of high spatial temporal accuracy based on turbulent structures, and verify theory and model, and make accurate prediction and control of turbulent drag, heat flux rate and turbulent noise in major engineering project. We hope the original research

results can provide scientific theory and method in major engineering areas such as development of large carrier equipment in aeronautical, space navigation industries, and control of atmospheric pollutions.

I. Scientific Target

Main target of this major research plan is to obtain original results in developing new ideas, new theories, new methods and new technologies, solve several key difficulties in major engineering applications, so as to promote innovation capabilities, and provide scientific theories for technology development. We also aim at fostering outstanding talents in turbulent research, developing several interdisciplinary research platforms in turbulent research, developing basic and applied basic research in complex problems in turbulence, and a school of turbulent research with Chinese characteristics. We plan to make breakthroughs in the following 4 aspects.

1. New ideas based on turbulent structures, exploring disruptive ideas;

2. New theories based on structural unit, new models based on spatial temporal coupling and physical constraints;

3. New method of characterizing turbulent structures based on Lagrange views, and computational and experimental method for near boundary 3D turbulent structures with spatial temporal analysis of high precision efficiency;

4. New technology of flow control, and drag reduction, thermal protection and noise reduction, new design based turbulent structure, and improvement on turbulent software.

II. Key Scientific Problem

1. Dynamics of turbulent structure generation in different conditions: study transitions from the view of turbulent structure generation, and propose transition theory based on dynamics of turbulent structure generation by breaking the current framework stability theory.

2. Dynamics of multi-spatial temporal scales: study the evolution of turbulent structures from spatial temporal coupling, break theoretical framework of turbulent energy level process develop turbulent theory, computation method and experimental techniques based on multi-spatial temporal scale dynamics.

3. Mechanism and principles of controlling the impact on mechanical, thermal and acoustic transport by turbulent structures: by fine description of turbulent structures, hence break the traditional framework of viscous vortex model, and make accurate prediction and control of drag, heat flow and flow noises.

III. Funding Plan for 2019

We plan to fund about 10 fostering projects; average funding is about 1 million yuan per project for 3 years. We plan to fund about 4 key projects and the average funding is about 4 million yuan per project for 4 years.

IV. Key Funding Areas for 2019

In 2019, we fund projects in the form of fostering projects and key projects, and start to fund integrated projects. The fostering projects will be of the exploring and novel type, and key projects will be of the type having originality, solid research accumulation, and

hopes of making breakthrough. The integrated projects are for very important and very hopefully making breakthrough projects. We encourage participation of different disciplines such as mechanics, mathematics, physics, atmospheric science, engineering thermal physics and information sciences.

i. Fostering projects and key projects

The following research directions will be funded.

1. Generation and evolution of complex turbulent structures

Study the effect of curved boundary on transition, and develop model of predicting flow transition under the influence of system rotation and curved boundary; study flow transition, separation and laminar mechanisms and models of prediction in high speed rotation conditions; develop hypersonic transition models (both physical and mathematical), and study the effect of Mach number, boundary temperature, boundary vibration, and roughness on hypersonic instability and transition; study mechanism of turbulent structure generation caused by high compressible flow and high temperature; develop physical and mathematical models turbulence formation in high temperature and high pressure conditions; explore transition mechanism of complex media flow; conduct studies on multi-physical interface instability and turbulent mixing structures and lower dimensional simplified models; and study mechanism of mixing flow transition with density variation.

2. Multi-time space scale interactions of turbulent structure evolution

Explore methods of identification, characterization and tracking of turbulent structure evolution; study fine description of turbulent structure in various conditions such as rotation, magnetic field, buoyancy, etc.; develop unified model of multi-phase turbulent flow dynamics and kinetics, study the effect of polymer, bubble and particles on turbulent structure; reveal the mechanism of interaction of wake and free surface in moving boundary; study the mechanism and evolution of interaction between internal and external flows, shack wave and turbulence, shock wave and boundary layer for typical aircraft; develop method of turbulent analysis and modeling based on artificial intelligence and physical constraint; develop model theory based on evolution of turbulent structures, RANS-LES mixing model and LES models; study nonlinear and memory properties of large scale turbulent structure, develop reduced dimension model for turbulent structure evolution, and conduct effective control method for large scale turbulent structures; reveal flow field features of turbulent flow around complex marine engineering structures and develop related computation models; develop models of multi-scale interaction in air fluid two phase flows; explore new concept, mechanism and flow control method for drag reduction.

3. Mechanism of impact of turbulent structure on mechanical, thermal and acoustic properties

Conduct studies on controls of typical unsteady flow separation; explore active and passive control method for moving boundary transition and turbulent drag reduction; study the effect and mechanism of multi-scale turbulent structure on mass and heat transfer in various physical conditions such as rotation, magnetic field and buoyancy; study mechanism of interaction between turbulent structure and aerothermodynamics in hypersonic flow, and principles of heat protection for key component of hypersonic aircraft; study physical mechanism of coupling, evolution, scattering and radiation of acoustic, wave, vortex caused pulses in turbulent boundary layer and fluid interface, propose models and prediction method for flow caused noises; study modeling and testing method for radiated acoustic spectrum by jet and fan noises; explore mechanism of sound generation con control

method for turbine blade noise; study mechanism of noise generation and control principles for 3d curved boundary layer transition flows; study mechanism and method of noise reduction for underwater crafts traveling in high Reynolds number based on flow structures.

4. High precision computation of turbulent flows and high resolution experimental techniques

Develop high precision robust numerical method for multi-phase flows in extreme conditions; develop high precision simulation and turbulent computation model for aircraft in large angle of attack turbulent flows; develop high precision experiment method for turbulence boundary layer structure and hypersonic boundary layer aerothermodynamics; develop time resolution measurement technology for highly unsteady, extreme velocity, temperature and pressure conditions; conduct studies on flight and ground testing technology for hypersonic aircraft; study synchronized test and experimental method for turbulent structure parameters, noise and pulse stress; study high precision experimental measurement method and technology for flow field in rotating, magnetic field and buoyancy conditions.

ii. Integrated projects

We plan to fund in the following areas:

1. Large passenger airplane drag reduction and noise reduction

Research objectives: reveal the mechanism of the generation, evolution of turbulent structure on lift and drag and aerodynamic noise affecting the performance of large passenger airplanes, develop key technology of improving aerodynamics and design level for large passenger airplanes, and achieve major results using typical applications by demonstration.

Research contents: mechanism of turbulent generation and effects on large passenger airplane; design principles for drag reduction and noise reduction, and study the mechanism of turbulent structure on aerodynamic drag and noise; integrated design method using turbulent flow for modern large passenger airplanes.

2. Heat protection for hypersonic aircraft

Research objectives: using turbulent structure, to find key scientific problems, and make breakthrough in heat protection and drag reduction, achieve major research results and applications using typical application by demonstrations.

Research contents: effect of typical shape of hypersonic aircraft on physical structure of flows during transition; quantitative correlation between physical structure of flows and friction drag, and aerodynamic heating; high precision flow numerical and experimental method; new concept and control method in heat protection and drag reduction.

3. Noise reduction for underwater craft

Research objectives: break technical difficulties of noise reduction for underwater craft traveling in high Reynolds number by making use of turbulent structure to formulate core scientific problems, achieve major research results and applications using typical application by demonstrations.

Research contents: parameter characterization and analysis of sound structures of complex body shape and moving boundary layer turbulent noises; mechanism and model of curved and rough surface high Reynolds number boundary layer flow caused noises; precision numerical simulation of high Reynolds number flow noise; experimental methods for testing high Reynolds number turbulent structure, noise and pule stress; smart control

and new concept and new method of noise reduction for high Reynolds number turbulent structures.

V. Basic Principles of Selection

This major research plan requires that

1. Research should meet the requirement outlined in this *Guide*;

2. Exploratory research is encouraged; priority is given to new concept, new theory, new systems and new method of turbulent structure evolution and models;

3. Interdisciplinary research is encouraged;

4. International cooperation is encouraged;

5. Please be different from the content of the major research plan "basic research on turbulent combustion for engines".

Fundamental Theory and Key Technology of Coexisting-Cooperative-Cognitive Robots (Tri-Co Robots)

Tri-Co Robots refer to the robots that can interact naturally with the working environment, human, and other robots, adapt themselves to complex dynamic environments autonomously, and cooperate with each other. The Tri-Co robots are characterized as with flexible and reconfigurable structure, multi-modal perception, as well as distributed and autonomous cooperation. This Research Initiative aims at developing fundamental theory and key technology for Tri-Co robots in terms of robotic structure, perception and control to meet the challenges in intelligent manufacturing, rehabilitation and national security, and laying down the foundations for the nation's robotic technology development, commercialization, and applications.

I. Program Objectives

This major research plan aiming at international robotic research frontiers, centered on fundamental theory and design method of Tri-Co (human-machine-environment) robots by enhancing disciplinary crossing and integration, seeks to (i) make innovative achievements in rigid-flexible-soft coupled structure design, multi-modal and dynamic environmental perception with human-machine cooperation, and distributed robotic systems with swarm intelligence, (ii) foster internationally high-impact academic scholars and leaders, and (iii) improve the international impact and overall innovation capability of our nation's robotic research.

II. Major Research Topics

1. Kinematics and controllability of the integrated rigid-flexible-soft robots

Rigid-flexible-soft robot design and mechanical behavior analysis, dynamics and

stiffness control for robot-human-environment interaction.

2. Multi-modal perception of human-robot-environment and autonomous interaction

Multimodal perception and scene understanding in unstructured environment, bio-signal-based behavioral perception and human-robot autonomous interaction.

3. Swarm intelligence and related software systems

Mechanism of individual autonomy and swarm intelligence, multi-model distributed framework of swarm robot operating system.

III. Major Research Directions in 2019

The programs consist of Key Program and Integration Program. The average funding of Key Program is 3 million yuan per project, and for Integration Programs is 13 million yuan per project.

1. Key Program

Key programs mainly supports research on Tri-Co Robots structure, perception and control with potential application prospects in the fields of intelligent manufacturing, rehabilitation and national security, etc. The specific funding directions are as follows:

(1) Innovative mechanism design of smart robotics;

(2) New concept human-machine collaboration system;

(3) Swarm intelligence and robotic operating system.

2. Integration Program

Integration program mainly supports the research that has achieved important progress under the support of previous Key Program, and through integration and sublimation, it is expected to make a major breakthrough in resolving the needs of industries and major national applications. The specific funding directions are as follows:

(1) In view of the demand for production mode and equipment innovation for large and complex component manufacturing in key industries, the research studies the new principle of high-performance machining and manufacturing using robots. It focuses on key issues such as robot body design and control, online sensing and monitoring of manufacturing process, process knowledge and multi-robot coordinated control driven by multi-sensor information, and demonstration in high-efficiency and high-precision machining of large complex curved surfaces or thin-walled components.

(2) In view of the demand for rehabilitation, replacement and enhancement of limb movement function, the research studies the design, manufacturing and control of Tri-Co Robots. It focuses on solving key problems such as life-like actuation, perception, and flexible and dexterous mechanism design, human-computer interaction biomechanical optimization and neural perception and control, and developing a prototype with targeted indications.

(3) In view of the demand of swarm robots in the fields of rescue, security and national defense, the research studies swarm intelligence of special-use robots, human-machine hybrid intelligent principle and verification platform. It focuses on the innovative application of the multi-state distributed robot operation system, solves the key problems of the swarm robots' autonomous control and learning, cluster scalable formation and autonomous coordination, self-organizing group network and real-time communication, and demonstrates and verifies the ability of executing complex tasks for multi-domain and

heterogeneous swarm robots.

IV. Major Selection Criteria

To ensure that the overall goal can be achieved, it is required that all proposed research should strictly follow this guideline, and all proposals will be evaluated based on the following criteria:

(1) Encourage exploratory research in frontier fields and priority will be given to the new research directions;

(2) Encourage interdisciplinary research and strongly support biomedical-engineering cross-disciplinary research with substantive medical studies for rehabilitation programs;

(3) The research with substantive international cooperation will be considered with high priority;

(4) Proposals submitted by junior scholars will be considered with high priority;

(5) Integration Program needs to reflect the inheritance and major improvement of the research results from the previous funded program, and meanwhile must have leading research goals and standards. In principle, the research group should be composed of people from multi-disciplinary backgrounds to conduct research jointly and form an innovative research model and mechanism of cross-integration;

(6) The proposals not consistent with the objectives of this program and not related to Tri-Co robots will not be considered.

V. Application Guidelines

(1) Please read this guideline carefully before filling in applications. This major research plan aims to guide research directions strategically and integrate advantages in related fields, then to build a project cluster with a unified research goal or direction. Proposals should focus on specific key topics and relations with the most relevant topics to the guidelines should be illustrated clearly. The contributions to solving core issues and to the overall research objectives of this major research plan should be illustrated in the proposals as well. If the applicant has undertaken other national science and technology projects related to this major research plan, distinction and relationship between the proposed project and other related undertaken projects should be declared in the “Research Background” in the proposals.

(2) In order to ensure that the research direction of the project is consistent with the objectives of the major research projects, and promote inter-project communication, multi-disciplinary integration, and talent fostering, there will be an annual academic exchange meeting for the funded programs each year, and academic discussions in relevant fields irregularly. If funded, the person in charge is obliged to participate in the above academic activities. During the implementation period, the research group will participate in the “Integration Robot Challenge” at least once and promise to abide by the relevant data and materials sharing rules.

(3) Choose funding category of “Major Research Plan” and sub-category of “Expletory Program” or “Key Program” in your application. Explanation of “Research on Fundamental Theory and Key Technology of Coexisting-Cooperative-Cognitive Robots/Tri-Co Robots” should be indicated. Application code should be chosen according

to your specific research topic.

(4) The application should be submitted to the Department of Engineering and Materials Sciences in NSFC.

Scientific Foundation for High Temperature Materials, Advanced Manufacturing and Fault Diagnosis of Aero Engines

Aero engines are among the most important technologies for the country and are crucial both economically and technologically regions. Any breakthrough in this area will lead to considerable advancements of the aero engine industry. An aero engine works in the conditions of exceedingly high temperature, high pressure, high speed and variable loads. As such, design and manufacturing of the key components of aero engines require advanced technologies of high complexity as well as advanced materials. Furthermore, due to the extreme service conditions, the operation monitoring is also extremely important for safety concerns. However, the inadequacy in relevant basic scientific research has greatly limited the development of aero engines in China. The major research plan focuses on the investigations in high temperature materials, advanced manufacturing and operation malfunction diagnostics, in the hope to overcome the bottlenecks and to provide the fundamental innovative think tank and scientific supports.

I. Scientific Target

The major research plan is to meet the nation's strategic needs. It will especially focus on the investigations of high temperature materials, advanced manufacturing and operation malfunction diagnostics. It will attempt to advance the aeroengine industry of China via fundamental researches of multidisciplinary efforts and profound integrations. Under the stable and intensive support, the initiative will cluster and build an international level team on the fundamental research of aero engines.

II. Key Scientific Problems

1. High temperature materials for aero engines—property optimization and long-term stability in service

Composition design, phase structure optimization, microstructural evolution in service conditions and their relation to the high temperature properties; initiation and development of defects in the high temperature materials during processing and service, and their multiple-scale characterization and tailoring; search for new high temperature materials for aero engines.

2. Mechanism of synergistic control of surface precision and performance of the key components of aero engines

Mechanisms of manufacturing and precision control of aeroengine key components, mechanisms of the interaction of non-traditional/hybrid energy field with high-temperature

materials, evolution and control of machined surface states for aeroengine key components.

3. Principle of state information sensing and intelligent diagnosis/prediction for aero engines

The theory and methodology for information sensing and monitoring of aero engines; artificial intelligence and big data methodologies for fault diagnosis; fault-tolerant control and sparse sensing fault prediction methodologies for aero engines.

III. Funding Research Directions in 2019

The support will be in the forms of Fostering Program and Key Program. For Fostering Program, the direct support will be on average 650,000 yuan/3 years. For Key Program, the direct support will be on average 3,500,000 yuan/4 years.

Fostering Program

1. High temperature materials

(1) Compositional design and microstructure optimization, and their effects on properties;

(2) Correlation between microstructural evolution and the stability of properties during processing and service;

(3) Multi-scale characterizations of the properties and structural defects in service conditions.

2. Advanced manufacturing

(1) Governing rules for the relationship between processing and component quality as well as performance of the component;

(2) Mechanisms of the effects of non-traditional/hybrid energy field on the materials of the aeroengine components;

(3) Data driven process modelling and optimization and processing control.

3. Fault diagnosis

(1) Damage identification for aeroengine blades, high pressure turbine bladed-discs;

(2) Dynamic sensing, testing, fault isolation and fault-tolerant control for high temperature components;

(3) Multi-information fusion and intelligent prediction.

4. Other frontier researches on new concepts, new principles, and new methodologies closely related to the scientific objectives of the major research plan.

Key Program

Priority support will be given to the researches related to: composition design of high temperature materials for aero engines, microstructure tailoring and characterization, long service life and its stability, influences of manufacturing process on macro/micro geometry and performance of components, evolution and control of machined surface states for aeroengine components, and mechanism and characterization of the faults for aero engines.

IV. Basic selection criteria

In order to ensure that the overall goals can be achieved, it is required that all proposed research efforts should strictly follow the Notes to Applications. All proposals will be evaluated based on the following criteria:

(1) Encourage frontier and exploratory research on new concepts, new theories and new methodologies; priority will be given to original research;

(2) Joint efforts between aero-engine enterprises and institutes are strongly encouraged;

(3) Interdisciplinary proposals are encouraged;

(4) The proposals not consistent with the objectives of this Initiative and not closely related to the materials, manufacturing and diagnosis of aero-engines will not be considered.

V. Notes to applications

(1) Please read the Notes to Applications carefully prior to filing in applications. This major research plan aims to guide research directions strategically and to integrate advantages in related fields so as to build a project cluster with a unified research goal or direction. Proposals should focus on the key topics specified in the Notes to Applications. The contributions to the focused scientific topic and to the overall research objectives of this major research plan should be clearly stated in the proposals. Proposals not complying with the Notes will not be considered. If the applicant has undertaken other National Science and Technology Projects related to this major research plan, distinction and relationship between the proposed project and other related undertaken projects should be declared in the "Research Background" in the proposals.

(2) Choose funding category of "major research plan" and sub-category of Fostering Program or Key Program in your application. Explanation of "Scientific foundation for high temperature materials, advanced manufacturing and fault diagnosis of aero engines" should be indicated. Application code should be chosen according to your specific research topic.

(3) The application should be submitted to the Department of Engineering and Materials Sciences in NSFC.

Young Scientists Fund

The Young Scientists Fund supports young scientists to freely choose their research topics within the funding scope of NSFC to conduct basic research, fosters the ability of young scientists to independently undertake research projects and conduct creative research, stimulates young scientists' creative thinking and trains backup talents for basic research.

Applicants for the Young Scientists Fund should:

(1) Have experience of doing basic research;

(2) Have senior professional position (title) or PhD degree, or be recommended by 2 researchers with senior professional position (title) in the same research area;

(3) Be younger than 35 by January 1 of the year of application (born on or after January 1, 1984). Female applicants should be younger than 40 by January 1 of the year of application (born on or after January 1, 1979).

Full time PhD students who satisfy the above criteria may apply through their host institutions with the consent of their supervisors. Those who are the PIs of ongoing NSFC projects or have undertaken projects of Young Scientists Fund, including one-year small fund for exploratory studies, and terminated or withdrawn projects, cannot apply again.

For Young Scientists Fund, the creative potential of the applicant is mainly evaluated. Applicants should follow the outlines of proposal for Young Scientists Fund when preparing applications. The research period is 3 years in general. (The funding period for applications submitted by post-doctors is decided in consideration of the letter of commitment from their host institutions. The start time shall be January 1, 2020 and the finish time shall be December 31, 20XX.)

Special reminders to the applicants:

(1) Starting from 2019, participants are no longer listed in Young Scientists Fund, so that the reviewers will focus on the applicant's ability to independently carry out the science project and conduct innovative research.

(2) In 2019, for Young Scientists Fund, pilot paperless applications are carried out. In process of the submission, the supporting institution shall

only confirm the online application and the attachments, without having to submit a paper form application. Once approved, the signature and seal page (A4) of the application form should be submitted at the time of submitting the research project plan. The signature and seal information should be consistent with that of the electronic application.

In 2018, a total of 17,671 Young Scientist Fund projects were funded. The direct cost was 417.644 million yuan. The average funding was 236.3 thousand yuan per project, with a success rate of 20.54% and a decrease of 1.87% over that of 2017 (for the funding situation, please refer to the table below).

Funding of the Young Scientists Fund Projects in 2018

Unit: 10,000 yuan

Departments	No. of applications	Awards				Success rate (%)
		No. of awards	Funding for direct cost	Average funding for direct cost	Share of NSFC total funding for direct cost (%)	
Mathematical and Physical Sciences	6,054	1,748	43,630	24.96	10.45	28.87
Chemical Sciences	7,086	1,545	39,260	25.41	9.40	21.80
Life Sciences	11,481	2,350	58,240	24.78	13.94	20.47
Earth Sciences	6,490	1,763	43,220	24.52	10.35	27.16
Engineering and Materials Sciences	14,283	3,077	76,752	24.94	18.38	21.54
Information Sciences	8,280	2,111	52,054	24.66	12.46	25.50
Management Sciences	4,575	855	15,808	18.49	3.79	18.69
Health Sciences	27,793	4,222	88,680	21.00	21.23	15.19
Total or average	86,042	17,671	417,644	23.63	100.00	20.54

In 2019, the average funding intensity for Young Scientist Fund is expected to be consistent with that of 2018. Please write the application truthfully according to the actual need for research.

Please refer to the respective sections in each department for research areas and orientations of the Young Scientist Fund projects.

Department of Mathematical and Physical Sciences

The development of young scientists is particularly important for the development of mathematical and physical sciences. The Department has always been paying attention to fostering and supporting young scientists, and the funding rate of the Young Scientists Fund has always been higher than that of General Program projects. In 2019, the Department will maintain a higher funding rate for the Young Scientists Fund so as to give more young people the opportunity to do independent research, and to foster outstanding talents for basic research.

The Department received 6,054 applications in 2018, accepted 6,009, and funded 1,748. The success rate was 28.87%, and the direct cost funding was 249,600 yuan per project on average. The funding level in 2019 will be about the same as 2018.

Funding for Projects of the Young Scientists Fund in
Department of Mathematical and Physical Sciences in 2017 and 2018

Unit: 10,000 yuan

Divisions		2017			2018		
		Projects	Direct cost	Funding rate (%)	Projects	Direct cost	Funding rate (%)
Mathematics	Mathematics I	290	6,382	29.74	301	7,074	29.86
	Mathematics II	308	7,071	29.62	297	7,067	27.94
Mechanics	Basic Problems and Methods in Mechanics	5	122	31.25	6	160	28.57
	Dynamics and Control	57	1,435	29.23	59	1,487	28.92
	Solid Mechanics	128	3,182	29.56	127	3,214	28.80
	Fluid Mechanics	84	2,069	29.68	82	2,083	28.77
	Bio-Mechanics	22	547	28.95	24	622	29.27
	Explosive and Impact Dynamics	41	1,044	29.71	51	1,318	28.81
Astronomy	Astrophysics	43	1,161	31.16	45	1,181	29.41
	Astrometry and Celestial Mechanics	55	1,400	28.95	51	1,335	28.49
Physics I	Condensed Matter Physics	205	5,070	29.58	203	5,173	28.79
	Atomic and Molecular Physics	49	1,208	29.52	48	1,271	29.45
	Optics	145	3,575	29.65	129	3,314	28.79
	Acoustics	27	649	30.34	30	765	29.13
Physics II	Fundamental Physics and Particle Physics	69	1,639	29.74	74	1,844	30.20
	Nuclear Physics, Nuclear Technology and Its Application	79	2,034	29.15	82	2,123	29.82
	Particle Physics and Nuclear Physics Experimental Facilities	82	2,084	29.18	76	1,946	26.95
	Plasma Physics	60	1,488	30.93	63	1,653	28.64
Total		1,749	42,160	29.65	1,748	43,630	28.87
Direct cost per project		24.11			24.96		

Department of Chemical Sciences

The Department upholds the principle of people first and fosters innovative talents, brings into full play the maintaining and fostering role of the Young Scientists Fund, and steadily enhances the funding following the idea of properly controlling the funding intensity and further expanding the funding scope. The Young Scientists Fund stresses on the research projects with innovative ideas, discourages the research that simply continue the advisors' topics, and gives less weight to research accumulation and the constitution of the relevant research teams, so as to facilitate the growth of young scientists.

In 2018, new discipline codes were employed to conduct funding and management in the Department. 7,086 proposals for the Young Scientists Fund were received by the Department (925 proposals and 15.01% more than that of 2017). 1,545 proposals were funded with the success rate of 21.80% and the average funding intensity of 254,100 yuan per project. In 2018, 3.21% of the success rate decreased compared with that of 2017 based on the guarantee of the funding intensity by the Department. In 2019, the average funding intensity per project will be at the same level as that of 2018.

Funding for Projects of the Young Scientists Fund in Department of Chemical Sciences in 2017 and 2018

Unit: 10,000 yuan

2017				2018			
Disciplines	Projects	Direct cost	Funding rate (%)	Divisions	Projects	Direct cost	Funding rate (%)
Inorganic Chemistry	203	4,925	25.15	Synthetic Chemistry	261	6,676.2	22.04
Organic Chemistry	241	5,849	25.37	Catalysis and Surface/ Interface Chemistry	173	4,396	21.82
Physical Chemistry	292	7,086	25.35	Chemical Theory and Mechanism	81	2,058	21.77
Analytical Chemistry	167	4,053	25.30	Chemical Metrology	147	3,732.5	22.07
Macromolecular Science	112	2,719	25.63	Materials Chemistry and Energy Chemistry	319	8,170.3	21.38
Environmental Chemistry	177	4,306	25.21	Environmental Chemistry	194	4,930	21.65
Chemical Biology	54	1,311	25.47	Chemical Biology	121	3,072	22.16
Chemical Engineering and Industrial Chemistry	295	7,151	23.77	Chemical Engineering and Industrial Chemistry	249	6,225	21.90
Total or average	1,541	37,400	25.01	Total or average	1,545	39,260	21.80
Direct cost per project	24.27			Direct cost per project	25.41		

Department of Life Sciences

In 2018, the Department received a total of 11,481 applications for the Young Scientists Fund. 11,240 applications were accepted and 2,350 projects were funded with a funding rate of 20.47%.The average direct cost of funding was 247,800 yuan per project. The Department will continue to follow the principle of "stabilizing research teams, fostering young talents, stimulating innovative thinking and supporting independent research" for the Young Scientists Fund, and provide steady support to researchers in the early stage of their academic career. In 2019, the average direct cost of funding will be roughly the same as that in 2018. **For application details and special notifications, please refer to the section of General Program of the Department in this *Guide*.**

Funding for Projects of the Young Scientists Fund in Department of Life Sciences in 2017 and 2018

Unit: 10,000 yuan

Divisions		2017			2018		
		Projects	Direct cost	Funding rate (%)	Projects	Direct cost	Funding rate (%)
I of Biology	Microbiology	160	3,842	22.86	162	4,034	21.40
	Botany	156	3,740	26.76	144	3,575	22.36
	Zoology	74	1,766	26.06	74	1,823	24.26
II of Biology	Genetics and Bioinformatics	114	2,746	24.73	114	2,835	24.73
	Cell Biology	94	2,256	32.87	74	1,864	22.84
	Developmental Biology and Reproductive Biology	50	1,206	24.75	51	1,251	23.83
Biomedicine	Immunology	58	1,400	27.49	58	1,442	24.68
	Physiology & Integrative Biology	47	1,134	25.13	45	1,135	22.61
	Neurosciences and Psychology	123	2,941	20.81	120	2,984	19.87
Interdisciplinary Research	Biophysics/Biochemistry/Molecular Biology	105	2,522	26.85	106	2,628	21.90
	Biomaterials/ Imaging/Tissue Engineering	72	1,739	20.81	70	1,728	18.04
Environment and Ecology	Ecology	160	3,843	26.02	159	3,950	25.56
	Forestry and Grassland Science	193	4,615	21.28	171	4,243	17.48
Agriculture and Food Science	Agriculture and Crop Sciences	206	4,940	20.44	199	4,942	18.69
	Food Science	216	5,172	19.57	222	5,418	18.05
Agricultural Environment and Horticulture	Plant Protection	133	3,198	21.49	135	3,347	21.06
	Horticulture and Plant Nutrition	140	3,351	19.64	144	3,570	17.71
Agriculture Animal	Animal Husbandry	94	2,253	20.94	99	2,437	18.82
	Veterinary Medicine	116	2,785	23.82	117	2,892	22.85
	Aquaculture	84	2,011	19.91	86	2,142	17.95
Total or average		2,395	57,460	22.67	2350	58,240	20.47
Direct cost per project		23.99			24.78		

Department of Earth Sciences

In 2018, the Department received 6,490 applications for the Young Scientists Fund from 925 research institutions, among which, 4,003 were from universities (61.68%), and 2,193 from research institutes (33.79%). Totally, 1,763 projects were awarded with a fund of 432.2 million yuan (direct expenses, and hereinafter), with the direct cost funding of 245,200 yuan per project and a funding rate of 27.16%. Among the projects funded in 2018, 1,104 were applied through universities (62.62%), and 611 through research institutes (34.66%). In 2019, the direct cost funding per project is expected to be similar to the amount approved in 2018. One of the most important goals of the NSFC is to support outstanding young scientists continuously and steadily. The Department will further increase the funding for young scientists, especially outstanding young scientists. The main objective of Young Scientists Fund is "cultivation", and to provide more opportunities for early-career young scholars, especially for recently-graduated scientists to start their research as soon as possible.

Funding for Projects of the Young Scientists Fund in Department of Earth Sciences in 2017 and 2018

Unit: 10,000 yuan

Divisions		2017			2018		
		Projects	Direct cost	Funding rate (%)	Projects	Direct cost	Funding rate (%)
I	Geography	640	15,451	28.37	400	9,789	27.21
II	Geology	391	9,431	28.40	253	6,207	27.15
	Geochemistry	136	3,274	28.45	52	1,272	27.23
III	Geophysics and Space Physics	178	4,273	28.53	171	4,196	27.14
	Environmental Earth Science	—	—	—	525	12,859	27.19
IV	Marine Science	225	5,417	28.45	229	5,634	27.07
V	Atmospheric Science	142	3,424	28.40	133	3,263	27.14
Total or average		1,712	41,270	28.41	1,763	43,220	27.16
Direct cost per project		24.11			24.52		

Note: The statistics of this table in 2017 was made according to the former sub-disciplines in the Department.

Department of Engineering and Materials Sciences

In order to encourage and foster innovative young researchers and to create a good academic situation, the Department will continue to implement favorable funding policy for the Young Scientists Fund. In 2018, the Department received 14,283 applications (279 rejected) with an increase of 8.77%. 3,077 projects were funded with a total direct cost of 767.52 million yuan. The average funding was 249,400 yuan per project with a success rate of 21.54% (23.46% in 2017). In 2019, the average funding per project for Young Scientists Fund will be the same as 2018.

Please refer to the General Program and other related parts of this *Guide* for general instruction of the Department and detailed requirements on application.

Funding for Projects of the Young Scientists Fund in Department of Engineering and Materials Sciences in 2017 and 2018

Unit: 10,000 yuan

Divisions		2017			2018		
		Projects	Funding for direct cost	Success rate (%)	Projects	Funding for direct cost	Success rate (%)
Materials Sciences I	Metallic Materials	244	5,844	23.71	238	5,945	20.31
	Polymer Materials	260	6,236	22.89	246	6,151	20.99
Materials Sciences II	Inorganic Non-Metallic Materials	380	9,128	23.68	361	9,045	23.01
Engineering Sciences I	Metallurgy and Mining Science	339	8,136	23.05	356	8,854	20.86
Engineering Sciences II	Mechanics and Mechanical Manufacturing	546	13,098	23.07	557	13,914	21.46
Engineering Sciences III	Engineering Thermo Physics and Energy Utilization	249	5,964	23.10	251	6,285	21.56
Engineering Sciences IV	Architecture, Environmental and Civil Engineering	567	13,606	24.47	564	14,027	22.01
Engineering Sciences V	Electrical Science and Engineering	204	4,904	23.10	206	5,129	21.75
	Hydrology and Marine Engineering	291	6,994	23.37	298	7,402	21.39
Total		3,080	73,910	23.46	3,077	76,752	21.54
Direct cost per project		24.00			24.94		

Department of Information Sciences

In 2018, the Department received 8,280 applications for the Young Scientists Fund, which was increased by 8.66% compared with that in previous year,. We funded 2,111 projects with an average funding rate of 25.50%. The total direct cost funding was 520.54 million yuan and the average direct cost funding intensity was 246,600 yuan per project. In 2019, the Department will continue to pay attention to applications for the Young Scientist Fund, and the direct cost funding intensity will be about the same.

Funding for Projects of the Young Scientists Fund in Department of Information Sciences in 2017 and 2018

Unit: 10,000 yuan

Divisions		2017			2018		
		Projects	Direct cost funding	Funding rate (%)	Projects	Direct cost funding	Funding rate (%)
I	Electronics and Technology	192	4,692	27.08	183	4,555	26.83
	Information and Communication System	179	4,354.5	27.25	179	4,405.5	26.88
	Information Acquisition and Processing	183	4,375.5	27.35	166	4,109.5	26.99
II	Theoretical Computer Science, Computer Software and Hardware	121	2,934	29.16	118	2,915	29.80
	Computer Application	283	6,991	29.06	179	4,452	29.68
	Network and Information Security	166	4,035	29.02	162	3,975	29.67
III	Control Theory and Control Engineering	421	8,447	23.24	397	9,813	24.72
	Systems Science and System Engineering				223	5,494	24.64
	AI and Intelligent System				17	340	20.00
IV	Semiconductor Science and Information Devices	192	4,670	25.70	188	4,620	22.60
	Information Optics and Photoelectric Devices	133	3,235	25.73	118	2,917	22.82
	Laser Technology and Technical Optics	135	3,284	25.71	171	4,226	22.41
Total or average		2,031	49,370	26.65	2,111	52,054	25.50
Direct cost per project		24.31			24.66		

Department of Management Sciences

In recent years, the application quality and research level of the Young Scientists Fund in the Department have shown significant improvement. Most applicants focused on scientific frontier areas, proposed appropriate research methods, and have published high-level academic papers. On the other hand, some applicants still lacked the understanding of research work of projects funded by NSFC; therefore, the proposed research content could not be completed with the limited budget or within the proposed time period. Some other applicants repeated their PhD or postdoctoral research work, or failed to provide information as required by NSFC.

In 2018, the Department received 4,575 applications for the Young Scientists Fund, much more than the application number in 2017. 855 projects were funded with a funding rate of 18.69%, and the average funding for direct cost was 184,900 yuan per project. In 2019, the direct funding level of the Yong Scientist Fund will be the same as that in 2018.

Please note that the requirements given in the general description section of the General Program of the Department in this *Guide* are also applied to the Young Scientists Fund, so please read carefully before submitting proposals.

Funding for Projects of the Young Scientists Fund in Department of Management Sciences in 2017 and 2018

Unit: 10,000 yuan

Divisions		2017			2018		
		Projects	Direct cost	Funding rate (%)	Projects	Direct cost	Funding rate (%)
I	Management Science and Engineering	223	4,018	20.44	233	4,308.17	19.50
II	Business Administration	209	3,766	20.31	208	3,845.92	19.21
III	Economic Sciences	188	3,388	19.09	206	3,807.99	18.04
	Macro-Management and Policy	208	3,518	18.01	208	3,845.92	18.01
Total or average		815	14,690	19.75	855	15,808	18.69
Direct cost per project		18.02			18.49		

Department of Health Sciences

Eligible young scientists are encouraged to submit proposals to the Department for funding. Applicants are expected to have the ability to undertake and complete research project independently, and the ability to identify creative scientific questions and research schemes. The PDF copies of no more than five relevant representative papers should be attached to the proposal. For more detailed information, please refer to sections in the Young Scientists Fund and General Program in this *Guide*.

The funding intensity for the Young Scientists Fund will remain the same as that in 2018.

Funding for Projects of the Young Scientists Fund in Department of Health Sciences in 2017 and 2018

Unit: 10,000 yuan

Divisions		2017			2018		
		Projects	Direct cost	Success rate (%)	Projects	Direct cost	Success rate (%)
I	Respiratory system, circulatory system, blood system	447	8,952	18.07	447	9,396	16.20
II	Digestive system, urinary system, endocrine system/metabolism and nutrition support, ophthalmology, otorhinolaryngology head and neck science, oral and craniomaxillo-facial Science	590	11,792	16.68	594	12,469	14.56
III	Neurological and psychiatric diseases, gerontology	357	7,131	17.53	358	7,525	15.55
IV	Reproductive system/ perinatology/neonatology, medical immunology	247	4,940	17.31	250	5,260	14.76
V	Medical imaging and biomedical engineering, special medicine, forensic sciences	229	4,581	17.26	232	4,867	15.01
VI	Medical pathogenic microorganisms and infection, orthopedics and sports medicine, emergency and intensive care medicine/trauma/ burns/laboratory medicine/plastic surgery/ rehabilitation medicine	371	7,415	16.29	372	7,805	14.62
VII	Oncology (leukemia not included)	853	17,052	16.28	857	18,000	15.24
VIII	Skin and appendages, preventive medicine, endemiology, occupational medicine, radiology	230	4,593	22.82	228	4,789	19.98
IX	Materia medica and pharmacology	307	6,172	23.29	310	6,505	20.57
X	Chinese medicine, Chinese materia medica, integrated Chinese and western medicine	569	11,382	14.15	574	12,064	12.49
Total or average		4,200	84,010	17.03	4,222	88,680	15.19
Direct cost per project		20.00			21.00		

Fund for Less Developed Regions

The Fund for Less Developed Regions supports scientists in specified regions of China to conduct creative research within the funding scope of NSFC, so as to foster and support researchers in the regions, to stabilize and gather outstanding talents to facilitate the construction of the regional innovation system as well as the social and economic development of the regions.

Applicants for the Fund for Less Developed Regions should:

(1) Have the experience of undertaking basic research project or doing other basic research;

(2) Have the senior academic position (title) or doctoral degree, or recommendations by 2 researchers with senior academic position (title) in the same research area.

Researchers meeting above qualifications and working in Inner Mongolia Autonomous Region, Ningxia Hui Autonomous Region, Qinghai Province, Xinjiang Uyghur Autonomous Region, Xinjiang Production and Construction Corps, Tibet Autonomous Region, Guangxi Zhuang Autonomous Region, Hainan Province, Guizhou Province, Jiangxi Province, Yunnan Province, Gansu Province, Yanbian Korean Prefecture of Jilin Province, Enshi Tujia and Miao Prefecture in Hubei Province, Xiangxi Tujia and Miao Prefecture in Hunan Province, Liangshan Yi Prefecture in Sichuan Province, Ganzi Tibetan Prefecture in Sichuan Province, Aba Tibetan and Qiang Prefecture in Sichuan Province, Yan'an City and Yulin City in Shaanxi Province, may apply for the Fund for Less Developed Regions. Researchers seconded by the Organization Department of the Central Committee of the CPC to Xinjiang Uyghur Autonomous Region and Tibet Autonomous Region as aid scientists for 3 or more years are also eligible to apply for this fund, on the condition that they provide certificate documents issued by the organization departments or personnel department of their host institutions to prove their identity of aid scientists when applying for this fund.

Researchers from other provinces and regions, and researchers from the affiliated institutions to the central government or the PLA in the above regions and provinces cannot apply, but may join the application as main participants. Graduate students cannot apply, but on-job students may apply through their

employer institutions at the consent of their supervisors. Researchers without a supporting institution or whose supporting institutions have not been registered at NSFC cannot apply for the Fund for Less Developed Regions.

In order to provide balanced preference for qualified applicants for the Fund for Less Developed Regions and encourage them to apply for projects of General Program and other competitive programs of NSFC, researchers who have been granted 3 or more projects under the Fund for Less Developed Regions are not allowed to apply for this fund again since the year 2016, but the Fund for Less Developed Regions grants approved in 2015 and earlier will not be counted in.

Applications for Fund for Less Developed Regions should be in accordance with the fund's outline requirements. The number of cooperative research institutes shall not exceed 2, and the fund duration shall be 4 years (only post-doctoral researchers can fill in duration according to the actual situation. The start time shall be January 1, 2020 and the finish time shall be December 31, 20XX).

In 2018, the Fund for Less Developed Regions supported 2,937 projects with a total funding of 1.10333 billion yuan. The average funding was 375,700 yuan per project, and the success rate was 16.41%, which is 2.52% lower than that in 2017 (please refer to the table below for the funding statistics).

Funding for Projects of the Fund for Less Developed Regions in 2018

Unit: 10,000 yuan

Departments	No. of applications	Awards				Success rate (%)
		No. of awards	Funding for direct cost	Average funding for direct cost	Share of NSFC total funding for direct cost (%)	
Mathematical and Physical Sciences	870	175	6,990	39.94	6.34	20.11
Chemical Sciences	1,350	235	9,400	40.00	8.52	17.41
Life Sciences	3,871	739	29,260	39.59	26.52	19.09
Earth Sciences	1,064	179	7,140	39.89	6.47	16.82
Engineering and Materials Sciences	2,333	344	13,750	39.97	12.46	14.74
Information Sciences	1,463	225	8,519	37.86	7.72	15.38
Management Sciences	938	145	4,074	28.10	3.69	15.46
Health Sciences	6,011	895	31,200	34.86	28.28	14.89
Total or average	17,900	2,937	110,333	37.57	100.00	16.41

In 2019, the average funding for direct costs is expected to be consistent

with that of 2018. Please refer to the actual funding levels of relevant departments and make budget request in a practical manner.

Please refer to sections of the General Program of various departments for the funding scope of the Fund for Less Developed Regions and funding statistics in recent years and relevant requirements.

Department of Mathematical and Physical Sciences

In 2018, the Department received 870 applications, accepted 861, and funded 175, with a success rate of 20.11%, and direct cost funding of 399,400 yuan in average. The Fund for Less Developed Regions in mathematical and physical sciences is aiming at creating a good research environment for these regions, fostering and stabilizing an appropriate amount of researchers, training talents in basic research for local scientific and technological development, and increasing the capability of solving urgent scientific problems in the development of national economy and society. In the evaluation of proposals for the Fund, special attention is paid to researches that have relative good research background with characteristics and advantage, so as to give full play to the role of the Fund for Less Developed Regions in talent fostering, and strengthen the support to researchers in Western China. The funding level in 2019 will be about the same as 2018.

Funding for Projects of the Fund for Less Developed Regions in Department of Mathematical and Physical Sciences in 2017 and 2018

Unit: 10,000 yuan

Divisions		2017			2018		
		Projects	Direct cost	Success rate (%)	Projects	Direct cost	Success rate (%)
Mathematics	Mathematics I	48	1,698.5	28.07	36	1,332	22.22
	Mathematics II	35	1,247.5	20.23	42	1,619	17.87
Mechanics	Basic Problems and Methods in Mechanics	2	76	50.00	1	36	25.00
	Dynamics and Control	3	130	21.43	4	170	22.22
	Solid Mechanics	10	397	22.73	11	467	18.97
	Fluid Mechanics	5	189	23.81	5	194	19.23
	Bio-Mechanics	1	44	20.00	2	85	25.00
	Explosive and Impact Dynamics	1	42	33.33	1	40	33.33
Astronomy	Astrophysics	9	360	33.33	6	257	24.00
	Astrometry and Celestial Mechanics	0	0	0	1	40	12.50
Physics I	Condensed Matter Physics	25	985	24.04	26	1,132	19.40
	Atomic and Molecular Physics	8	326	30.77	5	210	25.00
	Optics	11	446	20.00	13	531	19.70
	Acoustics	3	121	30.00	3	115	25.00
Physics II	Fundamental Physics and Particle Physics	7	266	19.44	8	312	18.18
	Nuclear Physics, Nuclear Technology and Its Application	8	321	29.63	6	244	21.43
	Particle Physics and Nuclear Physics Experimental Facilities	3	133	37.50	3	118	42.86
	Plasma Physics	4	158	20.00	2	88	16.67
Total or average		183	6,940	24.14	175	6,990	22.11
Direct cost per project		37.92			39.94		

Department of Chemical Sciences

On the basis of stabilizing the funding scale of the Fund for Less Developed Regions, the Department will make efforts to further promote the research quality and efficiency of the Fund, stabilize a batch of research talents for fundamental research, and continuously bridge the gap with the developed regions. Applicants are encouraged to carry out research by taking advantage of the local resources, so as to promote the economic development of the regions in a coordinated way.

In 2018, new discipline codes were employed to conduct funding and management in the Department. 1,350 proposals for the Fund for Less Developed Regions were received by the Department (138 proposals and 11.39% more than that of 2017). 235 proposals were funded with the success rate of 17.41% and the average funding intensity of 400,000 yuan per project. In 2018 the success rate decreased by 2.72% compared with that of 2017 based on the guarantee of the funding intensity by the Department. In 2019, the average funding intensity per project will be at the same level as that of 2018.

Funding for Projects of the Fund for Less Developed Regions in Department of Chemical Sciences in 2017 and 2018

Unit: 10,000 yuan

2017				2018			
Disciplines	Projects	Direct cost	Funding rate (%)	Divisions	Projects	Direct cost	Funding rate (%)
Inorganic Chemistry	36	1,317	20.11	Synthetic Chemistry	45	1,800	17.51
Organic Chemistry	55	2,094	20.22	Catalysis and Surface/Interface Chemistry	23	920	17.04
Physical Chemistry	34	1,294	20.48	Chemical Theory and Mechanism	10	400	18.18
Analytical Chemistry	27	1,028	20.00	Chemical Metrology	26	1,040	17.57
Macromolecular Science	16	609	20.51	Materials Chemistry and Energy Chemistry	40	1,600	17.54
Environmental Chemistry	30	1,142	20.27	Environmental Chemistry	33	1,320	17.55
Chemical Biology	6	229	22.22	Chemical Biology	20	800	16.53
Chemical Engineering and Industrial Chemistry	40	1,563	19.32	Chemical Engineering and Industrial Chemistry	38	1,520	17.43
Total or average	244	9,330	20.13	Total or Average	235	9,400	17.41
Direct cost	38.24			Direct cost	40.00		

Department of Life Sciences

In 2018, the Department received 3,871 applications for the Fund for Less Developed Regions (accepted 3,753 as eligible applications), and funded 739 projects. The funding rate was 19.10% with the average direct cost of 395,900 yuan per project. The average funding for 2019 will be similar with that of 2018. In the future, the Department will continue to follow the principle of "fostering regional talents, supporting sustained exploration, gathering outstanding talents and promote regional development" for this Fund, provide steady support to local talents and supporting researches related to local resources and natural conditions. **For more detailed information, please refer to the sections in the General Program of the Department in this *Guide*.**

Funding for Projects of the Fund for Less Developed Regions in Department of Life Sciences in 2017 and 2018

Unit: 10,000 yuan

Divisions		2017			2018		
		Projects	Direct cost	Funding rate (%)	Projects	Direct cost	Funding rate (%)
I of Biology	Microbiology	42	1,615	20.69	40	1,590	18.78
	Botany	58	2,193	21.17	62	2,448	18.73
	Zoology	27	1,029	21.60	23	912	19.17
II of Biology	Genetics and Bioinformatics	19	739	20.65	18	694	20.00
	Cell Biology	13	476	23.21	11	437	19.64
	Developmental Biology and Reproductive Biology	8	306	21.62	7	265	20.59
Biomedicine	Immunology	6	221	22.22	6	226	18.75
	Physiology & Integrative Biology	10	365	23.26	8	335	18.60
	Neurosciences and Psychology	19	689	22.89	20	796	19.42
Interdisciplinary Research	Biophysics/Biochemistry/Molecular Biology	12	459	21.43	13	530	18.31
	Biomaterials/ Imaging/Tissue Engineering	7	255	23.33	6	218	21.43
Environment and Ecology	Ecology	79	3,000	21.64	74	2,932	19.07
	Forestry and Grassland Science	88	3,341	21.84	83	3,296	18.86
Agriculture and Food Science	Agriculture and Crop Sciences	91	3,468	20.54	90	3,571	18.91
	Food Science	66	2,507	21.64	55	2,183	19.03
Agricultural Environment and Horticulture	Plant Protection	50	1,921	20.92	51	2,004	19.71
	Horticulture and Plant Nutrition	69	2,626	21.56	71	2,815	19.35
Agriculture Animal	Animal Husbandry	51	1,946	21.52	48	1,888	19.60
	Veterinary Medicine	39	1,479	21.55	40	1,590	19.32
	Aquaculture	11	425	19.30	13	530	18.06
Total or average		765	29,060	21.39	739	29,260	19.10
Direct cost		37.99			39.59		

Department of Earth Sciences

In 2018, the Department received 1,064 applications for the Fund for Less Developed Regions from 147 research institutions, among which, 932 were from universities (87.59%), and 110 from research institutes (10.34%). Totally, 179 projects were awarded with a direct expense of 71.4 million yuan. The average award was 398,900 yuan per project, and the funding rate was 16.82%. Among the projects funded in 2018, 159 were applied through universities (88.83%), and 18 through research institutes (10.06%). In 2019, the direct cost funding per project is expected to be similar to the amount approved in 2018.

Funding for Projects of the Fund for Less Developed Regions in Department of Earth Sciences in 2017 and 2018

Unit: 10,000 yuan

Divisions		2017			2018		
		Projects	Direct cost	Funding rate (%)	Projects	Direct cost	Funding rate (%)
I	Geography	118	4,475	20.03	62	2,463	16.89
II	Geology	23	881	19.83	13	503	17.33
	Geochemistry	20	737	20.62	5	208	16.13
III	Geophysics and Space Physics	7	273	19.44	7	288	16.28
	Environmental Earth Science	—	—	—	74	2,953	16.82
IV	Marine Science	7	258	20.59	8	322	16.67
V	Atmospheric Science	12	456	20.00	10	403	16.67
Total or average		187	7,080	20.06	179	7,140	16.82
Direct cost per project		37.86			39.89		

Note: The statistics of this table was made according to the former sub-disciplines in the Department before 2017.

Department of Engineering and Materials Sciences

According to NSFC policy on the Fund for Less Developed Regions, the Department will provide steady support to foster researchers in these regions, and encourage applicants to do basic researches by taking advantage of local resources and for regional economic development. In 2018, the Department received 2,333 applications (87 rejected) with an increase of 12.27%. 344 projects were funded with a total direct cost of 137.50 million yuan. The average funding was 399,700 yuan per project with a success rate of 14.74% (17.90% in 2017). In 2019, the average funding per project for Fund for Less Developed Regions will be the same as 2018.

Please refer to the General Program and other related parts of *Guide* for general instruction by the Department and the funding scope for the Fund.

Funding for Projects of the Fund for Less Developed Regions in Department of Engineering and Materials Sciences in 2017 and 2018

Unit: 10,000 yuan

Divisions		2017			2018		
		Projects	Direct cost	Success rate (%)	Projects	Direct cost	Success rate (%)
Materials Sciences I	Metallic Materials	37	1,415	17.29	34	1,340	15.38
	Polymer Materials	24	907	18.46	22	874	14.97
Materials Sciences II	Inorganic Non-Metallic Materials	43	1,628	17.70	36	1,478	15.45
Engineering Sciences I	Metallurgy and Mining Science	52	1,960	17.87	46	1,828	15.49
Engineering Sciences II	Mechanics and Mechanical Manufacturing	63	2,378	18.42	59	2,344	14.64
Engineering Sciences III	Engineering Thermo Physics and Energy Utilization	18	678	19.57	17	674	14.53
Engineering Sciences IV	Architecture, Environmental and Civil Engineering	74	2,860	17.29	76	3,020	13.74
Engineering Sciences V	Electrical Science and Engineering	24	905	17.91	22	897	14.19
	Hydrology and Marine Engineering	37	1,409	18.14	32	1,295	15.46
Total or average		372	14,140	17.90	344	13,750	14.74
Direct cost per project		38.01			39.97		

Department of Information Sciences

In 2018, the Department received 1,463 applications for the Fund and funded 225 projects with a total direct cost funding of 85.19 million yuan. The funding rate was 15.38% and the average direct cost funding was 378,600 yuan per project. In 2019, the Department will continue to give preferential support to the Fund for Less Developed Regions, and the average direct cost funding will be about the same. All eligible researchers are welcome to apply.

Funding for Projects of the Fund for Less Developed Regions in Department of Information Sciences in 2017 and 2018

Unit: 10,000 yuan

Divisions		2017			2018		
		Projects	Direct cost funding	Funding rate (%)	Projects	Direct cost funding	Funding rate (%)
I	Electronic Science and Technology	15	563	18.52	16	592	16.49
	Information and Communication System	16	585	17.58	17	627	16.04
	Information Acquisition and Processing	18	657	17.48	14	520	16.47
II	Theoretical Computer Science and Computer Software and Hardware	20	786	18.02	18	679	15.93
	Computer Application	53	2,000	17.49	30	1,154	15.62
	Network and Information Security	20	758	17.24	20	757	15.87
III	Control Theory and Control Engineering	49	1,870	17.43	39	1,471	37.70
	Systems Science and System Engineering				40	1,519	37.98
	AI and Intelligent Systems				4	152	38.00
IV	Semiconductor Science and Information Devices	12	472	17.65	12	466	15.38
	Information Optics and Photoelectric Devices	7	274	17.50	7	272	15.91
	Laser Technology and Technical Optics	8	315	17.39	8	310	16.67
Total or average		218	8,280	17.62	225	8,519	15.38
Direct cost per project		37.98			37.86		

Department of Management Sciences

In 2018, the Department received 938 applications for the Fund for Less Developed Regions, 20% more than those in 2018. 145 projects were funded with a funding rate of 15.46%, and the average funding for direct expenses was 281,000 yuan per project.

In 2019, the average funding for direct expenses will be the same as that in 2018.

Please note that the requirements described in the general description section of the General Program of the Department in this *Guide* are also applied to the Fund for Less Developed Regions, so please read carefully before submitting proposals.

Funded for Projects of the Fund for Less Developed Regions in Department of Management Sciences in 2017 and 2018

Unit: 10,000 yuan

Divisions		2017			2018		
		Projects	Direct cost	Funding rate (%)	Projects	Direct cost	Funding rate (%)
I	Management Science and Engineering	32	899	17.88	34	955.3	16.27
II	Business Administration	34	955	17.80	37	1,039.6	15.16
III	Economic Sciences	34	955	16.92	36	1,011.5	15.38
	Macro Management and Policy	36	1,011	17.06	38	1,067.6	15.14
Total or average		136	3,820	17.39	145	4074	15.46
Direct cost per project		28.09			28.10		

Department of Health Sciences

The Department mainly funds the basic research and the clinical basic research in the occurrence, development, outcome, diagnosis, treatment and prevention of diseases.

Researchers matching the conditions of the Fund for Less Developed Regions are encouraged to apply. The Fund for Less Developed Regions aims to train the scientific research teams of the specific regions, promote the development of science and technology in relevant regions, and serve the local economic and social development. Applicants are encouraged to propose creative research ideas, and conduct basic research on local diseases by using modern medical research concepts and methods. Joint research by applicants with researchers in developed regions is also encouraged in order to fully utilize the various advanced research facilities in developed regions.

The PDF copies of no more than five relevant representative papers should be attached to the proposal. For more detailed information, please refer to sections in the Fund for Less Developed Regions and General Program in this *Guide*.

In 2018, 6,011 proposals were received by the Department, and 895 of them were funded, with an average funding of 348,600 yuan (direct cost). The funding intensity of this program will remain the same as that in 2018 and the applicants are expected to fill in the budget form with detailed justification.

An overview of the award number, funding, and success rate of the Fund for Less Developed Regions in 2017 and 2018 by the Department is listed in the table below.

Funding for Projects of the Fund for Less Developed Regions in Department of Health Sciences in 2017 and 2018

Unit: 10,000 yuan

Divisions		2017			2018		
		Projects	Average funding for direct costs	Success rate (%)	Projects	Average funding for direct costs	Success rate (%)
I	Respiratory System, Circulatory System, Blood System	97	3,301	18.27	96	3,347	17.14
II	Digestive System, Urinary System, Endocrine System/Metabolism and Nutrition Support, Ophthalmology, Otorhinolaryngology Head and Neck Science, Oral and Craniomaxillo-Facial Science	108	3,637	17.22	107	3,708	15.60
III	Neurological and Psychiatric Diseases, Gerontology	59	1,999	14.64	58	2,026	12.18
IV	Reproductive System/ Perinatology/Neonatology, Medical Immunology	40	1,353	18.02	39	1,362	15.23
V	Medical Imaging and Biomedical Engineering, Special Medicine, Forensic Sciences	33	1,107	16.67	32	1,109	14.55
VI	Medical Pathogenic Microorganisms and Infection, Orthopedics and Sports Medicine, Emergency and Intensive Care Medicine/Trauma/ Burns/Laboratory Medicine/Plastic Surgery/ Rehabilitation Medicine	81	2,723	16.04	79	2,755	14.18
VII	Oncology (Leukemia not included)	139	4,681	13.52	136	4,712	11.93
VIII	Skin and Appendages, Preventive Medicine, Endemiology, Occupational Medicine, Radiology	62	2,141	22.79	61	2,150	19.93
IX	Materia Medica and Pharmacology	59	2,007	18.97	58	2,029	15.85
X	Chinese Medicine, Chinese Materia Medica, Integrated Chinese and Western Medicine	234	7,921	18.53	229	8,002	15.86
Total or average		912	30,870	17.01	895	31,200	14.89
Direct cost		33.85			34.86		

Excellent Young Scientists Fund

The Excellent Young Scientists Fund supports young scholars with good achievements in basic research to conduct innovative research in areas on their own choice, so as to promote fast growth of creative young talents and foster a number of outstanding talents on the international science frontiers. It mainly supports applicants who meet the following qualifications:

(1) Citizenship of the People's Republic of China;

(2) Under the age of 38 (for male, born on or after January 1, 1981) or 40 (for female, born on or after January 1, 1979) by January 1 of the year of application;

(3) Good scientific integrity;

(4) Senior professional position (title) or PhD degree;

(5) Experience of conducting basic research projects or other basic research;

(6) No employment with foreign institutions;

(7) Able to work in host institution for no less than 9 months per year.

Young Chinese scholars without Chinese citizenship may apply if they meet the requirements from (2) to (7) listed above.

The following people may not apply:

(1) Grantees of the National Science Fund for Distinguished Young Scholars or the Excellent Young Scientists Fund;

(2) Applicants for the National Science Fund for Distinguished Young Scholars in the same year;

(3) Post-doctors and graduate students.

Special reminder to the applicants:

(1) Concerning the coordination between Excellent Young Scientists Fund and other National S&T Talent Plans, Central Talent Coordination Group shall make overall deployment and further notice;

(2) In 2019, for Excellent Young Scientists Fund, pilot paperless application is carried out. In the process of submission, the supporting institution shall only confirm the online application and the attachments, without having to submit a paper form application. After the project has been approved, the signature and seal page (A4) of the application form should be submitted at the time of submitting the research project plan.

The signature and seal information should be consistent with that of the electronic application.

In 2018, NSFC received 5,421 applications for the Excellent Young Scientists Fund and granted 400 awards with a total funding of 520 million yuan for direct cost.

In 2019, the Fund plans to grant 400 projects and the average funding is 1.3 million yuan per project for 3 years.

Funding for Projects of Excellent Young Scientists Fund in 2018

Departments	No. of applications	No. of awards	Success rate (%)
Mathematical and Physical Sciences	637	47	7.38
Chemical Sciences	750	57	7.60
Life Sciences	775	58	7.48
Earth Sciences	558	40	7.17
Engineering and Materials Sciences	1,013	74	7.31
Information Sciences	869	60	6.90
Management Sciences	189	14	7.41
Health Sciences	630	50	7.94
Total or average	5,421	400	7.38

National Science Fund for Distinguished Young Scholars

The National Science Fund for Distinguished Young Scholars supports young scholars who have made outstanding achievements in basic research to select their own research directions and conduct creative research, so as to speed up the growth of young scientific talents, attract overseas talents and foster a group of prominent academic pacemakers in the forefront of international science and technology.

Eligibility for application:

(1) Citizenship of the People's Republic of China;

(2) Under the age of 45 by January 1 of the year of application (born on or after January 1, 1974);

(3) Good scientific integrity;

(4) Senior professional position (title) or PhD degree;

(5) Experience of conducting basic research projects or other basic research;

(6) No employment by foreign institutions;

(7) Able to work in host institution for no less than 9 months per years.

Young Chinese scholars without Chinese citizenship may apply if they meet the requirements from (2) to (7) listed above.

The following people may not apply:

(1) Post-doctors doing research or graduate students;

(2) Grantees of ongoing project of the Excellent Young Scientists Fund (application is allowable on the year of completion of the ongoing project of the Excellent Young Scientists Fund);

(3) Applicants for the Excellent Young Scientists Fund in the same year;

(4) Having received the National Science Fund for Distinguished Young Scholars.

Special reminder to the applicants:

(1) Concerning the coordination between Excellent Young Scientists Fund and other National S&T Talent Plans, Central Talent Coordination Group shall make overall deployment and further notice

(2) To further simplify application materials and management procedure, since 2019 recommendation comments from the host institutions and **comments from Academic Committee or Expert Panel** are not required.

In 2018, NSFC received 2,974 applications for the National Science Fund for Distinguished Young Scholars and granted 199 awards with a total funding of 682.85 million yuan for direct cost.

In 2019, the National Science Fund for Distinguished Young Scholars plans to fund 200 projects, and the average funding is 3.5 million yuan per project for 5 years (2.45 million yuan per project for 5 years in the Department of Mathematical and Physical Sciences and the Department of Management Sciences).

Funding for Projects of the National Science Fund for Distinguished Young Scholars in 2018

Departments	No. of applications	No. of awards	Success rate (%)
Mathematical and Physical Sciences	353	25	7.08
Chemical Sciences	433	30	6.93
Life Sciences	358	25	6.98
Earth Sciences	308	21	6.82
Engineering and Materials Sciences	558	38	6.81
Information Sciences	489	29	5.93
Management Sciences	109	7	6.42
Health Sciences	366	24	6.56
Total or average	2,974	199	6.69

Science Fund for Creative Research Groups

The Science Fund for Creative Research Groups supports prominent middle-aged and young scientists to work as academic leaders and PIs on creative research focusing on key research issues, and fosters research groups with international influence.

Applicants and participants should meet the following requirements:

(1) Experience of conducting basic research projects or other basic research;

(2) Guarantee to work in host institutions for no less than 6 months per year within the funding period;

(3) Have a research team based on long-term collaboration, including 1 academic leader and 5 or more backbone researchers;

(4) The academic leader or the PI should have senior professional position (title), high academic qualifications and international influence, and be less than 55 years old by January 1 of the year of application (born on or after January 1, 1964);

(5) Backbone researchers or group members should hold senior professional position (title) or have PhD degrees;

(6) Applicants and participants should be in the same host institution.

PIs who have been awarded the Science Fund for Creative Research Groups before may not apply again. PIs and participants with senior academic title of an ongoing project supported by the Science Fund for Creative Research Groups may not apply or participate in the application. Participants who quit from a project supported by the Science Fund for Creative Research Groups are not permitted to apply again in 2 years after the withdrawal.

Applicants with senior academic titles may only apply for one project of the Science Fund for Creative Research Groups each year. **The total number of Science Fund for Creative Research Groups and Basic Science Center Program shall not exceed 1.**

Notes to applicants:

In 2019, the funding and managing mechanism for Science Fund for Creative Research Groups is further optimized. While maintaining the funding intensity, the funding duration is shortened from 6 years to 5 years. Extended funding is cancelled for the on-going (approved between 2013 and

2018) and newly-approved (2019 and after) Science Fund for Creative Research Groups. The applicant cannot apply for both Basic Science Center Program and the Science Fund for Creative Research Groups within the same year. To further simplify application materials and management procedure, since 2017 recommendation comments from the host institutions and comments from Academic Committee or Expert Panel are not required.

In 2018, a total of 256 applications for the Science Fund for Creative Research Groups and 38 awards were made with a total funding of 389.55 million yuan for direct costs.

In 2019, the Science Fund for Creative Research Groups plans to support 46 awards, with duration of 5 years and a funding amount of 10.5 million yuan per award for direct cost (7.35 million yuan for awards by the Department of Mathematical and Physical Sciences and the Department of Management Sciences).

Awards Granted by the Science Fund for Creative Research Groups in 2018

Unit: 10,000 yuan

Departments	No. of applications	Awards		Success rate (%)
		No. of awards	Direct cost	
Mathematical and Physical Sciences	34	5	4,935	14.71
Chemical Sciences	29	5	5,250	17.24
Life Sciences	44	5	5,250	11.36
Earth Sciences	35	5	5,250	14.29
Engineering and Materials Sciences	44	6	6,300	13.64
Information Sciences	41	5	5,250	12.20
Management Sciences	5	2	1,470	40.00
Health Sciences	30	5	5,250	16.67
Total or average	262	38	38,955	14.50

Basic Science Center Program

The Basic Science Center aims to gather and integrate domestic advantageous scientific research resources, target at international science frontiers, advance deployment, give full play to the advantages and characteristics of the science funding system, rely on high-level academic leaders, attract and assemble outstanding S&T talents, and promote in-depth cross-discipline integration, support scientific personnel to conduct research and exploration in a relatively long-term and stable way, produce a number of original achievements at international leading level, seize the dominant position in international scientific development and establish a number of academic highlands with important international influence.

Applicants and key participants for the Basic Science Center Program should meet the following qualifications:

(1) Have the experience of undertaking basic research project or doing other basic research;

(2) The consortium should be an excellent research team with multi-disciplinary crossings at the scientific frontiers, including 1 academic leader and at most 4 key applicants;

(3) As the applicant, the academic leader should be an internationally well-known scientist in the field, with senior academic position (title), outstanding academic ability and a proven track record of coordinating and managing large-scale projects, strong coordination and cohesion, able to assemble excellent researchers from various scientific backgrounds, under the age of 60 by January 1 of the year of application (born on or after January 1, 1959);

(4) Key applicants should be mainly young or middle-aged, with senior academic position (title) and outstanding research achievements in related scientific fields and potential for continuous growth.

Note to applicants:

In 2019, on the basis of basic science center pilot program, further regulation on the funding management of basic science center program is conducted.

Applicants can submit the proposal to NSFC from the host institutes

during the general submission period.

The funding cycle will be "5+5" years mode. 5 years is one funding period. Up to 2 periods can be applied for.

The total number of host institutions and cooperative research institutions cannot exceed 3.

During the stage of application, the Basic Science Center Program are not counted in the total number of applications and on-going projects, but are counted before receiving NSFC's formal funding decision and after approval. After receiving the Basic Science Center program, the applicant and the key participants cannot apply for or participate in other types of program other than the National Science Fund for Distinguished Young Scholars and the Excellent Young Scientist Fund.

The total number of applications for National Major Instrument Equipment R&D Program and Basic Science Center program within the same year cannot exceed 1.

The total number of Creative Research Group and Basic Science Center Program the researcher applies for either as the applicant or the main participant (including key participants and key research personnel) cannot exceed 1.

The applicant and the participant with senior academic positions (titles) of the on-going Basic Science Center Program cannot apply for the same program either as the applicant or as the participant, unless it is in the last year.

In the course of application, select "Science Center Program" in the funding category, "Basic Science Center Program" in the subclass introduction and the correct application code according to the actual research content.

The funding period of Basic Science Center Program is 5 years and the duration shall be "from January 1, 2020 to December 31, 2024". The direct cost shall not exceed 80,000,000 yuan (for Mathematics and Management Sciences, the direct cost shall not exceed 60,000,000 yuan). The applicant may apply for extended funding within 3 months after the funding finishes based on actual work demands. The extended funding period is 5 years.

Joint Research Fund for Overseas Chinese Scholars and Scholars in Hong Kong and Macao

In order to take advantage of the overseas (including Hong Kong and Macao) resources in science and technology and encourage overseas excellent young scholars to serve mainland China, NSFC sets up the Joint Research Fund for Overseas Chinese Scholars and Scholars in Hong Kong and Macao to support excellent overseas (including Hong Kong and Macao) Chinese scholars under the age of 50 to conduct high-level joint research with scientists in mainland China.

The Joint Research Fund for Overseas Chinese Scholars and Scholars in Hong Kong and Macao adopts a "2+4" funding mode, and extended funding may be requested at the end of the two-year period.

Special reminder to the applicants: since 2019, Joint Research Fund for Overseas Chinese Scholars and Scholars in Hong Kong and Macao is not launched. After 2020, extended program for Joint Research Fund for Overseas Chinese Scholars and Scholars in Hong Kong and Macao will not be launched.

Extended Funding Projects

1. Eligibility for application:

(1) Grantees of two-year projects of the Joint Research Fund for Overseas Chinese Scholars and Scholars in Hong Kong and Macao who were approved in 2016 are eligible, if their projects have made substantial progress and have been completed in due time. For grantees of two-year projects of the Joint Research Fund for Overseas Chinese Scholars and Scholars in Hong Kong and Macao who were approved in 2015, they are eligible for application if they have not applied for extended funding after the completion of the two-year project or failed to obtain extended funding;

(2) Applicants have to ensure enough time to stay at the host institution for research during the funding period (2 years) of the project;

(3) Applicants have to sign extended agreement of cooperation with the host institution. The agreement should include such content as the title, research direction and proposed goal of the joint research project, the host institution's promise to provide main experimental facilities, human resources, and other materials necessary for the joint research;

(4) Proposed extended cooperation should be focused on the international science frontiers with much significance and should facilitate disciplinary development and talent fostering;

(5) The applicants are required to work in the host institution for more than 2 months per year;

Both the applicant and the collaborator may apply for no more than one extended project of the Joint Research Fund for Overseas Chinese Scholars and Scholars in Hong Kong and Macao. Those who have not finished their post-doctor or graduate studies are not eligible collaborators in mainland China.

2. Notes to applicants:

(1) The extended funding mainly evaluate the progress of the cooperative work, whether the proposed research for extended funding is at the international frontier of research, and its contribution to disciplinary development and talent fostering;

(2) Applicants are advised to prepare their research proposals by providing accurate information in accordance with the outlines for the Joint Research Fund for Overseas Chinese Scholars and Scholars in Hong Kong and Macao, and submit the proposals with relevant required supplementary documents, including the agreement covering the duration of the project.

In 2018, NSFC received 73 extended funding applications for the Joint Research Fund for Overseas Chinese Scholars and Scholars in Hong Kong and Macao and granted 22 awards with a total funding of 39.6 million yuan for direct cost.

In 2019, the Joint Research Fund for Overseas Chinese Scholars and Scholars in Hong Kong and Macao plans to fund 20 extended projects and the total funding for direct cost will be 1.8 million yuan per project for 4 years.

International (Regional) Cooperation and Exchange Programs

In order to improve the quality of China's scientific research and its international competitiveness, the International (Regional) Cooperation and Exchange Programs aim at funding Chinese scientists to conduct substantial cooperation with their international collaborators in science frontier and take full advantage of international scientific and technological resources on the basis of "equal cooperation, mutual benefits, and equal sharing of research results".

The funding system of the International (Regional) Cooperation and Exchange Programs is currently comprised of Key International (Regional) Joint Research Program, International (Regional) Joint Research and Exchange Programs funded under the Agreements/MoUs between NSFC and its foreign partners, and Research Fund for International Young Scientists.

Key International (Regional) Joint Research Program

The Key International (Regional) Joint Research Program (hereafter referred to as Key Joint Research Program), gives priority to research in the following areas: the priority funding areas of NSFC, areas that China urgently needs to develop, international mega projects and programs with Chinese participation, and utilizing large-scale scientific facilities abroad.

Researchers applying for this program shall, in accordance with the priority funding areas announced by relevant scientific departments, choose innovative joint research subjects centering on major scientific issues, and clarify the necessity and complementarities of the cooperation. Chinese applicants and their foreign partners shall have long-term steady collaboration (e.g., coauthored publications and continued personnel exchanges and interactions) and the overseas partners shall have matching resources for this research. In the process of cooperation, attention shall be given to the protection of intellectual property rights.

In 2018, altogether 106 out of the total 685 applications under the Key International (Regional) Joint Research Program were funded with a total funding of 257 million yuan for direct costs, and an average success rate of 15.47 %.

In 2019, the Key International (Regional) Joint Research Program plans to fund 100 projects with the same average funding for direct costs per project as in 2018, and each project usually lasts for 5 years.

Eligibility of Applicants

(1) With the title of professor or associate professor; and as the PIs of on-going or completed NSFC research project with the duration of no less than 3 years.

(2) Holding National Overseas High-level Talent Introduction Plan (Thousand Talent Plan), Innovative Talent Long-term Project or Young Talent Project.

Eligibility of Foreign Partners

(1) Independent researchers in charge of research laboratories or key research projects abroad;

(2) With the title of professor or associate professor in the host countries/regions.

Appendix Documents

Aside from the Chinese application form, the applicant should also submit the following documents as required:

(1) English Application Form: The English Application Form can be downloaded in NSFC's Internet-based Science Information System (ISIS) and should be uploaded online when filled in.

(2) Letter of Agreement: A copy of the Letter of Agreement signed between the collaborating PIs should be provided. Unilaterally signed letters are not valid. The Letter of

Agreement mainly covers:

(i) Research contents and objectives;

(ii) List of collaborating PIs and participants;

(iii) Period, mechanism and plan of joint research;

(iv) Ownership, use and transfer of IP rights;

(v) Relevant budgetary arrangements.

The applicant could refer to the sample Letter of Agreement which can be downloaded at http://www.nsfc.gov.cn/Portals/0/fj/fj20161230_02.doc.

(3) Documents verifying the foreign partners' holding of or participation in research projects related to the submitted application, as well as a list of publications related to the submitted application by the foreign partners in the past 3 years.

(4) Letter of confirmation by the foreign collaborator: If the foreign collaborator cannot sign the English Application Form, a letter of confirmation by him/her should be provided. The letter of confirmation should contain contact information about the foreign collaborator. The letter of confirmation should be written in official forms including the title, logo and contact information of the foreign collaborator's employer. In addition, the letter of confirmation should contain detailed information such as the title of the research, the content and period of cooperation, the way to share IPR, etc. The foreign collaborator should confirm in the letter that he/she has read and agrees with the English Application Form.

Funding Priorities for the International (Regional) Joint Research Program in 2019:

1. Department of Mathematical and Physical Sciences

(1) New methods and new technologies of experimental mechanics

(2) Nonlinear mechanical issues of complex systems

(3) Sky surveys and space observations

(4) New astronomical technological methods associated with the large telescopes

(5) Quantum computation and simulation in extensible solid physics system

(6) Light field control and its interaction with matter

(7) Precision measurement of physical constants

(8) Research on high performance particle detector

(9) Hadron structure and new cutting-edge research of hadron states

(10) Physical uncertainty of magnetically confined fusion plasma and advanced measurement diagnosis technology

(11) Physical issues in new energy

(12) Joint research based on large-scale scientific facilities at home and abroad

2. Department of Chemical Sciences

(1) Catalysis and chemical precision synthesis

(2) Green chemistry and the reaction and process of sustainable chemistry

(3) Process and mechanism of surface and interface chemistry

(4) Theoretical and computational chemistry of complex systems

(5) Precise chemical measurement and imaging

(6) Molecular assembly, structure and function

(7) Molecular basis for advanced functional materials

(8) Natural products chemistry and drug discovery

(9) Chemical biology

(10) Environmental pollution chemistry and control

(11) Scientific issues on the medium scale in chemical process

(12) Artificial intelligence chemistry

Applicants should focus on topics featuring basic, interdisciplinary, frontier and complementary research.

3. Department of Life Sciences

(1) Biological characteristics and pathogenic mechanism of important pathogenic microorganisms

(2) Plant systems and evolution

(3) Adaptation and response of species and ecosystems to global climate change

(4) Degradation mechanism and restoration of forest

(5) Biomolecular system simulation and design synthesis

(6) Organ's engineering construction and biomimetic construction

(7) Tumor's immune recognition, response and regulation mechanism

(8) The neurobiological basis of instinctual behavior

(9) Exercise and health

(10) The development process of human cognition and social behavior

(11) Molecular mechanism of tissue organ development and regeneration

(12) Molecular mechanisms of cell proliferation, differentiation, senescence and death

(13) Chromatin structure and function and epigenetic regulation

(14) Excavation and utilization of excellent germplasm resources of crops

(15) Food safety, quality and nutrition associated with food production

(16) Invasion, expansion and adaptation mechanisms of agricultural pests

(17) Quality formation and regulation mechanism of horticultural products

(18) Formation and adaptive evolution of animal diversity pattern

(19) Mechanism and nutritional regulation of high quality traits in livestock and poultry

(20) Basic research on prevention and control of animal diseases

(21) Resource assessment and protection of aquaculture species

China's international cooperation and exchanges in the field of biology should be guided by national needs and national interests, and be closely combined with China's medium and long-term scientific and technological development plans and major scientific and technological special program. Due attention will be paid to joint research between strong partnering research teams and joint research between Chinese researchers and foreign partners with superior research capacities or facilities. Chinese applicants are encouraged to take the lead in joint research activities.

4. Department of Earth Sciences

(1) Surface critical processes and their multivariate effects

(2) Environmental pollution and its impacts

(3) Eco-environment effect of globalization and human activities

(4) System and mechanism of metallogenic accumulation

(5) Processes in and between continental plates

(6) Coupling relation between deep and surface earth processes

(7) Mechanism, monitoring, early warning and risk prevention and control of geological disasters

(8) Solar-terrestrial energy transfer between and its impact on human activities

(9) Water cycle and ecohydrological process

(10) Key processes and extreme weather events in weather and climate system

(11) Monsoon, drought and global change

(12) Origin and major evolutionary events of key biological taxa and the environmental backgrounds

(13) Life process under extreme conditions

(14) Dynamic process and mechanism of marine multi-scale interactions

(15) Marine ecological system security and deep-sea biological resources

(16) Advanced technology platforms to promote the development of earth and planetary sciences

(17) Resources, environment and ecology along the Belt and Road regions

5. Department of Engineering and Materials Sciences

(1) Energy materials

(2) Nano material and devices

(3) Biomedical materials

(4) High performance structural materials

(5) Sustainable materials

(6) Resource circulation and clean metallurgy

(7) Advanced manufacturing, green manufacturing and smart manufacturing

(8) Sustainable energy, efficient and clean utilization of energy

(9) High efficiency power electronic system

(10) Efficient high quality motor system

(11) Water resources and water environment

(12) Urban water environment and water quality safety

(13) Civil engineering disaster prevention and whole life reliability

(14) Deep-sea engineering

6. Department of Information Sciences

(1) The basic theory and key technologies in the new generation of mobile communications

(2) Information detection and processing in medical sciences

(3) Theory and design of millimeter wave circuit and antenna integration

(4) Theory and key technologies of probing imaging

(5) Basic theory and method of system software

(6) Network and information security

(7) Social media analysis and processing in big data environment

(8) Aero engine control

(9) Security and protection of physical information system

(10) Deep learning new theory and new methods

(11) Optoelectronic technology for environmental detection

(12) Imaging technology for photoelectric medical science

(13) Extremely energy efficient integrated circuit and system architecture

(14) New optical materials

7. Department of Management Sciences

(1) Behavioral law in the management systems
(2) Analysis, experiment and modeling of complex management systems
(3) Complex engineering and complex operation management
(4) Analysis and optimization of traffic system in mobile Internet environment
(5) Data-driven financial innovation and risk laws
(6) Laws of entrepreneurial activity and its ecosystem
(7) Laws of the transformation and innovation of Chinese enterprises
(8) Enterprise innovation behavior and national innovation system management
(9) Management science issues in service economy
(10) Laws governing China's green and low-carbon socio-economic development
(11) Research on China's economic restructuring and mechanism reconstruction
(12) Laws of the basic management of national security
(13) Basic laws of state and social governance
(14) Rules and mechanisms of new urbanization management
(15) Mobile Internet medical and health management
(16) Coordination mechanism for international macroeconomic policy and international economic governance structure
(17) Ethics and integrity in scientific research

8. Department of Health Sciences

(1) New mechanisms of the common pathology of development, inflammation, metabolism, probiotics, microenvironment, etc.
(2) Pathogenesis and precise diagnosis and treatment of major chronic diseases
(3) Epidemiology of chronic diseases and injuries and related prevention and intervention strategies
(4) Rapid identification, pathogenesis, prevention, early warning new treatment of emerging and emergency infectious diseases
(5) Infectious diseases and antibiotic resistance
(6) Frontier research on first aid, trauma, rehabilitation and regenerative medicine
(7) Women and children's health
(8) Research on the frontier of reproduction, development, aging related diseases
(9) Nutrition, environmental, genetic and health
(10) Stem cells and diseases
(11) Organ fibrosis and prevention mechanism
(12) Tissue and organ damage, dysfunction and intervention
(13) Protection of organs and replacement therapy
(14) Pathogenesis and intervention of neuropsychiatric disorders
(15) Mechanisms of immune-related diseases and new immunotherapy strategies
(16) Interdisciplinary scientific research on diseases
(17) Medical imaging and biomedical engineering
(18) Innovative medical technologies and personalized medicine
(19) Biomarkers and personalized medicine
(20) Discovery of new drug targets and pharmacological validation
(21) Modern scientific connotation of traditional Chinese medicine theories
(22) Material basis and mechanism of traditional Chinese medicine
(23) Basic research on special and forensic medicine

In principle, PIs in programs with large funding amounts such as Key

International (Regional) Joint Research Program, Major Program, Key Projects of Major Research Plan Program granted in 2018 will not be considered for funding under the Key International (Regional) Joint Research Program in 2019.

International (Regional) Cooperation and Exchange Programs under Agreements/MoUs

Jointly organized and funded by NSFC and foreign science funding agencies (or research institutions and international organizations), the International (Regional) Cooperation and Exchange Programs under Agreements/MoUs support bilateral and multilateral joint research and academic exchanges between Chinese scientists and their foreign partners. In recent years, greater efforts by NSFC have been focused on policy research on international collaboration, and both the cooperation network and funding areas have been expanded with the U.S., Canada, and Australia. More extensive exchanges have been conducted between NSFC and partners in South America. The partnership between NSFC and European partners has been promoted comprehensively by further enhanced diverse collaborative activities with respective European partner countries and the EU as a whole. The collaboration mechanisms with Japan and South Korea have been further deepened, with expanded funding scale for the Asian 3 Foresight Program. The scientific cooperation with Israel and Singapore has also been promoted to more expanded research areas. Greater efforts have been put in furthering the bilateral cooperation with partners of key potentials and impacts in such developing countries as India, South Africa, Brazil, Thailand, Egypt, etc. Multi-lateral international cooperation between Chinese applicants and their international partners has been encouraged to take advantage of the coordinative role played by international scientific organizations in promoting cross-border scientific research plans, and participate in and conduct cross-border regional research plans. Besides, NSFC plays an active role in promoting the cooperation between Chinese scientists and their partners along the Belt and Road route. Adhering to the “one country, two systems” policy of the central government, NSFC has always been attaching significance to the collaboration between researchers in mainland China with partners in Hong Kong, Macao and Taiwan regions. NSFC has by far concluded 92 cooperation agreements/MoUs with science funding agencies and research institutions in 49 countries/regions. Through negotiation, NSFC reaches agreements with its foreign partners on cooperation and exchange pattern, funding area, volume of awards, funding amount and review mechanism. Based on mutual agreement, NSFC launches joint call for proposals with its foreign partners on their websites and then organize scientists to submit and review applications.

The International (Regional) Cooperation and Exchange Programs under Agreements/MoUs include Joint Research Program and Personnel Exchange Program.

The Joint Research Program under Agreements/MoUs includes bilateral or multilateral joint research projects funded by NSFC and its international partners under the framework of cooperation agreements/MoUs signed between them to support Chinese researchers and their collaborators abroad to carry out research in basic sciences.

The Personnel Exchange Program under Agreements/MoUs aims to encourage NSFC grantees to participate in extensive international cooperation and exchange activities, and to enhance the innovativeness, talent training, disciplinary development and research quality of the on-going NSFC projects. The Personnel Exchange Program under Agreements/MoUs include personnel exchange program and academic conference program featuring the mobility of scientists. Meanwhile, it encourages scientists to maintain sound bi/multilateral relations with overseas partners through wide cooperation and exchange, laying a solid foundation for future in-depth and substantial collaboration. Academic Conference Program under Agreements/MoUs is aimed at supporting scientists to hold bilateral or multi-lateral international conferences in China or outside the mainland with a view to enabling Chinese scientists to keep pace with the latest research frontiers and hotspots in the international academic arena, to enhancing the partnership between Chinese scientists and their foreign peers, and to promoting the visibility of the results achieved by NSFC funded projects and raising the profile of China's academic community.

Applicants could refer to the following introductions and the calls for proposals irregularly launched on NSFC website for application eligibility, priority funding areas, funding duration, and application requirements. In addition, the National Overseas High-level Talents Program ("Thousand Talents Program"), Innovative Talents Long-Term Project holders or Young Talent Project holders are not restricted by the application limit listed in the International (Regional) Cooperation and Exchange Programs under Agreements/MoUs, when applying for the collaborative research projects.

Applicants could also refer to the column for International Cooperation on NSFC's website for relevant information about these programs in 2019. An introduction of the funding opportunities under this category in 2019 is listed as follows.

Asia and Africa

Japan

Japan Science and Technology Agency (JST)

The NSFC and JST Joint Research Program initiated in 2004 on the theme of "S&T for Environmental Conservation and Construction of a Society with Less Environmental Burden". Every year both sides negotiate and define specific priority areas for cooperation, followed by a bilateral workshop alternately held in China and Japan in the defined priority area. Participants in the annual workshop will propose concrete research topics for joint funding. Since 2015, the priority area for both sides has been changed into biological genetic resources.

In 2019, NSFC and JST would continue to release a call for join research projects. For more information regarding application, please refer to the call for proposals to be launched by NSFC in the column of "Notice and Announcements" on its website in due time.

Japan Society for the Promotion of Science (JSPS)

The call for proposals of exchange project and bilateral workshop is issued jointly by both NSFC and JSPS on their respective websites in June every year. The submission

deadline is Friday of the first complete week in September.

(1) Exchange Project

NSFC and JSPS jointly support 10 exchange projects each year, the duration of which is 3 years. The exchange volume shall not exceed 60 person-days per year for each side.

(2) Bilateral Workshop

NSFC and JSPS support 4 bilateral workshops per year organized jointly by Chinese and Japanese scientists, of which two are held in China and two in Japan. Participants of a bilateral workshop from each side must come from at least three institutions.

In 2019, NSFC and JSPS will also release a call for join research projects. For more information regarding application, please refer to the call for proposals to be launched by NSFC in the column of "Notice and Announcements" on its website in due time.

South Korea

National Research Foundation (NRF)

NSFC and NRF will jointly support joint research project, exchange project and bilateral workshop in 2019.

Two calls for proposals will be released in 2019 by both foundations on their respective websites, one for joint research project, and the other for exchange project & bilateral workshop. The joint funding decision for exchange project and bilateral workshop will be made at the Sino-Korean Joint Committee on Basic Science after deliberation and discussion of participating experts.

(1) Joint Research Project

Two three-year joint research projects are planned to be funded by NSFC and NRF in 2019 with NSFC investing 2 million yuan (direct cost) for each project.

(2) Exchange Project

Around 20 two-year exchange projects are planned to be funded by NSFC and NRF in 2019.

(3) Bilateral Workshop

Around 10 bilateral workshops are planned to be funded by NSFC and NRF in 2019. Participants of bilateral workshops from each side must come from at least three institutions.

Israel

Israel Science Foundation (ISF)

NSFC and ISF together fund joint research projects and bilateral workshops.

(1) Joint Research Project

The priority collaborative areas in 2019 are mathematics, physics, chemistry, earth sciences, nanotechnology, and computer science. Around 35 three-year projects are planned for joint funding with NSFC investing 2 million yuan (direct cost) for each project.

(2) Bilateral Workshop

Each year, no more than 2 bilateral workshops are planned to be funded by NSFC and ISF. The workshop themes are decided by both sides through negotiation.

Three Asian Countries (China, Japan and South Korea)

A3 Foresight Program

The A3 Foresight Program is a funding program for joint research which was set up and sponsored by NSFC, Japan Society for the Promotion of Science (JSPS) and National Research Foundation of Korea (NRF) together. China, Japan and South Korea support the cooperation of scientists from the three countries to conduct world-class cutting-edge research in selected strategic areas, so as to foster excellent young researchers and make contributions to the solution of common regional issues.

The priority area of A3 Foresight Program for each year is in accord with the theme of the Northeastern Asian Symposium jointly organized by NSFC, JSPS and NRF in the previous year. The priority collaborative area in 2019 is nuclear physics in 21st century.

The call for proposals is simultaneously announced on the websites in November by the three parties and 2 five-year projects will be jointly funded annually, with NSFC investing 4 million yuan (direct cost) in each approved project.

Thailand

National Research Council of Thailand (NRCT)

NSFC and NRCT jointly support joint research project, exchange project and bilateral workshop. In 2019, NSFC and NRCT will also release a call for join research projects. For more information regarding application, please refer to the call for proposals to be launched by NSFC in the column of “Notice and Announcements” on its website in due time.

Thailand Research Fund (TRF)

NSFC and TRF jointly support joint research project, exchange project and bilateral workshop.

(1) Joint Research Project

In 2019, the joint call for proposals with specific collaborative topics will be launched by NSFC and TRF on their websites respectively, and around 5 projects with duration of three years will be funded, with an investment of 2 million yuan (direct cost) by NSFC for each project.

(2) Exchange Project

Chinese and Thai scientists are required to submit proposals to NSFC and TRF respectively. The two agencies would make a funding decision after consultation.

(3) Bilateral Workshop

NSFC and TRF support bilateral workshops every year. The themes and number of workshops to be funded will be decided by both sides through negotiation.

Singapore

National Research Foundation of Singapore (NRF)

NSFC and NRF together fund joint research projects and bilateral workshops.

In 2019, NSFC and NRF will also release a call for join research projects. For more information regarding application, please refer to the call for proposals to be launched by NSFC in the column of “Notice and Announcements” on its website in due time.

Pakistan

Pakistan Science Foundation (PSF)

NSFC and PSF together fund joint research projects and bilateral workshops.

(1) Joint Research Project

In 2019, the joint call for proposals with specific collaborative topics will be launched by NSFC and PSF on their websites respectively, and around 10 projects with duration of three years will be funded, with an investment of 2 million yuan (direct cost) by NSFC for each project.

(2) Bilateral Workshop

NSFC and PSF support bilateral workshops every year. The themes and number of workshops to be funded will be decided by both sides through negotiation.

Egypt

Academy of Scientific Research and Technology (ASRT)

NSFC and ASRT signed a scientific agreement in November 25, 2002. As of now, the two sides have jointly funded 8 exchange projects and 3 bilateral workshops.

In 2019, NSFC and ASRT will also release a call for join research projects. For more information regarding application, please refer to the call for proposals to be launched by NSFC in the column of "Notice and Announcements" on its website in due time.

Sri Lanka

National Science Foundation of Sri Lanka (NSF)

NSFC and NSF together fund joint research projects and bilateral workshops.

(1) Joint Research Project

For information regarding application in 2019, please refer to the call for proposals to be launched by NSFC in the column of "Notice and Announcements" on its website in due time.

(2) Bilateral Workshop

NSFC and NSF support bilateral workshops every year. The themes and number of workshops to be funded are decided by both sides through negotiation.

Mongolia

Mongolian Foundation for Science and Technology (MFST)

NSFC and MFST signed a scientific agreement in July 3, 2017. NSFC and MFST together fund joint research projects and bilateral workshops.

In 2019, NSFC and MFST will release a call for join research projects. For more information regarding application, please refer to the call for proposals to be launched by NSFC in the column of "Notice and Announcements" on its website in due time.

Other Cooperation Channels

NSFC has signed bilateral collaborative agreements for funding personnel exchange projects and bilateral workshops with the Department of Science and Technology of India (DST), Council of Scientific & Industrial Research of India (CSIR), Iran National Science Foundation (INSF), etc. The specific projects as proposed by scientists will be jointly decided on a case by case basis through mutual agreement.

International Scientific Organizations

Center of European Nuclear Research (CERN)

According to the cooperation agreement with CERN, NSFC supports Chinese scientists' participation in international collaborative research on LHC experiment at CERN together with the Chinese Ministry of Science and Technology and the Chinese Academy of Sciences.

In 2019, NSFC and CERN will also release a call for join research projects. For more information regarding application, please refer to the call for proposals to be launched by NSFC in the column of "Notice and Announcements" on its website in due time.

International Center for Theoretical Physics (ICTP)

About 50 Chinese young scholars are funded by NSFC every year in the areas of mathematics, physics and earth sciences to participate in various research activities at ICTP, such as summer seminars and short-term joint research.

An open call for candidates of short-term specific activities at ICTP is announced on NSFC's website in November every year. A name list of candidates is recommended by NSFC to ICTP after being selected by relevant experts. The recommended candidates should apply to ICTP according to requirements of each ICTP activity.

International Institute of Applied Systems Analysis (IIASA)

NSFC encourages Chinese scientists to conduct multilateral cooperation with various IIASA Programs in the areas of energy, environment, land use, water, population, etc., and to jointly apply for research funding from various governmental organizations, private and national science foundations, World Bank and EU Framework Program.

NSFC provides full support for 5-7 Chinese young scholars to participate in the annual 3-month Young Scientists Summer Program (YSSP) from June to August at IIASA in Vienna every year. For detailed information and application forms, please refer to the IIASA website (www.iiasa.ac.at). Besides, NSFC also supports workshop, exchange and joint research projects jointly applied by Chinese and IIASA scientists.

As per IIASA's 10-Year Strategic Plan (2011-2020), Chinese scientists and IIASA researchers are encouraged to conduct joint scientific research on 3 global issues, i.e., food and water, energy and climate change, poverty and equity, based on systematic analysis methods.

For more information regarding application in 2019, please refer to the call for proposals to be launched by NSFC in the column of "Notice and Announcements" on its website in due time.

Consultative Group on International Agricultural Research (CGIAR)

NSFC has reached agreements with 11 CGIAR affiliated institutes/centers (i.e., Bioversity International, CIAT, CIFOR, CIMMYT, CIP, ICARDA, ICRAF, ICRISAT, IFPRI, ILRI, and IRRI) to fund joint research projects conducted by scientists from both sides.

The call for proposals is released by NSFC on its website in February every year,

and the deadline for application in 2019 is April. Around 12 projects are planned for funding in 2019 with an average funding amount of 2 million yuan (direct cost) per project with duration of 5 years.

United Nations Environment Program (UNEP)

According to the cooperation agreement between NSFC and UNEP, both sides support scientists to conduct scientific collaborative research in the fields of eco-system, climate change, resource efficiency and environment governance. Special importance is placed on cooperation with developing countries in Africa and Asian-Pacific regions.

The call for proposals is released by NSFC on its website in February every year, and the deadline for application in 2019 is April. Around 4 projects are planned for funding in 2019, with a funding amount of 3 million yuan (direct cost) per project for 5 years.

Multilateral Collaboration under Belmont Forum (BF/IGFA)

According to the agreement between NSFC and Belmont Forum, since 2014 NSFC have supported Chinese scientists to participate in the multilateral cooperation under the framework of Belmont Forum. For more information regarding application in 2019, please refer to the call for proposals to be launched by NSFC in the column of "Notice and Announcements" on its website in due time.

International Centre for Integrated Mountain Development (ICIMOD)

According to the agreement between NSFC and ICIMOD, starting from 2016, both sides have supported Chinese scientists, ICIMOD scientists and scientists from ICIMOD member countries to carry out cooperation and advance research in China and the surrounding countries on the region of Hindu Kush-Himalayas. For more information regarding application in 2019, please refer to the call for proposals to be launched by NSFC in the column of "Notice and Announcements" on its website in due time.

BRICS STI Framework Program

According to the agreement to fund joint research projects under the framework of BRICS STI Framework Program among research funding agencies such as NSFC, Chinese Ministry of Science and Technology (MOST), Brazil National Council for Scientific and Technological Development (CNPq), Foundation for Assistance to Small Innovative Enterprises of Russia (FASIE), Russia Ministry of Education and Science (MON), Russian Foundation for Basic Research (RFBR), Department of Science and Technology of India (DST), Department of Science and Technology of South Africa (DST), and National Research Foundation of South Africa (NRF), the aforementioned parties have jointly supported scientists from the countries to carry out cooperation starting from 2016. For more information regarding the third round of application, please refer to the call for proposals to be launched by NSFC in the column of "Notice and Announcements" on its website in due time.

America and Australasia

USA

The National Science Foundation (NSF)

According to the cooperation agreement between NSFC and NSF, both sides jointly support research projects and bilateral workshops in areas of common interests.

(1) Joint Research Project

NSFC and NSF accept joint research applications in the areas of food, energy and water, dimensions of biodiversity, and the evolution and ecology of infectious diseases in the year of 2019.

NSFC and NSF will together publish guides to programs. Chinese and USA researchers submit to NSFC and NSF respectively. NSFC and NSF jointly make final funding decisions based on the agreed evaluation methods and procedures. For detailed requirements about application in 2019, please refer to the call for proposals to be launched on NSFC's website.

(2) Bilateral Workshop

NSFC and NSF will fund bilateral workshops in areas and numbers mutually identified and agreed by both parties.

The National Institutes of Health (NIH)

According to the cooperation agreement between NSFC and NIH, both sides jointly support research projects and bilateral workshops in areas of common interests.

(1) Joint Research Project

NSF and NIH will accept joint research applications in the areas of cancer, environmental health, mental health, neurological disorders, eye and visual system in the year of 2019.

NSFC and NIH will together publish guides to programs. Chinese and USA researchers submit to NSFC and NIH respectively. NSFC and NIH jointly make final funding decisions based on the agreed evaluation methods and procedures. For detailed requirements about application in 2019, please refer to the call for proposals to be launched on NSFC's website.

(2) Bilateral Workshop

NSFC and NIH will fund bilateral workshops in areas and numbers mutually identified and agreed by both parties.

Bill & Melinda Gates Foundation (BMGF)

According to the cooperation agreement between NSFC and BMGF, both sides jointly support research projects and bilateral workshops in areas of common interests.

(1) Joint Research Project

NSFC and BMGF will accept joint research applications in the area of agriculture in the year of 2019.

NSFC and BMGF will together publish the guide to programs. Chinese and USA researchers submit to NSFC and BMGF respectively. NSFC and BMGF jointly make final funding decisions based on the agreed evaluation methods and procedures. For detailed requirements about application in 2019, please refer to the call for proposals to be launched

on NSFC's website.

(2) Bilateral Workshop

NSFC and BMGF will fund bilateral workshops in areas and numbers mutually identified and agreed by both parties.

Canada

Canadian Institutes of Health Research (CIHR)

According to the cooperation agreement between NSFC and CIHR, both sides jointly support research projects and bilateral workshops in areas of common interests.

(1) Joint Research Project

NSFC and CIHR will together publish the guide to programs. Chinese and Canadian researchers submit to NSFC and CIHR respectively. NSFC and CIHR jointly make final funding decisions based on the agreed evaluation methods and procedures. For detailed requirements about application in 2019, please refer to the call for proposals to be launched on NSFC's website.

(2) Bilateral Workshop

NSFC and CIHR will fund bilateral workshops in areas and numbers mutually identified and agreed by both parties.

Fonds de Recherche du Québec (FRQ)

According to the cooperation agreement between NSFC and FRQ, both sides jointly support research projects and bilateral workshops in areas of common interests.

(1) Joint Research Project

NSFC and FRQ will together publish the guide to programs. Chinese and Quebec researchers submit to NSFC and FRQ respectively. NSFC and FRQ jointly make final funding decisions based on the agreed evaluation methods and procedures. For detailed requirements about application in 2019, please refer to the call for proposals to be launched on NSFC's website.

(2) Exchange Program

NSFC and the FRQ provide support for exchange visits between Chinese and Quebec researchers with duration of 1-3 months. For detailed requirements about application in 2019, please refer to the call for proposals to be launched on NSFC's website.

(3) Bilateral Workshop

NSFC and FRQ will fund bilateral workshops in areas and numbers mutually identified and agreed by both parties.

Australia

National Health and Medical Research Council of Australia (NHMRC)

According to the cooperation agreement between NSFC and NHMRC, both sides jointly support research projects and bilateral workshops in areas of common interests.

(1) Joint Research Project

NSFC and NHMRC will together publish the guide to programs. Chinese and Australian researchers submit to NSFC and NHMRC respectively. NSFC and NHMRC jointly make final funding decisions based on the agreed evaluation methods and procedures. For detailed requirements about application in 2019, please refer to the call for proposals to be launched on NSFC's website.

(2) Bilateral Workshop

NSFC and NHMRC will fund bilateral workshops in areas and numbers mutually identified and agreed by both parties.

New Zealand

Health Research Council (HRC)

According to the cooperation agreement between NSFC and HRC, both sides jointly support research projects and bilateral workshops in areas of common interests.

(1) Joint Research Project

NSFC and HRC will accept joint research applications in the area of biomedicine in the year of 2019.

NSFC and HRC will together publish the guide to programs. Chinese and New Zealand researchers submit to NSFC and HRC respectively. NSFC and HRC jointly make final funding decisions based on the agreed evaluation methods and procedures. For detailed requirements about application in 2019, please refer to the call for proposals to be launched on NSFC's website.

(2) Bilateral Workshop

NSFC and HRC will fund bilateral workshops in areas and numbers mutually identified and agreed by both parties.

Chile

National Commission for Scientific and Technological Research of Chile (CONICYT)

According to the cooperation agreement between NSFC and CONICYT, both sides jointly support research projects and bilateral workshops in areas of common interests.

(1) Joint Research Project

NSFC and CONICYT will together publish the guide to programs. Chinese and Chilean researchers submit to NSFC and CONICYT respectively. NSFC and CONICYT jointly make final funding decisions based on the agreed evaluation methods and procedures. For detailed requirements about application in 2019, please refer to the call for proposals to be launched on NSFC's website.

(2) Bilateral Workshop

NSFC and CONICYT will fund bilateral workshops in areas and numbers mutually identified and agreed by both parties.

Argentina

National Scientific and Technical Research Council of Argentina (CONICET)

According to the cooperation agreement between NSFC and CONICET, both sides jointly support research projects and bilateral workshops in areas of common interests.

(1) Joint Research Project

NSFC and CONICET will together publish the guide to programs. Chinese and Argentine researchers submit to NSFC and CONICET respectively. NSFC and CONICET jointly make final funding decisions based on the agreed evaluation methods and procedures. For detailed requirements about application in 2019, please refer to the call for proposals to be launched on NSFC's website.

(2) Bilateral Workshop

NSFC and CONICET will fund bilateral workshops in areas and numbers mutually identified and agreed by both parties.

Other Cooperation Channels

NSFC has signed bilateral collaborative agreements for funding joint research projects, personnel exchange projects and bilateral workshops with the Department of Energy of the United States (DOE), the Natural Sciences and Engineering Research Council of Canada (NSERC), the Australian Research Council (ARC), National Council for Scientific and Technological Development of Brazil (CNPq), Secretaria de Educacion Superior, Ciencia, Tecnologia e Innovacion of Ecuador (SENESCYT), Consejo Nacional de Ciencia y Tecnolog á of Mexico (CONACTY), and the Ministerio de Ciencia, Tecnolog á y Medio Ambiente-Rep ública de Cuba (CITMA), etc. The specific projects are jointly decided on a case by case basis through mutual agreement.

Europe

European Research Council (ERC)

Talent Program

NSFC and ERC together fund Chinese researchers to go to Europe for single long-term or multiple short-term research visits (6 to 12 months in total). Chinese researchers could join the ERC-funded project teams to carry out joint research of mutual benefits in closely related scientific fields. NSFC will support the international travel expenses for Chinese researchers while ERC will provide their local and research costs in Europe through its funded projects. For detailed requirements about applications in 2019, please refer to the call for proposals to be launched on NSFC's website.

European Commission Research and Innovation (DG-RTD)

Joint Research Program

According to the agreement on cooperation, NSFC and DG-RTD provide support for multilateral research projects in areas of common interest between researchers from China and multiple European countries. Both sides will jointly launch call for proposals. Chinese and European applicants shall submit proposals to NSFC and DG-RTD respectively. For detailed requirements about applications in 2019, please refer to the call for proposals launched on NSFC's website.

UK

Royal Society (RS)

(1) Exchange Program

NSFC and the Royal Society of UK (RS) provide support for exchange visits between Chinese and UK researchers with duration of 2 years. NSFC provides up to 100,000 yuan for each project, covering international travel costs of Chinese scientists to UK and local costs of British scientists in China. RS provides at most 12,000 pounds for

each project, covering international travel costs for British scientists to China and local costs for Chinese scientists in UK. For detailed requirements about applications in 2019, please refer to the call for proposals to be launched on NSFC's website.

(2) Talent Program

NSFC, RS and the Academy of Medical Sciences (AMS) together set up the Talent Program to support the exchange visits as well as joint research activities between excellent young Chinese researchers and their British collaborators. NSFC will provide, in a period of three years, up to half a million yuan for each grantee while RS or AMS will offer up to 111,000 pounds for each grantee to use as salary top-up, research and training as well as international cooperation and exchange costs. For detailed requirements about applications in 2019, please refer to the call for proposals to be launched on NSFC's website.

Royal Society of Edinburgh (RSE)

Exchange Program

NSFC and the Royal Society of Edinburgh (RSE) provide joint funding for 2-year joint projects between scientists from China and Scotland, UK, in areas of common interest, according to the MoU signed between NSFC and RSE. The specific areas for cooperation and the number of projects to be approved each year are decided by both sides through negotiation. NSFC provides up to 100,000 yuan for each project, covering international travel costs for Chinese scientists to Scotland and local costs for Scottish scientists in China. RSE provides at most 12,000 pounds for each project, covering the international travel costs for Scottish scientists to China and local costs for Chinese scientists in Scotland. For detailed requirements about applications in 2019, please refer to the call for proposals to be launched on NSFC's website.

Research Councils UK (RCUK)

(1) Joint Research Program

NSFC, together with EPSRC, BBSRC, NERC, MRC, ESRC and STFC, the 6 research councils under RCUK, support substantial collaborations between scientists of both countries in areas of common interest, in consideration of the existing cooperation between scientists. NSFC and the RCUK will announce their call for proposal after discussion, and scientists from both countries shall submit proposals to their respective funding agencies. According to the agreed evaluation approach and procedures, NSFC and RCUK will jointly make decisions for funding. For detailed requirements about applications in 2019, please refer to the call for proposals to be launched on NSFC's website.

(2) Bilateral Workshop

NSFC will continue to cooperate with EPSRC, BBSRC, NERC, MRC, ESRC and STFC to fund small-scale bilateral workshops co-organized by Chinese and British scientists.

Germany

German Research Foundation (DFG)

According to the agreement on cooperation between NSFC and DFG, both sides provide support for joint research projects in areas of common interest between researchers from China and Germany. Scientists from both countries shall submit proposals to their respective funding agencies, and according to the agreed evaluation approach and procedures, NSFC and DFG will jointly make decisions for funding. For detailed

requirements about applications in 2019, please refer to the call for proposals to be launched on NSFC's website.

France

French National Center for Scientific Research (CNRS)

Exchange Program

NSFC and CNRS support exchange visits with duration of 3 years between Chinese and French scientists. NSFC funds up to 150,000 yuan for each project, covering the international travel costs for Chinese scientists to France and the local costs for French scientists in China, and CNRS funds the local expenses for Chinese scientists in France and international travel costs for French scientists to China. For detailed application requirements in 2019, please refer to the call for proposals launched on NSFC's website.

Russia

Russian Foundation for Basic Research (RFBR)

Joint Research Program

According to bilateral cooperative agreement, NSFC and RFBR encourage scientists or research teams of both countries to carry out substantial joint research in areas of common interest with duration of three years. For detailed application requirements in 2019, please refer to the call for proposals launched on NSFC's website.

Exchange Program

NSFC and RFBR jointly support exchange activities between Chinese and Russian researchers for duration of 2 years. Projects approved receive a two-year funding of 150,000 yuan from NSFC, for Chinese researchers' international travel and living expenses in Russia. RFBR also provides funding for Russian researchers' international travel and living expenses in China. For detailed application requirements in 2019, please refer to the call for proposals launched on NSFC's website.

Finland

Academy of Finland (AF)

(1) Exchange Program

Chinese and Finnish researchers shall submit their applications for personnel exchanges and visits to their respective funding agencies 3 months in advance. For Finish researchers to visit China, the Finnish and Chinese PIs shall submit their applications 3 months in advance to AF and NSFC respectively. For Chinese researchers to visit Finland, the Chinese PI shall submit the application 6 months in advance to AF and NSFC respectively. The joint funding decision is made according to respective evaluations and consultation. No call for proposal will be launched on NSFC's website and applications can submit anytime throughout the year.

(2) Bilateral Workshop

Chinese and Finnish researchers shall submit their applications for bilateral workshops to their respective funding agencies 3 months in advance, and the joint funding decision is made according to respective evaluations and consultation. No call for proposal will be launched on NSFC's website and applications can submit anytime throughout the year.

Netherlands

Netherlands Organization for Scientific Research (NWO)

(1) Joint Research Program

NSFC and NWO encourage scientists or research teams of both countries to carry out substantial joint research in areas of common interest. For detailed requirements about application in 2019, please refer to the call for proposals to be launched on NSFC's website.

(2) Exchange Program

For Dutch researchers to visit China, the Chinese and Dutch PI should apply to NSFC and NWO 3 months in advance. For Chinese researchers to visit the Netherlands, the Chinese PI should apply to NSFC and NWO 6 months in advance. Both organizations will make joint funding decisions based on respective evaluations. No call for proposal will be launched on NSFC's website and applications can be submitted anytime throughout the year.

(3) Bilateral Workshop

Chinese and Dutch researchers shall submit applications for bilateral workshops to their respective funding agencies 3 months in advance, and both organizations will make joint funding decisions based on respective evaluations. No call for proposal will be launched on NSFC's website and applications can be submitted anytime throughout the year.

Switzerland

Swiss National Science Foundation (SNSF)

Joint Research Program

NSFC and SNSF support substantial joint research between scientists from both countries in areas of mutual interest based on the existing collaboration. NSFC and SNSF will together publish the guide to programs, decide through discussion how to organize evaluation and jointly make the final funding decision. Researchers from both countries shall submit their proposals to their respective funding organizations. For detailed requirements about applications in 2019, please refer to the call for proposals launched on NSFC's website.

Sweden

Swedish Research Council (VR)

Exchange Program

NSFC and VR support exchange visits with duration of 2 years between Chinese and Swedish scientists. NSFC funds up to 250,000 yuan for each project, covering the international travel costs for Chinese scientists to Sweden and the accommodation, inter-city transportation for Swedish scientists in China as well as the fees for holding small-scale China-Swedish bilateral workshop. VR funds the local expenses for Chinese scientists in Sweden and international travel costs for Swedish scientists to China as well as the fees for holding small-scale China-Swedish bilateral workshop. For detailed application requirements in 2019, please refer to the call for proposals launched on NSFC's website.

Swedish Foundation for International Cooperation in Research and Higher Education (STINT)

Exchange Program

NSFC and STINT together support the exchange visits and small-sized bilateral workshops between Chinese and Swedish researchers, and the duration of the approved projects lasts 3 years. The funding from NSFC and STINT will cover the international travel costs for Swedish researchers to China and Chinese researchers to Sweden, as well as expenses of the accommodation, meals and inter-city transportation of Swedish researchers in China and Chinese researchers in Sweden, and small-sized bilateral workshops. Up to 400,000 yuan from NSFC and up to 600,000 Swedish krona from STINT is allocated for each approved joint project. For detailed requirements about application in 2019, please refer to the call for proposals to be launched on NSFC's website.

Belgium

The Research Foundation-Flanders (FWO)

Exchange Program

NSFC and FWO support exchange visits with duration of 2 years between Chinese and Flemish scientists from Belgium. NSFC funds up to 100,000 yuan for each project, covering the international travel costs for Chinese scientists to Flanders, Belgium and the local costs for Flemish scientists in China. FWO funds the local expenses for Chinese scientists in Flanders, Belgium and international travel costs for Flemish scientists to China. For detailed application requirements in 2019, please refer to the call for proposals launched on NSFC's website.

The Fund for Scientific Research (FNRS)

Exchange Program

NSFC and FNRS jointly support exchange activities between researchers from China and Brussels-Wallonia Federation (BWF) of Belgium for duration of 2 years. Projects approved receive a two-year funding for Chinese researchers' international travel to Belgium and Belgian researchers' living expenses in China. FNRS also provides funding for Belgian researchers' international travel to China and Chinese researchers' living expenses in Belgium. For detailed requirements about applications in 2019, please refer to the call for proposals launched on NSFC's website.

Ireland

Science Foundation Ireland (SFI)

Joint Research Project

NSFC and SFI support substantial joint research between scientists from both countries in areas of mutual interest based on the existing collaboration. NSFC and SFI will together publish the guide to programs. Chinese and Irish researchers submit to NSFC and SFI respectively. NSFC and SFI jointly make final funding decisions based on the agreed evaluation methods and procedures. For detailed requirements about application in 2019, please refer to the call for proposals to be launched on NSFC's website.

Czech Republic

Academy of Science of the Czech Republic (CAS)

Exchange Program

NSFC and CAS together fund the exchange visits between Chinese and Czech researchers with a duration of 2 years. NSFC funds up to 100,000 yuan for each project,

covering the international travel costs for Chinese scientists to Czech Republic and the local costs of Czech scientists in China. CAS funds the local expenses for Chinese scientists in Czech and international travel costs for Czech scientists to China. Chinese and Czech scientists should apply from NSFC and CAS respectively. For detailed requirements about application in 2019, please refer to the call for proposals to be launched on NSFC's website.

Belarus

Belarusian Republican Foundation for Fundamental Research

Exchange Program

NSFC and BRFFR jointly support exchange activities and small bilateral workshops between researchers from China and Belarus for duration of 2 years. Projects approved receive a two-year funding of 200,000 yuan for Chinese and Belarusian researchers' international travels, accommodation, meals, inter-city transportation and small bilateral workshop fees. For detailed requirements about applications in 2019, please refer to the call for proposals launched on NSFC's website.

Hong Kong and Macau SARs and Taiwan Region of China

NSFC has established cooperation with the Research Grant Council of Hong Kong (RGC), Beijing-Hong Kong Academic Exchange Centre, Macau Foundation, Macau Foundation for the Development of Science and Technology, and K.T. Li Foundation for the Development of Science and Technology in Taiwan, jointly funding cooperation and exchange between researchers from mainland China and Hong Kong and Macau SARs, and between researchers from two sides of the Taiwan Straits in areas of common interest. Types of activities that can be funded are joint research projects and exchange projects (including academic workshop and exchange visit).

Hong Kong

NSFC and the Research Grant Council of Hong Kong (RGC) will continue to fund join research in areas of natural sciences in 2019. Priority funding areas include information sciences, biological sciences, new materials, marine and environmental sciences, medical sciences, and management sciences. Meanwhile, to encourage academic exchanges between young researchers from Hong Kong SARs and inland China, academic forums are organized and funded in areas of common interest. For detailed requirements, please refer to the call for proposals launched on NSFC's website.

Macau

In 2019, NSFC and Macau Foundation for Science and Technology Development (FDCT) will, under the framework of the newly signed cooperative agreement, together fund joint basic research projects between scientists from inland China and Macau. The priority areas include: information science, TCM research, marine science, environmental science, biological science, new materials, as well as management science. Meanwhile, NSFC and FDCT will organize and fund academic workshops in areas of mutual interest for

academic communities from inland China and Macau region. For detailed requirements, please refer to the call for proposals launched on NSFC's website.

Taiwan

NSFC has been dedicated to encouraging and promoting scientific cooperation and exchange between scientists on both sides of the Taiwan Straits. In 2019, NSFC will continue to support cross-Straits academic workshops held by scientists from mainland China and Taiwan region. NSFC will also fund substantial joint research projects according to the consensus reached with K.T. Li Foundation for the Development of Science and Technology. For detailed requirements, please refer to the call for proposals launched on NSFC's website.

In view of the fact that some universities in Hong Kong and Macao have established research branches in different forms in mainland China, NSFC will not accept applications by one scientist as both inland and outside PIs at the same time.

Sino-German Center for Research Promotion

The Sino-German Center for Research Promotion is a research funding agency, jointly set up by the National Natural Science Foundation of China (NSFC) and German Research Foundation (DFG), and put into operation in October 2000. It aims at promoting scientific cooperation and exchange between Chinese and German researchers and providing all-around services with its diverse funding instruments for researchers at various stages of their career development, and thus is able to push forward in-depth cooperation and development in fundamental science between China and Germany.

1. Subjects Covered

The Sino-German Center for Research Promotion mainly supports the cooperation activities between Chinese and German Scientists in fundamental research in all fields of natural sciences.

2. Eligibility for Applicants

An applicant from China must be a PI or participant in an NSFC grant project (either ongoing or already completed); or an excellent young researcher who is less than 35 years old and holding a doctorate. Applicants from Germany must be eligible to apply for funding from DFG. Eligible Chinese and German scientists might submit a proposal jointly to the Sino-German Center for Research Promotion.

3. Application Limit

The projects funded by the Sino-German Center for Research Promotion will not subject to NSFC's regulation on the limit of the number of projects that an individual researcher could undertake or apply for.

4. Programs

(1) Preparatory Visit

Chinese and German scientists might apply to the Sino-German Center for funds to pay a short visit to their partners' institutions in order to make preparations and plans for proposing a Bilateral Workshop, Summer School, Young Scientist Forum, Mobility Program or NSFC-DFG Joint Research Project. Through the short visit, the two sides could work out a plan for a joint project efficiently, complete the preparation and submit their joint proposal as soon as possible.

(2) Bilateral Workshop

The most fundamental program supported by the Sino-German Center is Bilateral Academic Workshops which aim at promoting setting up new partnerships, deepening existing partnerships, and stimulating new joint research projects between Chinese and German scientists. The workshops must have specific scientific themes, and be coordinated and co-hosted by senior scientists from both sides. To ensure the authoritativeness and representativeness, participants of the workshops must be representative scientists in related fields in both countries, and should come from different institutions and regions. The workshop could be held either in China or Germany. The Sino-German Center could provide funding for up to 40 participants for each workshop, i.e., not more than 15 participants from the travelling party and at most 25 participants from the hosting party. The number of participants from the same institution should not exceed a third of all the participants from that party. In addition, scientists from a third party can be invited to the workshop and the total number of such scientists should be no more than three, that is, 20% of the number of participants from the travelling party. Formal representatives from Germany must have doctorates. The Center provides funding for domestic and international travel expenses, local subsistence of all formal participants, venue fees and other necessary costs of the workshop according to its current funding rates standard.

(3) Mobility

The mobility program aims at supporting in-depth cooperation and exchanges between Chinese and German scientists in a specific field over a period of 3 years. It mainly supports scientists' short-term visits and small-scale workshops. The Sino-German Center covers domestic and international travel expenses, accommodation costs, meal cost and venue fees according to its current funding rates standard.

(4) Summer School

Summer school aims to introduce advanced scientific methods, techniques and their applications to young scientists and provide them with training and discussion on specific issues in a certain area. The Sino-German Center attaches great importance to the screening/selection of the young scientists to attend the Summer School and requires that the participants of the seminars must be selected according to an open and competitive selection procedure. Therefore, the detailed description of selection procedure is considered as a necessary part of an application form.

The Sino-German Center may fund 4 to 6 senior experienced scientists from both countries as lecturers. The applicants on both sides must be from the funded lecturers. Participants are mainly university undergraduates, graduates or young researchers from both countries. The number of participants is decided according to specific conditions, such as equipment and infrastructure of the laboratory, but it shall not exceed 40 persons in total. The number of participants shall not exceed 15 from travelling party, and 25 from the hosting party. The Summer School can be held either in Germany or in China and usually

lasts at most 14 days, including one day for arrival and one for departure. The Center provides funding for all formal participants and lecturers for domestic and international travel expenses, local accommodation & meal costs and venue fees according to its current funding rates standard.

(5) Young Scientists Forum

The forum aims at providing a venue for Chinese and German young scientists active in their own fields to meet and discuss with each other, providing them with an opportunity to introduce their own work to the outstanding scientists and learn new research methods. The forum could be held either in China or Germany. The Sino-German Center in principle provides 5 to 7 days' funding including one day's academic visit and arrival & departure. The total number of participants shall not exceed 42 persons. The travelling party shall not be more than 16 persons (15 young scientists and one senior scientist). The receiving party shall not exceed 26 persons (25 young scientists and one senior scientist). In addition, scientists from a third party can be invited to the workshop and the total number of such scientists should be no more than three, that is, 20% of the number of participants from the travelling party. Apart from the basic eligibility required, the participants shall be less than 40 years old (as of the holding date of forum). The German participants must have doctorates. The Chinese assistant professors are also eligible to attend. The organization of the forum shall be coordinated by a young scientist from each side. The Center provides funding for international travel expenses, inter-city travel expenses, local subsistence costs and venue fees according to its current funding rates standard.

(6) Lindau Program

Lindau Nobel Laureate Meeting is held in late June each year in Lindau, Germany. Excellent young scientists from around the Globe are also invited to attend the event. The Sino-German Center, together with Lindau Nobel Laureates Foundation, invites and funds 30 to 45 (including 15 in the field of economics) excellent Chinese PhD students to participate in the Nobel Laureate meeting in Lindau, Germany, followed by a week-long academic visit to the German research institutions famously in relevant disciplines solely organized by the Center.

Candidates are selected throughout China and must be recommended by their home institutions. The final approval list is decided by correspondence review and interviews by a panel of Chinese and German experts. The Center provides funding for formally selected students for international travel expenses, inter-city travel expenses and accommodation costs according to its current funding rates standard. The Center will handle the VISA affairs for the selected students and pay for the related fees.

(7) Post-Lindau Program

Grantees of Lindau Program who has got the PhD degree and a permanent position in a Chinese research institution may apply for the funding from the Sino-German Center for an academic stay of less than 12 months in Germany if they could get invitations from German research institutions or universities, and approval from their host institutions. The Center provides funding for international travel expenses, inter-city travel expenses, accommodation costs and insurance expenses according to its current funding rates standard.

The detailed requirements, application forms and processes of each type of program in 2019 can be found on the website of the Center (http://www.sinogermanscience.org.cn).

The Research Fund for International Young Scientists

The Fund supports foreign young scientists to conduct basic research in mainland China in all areas of NSFC's funding scope so as to promote long-term sustainable academic collaboration and exchanges between Chinese and foreign young scientists.

Grantees are also eligible for renewing the existing Fund in case of need.

Applicants with foreign citizenship should meet the following qualifications:

(1) Less than 40 years old by January 1, 2019 (born on or after January 1, 1979);

(2) Have a PhD degree;

(3) Have the experience of conducting basic research or postdoctoral research;

(4) Guarantee of full-time work at the host institutions during the project implementation;

(5) Abide by Chinese laws and NSFC's relevant rules and regulations while doing research in China.

The host institution should meet the following conditions:

(1) Appoint a contact person responsible for providing consultation to the institution's applicant and assist project management such as the use of budget.

(2) Sign an agreement with the applicant. The agreement should include the following items:

(i) The title of the research project and the expected outcomes;

(ii) Living expenses and necessary working conditions that the host institution offers;

(iii) The attribution of the intellectual property;

(iv) Obligation to have applicant work in full time at the host institution during the project implementation.

The PI of the granted project can apply for renewal if needed and provided that the on-going project has made good progress.

In 2018, 140 foreign young scientists were granted with 45 million yuan for direct cost. Among them, 8 foreign young scientists were granted project renewal. It is expected that 150 foreign young scientists (including 20 project renewals) will be granted with 45 million yuan for direct cost in 2019.

Project duration:

Programs funded in 2019 start from January 1, 2020. The funding amount is 200,000 yuan per project for one year or 400,000 yuan per project for two years, which only includes direct cost.

Application procedure

Applicants should fill out and submit online proposal forms via the Internet-based Science Information System with the following supplementary documents:

(1) Copy of agreement signed by applicant and host institution;

(2) Copies of the front pages of no more than five representative papers.

Please pay attention to the column of Research Fund for International Young Scientists on NSFC's homepage for more detailed information on application and requests.

Please visit http://www.nsfc.gov.cn/nsfc/cen/gjhz/jjzb/index.html.

Programs of Joint Funds

The joint funds set up by NSFC and other relevant government departments, provincial governments and industrial sectors aim at supporting basic research in agreed scientific areas.

The joint funds are designed to give full play to the guiding role of the National Natural Science Fund, guide and integrate social resources in basic research, promote cooperation of relevant departments, industries and regions with universities and research institutions, foster scientific and technological talents and enhance China's indigenous innovation capabilities in relevant research areas, industries and regions.

The joint funds are part of the Natural Science Funds. The application, evaluation and management of the joint funds will comply with management methods such as the *Regulations*, NSFC's Rule on Funding Management and NSFC's Rule on Joint Fund Management.

In 2018, the joint funds in the *Guide* include NSAF Joint Fund, Astronomical Joint Fund, Joint Fund for Scientific Research of Large Scientific Installations, Joint Fund for Advanced Aerospace Manufacturing Technology Research, Civil Aviation Joint Research Fund, NSFC-GenerTec Joint Fund for Basic Research, Joint Fund for Seismological Science, Joint Fund for Iron and Steel Research, Joint Fund for the Innovation-Driven Development of China Automobile Industry, Yalong River Joint Fund, Joint Fund for Smart Grid, Joint Fund for Nuclear Technology Innovation, NSFC-Guangdong Joint Fund, NSFC-Yunnan Joint Fund, NSFC-Xinjiang Joint Fund, NSFC-Henan Joint Fund, Joint Fund to Promote Cross-Straits Scientific and Technological Cooperation, NSFC-Shandong Joint Fund, NSFC-Liaoning Joint Fund, NSFC-Zhejiang Joint Fund for the Integration of Industrialization and Informatization, NSFC-Shanxi Joint Fund for Coal-Based Low-Carbon Technology, NSFC-Guangdong Center for Big Data Research and NSFC-Shenzhen Robotics Research Center Project, etc. **Guidance for other Joint Funds will be published on NSFC website.**

Applicants for the Joint Funds should:

(1) Have the experience of conducting basic research;

(2) Hold senior professional position (title) or PhD degree;

(3) Meet other requirements in the *Guide*.

For any research achievements funded by the Joint Fund, NSFC's

contribution and support to the project should be acknowledged in a prominent place and in an appropriate form according to the *Guide* with the title of the joint fund and the project number.

Applications for the joint funds should be prepared according to relevant project type (such as General Program or Key Program) outlines. Please select "Joint Fund" for funding category, "Fostering Program Project" or "Key Program Project" or "Foster Local Talents" or "Center Project" or "Integrated Project" for subcategories, and select the name of the joint fund in the notes section.

The number of collaborative institutions for "Key Program Project" or "Fostering Program Project" shall not exceed two.

The funding duration for "Fostering Program Project" is three years and the funding period shall be "from January 1, 2020 to December 31, 2022" in the application. The funding duration for "Key Program Project" is four years and the funding period shall be "from January 1, 2020 to December 31, 2023" in the application.

NSAF Joint Fund

Jointly set up by NSFC and the China Academy of Engineering Physics (CAEP), the Fund is aimed to mobilize excellent research teams of national institutions of higher learning and scientific research institutes so as to focus on core and fundamental issues in the field of national security and conduct transdisciplinary and forward-looking research. It also intends to promote openness and exchange, cultivate high-qualified talents of national defense science and technology, and upgrade the innovative ability of science and technology in national defense.

In 2019, this joint fund plans to fund three types of projects, namely Key Project, Fostering Project and Central Project. The Fostering Project is aimed at expanding the sharing of national large scientific devices undertaken by the CAEP and promoting exchanges and cooperation. The Key Project focuses on key bottlenecks in the arena of national strategic security, and the innovative and interdisciplinary research and forward-looking and disruptive basic research that may be applied in the future. The Central Project mainly provides stable funding for some important basic research areas.

In 2019, the NSAF Joint Fund accepts proposals from the following areas. The average direct funding of the Fostering Project is about 500,000 yuan with a period of 3 years; the average direct funding of the Key Project is about 3,300,000 yuan with a period of 4 years; the average direct funding of the Central Project is about 26,000,000 yuan with a period of 3 years.

I. Fostering Project

It mainly supports researchers to carry out scientific research based on scientific facilities such as China Mianyang Research Reactor and its neutron science platform, “Starlight III” laser device, high-average power terahertz free electron laser device and micro-nano processing platform. Before applying for the project, the applicant should communicate with the host institutions where the relevant device is located, fully understand the performance, status and user time allocation of the device. The applicant is encouraged to conduct cooperative research with the researchers of the institution where the device is located. The main funding areas include:

1. Scientific research work based on the afore-mentioned devices, in particular research in the fields of materials science, energy science, life sciences, information science, and cross-disciplinary issues;

2. Research on new principles, new methods, new effects and key technologies based on the device;

3. Research on experimental techniques, means and methods to improve the research performance of scientific devices.

II. Key Projects

It mainly supports cutting-edge interdisciplinary and disruptive research concepts such as high environment-adaptive functional materials, sensing technology of complex scene, micro-nano surface reconstruction technology for material performance improvement, and quantum sensing science. Applicants and research teams should have a good research

foundation in relevant research fields. Not all research contents listed in this *Guide* are required to be covered, but the research should have its emphasis and resolve one or several key scientific issues accurately.

1. Functional materials with high environmental adaptability

It aims to integrate the theories and methods of materials science, nuclear science, chemistry, etc., and to study major basic scientific issues of materials application in the environment long-term heat, low-dose irradiation, complex atmosphere and high overload. The proposal should study the behavior and mechanism of the material response in complex environments, develop material theory, design new methods and advanced preparation techniques to adapt to complex environments, and create nuclear materials, energetic materials, special polymer materials, new battery materials, and atmosphere with high environmental adaptability. As a result the innovation-based development of the materials science and technology addressing the specific national need shall be promoted. Main funding areas include:

(1) Synergistic mechanism and regulation method of high-polymer bonded explosives;

(2) Multi-scale structural design and performance customization of polymer materials;

(3) The toughening design of lithium hydrides and the damage behavior in complex environments;

(4) Research on cross-scale porous metal vibration damping material system

2. IntelliSense technology for complex scenarios

The proposal aims to explore how to integrate sensing, detection, artificial intelligence and micro-nano manufacturing technologies to acquire intelligent sensing principles and methods for multi-physical sensing and accurate detection under complex conditions, thereby constructing a new generation of intelligent sensing systems and improving the comprehensive intelligent perception and self-determination capabilities in the electromagnetic environment. The research will promote the demand-driven innovation-based development of IntelliSense technology. Main funding area includes:

(1) Research on online non-destructive testing technology for multi-layer complex structure state changes;

(2) Research on long-term online stability detection technology for multi-component gases;

(3) Research on composite sensitive intelligent micro-sensing technology;

(4) Research on multi-task AI brain model and architecture for complex environments.

3. Micro-nano surface reconstruction technology for material performance improvement

The proposal should integrate material science, surface/interface science and micro-nano technology and perform micro-nano-scale processing and manipulation on the surface of materials. The purpose is to achieve material surface topography reconstruction, organizational structure regulation, environmental adaptability improvement, specific function design, etc. The comprehensive performance of nuclear materials, energetic materials, polymer materials and other functional materials in a specific use environment should also be improved. The main research contents include micro-nano scale effect and application of materials, micro-nano-scale tissue structure regulation mechanism, surface

micro-nano structure and functional design. The main funding area includes:

(1) Surface remodeling and activity regulation of hydrogen storage materials;

(2) Surface reconstruction of energy storage materials and its surface interface regulation;

(3) Functional design and preparation of active metal surface.

4. Quantum sensing science and technology for information security

The proposal is aimed to develop a comprehensive chain of studies from structural analysis to dynamic response and scale effects of stability and reliability around the basis of quantum sensing technology. The main funding area includes:

(1) High-precision quantum measurement technology for motion systems;

(2) High-precision sensing physical basis of inertial signals in miniaturized units;

(3) Research on information perception and security sharing for overall reliability;

(4) High-precision spectroscopy of space-time quantum perception.

III. Center Project

The proposal should stabilize the development of cutting-edge scientific research related to national security and play an important role in personnel training and international exchange. It should focus on scientific goals, emphasize interdisciplinarity and integration. An annual funder workshop should be held each year. The proposals should cover the following three topics and will not be accepted if only one topic is involved:

(1) Computational science specialization: scientific computing and physical system simulation research;

(2) High-pressure science specialization: cutting-edge breakthrough in ultra-high pressure technology and state equation research;

(3) Basic physics specialization: basic research of system integration development needs.

Note: Please refer to Fund Office of CAEP (http://www.caep.ac.cn) for detailed information on specific content and form of research results, etc.

Joint Fund of Astronomy

NSFC and the Chinese Academy of Sciences jointly set up the Joint Fund of Astronomy. It aims at making use of NSFC's strength in evaluation, funding and management and promoting the effective use of the facilities of Chinese Academy of Sciences to conduct astronomical research by researchers in universities and other research institutions, develop astronomical methods and technology, improve observation capacity of these facilities, foster research talents in related areas, improve innovation capabilities and academic positions internationally, and make astronomical research in China better serve the national strategic needs.

As a part of the National Natural Science Fund, the application, evaluation and management of the Joint Fund of Astronomy comply with the regulations of NSFC.

The Joint Fund of Astronomy includes "Fostering Program Project" and "Key Program Project". Key Program Project will not specify project titles and applicants may decide their project titles, research contents, research schemes and research funding

according to the following 1-5 important scientific issues. The sixth issue is not within the scope of Key Program Project. In 2019, the Joint Fund of Astronomy plans to fund about 8-10 Key Program projects.

In 2019, for the Fostering Program Project, the average direct cost funding will be 500,000 yuan per project for 3 years, and for Key Program Project, the average direct cost funding will be 2.5 million yuan per project for 4 years.

There are 6 funding areas in 2019:

(1) Use of observation facilities of all wave band and data to conduct observation and theoretical research on cosmology, galaxies, stars, the sun and solar systems and other basic astronomical areas by scientists from research institutions and universities outside Chinese Academy of Sciences astronomical observatory system (researchers in Chinese Academy of Sciences astronomical observatory system are not allowed to apply as PIs, but may participate in the research as principal members of the research group). The use of FAST and LHAASO and the data obtained from these facilities to conduct astronomical research.

(2) Observation techniques for space programs, including new observation techniques, new methods in space and pre-studies on key techniques of astronomical satellite, etc.

(3) High energy, ultraviolet, optical, infrared and radio techniques related to astronomical observations, including high energy X, γ imaging technology, high-resolution detector technology (position resolution and energy resolution), the detection of week photoelectric signals, storage and transmission techniques, high energy, optical, infrared and radio techniques related to astronomical telescopes, automated control techniques and machinery, etc.

(4) Applied basic research on problems in major astronomical projects such as data, computation and information access, etc., including storage and sharing of mass astronomical data, data mining, high performance computation and virtual observatory techniques.

(5) Basic astronomical methods (astronomical measurement and celestial mechanics) and key scientific issues originated from national strategic needs.

(6) Pre-studies on scientific problems and technical schemes in large astronomic observation facilities that are under planning, including frontier scientific problems to be studies, assessment on proposed technical scheme for planned observation facilities, clarification of technical parameters of the facilities, and verification of scientific targets according to the capability of the planned observation facilities.

Joint Fund of Large Scientific Facilities Research

Jointly funded by NSFC and the Chinese Academy of Sciences, the Joint Fund aims to use the advantages of NSFC's review, funding and management system, and attract and organize the strength of universities and colleges and scientific research institutes. To make full use of the large research facilities built by the Chinese Academy of Sciences as a comprehensive research platform with the purpose of conducting research on frontier research, multidisciplinary and comprehensive cross-disciplinary research. It intends to

cultivate scientific research talents for large scientific devices, open up new research directions, and exert the effectiveness of large scientific devices to promote openness and exchange. It strives to enhance China's independent innovation ability, the original innovation ability and international academic status in the frontier science and multidisciplinary research field, so that China's basic scientific research can better serve the national strategic needs.

The joint fund is an integral part of the science fund. The application, review and management of the joint fund are carried out in accordance with the *Regulations on the Management of the Joint Fund of the National Natural Science Foundation of China* and the Agreement of NSFC-CAS (Chinese Academy of Sciences) on the Joint Fund of Major Research Facility. The large scientific devices include: Beijing positive and negative electron collider and Beijing synchrotron radiation device, Lanzhou heavy ion accelerator and cooling storage ring device, Shanghai light source device (including protein facility with five lines and six stations), Hefei synchrotron radiation device, Hefei stable strong magnetic field device, and Chinese spallation neutron source device.

The types of projects funded by the joint fund include Cultivation Projects and Key Projects. In 2019, Key Projects provide a direct funding of 3 to 3.5 million yuan per project with a funding period of 4 years; the Cultivation Projects provide a direct funding of 500,000 to 600,000 yuan per year with a funding period of 3 years.

I. Three Research Aspects

1. Scientific research work based on platform devices, focusing on research in the fields of physical science, chemical science, information science, life science, materials science, energy science, environmental science, and other cross-cutting frontier issues;

2. Based on the research work of special devices, focusing on the high-energy physics research of Beijing spectrometer III (BESIII) on the Beijing positive and negative electron collider and the nuclear physics research of the Lanzhou heavy ion accelerator cooling storage ring device;

3. Research on experimental techniques, methods, methods and development of small specialized instruments to enhance the research capabilities of large scientific devices.

II. Main Funding Areas in 2019

1. Cultivation Project

Synchrotron radiation, neutron scattering, and steady-state strong magnetic fields research in the fields of physics, chemistry, information, life, medicine, environment, materials, energy, geosciences, agriculture, metrology, microelectronics, and micromechanics; Research on t-charm physics experiment and related software and data analysis methods on BESIII; nuclear physics experiment research and heavy ion application basic research on Lanzhou heavy ion accelerator and cooling storage ring; ion beam research in life, medicine, materials and semiconductor defects engineering; new techniques and methodological studies of beam lines; research on key technologies of advanced X-ray detectors; research on key technologies, methods and equipment for particle accelerators and particle detectors; magnetic resonance technology on steady-state strong magnetic field and research on new methods for material preparation.

2. Key Project

The Key Projects research field exceeds the actual number of funded projects. Applicants can independently determine the project title, research content and research plan according to the following research areas. Applicants are encouraged to conduct collaborative research with researchers in the laboratories where each device is located. The research areas are as follows:

1. Research on scientific problems based on synchrotron radiation devices

(1) Conversion and biological effects of environmental pollutants;

(2) The structure, function and dynamic process of biological macromolecules;

(3) Fine structure of cells and biological tissues;

(4) Structure, function and physical properties of complex materials;

(5) Structure, performance and dynamic processes of energy materials;

(6) New catalysts and catalytic mechanisms;

(7) Material structure and physical properties under extreme conditions.

2. Research on scientific problems based on steady-state strong magnetic field devices

(1) Physical properties of related system materials under strong magnetic field (≥20 T);

(2) Chemical synthesis, material preparation and properties under strong magnetic field (≥20 T);

(3) Research on the related mechanisms of life activities based on strong field magnetic resonance spectroscopy and imaging.

3. Research on scientific issues based on Chinese spallation neutron source devices

(1) Structure and performance of new energy materials, magnetic materials, functional materials and structural materials;

(2) Structure and performance of soft matter and biological macromolecular;

(3) New catalysts and catalytic processes;

(4) Study on the irradiation effects of materials and components.

4. Frontier physics and extension research based on BEPCII and HIRFL

(1) New hadron state search and hadron spectroscopy;

(2) The production and decay of charm element and charm;

(3) Heavy ion physics and strange nuclear reactions;

(4) Peculiar nuclear structure and fine spectroscopy;

(5) Heavy ion irradiation effect.

5. New principles, new methods and key technologies of the device

(1) New principles, new methods, new technologies and key components of the accelerator;

(2) New theories and key technologies of advanced light sources;

(3) New experimental methods and new techniques on heavy ion devices;

(4) New methods and new techniques for strong magnetic field experiments;

(5) New principles, new methods and key technologies for high power target stations and experiments of the spallation neutron source;

(6) New experimental methods and techniques for synchrotron radiation;

(7) New detectors and electronics technology;

(8) Experimental data analysis, processing methods and software.

Joint Fund for Aerospace Advanced Manufacturing Technology Research

Joint Fund for Aerospace Advanced Manufacturing Technology Research ("Joint Fund for Aerospace Advanced Manufacturing" for short) was jointly set up by National Natural Science Foundation of China (NSFC) and China Aerospace Science and Technology Corporation (CASC). The fund aims at playing a guiding and coordinating role of National Natural Science Fund, promoting the integration of industry-university-research, attracting and gathering social resources to participate in basic research for the development of aerospace advanced manufacturing technology and enhancing China's indigenous innovation capabilities in aerospace manufacturing industries. In 2019, the Joint Fund for Aerospace Advanced Manufacturing plans to fund two types of projects, namely Integrated Program and Key Program.

This joint fund calls for proposals over the country, which ensures fair competition and encourages interdisciplinary research and industry-university-research cooperation. Universities and research institutions with sufficient research conditions and abundant research strengths are preferentially selected and supported to conduct researches on the topics within the *Guide*. Applicants should have deep understanding of the key basic research problems and the actual needs of aerospace field in China, grasp the essentials of the Joint Fund for Aerospace Advanced Manufacturing Technology Research, concentrate on scientific problems, and focus research directions that closely related to the actual problems and needs of aerospace industries. Applicants are advised to apply projects in collaboration with the manufacturing institutions or the scientific research departments of CASC.

Joint Fund for Aerospace Advanced Manufacturing Technology Research is part of the fund of National Natural Science Foundation of China. The process of application, evaluation and management of the joint fund will comply with management methods such as the Regulations of NSFC, NSFC's Rule on Joint Fund Management, and NSFC's Rule on Funding Management. Proposals of this joint fund will be accepted and evaluated by the Department of Engineering and Materials Sciences of NSFC.

I. Themes for Integrated Program Projects in 2019

1. High stability manufacturing technology basis of high precision three-floated gyroscopes

Based on the increasing demands of precision stability of three-floated gyroscopes under long time hot standby conditions, proposals are expected to investigate the following issues: the control technique of the key parameter stabilities of dynamic pressure motor in three-floated gyroscopes is unclear; the evolvement rule of micro strains in the key assembly structures is poorly understood and the influence mechanism of oil slick viscosity disturbance torque is elusive. It aims at providing theories, methodologies and manufacturing technologies for high stability control techniques of three-floated gyroscopes, and improving the performance of the instruments under long time hot standby conditions

by solving the above key issues. Main research areas include: Key parameter stability control and life prediction of dynamic pressure motors; evolvement rule and control methods of micro strains in the key assembly structures; evolvement mechanism of oil slick viscosity disturbance torque and its influences.

2. Manufacturing basis of high-performance valves working under extreme conditions

Proposals are expected to focus on the following issues to figure out the scientific basis: the unclear effects of multiple influencing factors on valves in launch vehicles working under extreme conditions (liquid hydrogen/liquid oxygen environment, instant loading of 100 g), the elusive influences of material contact behaviors on the performance of valves, and the weak research on the precision manufacturing mechanism of valves. It is aimed to establish theoretical basis for highly reliable design and high-precision manufacturing of valves in launch vehicles. Main research areas include: correlations of the working performances of valves, and the materials and structure of matching pairs under extreme conditions; influence mechanisms of the contact behaviors of homogeneous and heterogeneous materials, or irregular-shaped structures on the direction and sealing performances; theory of precise material-structure coordinating manufacturing for directing abrasion and leakage restraining.

3. Failure evolution and suppression of long-life solar array under complex space environments

Proposals are expected to focus on the failure problem of solar array induced by complex space environment, such as high/low temperature (-195 ℃~+160 ℃) and high flux atomic oxygen (1×10^{27} atom/m^2), etc., and carry out basic research relating to structural mechanics of solar array, material corrosions and electric connection, aiming at revealing the failure evolution of solar array under in-service conditions, establishing new methods to suppress the failure and provide theoretical supports to the implementation of satellite navigation, human spaceflight, deep space exploration programs. Main research areas include: failure behaviors and suppression methods of multi-layer complex solar array structure under complex space environments; corrosion failure mechanisms and protection methods of irregular-shaped supporting base materials; electric connection failure mechanisms and suppression methods of solar array under complex space environments.

II. Themes for Key Program Projects in 2019

1. Manufacturing basis of lightweight and high strength large aerospace components

Main research areas include:

(1) Precision and property integrated control of thin-walled super alloy components by hydroforming;

(2) Forming mechanisms and defects control of irregular-shaped cross-section 3D components during free bending;

(3) Stabilization mechanisms and control methods of molten pools of in-situ alternating force field drilling welding for large scaled sealed cabin;

(4) Forming mechanisms and accuracy control of power spinning with opposite rollers for large thin-walled cylinders of rocket.

2. Precision mechanical machining and installation basis of aerospace

mechanical and electrical products

Main research areas include:

(1) Influence mechanisms and control methods of centroid stability in dynamic pressure motors on the day-to-day drift performance of dual-floated gyroscopes;

(2) Dynamic analysis of deployment and structure control technology of large space membrane structure;

(3) Mechanism investigation of the sealing performance of valves in space propulsion systems under long-time in-service conditions;

(4) Micro-generating mechanism and active control of edge integrity in aerospace servo couples.

3. High reliability manufacturing basis of aerospace electronics and electricity interconnection technology basis

Main research areas include:

(1) Anti-welding mechanisms of aerospace high power density DC contactor and the composite technologies of contact materials;

(2) Irradiation mechanisms of aerospace logic level power MOSFET and the basic manufacturing technologies.

4. Basic manufacturing technologies of aero-engines

Main research areas include:

(1) Control and optimization of in-situ laser forming for carbon fiber composite case dome in solid motor;

(2) Basic questions of mix braiding preform automatic precision forming equipment for nozzle throat;

(3) Mechanisms of nano-phase induced phase transformation in additive manufacturing of load arms for space propulsion;

(4) Deformation mechanisms and control methods of high temperature inner and outer surfaces pressure precision forming for large-scaled titanium nozzle.

5. Digital and intelligent basis in aerospace advanced manufacturing

Main research areas include:

(1) Key technology of intelligent flexible assembly for aerospace liquid rocket valves;

(2) Collaborative management theory and methods of the digital supply chain for complex aerospace product.

III. Notices of Application

(1) Applicants should have experiences of undertaking basic research projects or doing basic research; hold senior professional position (title). Post-doctors in station, graduate students, researchers without affiliation to a research institution or whose home institutions have not been registered at NSFC cannot apply as the Principle Investigator.

(2) The proposed project should be within the research areas and meet the requirement outlined in this *Guide*. Applicants should select “Joint Fund” for funding category, “Integrated Program Project” or “Key Program Project” for subcategories, and select “Joint Fund for Aerospace Advanced Manufacturing Technology Research” in the notes section. Applicants must select the application code for the Department of Engineering and materials sciences (starting with “E”) for “Application Code I” and choose

the proper application code based on research areas for "Application Code II". The number of collaborative institutions for "Integrated Program Project" shall not exceed three, and the number of collaborative institutions for "Key Program Project" shall not exceed two.

(3) Programs of these joint funds and other programs of NSFC shall comply with the same restriction on the total number of projects. Restriction on applications, limit on the number of undertaken programs and the program types that share the same restriction can be found in the *Guide*.

(4) Applicants are advised to prepare for the research proposals in accordance with the outlines for the Integrated Program Project or Key Program Project of this Joint Fund. The research area for the applicants of Integrated Program Project or Key Program Project should be stated at the beginning of the "Research Background and Significance" in the proposal. If the applicant has undertaken other National Science and Technology Projects related to this application, distinction and relationship between the proposed project and other related undertaken projects should be discussed in the "Research Basis and Working Conditions" in the proposal.

(5) For any project in collaboration with the attached institutions of CASC, the proposal should be recorded by the Department of Technology and Quality of CASC. Applicants may request background information from the Department of Technology and Quality of CASC.

(6) For any research achievements funded by the Joint Fund, including paper publications, books, patents and awards, etc., NSFC's support to the project should be acknowledged as "Supported by Joint Fund of Advanced Aerospace Manufacturing Technology Research (project No.)". For any research achievements involved with the technology secrets related to the manufacturing of CASC, the publication must be reviewed and agreed by CASC.

Joint Fund for Civil Aviation Research

The Joint Fund of Civil Aviation Research is jointly set up by NSFC and the Civil Aviation Administration of China (CAAC). The Fund is aimed to attract researchers across China to participate in basic research for the sustainable development of aviation science and technology, so as to foster high level scientific talents, enhance the ability of original innovation in the aviation industry, promote the integration of knowledge and technological innovation, and contribute to the building of China into a nation with strong aviation industry.

As a component of the National Natural Science Fund, the Joint Fund is open to all scientists across China. Researchers in non-aviation sectors are encouraged to carry out collaborative researches with those in aviation sectors.

I. Funding plan and priority areas in 2019

In 2019, the Joint Fund of Civil Aviation Research is going to support 3 Key Program Projects. Average funding (direct costs) for each "Key Program Project" will be 2.1 million. Average funding (direct costs) for each "Fostering Program Project" will be 0.4 million. The Fostering Program supports researches on scientific issues and new

technologies related to the sustainable development of civil aviation. Young researchers under the age of 35 (born after January 1, 1984) will be given priority. Priority funding areas in 2019 includes:

1. Fostering Program

(1) Intelligent transportation and information security for civil aviation; theories and methods of airspace resource management; theories and technologies of future air navigation system; system simulation and verification for passenger and freight traffic flow, flight flow and air traffic flow.

(2) Theories and technologies of situation awareness in airport; theories and technologies of information technology-based airline operations.

(3) Theories and technologies on aviation crime prevention and control; optimization and realization of coordinated decision making for aircraft emergency in abnormal situations.

(4) Theories and methods of the reliability and security of civil aviation system; aviation safety theory; new methods and technologies for airline safety inspection; processing techniques and inspection theory and technologies for new materials of aircraft operation and maintenance.

(5) Optimal design and simulation for civil aviation transport service quality; theories and methods of aviation medicine.

2. Key Program

(1) Civil aircraft landing gear thermal damage mechanism and key technologies of safety evaluation;

(2) Key technologies of in-situ minimally invasive intelligent maintenance for civil aviation engine;

(3) Optimal control theory and methods of high-bypass civil turbofan engine;

(4) Impact mechanism of controller fatigue on air traffic control and key early warning technologies.

NSFC-GenerTec Joint Fund for Basic Research

The NSFC-GenerTec Joint Fund for Basic Research was jointly established by NSFC and China Academy of General Technology in 2015. The joint fund aims at pooling talented scientists and research teams to solve major scientific issues and key technical problems for China Academy of General Technology in serving the country and fulfilling its mission, and promoting research and team building in related disciplines.

In 2019, the NSFC-GenerTec Joint Fund for Basic Research calls for proposals of “Key Program Project” and “Fostering Program Project”. Average funding (direct cost) for each “Key Program Project” will be 2.6 million for 4 years and the funding could be increased for projects of strong innovation and high quality. Average funding (direct cost) for each “Fostering Program Project” will be 0.7 million for 3 years. The NSFC-GenerTec Joint Fund for Basic Research is open to all Chinese researchers. Qualified researchers are welcomed to apply for this fund according to the research scope and requirements listed in this *Guide*.

I. Themes for Key Program Project

1. AI-based attack and defense technology for cybersecurity

2. Key technology for guiding personal behaviors in social network

3. Key technology for self-adaption based speech to text conversion

4. Key technology for intelligent modeling in 3D/4D printing

5. Beam forming and specific signal detection in 5G scenario

6. Cognitive computing based hotspot analysis and inference

7. Cross platform memory forensics for attacks of specific 0-day vulnerabilities

8. Key technology of new deep learning with low-quality small-sized samples

9. Deep learning-based audio/video synthesis technology

10. Deep learning-based traceability analysis and forensics for digital images

11. Natural language processing, knowledge base system creating and application for a specific domain

12. Technology of virtual identity creation and application in cyberspace

13. Psychological analysis based on network behaviors

14. Video-stream intelligent search based on target behavior analysis

15. Analysis of human behaviors and evolution of major events based on integration of geo-spatial data

16. Intelligent detection technology against APT attacks

17. Intelligent detection technology against encrypted communication based on network security perception

18. Deep learning-based intelligent perception, security monitoring and attack scenario creation for high throughput network

19. Analysis methods for new passwords with unconventional theoretical complexity

20. Cryptographic theory and key technologies based on superlattice physical unclonable functions

21. Intelligent source code vulnerability detection technology based on knowledge graph

II. Themes for Fostering Program Project

1. Intelligent analysis and processing of big data

Research on entity relation extraction, subject classification and automatic summary generation for large-scale text; human identity disambiguation and fusion algorithm in a big data environment; knowledge inference and automatic update method for knowledge graph of social media; cognitive characteristics difference analysis based on open source data of users in a multilingual environment; user behavior characteristics in large scale information transmission process in social media; big data intelligent mining and inference technology based on uncertainty reasoning; hardware architecture system for acceleration of the AI computation; long distance target detection and identification technology based on multi-model ensemble machine learning.

2. Cyberspace security

Software theft detection technology for mobile platforms; information hiding detection methods and tools for commonly-used new media; AI-based side channel analysis method and side-channel-based reverse engineering; security test and evaluation for

machine learning algorithm and models; deep learning-based malicious sample detection and confrontation technology; instruction stream-level intelligent vulnerability mining technology based on processor tracing and deep learning; memory forensics and confrontation technology in cold starts on Android system; key defense technology for spoofing attacks in cyberspace.

3. Internet of Things

Key block chain technology for the Internet of Things; vulnerability analysis and confrontation technology for industrial logic controllers; formal analysis-based reverse engineering and security analysis for industrial control system network protocol; numerical eigenvector-based firmware vulnerability analysis method for cross-platform IoT devices; knowledge graph construction-driven security situation awareness technology for IoT and industrial control system.

4. Block chain

Block chain-based identity management, covert transmission and privacy protection technology; block chain-based data provenance technology; block chain architecture-based technology for identification and localization of cyber threats.

5. 5G and Mobile Internet

5G authentication protocol security; access control technology for 5G; 5G slicing security technology; vulnerability analysis and detection technology for social behavior in mobile social networks.

6. Cloud computing security and dynamic password security

Analysis of threats to cloud computing security; vulnerability analysis, attack simulation methods, development of toolset for simulated attack scenarios; dynamic password security.

7. Real-time separation of far-field concurrent multiple-source acoustic signals

Research on theories and methods of real-time sensing of sensing terminals and blind source separation of far-field concurrent multiple-source acoustic signals, especially the development of algorithms and acoustic signal processing system that meet the requirements of low latency, high robustness and processing of concurrent multi-source acoustic events.

Joint Fund of Seismological Science

In view of the urgent needs of the national defense earthquake disaster reduction work and the development trend and research frontiers of the international seismological science, the joint fund in 2019 will focus on topics including “seismic structure and seismogenic environment”, “new technology, new theory and new method for earthquake monitoring and prediction” and “application basis of earthquake resilience technology”. The Fund accepts Key Project in the following three areas. The average direct funding is 2.8 million yuan per project, and the funding period is 4 years. The research period should be from January 2020 to December 2023.

I. Seismic structure and seismogenic environment

In view of the basic theoretical and technical issues such as active fault habits and

deep and shallow structural relationships, regional seismic tectonic models and seismic mechanisms, three-dimensional imaging and deep structures, this joint fund provides funding in the following four key research directions.

1. Study on the understanding and judgment method of fault activity in bedrock area

Scientific goal: To address the problem that the fault rupture mechanism and the traditional fault activity determination method cannot play its role in the bedrock area, explore the fault activity of the bedrock area and its judgment method, analyze the seismic hazard, and improve the research system of active faults. .

Main contents include:

(1) The relationship between structural geomorphology and fault activity in the bedrock area and paleo-earthquake;

(2) Relationship between fault structure and composition change and fault sliding habit;

(3) Fault-measurement activities in the bedrock area and dating methods for paleo-earthquake events;

(4) Fault rupture behavior and seismic hazard analysis.

2. Study on recurrence model of different types of active faults

Scientific Objective: proposals should focus on the key problem of the millennial to 10,000-year sliding habits of active faults of the research on earthquake rupture mechanism, based on the high-resolution remote sensing interpretation technology. Proposals should carry out coordinated research on high-resolution fault geomorphology and seismic geological relics to explore the recurrence model of large earthquakes on the large-scale strike-slip fault, reverse fault or normal fault system on the periphery and interior of the Qinghai-Tibet Plateau.

Main contents include:

(1) Temporal and spatial evolution characteristics of high-accuracy cumulative displacement;

(2) Faulted landforms and ancient earthquake sequences;

(3) Earth rupture earthquake recurrence model;

(4) Research on a new method for constructing an earthquake recurrence model.

3. Study on the relationship between deep and shallow geometric structure of different types of active faults and strong earthquake sites

Scientific Objective: To solve the uncertainty problem of high-magnitude earthquake occurrence location, based on large-scale active fault mapping technology, reflective seismic exploration and drilling and fault plane fine structure imaging, etc., proposals should study the relationship between surface faults and deep geometry of the same type active fault and fault plane, develop the theory of fault mechanics that determines the location and magnitude of the surface rupture-type earthquake.

The main contents include:

(1) Imaging of fault three-dimensional geometry;

(2) Three-dimensional fault model of active fault;

(3) High resolution imaging of the tomographic structure of the fault plane;

(4) Prediction method of earthquake occurrence location.

4. The present-day deformation characteristics of the main active faults of Sichuan-Yunnan and the mechanism of strong earthquakes

Scientific Objective: To map the relationship between the current motion state, the deep and shallow structural deformation and the large earthquake inoculation process in the key structural parts of the main seismic faults of the Chinese Seismological Science Experimental Site, proposals should apply continuous GPS observation, InSAR measurement, seismic observation, geological survey and numerical simulation and a variety of methods to study the three-dimensional stress-strain state of faults, reveal the fine characteristics of active fault sliding behavior, and explore the mechanism of strong earthquakes and occurrence.

The main contents include:

(1) 3D geometric structure and segmentation activity characteristics of active faults;

(2) Comprehensive observation of cross-fault encryption and movement state of deep and shallow faults;

(3) The activity mode and strain accumulation of the active fault zone;

(4) The relationship between deep and shallow structure and its control on earthquake rupture.

II. New technologies, new theories, new methods of earthquake monitoring and forecasting

In view of active block interaction and strong earthquake grouping activities, strong earthquake anatomy and seismogenic model, fault activity habits and strong earthquake rupture model, stress field spatiotemporal evolution and strong earthquake relationship, seismic electromagnetic precursor mechanism, and other issues, proposals should include 9 research directions.

1. Development of six-component seismic observation instruments

Scientific goal: To solve the problem of lack of rotational component of existing seismic observation, develop and test six-component seismic observation technology, develop high-sensitivity broadband seismic instrument, measure translational component and rotational component, and realize six-component observation.

The main contents include:

(1) Development of high-sensitivity broadband seismographs;

(2) Development of high precision fiber optic rotating seismograph;

(3) Research on six-component seismic observation methods;

(4) Research on comprehensive evaluation methods for high performance seismic observation systems.

2. Study on the interaction between block boundary faults and the spatial and temporal evolution mechanism of regional strong earthquakes

Scientific goal: According to the space-time evolution law and physical mechanism of regional strong earthquakes, select typical active blocks or partial boundaries, and comprehensively use geology, geodesy and numerical simulation to study the deep and shallow deformation characteristics of the block boundary fault system. Interaction and rheological response, explore the temporal and spatial evolution characteristics of strong earthquakes and their causes, and improve the long-term prediction level of large earthquakes.

The main contents include:

(1) Kinematics and deformation characteristics of the deep and shallow parts of the

block boundary fault system;

(2) Structural transformation relationship and fracture interaction;

(3) Regional crustal deformation field and rheological characteristics;

(4) Temporal and spatial evolution patterns and physical mechanisms of regional group strong earthquakes.

3. Study on the occurrence process and precursor mechanism of typical strong earthquakes

Scientific goal: According to the characteristics of abnormal distribution and physical mechanism of pre-earthquake earthquakes, select typical earthquake cases, establish seismic seismogenic models based on geological, geophysical, geodetic, geochemical and other observations, and analyze typical pre-earthquake anomalies or the physical mechanism of precursor anomalies, and reveal the mechanistic characteristics of typical anomalies before strong earthquakes.

The main contents include:

(1) Strong earthquake seismogenic model based on multidisciplinary observations;

(2) The relationship between the multi-physical (field) space-time evolution process and strong earthquakes;

(3) Seismic observation techniques and prediction methods related to the process of strong earthquakes.

4. Study on the relationship between tectonic stress field model and strong earthquake activity in Sichuan-Yunnan region

Scientific Objective: To construct a stress field model for the strong earthquakes in China's earthquake science experimental field, study the stress field model, comprehensive stress measurement, geodesy, seismic survey and other observational, construct the stress field model of the deep and shallow lithosphere in the Sichuan-Yunnan region, and analyze the regional tectonic stress loading characteristics of stress-strain accumulation in the main fault zone of Sichuan-Yunnan region.

The main contents include:

(1) Evolution characteristics of crustal strain field based on observations such as GNSS, InSAR and level;

(2) The crustal stress state of the key structural part based on the measured ground stress;

(3) Temporal and spatial variation characteristics of crustal stress based on the focal mechanism solution of small and medium earthquakes;

(4) Anisotropic characteristics of different depth media based on waveform data;

(5) Three-dimensional tectonic stress field model of Sichuan-Yunnan and its relationship with strong earthquake activity.

5. Construction of strong earthquake cascade rupture model for major fault zones in Sichuan-Yunnan region

Scientific goal: In order to solve the problem of continental strong earthquake cascade rupture mechanism, proposals should focus on the main fault zone in Sichuan-Yunnan region, use the fracture dynamics and section kinematics model to determine the mechanical parameters of the fault zone, study the relationship between fault heterogeneity and strong earthquake rupture and explore the main controlling factor of the rupture propagation distance of strong earthquakes.

The main contents include:

(1) Fine structure and medium model of the target fault zone;

(2) The effect of state non-uniformity of adjacent faults on cascaded rupture propagation;

(3) Fault mechanics parameters based on fracture dynamics and section kinematics models;

(4) Numerical simulation of main controlling factors of strong earthquake rupture propagation in fault zone.

6. Research on seismic electromagnetic anomaly and mechanism

Scientific Objective: In view of the application of new electromagnetic observation data in earthquake prediction in recent years, based on the observation data obtained by Zhang Heng electromagnetic satellite and very/low-frequency electromagnetic network, study the mechanism of seismic electromagnetic anomaly for strong earthquakes prediction.

The main contents include:

(1) Electromagnetic field background changes and electromagnetic anomaly extraction techniques;

(2) Research on the correlation between electromagnetic anomalies and seismic activity;

(3) Research on the mechanism of seismic electromagnetic anomalies;

(4) Earthquake prediction methods based on electromagnetic anomalies.

7. Research on seismic prediction methods based on numerical simulation and artificial intelligence

Scientific goal: In view of the application of artificial intelligence and numerical simulation technology in earthquake prediction, using multi-scale and multi-type geophysical and geochemical observation data, construct the digital model and boundary conditions of the source of strong earthquake area, and propose the medium and long-term prediction techniques and methods for regional strong earthquakes based on artificial intelligence and numerical simulation technology and the temporal and spatial evolution characteristics of regional strong earthquakes.

The main contents include:

(1) The source numerical model of the strong earthquake area and the temporal and spatial evolution characteristics of the regional stress;

(2) Regional synthetic seismic catalogues and temporal and spatial evolution characteristics of strong earthquakes;

(3) Medium and long-term prediction techniques and methods for regional strong earthquakes.

8. Study on the relationship between crust-mantle structure and strong earthquakes in the North China structural area

Scientific Objective: In view of the problem of frequent occurrence of strong earthquakes in the North China structural area and the insufficient spatial resolution of deep structure research, based on observations of dense seismic arrays and fixed seismic stations, develop high-resolution seismic imaging methods and construct a regional crust and fine structure model to provide seismological evidence for understanding the relationship between deep dynamics and strong earthquakes.

The main contents include:

(1) Wide-band mobile seismic encryption observation and structural imaging accuracy impact analysis;

(2) Full-waveform inversion and other high-resolution seismic imaging techniques;

(3) Construction of the regional crust and fine structure model;

(4) The relationship between deep structure and strong earthquake activity.

9. New technology and new method for active fault imaging and microseismic activity monitoring

Scientific goal: In view of the problem of insufficient imaging resolution of existing detection methods in the study of three-dimensional geometric structures and media properties of fracture zones, develop microseismic monitoring and structural imaging techniques and methods combining broadband and ultra-dense short-period arrays, study the relationship between fault geometry, medium structure and asperities, and provide new techniques and methods for studying the mechanism of earthquake in important fault zones.

The main contents include:

(1) Observation techniques and applications combining broadband and ultra-dense short-period arrays;

(2) Techniques and methods for monitoring and locating microseismic faults;

(3) Techniques and methods for imaging the geometry and media properties of fault zones;

(4) The relationship between the three-dimensional structure of the fault zone and the strong earthquake activity.

III. The seismic toughness technology application basis

In view of strong ground motion, urban and rural seismic toughness assessment theory and methods, and the role of earthquakes and secondary disasters, the joint fund should focus on the following four key research directions.

1. High-frequency strong ground motion and toughness fortification standards in Sichuan and Chongqing

Scientific Objective: To develop the high-frequency strong ground motion numerical simulation technology based on the deep and shallow attenuation medium model and earthquake rupture process for the analysis of the earthquake disaster and toughness in the Sichuan-Yunnan region where the mountains and basins are interspersed, the terrain is undulating, the basin is thick and the basement is undulating. So technical support will be provided to the standard setting of the fortification provides technical support.

The main contents include:

(1) Model of the elastic and attenuating medium containing the relief of the topography;

(2) Model of strong earthquake source rupture process;

(3) High-frequency strong ground motion simulation based on the rupture process and the attenuation medium;

(4) The main controlling factors of low frequency and high frequency components of ground motion;

(5) Research on urban and rural resilience standards.

2. Evaluation of seismic toughness and performance improvement of urban and rural projects

Scientific goal: To study the destructive characteristics of urban and rural complex seismic engineering, to study the destructive characteristics of strong earthquakes in urban

and rural complex engineering environments, to reveal the toughness recovery mechanism of important urban and rural functional infrastructure systems, to develop performance improvement techniques, and to establish urban seismic toughness assessment and method based on multiple information.

The main contents include:

(1) Destructive characteristics of strong ground motion in urban and rural complex engineering environment;

(2) Mechanism of seismic toughness recovery of urban and rural important functional infrastructure systems;

(3) Urban and rural system information acquisition technology and multi-scale seismic vulnerability analysis theory;

(4) The theory and method of urban seismic resilience assessment considering multi-information such as system correlation, resource scheduling and crowd behavior.

3. Research on disaster-causing mechanism and toughness improvement technology of offshore engineering under the combined action of earthquake and tsunami

Scientific goal: To study the mechanical effects of earthquakes and their tsunami on offshore engineering, study the failure mechanism of engineering systems under combined action, and propose technical means to mitigate compound disasters.

The main contents include:

(1) A risk model for the combined action of earthquakes and tsunamis;

(2) Test and analysis methods for the whole process of destruction of offshore engineering systems under the combined action of earthquake and tsunami;

(3) A qualitative design method that considers the effects of multi-level earthquakes and tsunami;

(4) Offshore engineering seismic toughness improvement technology based on intelligent control principle.

4. Earthquake landslide mechanism

Scientific goal: To clarify the risk of landslide caused by earthquake, clarify the trigger mechanism of earthquake landslide, collapse mode, critical condition, migration path of landslide, and study the relationship between fault properties and the number of landslides and affected area.

The main contents include:

(1) Earthquake landslide effects and disaster modes of different fault properties;

(2) Dynamic evolution mechanism and long-term effects of earthquake landslides in strong earthquake areas;

(3) Earthquake landslide risk assessment model.

Joint Fund for Iron and Steel Research

The Joint Research Fund for Iron and Steel was established jointly by the National Natural Science Foundation of China (NSFC) and Baowu Steel Group Co., Ltd. (formerly Baosteel Group Co., Ltd.). It aims to promote the science & technology innovation and develop the novel metallurgical and materials technologies through the pioneering

researches in close connection with major problems and development strategies of China's iron and steel industry, so as to improve the competitiveness of native iron and steel products and speed up the technological advancement of the Chinese iron and steel industry. In 2019, the last year of the fifth period of the agreement, a direct funding will be 0.5 to 0.8 million yuan per project for General Programs, and 2 to 3.5 million yuan per project for Key Programs.

The Joint Research Fund is open for the whole country.

The Joint Fund specifically supports fundamental researches with important scientific significance and application value that are urgently needed for the development of China's iron and steel industry, mainly focusing on key aspects of novel metallurgical technologies and interrelated processes, materials, energy, environment, equipment, and information sciences, etc.

The Joint Fund advocates interdisciplinary among different research fields and collaboration between R&D activities and industries. The involvement of young professionals and research institutions outside metallurgical science community are all encouraged. Any other resources than NSFC grants are also preferred.

I. General Program

(1) Fundamentals and technologies on synergistic treatment of solid waste during smelting of iron and steel;

(2) Physical metallurgical mechanism of new generation automotive steel with high performance produced by continuous casting & rolling and endless rolling technique;

(3) Fundamentals and technologies of laser texturing with high efficiency, disorder and uniformity on the surface of flat roll;

(4) Mechanism and key technology of transverse electromagnetic induction heating of sheet and strip;

(5) Metallurgical mechanism of narrow gap TIG welding for large-scale low temperature martensitic stainless steel components and regulation of weld microstructure;

(6) Hydrogen-induced delayed cracking mechanism of cold heading steel;

(7) Key technology, performance regulation and application fundamentals of lightweight material component connection on automobile body;

(8) Corrosion behavior and mechanism of N-alloyed metastable austenite stainless steel with high strength;

(9) Cold extrusion strengthening mechanism and active lubrication control technology of nickel-based superalloy fasteners for aeroengine;

(10) Mass transfer mechanism and chemical reaction mechanism in oxide layer on the surface of silicon steel with high magnetic induction orientation;

(11) Development of ceramic dust filter material for waste heat recovery of high temperature flue gas;

(12) Formation mechanism, synergistic retardation and catalytic degradation of UP-POPs during sintering process of iron ore;

(13) Quantitative assessment of carbon emission baseline and carbon data management in China's iron and steel industry;

(14) High temperature friction behavior and corresponding influence factors of coated hot-formed steel;

(15) Preparation, structure and performance control mechanism of coal tar pitch-based carbon materials.

II. Key Program

(1) Basic research on low-carbon smelting theory and technology of iron (E0414);

(2) Intelligent prediction, recognition and suppression of chatter during continuous rolling driven by multi-source data (E0421);

(3) Design theory of new martensitic G115 heat-resistant steel welding alloy for 630 ℃ thermal power units and property regulation of joint at elevated temperature (E0416);

(4) Integrative intelligent planning and intelligent scheduling theory, method and application for steel production (E042205);

(5) Cooperative mechanism and optimal regulation of carbon dioxide capture and sulfide removal from blast furnace gas (E042002);

(6) Open application for key projects in new process and new technology fields of iron and steel industry (E0412);

(7) Open application for key projects in energy and environmental protection related fields of iron and steel industry (E0420).

According to the application and evaluation, 5 to 8 key projects will be funded from the above fields.

Joint Fund for the Innovation-Driven Development of China Automobile Industry

The Joint Fund for the Innovation-Driven Development of China Automobile Industry is financially supported by NSFC, China Association of Automobile Manufacturers and eight domestic automobile enterprises, namely, First Automotive Works, Dongfeng Motor Corporation, SAIC Motor Corporation Limited, Chongqing Changan Automobile Co., Ltd., Guangzhou Automobile Group Co., Ltd., Brilliance Auto Group, Anhui Jianghuai Automobile Co., Ltd., China National Heavy Duty Truck Group Co., Ltd. By giving full play to the guiding and coordinative role of NSFC on the basis of combining government-industry-university-research and application, it attracts talents nationwide to concentrate on the major basic research in areas related to China's Automobile Industry Development, so as to promote the sustainable development and improve capability of independent innovation of the industry.

In 2019, the Joint Fund for the Innovation-Driven Development of China Automobile Industry calls for proposals of the "Key Project" in three priority areas with average direct funding of 2.5 million yuan per project for four years. Any eligible scientists and technicians over the country are encouraged to submit applications in accordance with research scope and requirements listed in this *Guide*.

I. Electrification

1. Research on Modeling and Optimal Control of Electric Networked

Automotive Data Driven

2. High-performance long-life automotive fuel cell stack design theory and manufacturing technology/vehicle fuel cell reactor operating state simulation and testing technology research

3. Motor vehicle motion planning and energy efficiency optimization based on space-time prediction

4. Designing and integration technology of fuel cell system for high-power commercial vehicles

5. Modeling method and application research of intelligent motor drive system for big data mining

6. Research on working mechanism and performance model of solid lithium battery for vehicle

7. Key technology foundation for high performance charging system for new high voltage power electronics

8. Optimization and control of electric vehicle integrated chassis in intelligent traffic environment

II. Light weight

1. Lightweight chassis component load model construction and lightweight performance design

2. Study on the structural performance control of high strength and high toughness automotive steel materials and the service performance of typical parts

3. Body material connection technology and service performance research

4. Automobile aluminum alloy material design, microstructure control and its component integration design

5. Dynamic mechanical properties evaluation of continuous fiber reinforced thermoplastic composites and durability design of its components

6. Commercial vehicle lightweight chassis system optimization design and application technology foundation

7. Research on delayed fracture mechanism and application of ultra-high strength steel for automobile

III. Intellectualization

1. Intelligent network communication information security protection and multi-objective control theory and key technologies

2. Over-the-horizon global perception fusion method and key technology of the intelligent network-connected vehicle

3. Smart car hybrid enhanced intelligent method and key technology based on driver's cognitive behavior

4. Hybrid control and real-time optimization of hybrid large commercial vehicles based on big data and vehicle networking

5. Research on decision-making and control of intelligent cars based on individual driving

6. Intelligent vehicle traffic scene understanding and road identification method

7. Intelligent networked multi-vehicle cooperative control theory and key

technologies

8. Intelligent vehicle fault diagnosis and fault-tolerant control technology

9. Intelligent vehicle virtual test method and key technology verification

10. Intelligent networked car expected functional safety basic theory and verification key technology

11. Hybrid vehicle intelligent control method and key technology based on brain-computer interaction

Yalong River Joint Fund

The Yalong River Joint Fund (II phase) was jointly set up by NSFC and Yalong River Hydropower Development Company, Ltd. (hereinafter referred to as Yalong River Company) from 2017 to 2019. Aiming at giving full play to NSFC's guiding role and combine with the national strategic needs, the Yalong River Joint Fund promotes the independent innovation capability of China's clean renewable energy and deep ground science, enhance the application of important achievements in basic research in the construction of the wind and water complementary clean energy demonstration base in the Yalong River Basin and in the underground laboratory in Jinping, China, provide scientific basis and technical support for solving the key issues facing China's development and utilization of clean renewable energy and deep ground science, and cultivate a group of scientific and technological talents.

In 2019, the Yalong River Joint Fund calls for proposals of "Key Project" and "Fostering Project" from the following 4 priority areas. The average direct funding of Key project is 3 million yuan per project for 4 years and that of the Fostering project is 500,000 yuan per project for 3 years. Any eligible scientists and technicians over the country are encouraged to submit applications in accordance with research scope and requirements listed in this *Guide*.

I. Basic Research of Deep Underground

1. Research on radiation background/advanced detection technology in extremely deep underground laboratory environment

Based on the extremely low background physics experiment of the underground laboratory in Jinping, China, proposals are expected to study various low temperature media such as liquid nitrogen, liquid helium, liquid argon, etc., which is necessary for very low background experiment for direct detection of dark matter and neutrino-free double beta decay. Its radionuclide will create important background for very low background experiments. Main research areas include:

(1) Study on the existence form, diffusion mode and adsorption, inhibition and removal methods of radionuclides in liquid nitrogen/liquid argon/liquid helium;

(2) Measurement methods and technical studies of extremely small concentrations of radionuclides (less than 1 microbeck/liter) in low temperature liquefied gases;

(3) Advanced detection methods, techniques and electronics studies;

(4) Research on advanced detection materials and detectors;

(5) Research on measurement technology of radionuclide content in human body;

(6) Research on whole body imaging technique of radionuclide irradiation in human body.

Note: this direction only accepts the application for the Key project and at least two topics of the above 6 topics should be included in the application.

2. Study on seepage stability and dynamic mechanical response of surrounding rock in extremely deep cavern

Based on the Jinping secondary diversion tunnel and the extremely deep underground laboratory cavern group project, the proposal should study on the seepage stability law and long-term safety evaluation method of the deep-buried cavern surrounding rock, so as to provide scientific basis for long-term safe operation and maintenance of deep underground laboratories and hydraulic tunnels. The research content includes:

(1) Research on hard rock water softening mechanism under high stress and high osmotic pressure;

(2) The structural characteristics and evolution law of the surrounding rock fracture network of the cavern in the deep environment;

(3) Study on seepage stability law and long-term mechanical behavior of surrounding rock in deep buried caverns;

(4) Study on dynamic mechanical response of high-osmotic pressure in deep-buried cavern surrounding rock;

(5) Evaluation and analysis of seepage stability of surrounding rock of deep cavern environment.

Note: this direction accepts application for both Fostering and Key project. The application for Key project includes but is not limited to (1), (3), (4) and (5); the Fostering project only accepts application for (2).

II. Development Technology of Complementary Renewable and Clean Energy of Wind, Light and Water

1. Research on the development strategy and related mechanisms of wind, light and water complementary clean energy in large river basins

Combining the wind, light and water multi-energy complementary bases in the Yalong River Basin, the proposal should comprehensively consider the boundary conditions such as an operational management entity, multiple power point access and cross-regional delivery, multi-level dispatching agency coordination, and power market trading. The purpose is to promote the implementation of complementary development of wind, light and water, realize the goal of mutual benefit and win-win result for participating parties, and carry out research on development strategy and related mechanisms. The research areas include:

(1) Research on complementary development models of wind, light and water;

(2) Research on cross-regional power transmission price mechanism, compensation mechanism and dispatching operation mechanism of wind, light and water complementary clean energy;

(3) Research on the impact assessment method for the complementary development of wind, light and water in large river basins on the socio-economic development of the basin;

(4) Research on complementary development strategies and promotion mechanisms

of wind, light and water;

(5) Research on intelligent centralized control scheduling mode and key technologies for multi-million-kilowatt wind, light and water.

Note: This direction accepts the application of "fostering project" and "key project", among which the "key project" application must include, but is not limited to, the research contents of the above (1), (2) and (3); the key project accepts the application of the research content in the above (4) or (5).

2. Research on key technologies of wind energy map in complex mountainous areas

Combined with the meteorological conditions and topographic conditions of the complex mountainous areas in the Yalong River Basin, the proposal should conduct complex mountain meteorological observations, wind resource optimization simulations and the construction of virtual wind towers.

This direction only accepts applications for "fostering projects".

III. High dam project construction and long-term safe and economical operation of river cascade power stations

1. Seismic mechanism, measures and seismic safety evaluation of 300-meter high-rise core rockfill dam in strong earthquake zone

At present, there is no mature experience in the seismic design of the 300-meter high-rise earth core rockfill dam at home and abroad. Based on the progress of dam filling of the Lianghekou Hydropower Station in the Yalong River Basin, the proposal should, according to the actual dam material source conditions, filling standards, dam body division and dam material static and dynamic parameters review, carry out the dam seismic response and measures analysis. The research content includes:

(1) Study on the theoretical method and dynamic constitutive model of dynamic parameters of ultra-high core rockfill dam;

(2) Study on dynamic characteristics, seismic response and seismic safety of dam materials for ultra-high earth core rockfill dam;

(3) Research on seismic measures of ultra-high core wall rockfill dam in high seismic intensity area.

This direction accepts applications for "fostering projects" and "key projects". The "key projects" application must include, but is not limited to, the research content of (2) and (3) above; the "fostering project" only accepts application for research content in the above (1).

2. Study on crack control of anti-shock and wear-resistant concrete for water discharge buildings under conditions of high altitude, high flow velocity and large temperature difference.

Combined with the drainage project of the Lianghekou Hydropower Station on the Yalong River, the proposal should study the theory and technology of anti-cracking risk of impact-resistant concrete under multi-field coupling conditions such as actual climatic environment, concrete material system and construction technology.

This direction only accepts applications for "fostering projects".

3. Research on dynamic safety and control theory and method of large-scale underground cavern group engineering design and construction under complex

geological conditions

On the basis of the Yalong River Kara Hydropower Station, under the integrated design of general contracting design and construction, the proposal should consider the key elements of surrounding rock stability, support design, construction method and safety monitoring during excavation of large underground powerhouse caverns under complex geological conditions. Research on the integrated dynamic safety and control theory and method of large-scale underground cavern group engineering design and construction under complex geological conditions should be carries out to resolve the influence of complex geological conditions on the construction of underground caverns. The research content includes:

(1) Research and application of integration technology and method for hydropower engineering design and construction;

(2) Research on dynamic inversion analysis method and construction technology countermeasures for design parameters of large underground caverns;

(3) Theoretical and applied research on rapid monitoring and feedback analysis and early warning methods for large-scale underground cavern group engineering design and construction;

(4) Research on the theory and key technology of dynamic optimization method for excavation and rapid support construction of large-scale underground cavern group design and construction.

This direction accepts the application of "fostering project" and "key project", and the "key project" application must include, but is not limited to, the research contents of (3) and (4) above; the "fostering project" accepts the above (1) or (2) research content.

IV. Large-Scale Hydropower Project Construction and Operation Intelligent Technology

1. Research on intelligent control theory of unmanned roller compactor for filling of high core rockfill dam

Combined with the construction of the intelligent roller compaction system for the dam of the Lianghekou Hydropower Project in the Yalong River Basin, the proposal should take use of the dynamic control, path tracking, intelligent obstacle avoidance and system safety technologies to realize the intelligent control of the roller compactor during the unmanned driving process. The research content includes:

(1) Research on dynamic modeling and control of multi-body systems of vehicles;

(2) Research on high-precision trajectory tracking control algorithm for unmanned driving;

(3) Research on unmanned intelligent sensing algorithm and obstacle avoidance strategy;

(4) Research on safety management strategy of driverless function.

This direction only accepts applications for Key Projects. The Key Project application must include, but is not limited to, the research content of (1), (2), (3) and (4).

2. Research on the theory of intelligent monitoring of high core rockfill dam construction

Combined with the control work of the dam construction process of the Lianghekou Hydropower Project in the Yalong River Basin, the proposal should study the basic theory

and engineering practical problems involved in the dam construction quality and schedule intelligent monitoring. The research content includes:

(1) Intelligent sensing, analysis and control of construction quality and progress of high core rockfill dam;

(2) Integration of construction quality and progress intelligent monitoring system for high core rockfill dam.

This direction only accepts applications for Key Projects.

3. Research on key technologies of online intelligent fault diagnosis and trend warning for hydropower equipment in intelligent power plants

Aiming at the operation safety and maintenance management of power generation equipment of cascade hydropower stations in the Yalong River Basin, the proposal should use the big data mining technology such as machine learning to study the intelligent theory and method of intelligent power plant hydropower equipment operation, solve the key technical problems faced by intelligent monitoring of hydropower equipment, and realize online intelligent fault diagnosis and trend warning. The research content includes:

(1) Research on monitoring indicator system and monitoring method for operation status of hydropower equipment;

(2) Research on fault eigenvalue acquisition method and fault correlation of hydropower equipment;

(3) Data mining and application of hydropower equipment based on big data.

This direction only accepts applications for Key Projects. The Key Project application must include, but is not limited to, the research content of (1), (2) and (3).

4. Applied research of intelligent technology in enterprise safety production management

By use of the Internet, big data and other technologies to realize the digital and intelligent management of the safety production elements of the Yalong River Basin, the proposal should carry out in-depth mining, model construction and analysis and calculation of safety management information in the process of power production and engineering construction, reveal the alienation of safety production, and find out the features to identify weak links in security management, provide early warning and response measures.

This direction only accepts applications for Fostering Projects.

Joint Fund for Smart Grid

The Joint Fund of Smart Grid is jointly established by NSFC and the State Grid Corporation of China. It aims at giving full play to the guiding role of NSFC and promoting the combination of industry and universities and research. It tries to attract and mobilize excellent science and technology resources of society to carry out basic frontier research for national strategic energy needs, and enhance the independent innovation capability and core competitiveness of China's power industry.

In 2019, the Smart Grid Joint Fund calls for proposals of Integration Projects and Key Projects from the following priority areas. The research period should be uniformly filled out as “January 1, 2020 to December 31, 2023”. The average direct funding of integration projects is 12 million yuan per project for four years; the average direct funding

of key projects is 2.6 million yuan per project for four years.

I. Integration Projects

Applicants may submit proposals in any of the following 2 directions and decide the project title and research plan independently.

1. Funding area one: Theory and method for supply and demand balance of high proportion renewable energy power system

Area of technology: New energy generation and grid connection.

Research purposes and significance: High-ratio renewable energy power system is an extreme scene after renewable energy dominates. Its power supply and load will have uncertainties in multiple time-space scale, and uncertainty and planning operation decision have strong dependence, which will fundamentally change the theory and implementation of supply and demand balance of traditional power systems. In order to cope with this challenge, proposals are expected to carry out research on the mechanism of supply and demand balance under multiple uncertainties, propose new theories and new methods to achieve a balance between supply and demand of high-renewable renewable energy power systems, and obtain a series of original results leading the international research direction, and contribute to “China's wisdom” for global green and low carbon development.

Scientific Objective: To address the core issues of supply and demand balance of high-ratio renewable energy power systems, explore the evolution trend of renewable energy resources; propose power and load uncertainty characterization methods; reveal the uncertainty of power supply and load under different time and space scales and its relationship between planning and operation decision-making, and come up with the supply-demand balance mechanism with decision-dependent uncertainty on both sides of power supply and load; explore methods to solve the key technical bottlenecks and countermeasures for improving the utilization rate of renewable energy, and finally propose new theories and methods for the supply and demand balance of high-ratio renewable energy power systems.

Main research contents include:

(1) The law of multi-time-scale changes in renewable energy resources;

(2) The characterization of the dual-sided uncertainty of supply and demand of high-ratio renewable energy power systems;

(3) Risk assessment of supply and demand mismatch in high-ratio renewable energy power systems;

(4) Coordination planning for supply and demand of high-ratio renewable energy power systems;

(5) Dynamic matching and optimization of supply and demand of high-ratio renewable energy power systems.

2. Funding area two: High-voltage DC current damping breaking mechanism and its application research

Area of technology: High voltage and insulation.

Research purposes and significance: High-voltage DC current breaking is the key technology for fault isolation and resection of high-voltage DC grids, and it is a technological frontier and problem in the field of electrical engineering. The existing high-voltage DC current breaking scheme is difficult to meet the dual requirements of the

high-voltage DC grid for its economic and technical indicators, and the scale application in the future is challenged. By studying new insulating dielectric materials, developing capacitors for current transfer, and exploring new methods of energy dissipation, proposals are expected to propose a new scheme and topology for high-voltage DC current breaking, which provides a scientific basis for the development of high-performance, low-cost high-voltage DC circuit breakers. It meets the urgent need for rapid isolation and removal of high voltage DC grid faults in the future.

Scientific goal: to reveal the mechanism of nonlinear transfer and damping suppression of high-voltage DC short-circuit current and its control method; to master the insulation recovery characteristics of new environmental protection medium fractures in high-voltage direct current breaking; to propose a new composite energy-consuming method; to come up with a high-performance, low-cost new damped DC breaking scheme and its topological structure, and develop 50 kV and above DC circuit breaker module prototypes, providing theoretical basis and technical support for the development and large-scale application of high-voltage DC circuit breakers in the future.

Main research content:

(1) High-voltage DC current damping breaking mechanism and circuit breaker topology research;

(2) Study on the mechanism of insulation strengthening of new environmental protection medium in high voltage DC breaking;

(3) Nonlinear mechanism and regulation of capacitor dielectric for current transfer and suppression;

(4) The shutdown performance of fully-controlled power electronic devices under high-voltage DC breaking conditions;

(5) New method and optimization of composite energy dissipation in high voltage DC breaking.

II. Key Projects

Applicants may submit proposals in any of the following 15 research directions and determine the project title, research content and research plan independently.

(1) Coordinated operation and control of complex AC/DC large power grids;

(2) Friendly interaction between large-scale new energy and large power grids;

(3) Coordinated control and stable operation of AC and DC power grids with high proportion of distributed new energy;

(4) Failure evolution mechanism and risk assessment of insulation performance of power transmission and transformation equipment;

(5) Overvoltage protection technology and equipment of ultra-high voltage system;

(6) Active distribution network intelligent sensing and efficient operation;

(7) Basic theory and key supporting technologies for competitive electricity sales market;

(8) High voltage power device packaging technology and failure mechanism;

(9) Energy storage device with safe high energy density at low cost;

(10) Basic theory of energy conversion and control for medium and low voltage DC distribution networks;

(11) Analysis method and control strategy of the stability mechanism of power

system with flexible DC;

(12) Safe and efficient operation mechanism of integrated energy systems such as water and electricity;

(13) Theory and method of multimodal data fusion analysis for power grid equipment;

(14) Intelligent identification and security prevention and control of network attacks for large power grids;

(15) Theory and method of wireless transmission of electrical energy for smart sensors.

Joint Fund of Nuclear Technology Innovation

Jointly set up by NSFC and Nuclear Industry Corporation Limited, the Joint Fund (hereinafter referred to as the "Nuclear Technology Innovation Joint Fund") is aimed to play the guiding role of the National Natural Science Fund, attract and gather outstanding talents in relevant research fields over the country, strengthen basic frontier technology research for national nuclear technology strategy needs, and promote the sustainable development of nuclear technology industry and the continuous improvement of independent innovation capability.

In 2019, the Nuclear Technology Innovation Joint Fund accepts the following Key Projects in 35 directions. The average direct funding is 2.8 million yuan per project with a funding period of 4 years. The research period should start from January 1, 2020 to December 31, 2023.

1. Research on the precision spectroscopy of the measurement of the basic properties of unstable nuclei

Advanced measurement techniques for the fundamental properties of unstable nuclei; laser techniques for producing polarized unstable nuclei and methods for precisely regulating ion velocities.

2. Direct measurement and transport physical mechanism research of the nuclear fusion device high-performance plasma core electric field

High-time-space-resolved heavy ion beam probe measurement technology for magnetic confinement fusion devices; direct measurement of electric field and magnetic field in high specific pressure fusion plasma core and related transport studies.

3. Fission Instant neutron and primary fission product correlation measurement

Multiple gamma (Greek symbols) conform to the primary fission product identification method; strong background environment fission prompt neutron multiplicity measurement technique; high-excited primary fission product and prompt neutron correlation measurement.

4. Research on nuclear diagnostic techniques and nuclear reactions in extreme environments with strong laser simulation

High-pulse laser induced nuclear reaction product detection technology; the influence of Coulomb shielding on the nuclear reaction cross section in plasma environment.

5. Research on key technologies of multi-physics coupling in complex process thermal process

Study on heat transfer characteristics of heat transfer-convection-radiation multiphysics coupling non-equilibrium flow in complex core structure during thermal process; flow instability of supercritical fluid in non-uniform heat release core; high temperature and high flow rate hydrogen medium research on the mechanism of action of structural materials.

6. Physical and thermal coupling analysis of fast reactor core and mechanism of sodium characteristics under severe accident

Multi-phase multi-component physics-thermal coupling analysis of meltdown accidents; delamination mechanism and effect on cooling performance after severe accidents; sodium leakage atomization mechanism and sodium combustion mechanism; study of the sodium boiling behavior containing wire wound fuel assemblies.

7. Phase-to-phase force model and boiling two-phase simulation verification of core-fuel assembly

The phase-to-phase force model for the Euler two-fluid CFD numerical simulation; the direct numerical simulation of the phase-to-phase force model of the beam-beam channel; the two-phase simulation verification and application of the 5×5 grid rod beam boiling.

8. Research on safety characteristics of lead-bismuth alloy thermal fluid

Study on the mechanism of heat transfer of lead-bismuth alloy under surface corrosion of structural materials; study on mechanism and influence of leakage process of heat transfer tube of lead-bismuth fast reactor steam generator; mechanism of thermal stratification of lead-bismuth alloy molten pool and its effect on system flow and heat transfer.

9. Study on the distribution characteristics of the inner boundary layer of the fuel assembly under non-steady state conditions

Study on the parameters of wall velocity and temperature under different unsteady factors in the inner boundary layer of fuel assembly; study on the key parameters of the boundary layer of the bundle wall under the interaction of the grid; the flow characteristics of the inner boundary layer of the fuel assembly under flow fluctuation and heat transfer mechanism.

10. Research on secondary circulation control method of supersonic rotating flow field

Secondary circulation simulation of supersonic rotating flow field; online control method of supersonic rotating flow field driven by secondary circulation.

11. Behavioral evolution and failure mechanism of multi-cladding structure dispersed fuel under the long refueling cycle of pressurized water reactor

Under the condition of long refueling cycle of pressurized water reactor: (1) study on swelling, creep and microstructure evolution of diffused fuel irradiation in multi-cladding structure; (2) study on interaction mechanism between each cladding structure and matrix; (3) dispersion of multiple cladding structure study on multi-field coupling numerical simulation method of fuel; (4) study on failure mechanism of multi-cladding structure dispersion fuel.

12. Study on the mechanism of fission product radionuclide interference on detection imaging

The fission product radionuclide interference suppression mechanism; the influence factors and mechanism of the radionuclide interference on the detection system under strong radiation environment; the dynamic calibration method of the detector.

13. Research on intelligent construction methods of hotspot information in nuclear radiation environment

Hot spot intelligent positioning method combining artificial potential field guidance and Bayesian estimation; hot spot distribution space intelligent reconstruction method based on multi-sensor information fusion; and radiation field intelligent estimation method based on particle filtering in multi-source environment.

14. Based on the cyclotron's proton beam energy, a wide range of continuous precision adjustment technology and experimental verification research

A new method for energy adjustment of medium-energy proton beam; a key technique for continuous and precise adjustment of proton beam energy based on high-current proton cyclotron; based on the experimental verification of medium-energy high-current proton cyclotron.

15. New technology for radiation monitoring and energy spectrum analysis

Radiation monitoring technology under high temperature, high humidity and strong radiation conditions; new technology for rapid analysis of gamma energy spectrum for high statistical fluctuations.

16. Study on gas-solid reaction of lanthanide metal with H_2O, precipitation of lanthanide oxalate and hot-pressed water

Thermodynamics and kinetics of gas-solid reaction of lanthanide metals with H_2O; thermodynamics and kinetics of lanthanide oxalate precipitation and hot-pressed water reaction; thermodynamics and kinetics of gas-solid reaction of Zr, Al and NO_x/H_2O.

17. Diluent extraction of the third phase formation mechanism and soft ligand complexing agent separation from the high-level liquid waste system

The effect of thinner structure and radiation degradation on the extraction of the third phase and the mechanism study; the separation of the secondary lanthanide from the high-level liquid waste by the soft ligand complexing agent.

18. Separation of lanthanide in alkaline system

Study on the oxidative dissolution of spent fuel alkali method; research on separation and purification of uranium and plutonium in alkaline system.

19. Research on new materials and mechanisms for iodine, strontium, barium and strontium application

Adsorption mechanism and structure optimization of iodine and ruthenium on metal organic framework (MOF) and molecular sieves; adsorption behavior and mechanism of ruthenium, osmium and MOF and molecular sieves under acidic conditions.

20. Multi-omics combined bio-radiation-sensitive molecular markers

Screening of radiation-sensitive molecular markers based on system biology techniques and study of dose response laws; development of radiation biological dosimeters based on radiation-sensitive molecular markers.

21. Health effects and biological mechanisms of long-term low-dose radiation exposure

Low-dose epidemiological database was established to correlate with health risks; health effects and mechanisms of low-dose radiation on the blood system or immune system.

22. Transuranium elements and the transfer law of polonium and lead in living organisms

The transfer law and measurement technology of neptunium, americium, plutonium, polonium, and lead in the living body.

23. Radioactive aerosol formation characteristics and behavioral rules

Production mechanism of ultra-uranium nuclides aerosol in the workplace and its particle size distribution; new technology for measuring the concentration of ultra-uranium nuclides aerosol; aerosol sedimentation of Cs and Sr under different meteorological conditions; enrichment and migration of Cs and Sr aerosols in plants.

24. Basic research on radiopharmaceuticals for the diagnosis or treatment of major diseases such as tumors

Tumor targeted diagnosis and treatment integrated radiopharmaceutical research; radiodiagnostic drug research for neurodegenerative diseases.

25. New technology for isotope separation and purification

The mechanism of adsorption and extraction of ^{99}Mo by functional ionic liquids, the mechanism of anti-radiation damage, and the high-efficiency separation of nuclides such as ^{225}Ac by accelerator.

26. Study on the mineralogical characteristics of sandstone-type uranium ore

Study on mineralogical characteristics of sandstone uranium ore; establishment of process mineralogical database of sandstone-type uranium deposit; study on mineral leaching reaction mechanism of sandstone uranium ore.

27. Theory and method of low permeability sandstone uranium reservoir reconstruction

Reservoir characteristics and seepage mechanism of low-permeability sandstone uranium deposits; mechanism and regularity of in-situ damage and permeability of low-permeability sandstone; chemical dissolution characteristics and pore evolution of low-permeability sandstone; multi-scale coupled evaluation method for permeability of multi-dimensional damaged sandstone; anisotropic seepage law of fracture network.

28. Spatial occurrence relationship and enrichment mechanism of titanium iron oxide and uranium minerals

Titanium iron oxides, uranium mineral types and their spatial characteristics in sandstone uranium deposits; ferrotitanium oxide alteration sequences and physicochemical conditions; symbiotic combination of ferrotitanium oxides and uranium minerals; the effect of ferrotitanium oxide alteration on uranium migration, precipitation and enrichment.

29. Mechanism of vertical migration of uranium and associated elements in sandstone-type uranium deposits

The occurrence and distribution of uranium and associated elements in the surface layer of sandstone-type uranium deposits; the vertical migration mechanism and regularity of uranium and associated elements and the influencing factors of characterization.

30. Study on mechanism of groundwater pollutants migration and transformation in uranium mine leaching and decommissioning mining area

Heavy metal ions and radionuclides in groundwater in decommissioned mining areas and their water migration characteristics; processes, mechanisms and microstructure of heavy metal ions and radionuclides at water-rock micro-interface; effects and mechanisms of sulfate and nitrate reduction and heavy metal ions and radionuclide migration process under microbial action.

31. Failure mechanism of structural materials during irradiation

Dynamic change of mechanical properties of materials during heavy ion irradiation; research on failure mechanism of mechanical properties of materials.

32. 3D printing reactor pressure vessel/fuel assembly components irradiation damage mechanism

The damage mechanism and defect evolution law of 3D printing reactor pressure vessel/fuel assembly components during irradiation; the influence of irradiation defects on mechanical and thermodynamic properties.

33. The interaction mechanism between the dispersed particle interface of ODS steel and irradiation defects

High-dose ion irradiation mechanical behavior and microstructure evolution of ODS steel for fast reactor; ODS dispersion particle interface characteristics and anti-irradiation performance rules; the influence law and mechanism of oxide particle and matrix interface characteristics for irradiation defects (dislocation clusters and He bubbles).

34. Plastic deformation mechanism and processing performance of N36 zirconium alloy

Study on the influence of plastic deformation and heat treatment on the texture and second phase of N36 zirconium alloy strip; the study of mutual solubility relationship, wear law and failure mechanism under continuous high-speed impact; the influence mechanism of N36 strip structure on the process and process parameters.

35. Special performance materials for seawater uranium extraction and related processes

Study on the mechanism and preparation method of special performance materials for seawater uranium extraction, evaluation of uranium adsorption performance and performance enhancement of materials.

NSFC-Guangdong Joint Fund

The third phase of the NSFC-Guangdong Joint Fund is jointly established by NSFC and the People's Government of Guangdong Province (NSFC-Guangdong Joint Fund) from 2016 to 2020. It aims at giving full play to the guiding role of NSFC, attracting and gathering outstanding scientists all over the country, solving the major S&T issues and key technology problems concerning the strategic development of economy, society and science and technology in Guangdong Province and its surrounding areas. It tries to promote the development of science and technology and build up the team of talents in Guangdong Province, enhance the independent innovation capability and international competitiveness of universities and research institutes in Guangdong Province, and promote the sustainable development of economy and society of Guangdong Province.

NSFC-Guangdong Joint Fund calls for proposals of Key Project or Integration Project from the following priority areas. Key Project provides an average direct funding of 3 million yuan per project for four years; integration Project provides an average direct funding of 14 million yuan for four years. Any eligible scientists and technicians over the country are encouraged to submit applications in accordance with research scope and requirements listed in this *Guide*.

I. Integration Projects (Resources and Environment)

i. Key technologies and theoretical research on active disaster prevention of earthquake disasters in Guangdong-Hong Kong-Macao Greater Bay Area

In order to prevent the earthquake risk and tsunami risk that may occur in the Guangdong-Hong Kong-Macao Greater Bay Area, the proposal should carry out multi-disciplinary and multi-disciplinary research on the tectonic setting of the earthquake, the physical process and disaster mechanism of earthquake occurrence, and the assessment and prediction of earthquake disasters. The proposal should identify the potential seismic source, crustal and near-surface three-dimensional velocity structure in the area, understand the physical laws of earthquake "pregnancy-occurrence", develop high-performance computing platform-based seismic rupture dynamics process and strong ground motion simulation technology and seismic damage assessment advanced algorithms, carry out seismic tsunami wave propagation and disaster prediction research, and provide technical support to actively defend against earthquake disasters in Guangdong-Hong Kong-Macao Greater Bay Area.

Main research areas include:

1. Characteristics of active faults and deep velocity structures in the Guangdong-Hong Kong-Macao Greater Bay Area

By use of dense array observations and combined with microseismic, fault-envelope, passive source imaging and other geophysical techniques, the proposal should identify land-based active faults and background environmental structures in the Guangdong-Hong Kong-Macao Greater Bay Area; based on existing coastal fault zone detection data and combined with the observation of submarine seismographs, the proposal should explain the characteristics of coastal active faults and crustal velocity structures in the Guangdong-Hong Kong-Macao Greater Bay Area and reveal the tectonic setting of strong earthquakes in this area.

2. Velocity structure characteristics of near-surface superficial and low-velocity sediments in the Guangdong-Hong Kong-Macao Greater Bay Area

The background seismic noise data is acquired by means of dense array observation. Combined with high-precision seismic imaging methods such as high-order surface wave imaging and waveform imaging, the velocity structure of the near-surface sedimentary layer with high accuracy in Guangdong, Hong Kong and Macao should be clarified. Seismic vibration amplification effect of shallow surface and low-velocity sediments near the surface should be simulated.

3. Prediction of dynamic fault rupturing process and prediction of strong ground motion

For the coastal faults and land active faults, the spontaneous fault rupture simulation of seismic fault dynamics should be carried out; the possible fault rupture process should be predicted; combined with the crustal and shallow velocity structure characteristics of the Guangdong-Hong Kong-Macao Greater Bay Area, a high-performance simulation method for large-scale seismic wave propagation should be developed; coastal faults and active faults induce strong ground motion distribution characteristics in the Guangdong-Hong Kong-Macao Greater Bay Area should be simulated and predicted.

4. Earthquake tsunami wave propagation process, disaster mechanism and hazard prediction

Based on the research results of coastal fault active faults, the earthquake source and its rupture process in the Guangdong-Hong Kong-Macao Greater Bay Area and other parts of the South China Sea should be studied. The high-performance numerical method for simulating the seismic tsunami wave propagation and disaster process should be simulated. Earthquakes and tsunami in other earthquake-stricken areas in the South China Sea and the distribution of hazards caused by them should be simulated and predicted.

5. Earthquake disaster risk assessment and prevention and control in Guangdong-Hong Kong-Macao Greater Bay Area

The proposal should collect and study the basic data such as the spatial distribution characteristics of the buildings and lifeline projects in the Guangdong-Hong Kong-Macao Greater Bay Area. Based on the predicted strong ground motion time history, it should simulate the damage and collapse of buildings under strong earthquakes, and predict the large-scale earthquakes and the hazards of buildings and lifeline projects in the Guangdong-Hong Kong-Macao Greater Bay Area, establish risk prevention and control of seismic fortification, reinforcement and reconstruction of buildings in the Guangdong-Hong Kong-Macao Greater Bay Area, as well as strengthen the active defense theory of earthquake disasters.

The application for this integration project should include the above five research contents, and carry out in-depth and systematic research on the project theme "Key Technology and Theoretical Research on Active Disaster Prevention of Earthquake Disasters in Guangdong-Hong Kong-Macao Greater Bay Area". The expected results should include principles, methods, technologies, models, patents, etc.

ii. Evolution mechanism and upgrading mechanism of arable land quality in red soil region

In face of the major demand for the development of modern high-efficiency agriculture in Guangdong, the proposal should study the theory and method of the evolution and improvement of arable land quality in the red soil region, explores the "evolution law-mechanism analysis-enhancement approach" of cultivated land quality, and study the temporal and spatial evolution, degradation and pollution of cultivated land quality in the red soil region. The mechanism and improvement mechanism should be verified by the application environment test and lay a theoretical foundation for the improvement of cultivated land quality in the red soil region. Main research area includes:

1. Temporal and spatial evolution of arable land quality in red soil region

Exploring the total factor system, three-dimensional composite structure and multi-functional transformation mechanism of cultivated land quality; studying the high-resolution remote sensing inversion mechanism and the big data-driven evaluation mechanism of cultivated land quality; studying the sky integrating multi-source remote sensing, Internet of Things and in-situ speed measurement ground-network integrated arable land quality monitoring and arable land quality monitoring mobile laboratory construction method; revealing the spatio-temporal pattern and evolution law of arable land quality in the red soil region under the background of rapid economic development.

2. Mechanism of farmland quality degradation in red soil region

Taking typical watersheds and regions as research objects, the proposal should study the mechanism of soil acidification and erosion and other soil degradation in the red soil region, reveal the driving and controlling mechanism of soil acidification under natural and artificial effects, and study the response mechanism of soil structure to different types of

erosion and management. To reveal the mechanism of the formation and stabilization of soil aggregates by the coupling of organic and inorganic materials; to study the microbial mechanism of soil degradation under high-intensity planting conditions such as multi-cropping and continuous cropping, and to reveal the principle of quality restoration of degraded cultivated land.

3. Mechanism and quality impact mechanism of arable land pollution in red soil region

Taking typical heavy metals and organic pollutants as research objects, the morphological characteristics and temporal and spatial distribution of heavy metal pollution in red soil region should be studied. The sources, morphological transformation, adsorption fixation and migration processes of heavy metals in soil should be studied and biogeochemical mechanism of cyclical coupling of heavy metal ions in organic matter and iron-manganese oxide should be revealed. The proposal should study pollution characteristics and migration, transformation and degradation processes of typical organic pollutants, reveal gene expression profile clustering and GO pathway enrichment mechanism of organic pollutant degrading bacteria, and analyze the effects of pollutants on arable land quality evolution mechanism.

4. Mechanisms and ways to improve the quality of arable land in red soil regions

The proposal should study soil acidification, erosion and typical heavy metal and organic pollution control mechanisms in red soil region and establish a model of cultivated land quality control; conduct the improvement of organic matter quality, mineral nutrient balance and efficiency, medium and low yield improvement, acidification improvement and pollution restoration technical integration; carry out basic theory and application environment test verification of cultivated land quality improvement; construct a multi-functional integrated intelligent farmland platform for monitoring and evaluation of cultivated land quality, protection and upgrading, ecological restoration and reconstruction.

The application for this integration project should include the above four research contents, and carry out in-depth and systematic research on the project theme “Evolution Mechanism and Improvement Mechanism of Cultivated Land Quality in Red Soil Region”. Research results should include papers, monographs, patents, etc.

II. Key Project

i. Agriculture

1. Research on the gene-mining and molecular mechanism of major crop important traits in South China

Taking the main crops and cash crops in South China as the research object, the proposal should take the high quality, high yield, disease resistance and other traits as the research objectives, excavate the important genes such as high quality, high yield and disease resistance, and study the mechanism of action of important stress-resistant genes under biotic and abiotic stress, high-efficiency molecular breeding and hybrid breeding mechanism and technology. Main research directions include:

(1) High-quality and high-yield gene mining and its mechanism of action;

(2) Disease resistance and insect resistance gene mining and its molecular mechanism;

(3) High-efficiency molecular breeding and cross-breeding mechanism and technology.

2. Formation mechanism of excellent traits of important domestic animals in South China

Taking the important domesticated animals in South China as the research object, the proposal should study the genetic basis of the formation of excellent traits and the nutritional regulation of reproductive performance. The main research directions are:

(1) The genetic basis for the formation of good traits of important domesticated animals in South China;

(2) Nutritional regulation and mechanism of reproductive performance of domesticated animals in South China.

3. Basic research on green prevention and control of pests in South China

In view of the technical bottlenecks in the development of agricultural industry in Guangdong and the major problems encountered in the development of important breeding industries, the pathogenic mechanisms, host immune mechanisms and toxicological mechanisms, as well as major pests and diseases, the proposal should study pathogenic mechanism, host immune mechanism and toxicological mechanism, as well as major pest and disease outbreak mechanism and prevention and control research, and environmentally friendly input and controlled release synergy mechanism related to pest and disease prevention and control. Main research directions:

(1) The occurrence and prevention and control mechanism of important diseases of major domesticated animals;

(2) The mechanism and prevention of major pests and diseases of major crops in South China;

(3) Research on the mechanism of controlled release and synergy of environmentally friendly inputs.

4. Functional factors of subtropical agricultural products and their molecular mechanisms of steady state processing

Focusing on the key factors in the functional factors, processing and storage of subtropical agricultural products, the proposal should analyze the quality and its changes in functional factors during the storage and transportation process and the generation of harmful substances, and innovate the key technologies for postharvest preservation. Main research directions include:

(1) Quality formation and steady-state regulation mechanism in processing sub-tropical agricultural products;

(2) Component interaction mechanism and food safety in the processing of subtropical characteristic agricultural products;

(3) Mechanism of post-harvest preservation and biotransformation of subtropical characteristic agricultural products.

ii. Resources and Environment

1. Marine resources and environment of South China Sea

The proposal should conduct relevant basic research in view of the South China Sea geological disasters and tectonic activities, energy resources, minerals, biological resources development and environmental impact of the South China Sea, and take into consideration of the hydrological dynamic environment, environmental changes and ecosystem response. Main research directions are:

(1) Energy and resource development in the South China Sea and its environmental impact;

(2) The process of interaction between the southern seawater dynamic environment and the air-sea;

(3) Environmental changes in the South China Sea and the response mechanism of the marine ecosystem;

(4) Fine structure and resource disaster response of deep reflection of lithosphere in the eastern margin of the South China Sea;

(5) The process of material source and sink and its ecological effects in the South China Sea.

2. Waste resource recycling and pollution control in South China

The proposal should conduct related research on the formation process, treatment and disposal, resource utilization and pollution control of waste (gas, liquid and solid) in South China. Main research directions are:

(1) Formation, resource utilization and pollution control of urban waste;

(2) Formation, resource utilization and pollution control of industrial waste;

(3) Formation, resource utilization and pollution control of agricultural waste;

(4) Formation, safe disposal and pollution control of hazardous waste.

3. The ecological environment of Guangdong-Hong Kong-Macao Greater Bay Area

The proposal should focus on the evolution and impact mechanism of ecological environment quality in Guangdong-Hong Kong-Macao Greater Bay Area, the restoration and reconstruction of damaged ecosystems in the estuary and coastal zones of Guangdong-Hong Kong-Macao Greater Bay Area, and the ecological security barrier system and its mechanism of action Main research directions are:

(1) The process of material source sink and its ecological and health effects in the Guangdong-Hong Kong-Macao Greater Bay Area;

(2) Evolution and impact mechanism of ecological environment quality in Guangdong-Hong Kong-Macao Greater Bay Area;

(3) Restoration and reconstruction of damaged ecosystems in the estuary and coastal zone of Guangdong-Hong Kong-Macao Greater Bay Area;

(4) The ecological security barrier of Guangdong-Hong Kong-Macao Greater Bay Area and its mechanism of action;

(5) The theory of natural resources and ecological assets monitoring and environmental restoration in the Guangdong-Hong Kong-Macao Greater Bay Area.

iii. Management Science

Research on collaborative development and innovation management in Guangdong-Hong Kong-Macao Greater Bay Area.

In view of the construction and development of Guangdong-Hong Kong-Macao Greater Bay Area, Guangdong Province has joined hands with Hong Kong and Macao to carry out joint theoretical and empirical research to build a world-class Bay Area and world-class urban agglomeration, create an international science and technology innovation center, promote the scientific and effective allocation of innovative elements, and enhance the innovation efficiency of Guangdong, Hong Kong and Macau. The main research directions include:

(1) Research on coordinated development mechanism and management innovation

of Guangdong-Hong Kong-Macao Greater Bay Area;

(2) Research on the formation mechanism of science and technology center oriented by science and technology industry;

(3) Research on eco-environment cooperation and regulation in Guangdong-Hong Kong-Macao Greater Bay Area;

(4) Research on financial cooperation and financial risk, enterprise investment and financing management in Guangdong-Hong Kong-Macao Greater Bay Area;

(5) Research on cross-border social governance, public safety and supervision in Guangdong-Hong Kong-Macao Greater Bay Area;

(6) Research on world-class industrial chain, value chain and cluster in Guangdong-Hong Kong-Macao Greater Bay Area.

NSFC-Yunnan Joint Fund

The NSFC-Yunnan Joint Fund is jointly established by NSFC and the Yunnan Provincial Government to implement the National Strategy of Innovation-Driven Development and the guidelines of the National Conference on Science and Technology. It aims at maximizing the guiding role of the National Natural Science Fund and pooling talented scientists across the country to carry out basic researches on important scientific issues and key technical problems that are closely related to the socio-economic and scientific development of Yunnan and surrounding regions, boosting the development of science and technology and the growth of scientific talents in Yunnan, improving indigenous innovation capability and international competitiveness of universities and research institutes of Yunnan and promoting the sustainable development of regional economy and society.

In 2019, the NSFC-Yunnan Joint Fund calls for proposals of Key Program in the following priority research areas. Average funding (direct costs) for each project will be 2.4 million for 4 years. The NSFC-Yunnan Joint Fund is open to all researchers across China. Qualified researchers all over the country are welcomed to apply for this fund according to the research scope and requirements listed in this *Guide*.

I. Biodiversity Conservation

1. Biodiversity

Proposals are encouraged to study the species, population and ecosystem diversity and adaptive evolution of important biological groups with distinctive characteristics of Yunnan.

Priority research areas:

(1) In-depth investigation, utilization and protection of biodiversity of Yunnan and surrounding Southeast Asian regions;

(2) Plant community change and characteristics of vegetation transition zone of Yunnan and surrounding border areas;

(3) Biodiversity mechanism of special biological groups in mountainous area of Southwest China and interaction mechanism among species;

(4) Service and impact of Yunnan ecosystem to endangered species;

(5) The impact of invasive species on biodiversity of Yunnan and prevention and control of harmful impact.

2. Agricultural and forest resources

Proposals are encouraged to study germplasm resources, pest/disease control and prevention, agro-ecosystem function, quality and comprehensive utilization of agricultural products based on important and distinctive agricultural and forest resources of Yunnan.

Priority research areas:

(1) Outstanding germplasm resources and genetic analysis of important traits of distinctive agricultural and forest resources of Yunnan;

(2) Basic research on the exploration and utilization of microorganisms beneficial to agriculture and forest in Yunnan;

(3) Pest and disease occurrence, prevention and control mechanism for agriculture and forest in Yunnan;

(4) Functions and preservation mechanism of agro-ecosystem biodiversity in Yunnan;

(5) Forming mechanism and comprehensive utilization of the good traits of distinctive agricultural and forest products of Yunnan.

II. Resources and Environment

1. Earth environment change of Yunnan and its resource and environment effect

Priority research areas:

(1) Mesozoic-Cenozoic earth environment change and mineralization mechanism in Yunnan;

(2) Causes and effects of the high geo-chemical background value of elements in soil of Yunnan;

(3) Basic research on the causes, prevention and control of major natural disasters of Yunnan.

2. Basic research on the restoration and treatment of pollution and environmental degradation

Priority research areas:

(1) Environmental pollution caused by exploitation of mineral resources in Yunnan and its prevention and control;

(2) Driving mechanism and restoration mechanism of environmental changes in plateau lakes and wetlands in Yunnan.

3. Key ecological and environmental issues in the context of the strategy of Yangtze River Economic Zone and the Belt and Road Initiative

Priority research areas:

(1) Biodiversity distribution pattern and its responses to watershed ecosystem in the upper stream of rivers in Yunnan;

(2) Responses to and impact on climate change of the ecosystem pattern in the upper stream of rivers in Yunnan;

(3) The impact of ecological environment improvement in Yunnan on water quality and water ecology of cross-border rivers.

III. Comprehensive Utilization of Mineral Resources and New Materials

1. Comprehensive utilization of mineral resources

Proposals are expected to be focused on theories, methods and cutting-edge technologies that meet the demands of comprehensive utilization of the advantageous mineral resources of Yunnan and the development of new material industries.

Priority research areas:

(1) Green use of silicon and distinctive nonferrous mineral resources in Yunnan;

(2) Recycling of wastes from the beneficiation and metallurgy of mineral resources in Yunnan;

(3) New methods for the separation and extraction of platinum group metals;

(4) Recovery of noble metals and other valuable resources from waste catalysts.

2. New materials

Proposals are expected to center on the key areas of the development of new material industry for green energy and environment in Yunnan and aim at solving scientific issues in material design, microstructure, interface property and environmental stability and developing theoretical system and synthetic technology basis. For key issues related to the design, preparation and application of rare-noble and nonferrous metal materials, proposals are expected to study the correlation between the overall properties of alloy and its structure and preparation process in order to provide theoretical guidance to the composition optimization and preparation technology of new materials.

Priority research areas:

(1) Photoelectric, thermoelectric and energy storage materials and devices based on advantageous resources in Yunnan such as aluminum, silicon, germanium and tin;

(2) High-performance noble metal catalysts and substitutes of noble metal catalysts;

(3) Basic research on the design and application of nonferrous (rare-noble) metal materials;

(4) Design and production of high-strength and corrosion-resistant aluminum alloy;

(5) Preparation of high-purity silicon, germanium, indium and gallium and their compounds.

IV. Population and Health

1. Basic researches on discovery of active substances and development of vaccines aiming at major human diseases using distinctive medicinal resources in Yunnan

Priority research areas:

(1) Discovery, structure optimization, function, pharmacological mechanism and toxicity of natural active substances based on distinctive resources in Yunnan;

(2) Applied basic research on vaccine innovation based on distinctive animal resources in Yunnan and pathogens of cross-border diseases;

(3) Effectiveness, material basis and pharmacological mechanism of ethnic medicine and featured Chinese traditional medicine in Yunnan;

(4) Formation mechanism and synthetic biology of active substances in important medicinal bio-resources in Yunnan;

(5) Applied basic research on the conservation and sustainable utilization of distinctive medicinal animals and plants in Yunnan.

2. Basic researches on the pathogenesis, prevention and treatment of

high-incidence diseases and major diseases in Yunnan

Priority research areas:

(1) Applied basic researches on high-incidence diseases, endemic diseases and drug addiction in Yunnan;

(2) Basic researches on the pathogenesis, prevention and treatment of insect borne tropical diseases and major infectious diseases in Yunnan and surrounding regions;

(3) Animal disease modeling for endemic diseases in Yunnan and related applied basic research;

(4) Applied basic research on stem cells using endemic animals in Yunnan based on genome editing.

NSFC-Xinjiang Joint Fund

The second phase of the NSFC-Xinjiang Joint Fund is jointly established by NSFC and the Peoples' Government of Xinjiang Uygur Autonomous Region for the period from 2016 to 2020 to implement the guidelines of the National Working Conference on Scientific and Educational Assistance to Xinjiang. It aims at making full use of the guiding role of the National Natural Science Fund, attracting a number of talented scientists to work in Xinjiang, boosting the development of science and technology and the growth of scientific talents in Xinjiang, improving innovation capabilities of universities and research institutes in Xinjiang and promoting the sustainable development of Xinjiang's economy and society.

In 2019, the NSFC-Xinjiang Joint Fund calls for proposals of Fostering Program, Key Program and Special Grant for Local Young Talents in 5 priority research areas. For Fostering Program, the average funding (direct costs) for each project will be 600,000 yuan for 3 years; for Key Program, the average funding (direct costs) for each project will be 2.8 million yuan for 4 years. Special Grant for Local Young Talents supports researchers with outstanding achievements in basic research in Xinjiang to conduct innovative research within the scope outlined in the *Guide*. It supports up to 2 local young researchers under the age of 45 in each research area, with a funding of 900,000 yuan (direct costs) for 4 years. The NSFC-Xinjiang Joint Fund is open to all Chinese researchers. It is a platform for providing scientific and technological assistance to Xinjiang. Qualified researchers are welcomed to apply for this fund according to the research scope and requirements listed in the *Guide*.

I. Agriculture, Biodiversity and Biological Resources

1. Agriculture

(1) Drought and salt tolerance mechanism, genetic improvement and germplasm innovation of featured crops in Xinjiang;

(2) Basic research on self-recycling and fruit-crop/grass intercropping system for organic orchard in Xinjiang;

(3) Basic research on pest/disease occurrence mechanism and its prevention and control for important crops, featured fruit trees and fruit in Xinjiang;

(4) Impact mechanism of hazardous weather on crop pests and diseases and its early warning;

(5) Basic research on remediation of farmland soil with diffuse pollution, harmless treatment of livestock/poultry excrement, effectiveness improvement and consumption reduction of chemical fertilizer and pesticide for oasis agriculture;

(6) Germplasm resources and genetic improvement of livestock and poultry in Xinjiang, meat processing and utilization;

(7) Etiology, pathogenesis, prevention and control of major diseases of livestock and poultry in Xinjiang;

(8) Protection and cultivation of featured forest resources in Xinjiang.

2. Biodiversity and bioresources

(1) Biodiversity of desert plants in Xinjiang and diversity maintenance mechanism;

(2) Active substances, genetic resources, genetic diversity and conservation of distinctive bio-resources in Xinjiang and Central Asia;

(3) Diversity and functions of microorganism in special environment or the rhizosphere of important crops of Xinjiang, functions of microorganism resources for featured food and fermented dairy products;

(4) Invasion and dissemination mechanism of harmful species in Xinjiang, adaptation mechanism of wild animals to extreme environment, impact of large-scale construction project on behavior of wild animals.

(5) Stress-resistant mechanism of important forage resources in Xinjiang, mechanism of damage caused by weeds and population expansion mechanism of weeds;

(6) Basic research on the power generation and high-efficiency utilization of distinctive biomass resources in Xinjiang.

II. Water Resources and Mineral Resources

1. Water resources

Proposals are expected to respond to the demand of guaranteeing water security in Xinjiang and conduct basic and applied basic researches on water resources and water environment.

(1) Moisture transport processes of desert ecosystem;

(2) Impact of water-saving irrigation on agro-ecological system in arid area;

(3) Water circulation process and trend in mountainous regions of Central Asia;

(4) Conjunctive use and optimization of surface and ground water of inland river basin.

2. Mineral resources

Proposals are expected to respond to the demands of guaranteeing of security of national resources and building a mineral resources base in Northwest China, focus on advantageous mineral resources in Xinjiang and neighboring areas, conduct researches on metallogenic mechanism and prognosis of the main mineral resources in Xinjiang, mining technology and environmental effect of mining.

(1) Metallogenic mechanism, reserves and mining prospect of major mining areas of Xinjiang;

(2) Protective extraction of mineral resources of Xinjiang and its environmental effects;

(3) Reservoir formation mechanism and distribution of large-scale oil and gas fields in Xinjiang and oil/gas exploration technology.

III. Comprehensive Utilization of Mineral Resources and New Materials

Proposals are expected to center on the advantageous mineral resources of Xinjiang such as nonferrous metal, coal, oil and gas and the development demands of related industries and conduct basic and applied basic researches on the green and high-efficiency mining and comprehensive utilization of mineral resources.

(1) Technologies for the green, safe and high-efficiency mining of large-scale open-pit mines in Xinjiang;

(2) Deep processing technology for nonferrous metals in Xinjiang and high value-added functional materials;

(3) Key technologies of green mining, smelting and clean, high-efficiency and comprehensive utilization of nonferrous metal resources in Xinjiang;

(4) Key technologies of the clean, high-efficiency and comprehensive utilization of coal, oil, gas and other mineral resources in Xinjiang.

IV. Electronic Information

(1) Testing of secure behavior for mobile terminal applications;

(2) Attack detection and protection mechanism for intelligent IoT security system;

(3) Mechanism and method of trusted identity recognition in uncontrolled environment;

(4) Internet attack detection technology and method based on machine learning;

(5) Key technology of robust detection of abnormal activity in audio-video multimodal collaboration;

(6) Key technology of topic detection and hot topic tracking in the multilingual environment of Xinjiang;

(7) Technology of intelligent analysis of aerial photography-based streaming media for public security;

(8) Analysis and prediction of the transmission process of harmful information on the network of Xinjiang.

V. Population and Health

(1) Epigenetic mechanism and precise diagnosis and treatment of cervical cancer and hematologic tumors;

(2) Etiology and pathogenesis of the high incidence of tuberculosis in Xinjiang and research on new vaccine for tuberculosis;

(3) Etiology, pathogenesis, prevention and treatment of orthopedic diseases such as osteoporosis and arthritis in the special environment of Xinjiang;

(4) Transfer of radionuclides to human body in typical mines of Xinjiang and corresponding occupational protection strategy;

(5) Basic research on pathogenesis, prevention and treatment of high-incidence cardiovascular diseases (especially hypertension and heart failure) in Xinjiang;

(6) Material basis of the therapeutic effect of folk medicine and medicinal resources in Xinjiang (including the separation and extraction, structure modification and pharmacological mechanism of the active substances of medicinal plants), and research on the advantages in the pharmacological function, efficacy and use method of special herbal medicine/folk medicine in the treatment of major diseases such as vitiligo, viral influenza,

cardiovascular diseases, neurodegenerative diseases and diabetes;

(7) Pathogenesis, prevention and treatment of sleep-related respiratory diseases, obesity and related metabolic diseases in Xinjiang;

(8) Big data-based intelligent medical and health policy making system and big data-based early warning, prevention and control system for infectious diseases exclusively or frequently occurring in Xinjiang.

NSFC-Henan Joint Fund

The second phase of the NSFC-Henan Joint Fund is jointly established by NSFC and the People's Government of Henan Province (NSFC-Henan Joint Fund) from 2016 to 2020. It aims at giving full play to the guiding role of NSFC, attracting and gathering outstanding scientists all over the country, solving the major S&T issues and key technology problems concerning the strategic development of economy, society and science and technology in Henan Province and its surrounding areas. It tries to attract, cultivate, and gather groups of scientific talents to Henan Province, enhance the independent innovation capability and international competitiveness of universities and research institutes in Henan Province, and promote the sustainable development of economy and society of Henan Province.

NSFC-Henan Joint Fund calls for proposals of Fostering Project and Key Project from five priority research areas in 2019. Fostering Project provides an average direct funding of 500,000 yuan per project for three years; Key Project provides an average direct funding of 2.2 million yuan per project for four years. Any eligible scientists and technicians over the country are encouraged to submit applications in accordance with research scope and requirements listed in this *Guide*.

I. Biology and Agriculture

1. Key Project

Proposals are expected to study, based on Henan livestock and poultry and aquatic aquaculture, basic research on zoonosis, antibacterial peptides of livestock and poultry, food-borne pathogens and quality of Yellow River carp; taking Henan's main crops as research objects, the proposal should conduct research on key functional gene mining and its regulation mechanism of important agronomic traits; carry out basic research on the disaster and prevention and control of important alien invasive organisms to support the healthy development of agriculture and forestry economy. Main research directions include:

(1) The mechanism of transmission of intestinal protozoa in the new animal source and human beings;

(2) Quality formation and regulation mechanism of the Yellow River;

(3) The mechanism of disasters of important alien invasive organisms in Henan Province;

(4) The molecular mechanism of the biological clock regulation and the formation of important agronomic traits of crops;

(5) The activity mechanism of antibacterial peptides of livestock and poultry against important animal pathogens;

(6) Key gene mining and regulation mechanism of maize high temperature tolerance;

(7) Formation and transmission mechanism of drug resistance of food-borne important pathogenic bacteria.

2. Fostering Project

Proposals are expected to study: biodiversity conservation and sustainable use in Henan; high quality, high yield, high efficiency, multi-resistant germplasm resources excavation, creation and genetic improvement; formation and regulation of important agronomic traits of crops; crop water, nutrient demand and its efficient use mechanism; agricultural pest-causing mechanism, early warning and green prevention and control; development and utilization of functional microbial resources; genetic improvement and sustainable use of featured forests, horticultural crops and traditional Chinese medicine plants; soil remediation of farmland; important economic traits improvement and nutrition regulation of main livestock and poultry, aquatic animals and pathogenesis of their disease prevention, prevention and control; pesticide residue control and quality safety system in agricultural products; quality change and regulation mechanism of major agricultural products during storage, processing and circulation.

II. Resources and Environment

1. Key Project

Proposals are expected to focus on the typical resource and environmental problems in Henan, carry out basic research on agricultural waste and carbon dioxide resource utilization, water environmental protection and ecological regulation in the lower Yellow River, and nitrogen deposition influence on soil environment; carry out basic research on the development of unconventional oil and gas and green granary integration technology in accordance with the advantages of Henan's resources and the demand of the special industries. Main research directions include:

(1) Interaction between microbial ecological processes driven by water and sediment in the lower Yellow River and heavy metal element circulation;

(2) Multi-field coupling and regulation mechanism in the construction process of green granary;

(3) The impact of atmospheric nitrogen deposition on the forest soil environment in the north-south climate transition zone of China;

(4) Study on the evolution process and regulation mechanism of the tidal flat ecosystem in the lower Yellow River;

(5) Freezing response characteristics and anti-burst mechanism of gas containing coal;

(6) The differential enrichment mechanism and resource effect of coalbed methane in Henan;

(7) Metallogenic regularity and green development and utilization of metal mineral resources in Henan.

2. Fostering Project

Proposals are expected to study: The impact of climate change on agricultural production and land use; the ecological mechanism of sustainable land use in the core food area; the key scientific issues of mineralization and comprehensive development and utilization of characteristics or shortage of mineral resources; clean conversion and efficient use of energy and resources; theory and mechanism of emission reduction and low carbon

emission conversion; the law of environmental impact of efficient resource exploitation; ecological and geological environmental impacts of major projects; regional ecological pattern evolution and ecological security regulation mechanism under the influence of high-intensity human activities; soil and water pollution environmental behaviors and effects of objects; ecological restoration theory and methods of degraded (damaged) ecosystems; new methods for comprehensive treatment and utilization of bulk solid waste; remote sensing data acquisition and time-space big data analysis and mining; natural disaster detection methods, formation mechanisms, and early warning technology system.

III. New Materials and Advanced Manufacturing

1. Key Project

Proposals are expected to focus on the characteristics and advantageous industries of Henan Province, conduct basic and applied research related to the manufacturing of new materials and advanced equipment. Main research directions include:

(1) Basic research on copper-based chalcogenide photovoltaic film materials;

(2) Research on responsive metal cluster-based smart materials;

(3) Research on new preparation technology of coal-based silicon carbide;

(4) Research on catalyst preparation for polyolefin special materials;

(5) Study on multi-level pore composites of MOFs/COFs for combined detection of multiple tumor markers;

(6) Study on the design, preparation and discoloration mechanism of molybdenum and tungsten polyacid-based color-changing materials;

(7) Thermal damage behavior and solidification structure control of high-strength and high-conductivity copper alloy for casting and rolling;

(8) Design, preparation and performance study of phase change energy storage materials (application code 2 selects the subordinate code of E01, E02 or E03);

(9) New system battery key materials;

(10) Study on the strengthening mechanism and performance of wear-resistant and erosion-resistant alloy materials;

(11) Theory and method of intelligent manufacturing and precision machining;

(12) Material-structure-performance integrated design and manufacturing;

(13) Energy-saving near-infrared ceramic coating refractory research.

2. Fostering Project

Proposals are expected to carry out the design, preparation and service performance research of key new materials such as new functional nanomaterials, composite materials, new energy materials, superhard materials, and structural materials; resource-oriented green metallurgical research; design and manufacturing research of energy-efficient equipment; advanced forming and additive manufacturing technology; mechanical surface/interface functional design and performance control; theory and method of intelligent manufacturing and precision machining; material-structure-performance integrated design and manufacturing technology; information perception and troubleshooting of mechanical system and manufacturing process.

IV. Management Sciences

Key Project

Proposals are expected to focus on major issues in Henan's economic and social development, carry out related research on intelligent manufacturing quality optimization in the big data environment, industrial transformation and development in the Central Plains region, rural revitalization strategy and modern agricultural management system, coal mine disaster risk and early warning and emergency management. Main research directions include:

(1) Quality optimization theory and method for intelligent manufacturing in big data environment;

(2) Industrial transformation and cluster research in the Central Plains region;

(3) Theoretical and policy research on rural revitalization strategy and modern agricultural management system in Central Plains;

(4) Research on risk identification, early warning and emergency management of hidden disasters caused by major disasters in coal mines;

(5) Digitalization of cultural scenes and visual management of related information.

V. Population and Health

1. Key Project

Proposals are expected to focus on high-risk and major diseases in Henan, such as digestive system malignant tumors, Parkinson's disease, irritable bowel syndrome, cataract, diabetic retinopathy, and pediatric neurogenic bladder, explore the pathogenesis and seek new targets, new drugs and new strategies for effective prevention and treatment, carry out relevant basic and clinical basic research; study on the mechanism and intervention strategy of coal mine gas explosion damage in view of occupational health and safety. Main research directions include:

(1) The role and mechanism of high ammonia microenvironment participating in the progression of liver cancer;

(2) Establishment of a precise evaluation system for the treatment of Parkinson's disease by dopamine neural precursor cell transplantation;

(3) Epigenetic regulation mechanism of cardia cancer metastasis and its targeted small molecule inhibitors;

(4) The role of psychological stress in the pathogenesis of irritable bowel syndrome and its mechanism;

(5) Accurate delivery of anticancer drugs and basic research on its biological effects;

(6) Study on the regulation mechanism of heat shock response in cataract and posterior cataract lesions;

(7) Reconstruction of neurogenic bladder function in children and its mechanism;

(8) Molecular mechanism and intervention strategy of coal mine gas explosion lung injury;

(9) Key mechanisms of diabetic retinopathy and new drug intervention;

(10) Exosomes regulate the damage repair mechanism of myocardial infarction;

(11) Function and mechanism of medicinal materials in Henan Province.

2. Fostering Project

Proposals are expected to conduct research on: diseases based on genomics, epigenomics and proteomics; immune regulation and disease; important medical pathogens and their interaction with the host; early screening, prevention and treatment of common

diseases, major diseases and chronic diseases in Henan Comprehensive; molecular genetics and early identification of hereditary diseases and congenital diseases; pathogenesis and prevention and treatment of cardiovascular and cerebrovascular diseases, digestive diseases, senile diseases, metabolic diseases; genetics of malignant tumors and drug resistance epigenetic mechanism research; basic research and clinical basic research in reproductive system, perinatal medicine; research on mechanisms of organ damage, regeneration, repair and transplantation; early identification and intervention of mental and psychological diseases; pathogen transmission, variation law and pathogenic mechanism; function mechanism and application of innovative drug design and synthesis; new methods and techniques for diagnosis based on molecular imaging; protection and utilization of local medicinal plants, and the discovery of active ingredients and its mechanism of action; the integration of Chinese and Western medicine for major diseases prevention.

Joint Fund to Promote Cross-Straits Scientific and Technological Cooperation

The second phase of the Joint Fund to Promote Cross-Strait Scientific and Technological Cooperation is jointly established by NSFC and Fujian Provincial Government for the period from 2016 to 2020. It aims at making full use of the guiding role of the National Natural Science Fund, attracting and gathering scientists across the Taiwan Strait to conduct S&T cooperation, solving major scientific issues and key technological problems mutually concerned by Fujian and Taiwan, boosting the growth of scientific talents, improving innovation capabilities of the cross-strait economic zone and promoting the sustainable development of regional economy and society.

In 2019, the Joint Fund calls for proposals of Key Program in 4 priority research areas. Average funding (direct costs) for each project will be 2.8 million yuan for 4 years. The joint fund is open to all Chinese researchers. Qualified researchers are welcomed to apply for this fund according to the research scope and requirements listed in this *Guide*.

I. Agriculture

1. Molecular mechanism of the formation of agronomic traits of important crops, cash crops and forest woods in Fujian and Taiwan;

2. Molecular basis of important traits of main aquaculture species in Fujian and Taiwan;

3. Pathogenesis and immune mechanism of important pathogens of livestock, poultry and aquaculture species in Fujian and Taiwan;

4. Processing and quality control of endemic agriculture products in Fujian and Taiwan;

5. Mechanism of pest spread and major diseases and ecological prevention of pests for important crops and forest woods in Fujian and Taiwan;

6. Temporal and spatial change of carbon storage, impact mechanism of carbon storage and carbon capture potentials of forests in Fujian and Taiwan.

II. New materials and advanced manufacturing

1. Graphene and graphene composites;

2. Organic optoelectronic materials/high-efficiency fluorescence materials for Micro-LED;

3. High-efficiency catalytic materials for synthetic ammonia, conversion of methane at low temperature, environmental purification and clean energy production;

4. Concrete degradation mechanism in ocean engineering environment;

5. New theories and methods for precision drive/transmission system of industrial robot;

6. Basics of precision manufacturing of components with microscale structure/flexible sensor/phase change switching device;

7. Damage mechanism and condition monitoring of structure components of important infrastructure such as sea-crossing bridge.

III. Electronic Information

1. Theory and methods of multi-source data integration, analysis and understanding for Fujian and Taiwan;

2. Key intelligent technology for offshore environment sensing, detection and control of harmful species;

3. Application basis of printed electronics and micro-nano optoelectronics;

4. Theory of secure and controllable communication for mobile social network in Fujian and Taiwan.

IV. Population and Health

1. Research on Traditional Chinese Medicine resources and innovative drugs in Fujian and Taiwan;

2. TCM diagnosis and treatment technology and mechanism of major disease treatment by featured Traditional Chinese Medicine in Fujian and Taiwan;

3. Pathogenesis and new diagnosis and treatment technology of neurodegenerative diseases and hereditary diseases;

4. Epidemiology, pathogenesis and new diagnosis and treatment technology of frequently-occurring tumors of the hematological, alimentary and respiratory systems in Fujian and Taiwan;

5. Pathogenesis and intervention of immune and metabolic disorders and large vessel diseases;

6. Drug target research and clinical translation for frequently-occurring viral infectious diseases in Fujian and Taiwan.

NSFC-Shandong Joint Fund

The second phase of the NSFC-Shandong Joint Fund is jointly established by NSFC and the People's Government of Shandong Province (NSFC-Shandong Joint Fund) from 2017 to 2021. It aims at giving full play to the guiding role of NSFC, attracting and

gathering outstanding scientists all over the country, promoting the development of Shandong Peninsula Independent Innovation Demonstration Zone and the Yellow River Delta Agricultural High-Tech Industry Demonstration Zone, solving the major S&T issues and key technology problems concerning the strategic development of economy, society and science and technology in Shandong Province and its surrounding areas. It tries to attract, cultivate, and gather groups of scientific talents to Shandong Province, enhance the independent innovation capability and international competitiveness of universities and research institutes in Shandong Province, and promote the sustainable development of economy and society of Shandong Province.

NSFC-Shandong Joint Fund calls for proposals of Key Project from three priority research areas in 2019 with direct funding of 3 million yuan per project for four years. Any eligible scientists and technicians over the country are encouraged to submit applications in accordance with research scope and requirements listed in this *Guide*.

I. Life Sciences

1. Molecular mechanism and germplasm innovation of salt and alkali resistance in crops of the Yellow River Delta

Aiming at the natural conditions of soil salinity in the Yellow River Delta, proposals are expected to use modern biological techniques to carry out molecular and molecular marker-assisted breeding of crops, and create excellent new germplasm with good agronomic traits and cultivate crop varieties suitable for saline-alkali soil. Main research directions include:

(1) Molecular mechanism and molecular marker-assisted breeding of main food crops with salt and alkali resistance;

(2) Molecular mechanism and germplasm innovation of economical crops such as cotton;

(3) Mechanism of interaction between crops and microorganisms and salt and alkali resistance;

(4) Regulatory pathways and molecular mechanisms of forest response to salt-alkali stress;

(5) Mining and utilization of important plant control factors such as salt and alkali resistance of economic plants.

2. Mechanism and regulation of salt and alkali resistance in facility crops

In response to the secondary salinization of soil caused by soil salinization and excessive fertilizer use in the Yellow River Delta, proposals are expected to study physiological and molecular mechanisms and regulation techniques of salt-alkali stress in facility crops, and explore high-quality genes related to salt and alkali, and create a new germplasm of salt-tolerant, high-quality facility crops. Main research directions include:

(1) Physiological and molecular mechanisms and regulation pathways of yield and quality of facility vegetables under saline-alkali environment;

(2) The molecular mechanism and regulation technology of the response fruit tree response to salt-alkali stress.

3. Saline-alkali ecosystem in the Yellow River Delta

The ecological environment of the Yellow River Delta is fragile. Based on the important needs of resource development and utilization and ecological functions in the

region, proposals are expected to use ecological research methods to study the function and regulation mechanism of saline-alkali ecosystem. Main research directions include:

(1) Construction and maintenance of stable ecosystem of plantation forest in the Yellow River Delta;

(2) Research on cultivation and replacement of plantations in the Yellow River Delta;

(3) Construction of the ecological circle of the wetland fragmentation habitat of the Yellow River Delta;

(4) The ecological adaptation mechanism of the introduction of halophytes in the arid area to the saline-alkali land in the Yellow River Delta.

4. Marine aquaculture quality improvement and space expansion

Focusing on the development and transformation of the marine aquaculture industry in Shandong Province and the development needs of improving quality and efficiency, proposals are expected to conduct basic research on the optimization and expansion of marine aquaculture environment, the germplasm improvement of important marine organisms and the mechanism of disease occurrence.

(1) Basic research on genetic analysis and molecular breeding of bioeconomic traits of important marine aquaculture;

(2) Research on the mechanism of disease occurrence and immune control of important marine organisms;

(3) Basic research on seawater industrialized circulating aquaculture;

(4) Study on biodiversity and aquaculture capacity of the cold water mass culture area of the Yellow Sea;

(5) Adaptation of aquaculture fish to the culture environment and its mechanism;

(6) Research on the detection and comprehensive utilization of Antarctic krill resources.

II. Geo-Sciences

1. Saline soil improvement in the Yellow River Delta

Soil salinization is the main factor that restricts the development of high-efficiency ecological agriculture in the Yellow River Delta. Based on the comprehensive treatment and utilization of saline-alkali land in the Yellow River Delta, proposals are expected to study the mechanism and key technologies for the improvement of saline-alkali land using technical methods such as engineering, agronomy, biology, and chemistry, and lay the foundation for ensuring food security and ecological security. Main research areas include:

(1) The mechanism and key technologies of microbial improvement of saline-alkali land;

(2) The mechanism of nutrient enhancement on saline-alkali farmland in the Yellow River Delta;

(3) Study on the mechanism, effect and regulation of soluble substances in the saline soil in the Yellow River Delta;

(4) Study on integrated management and technology model of water-fertilizer-salt integration in saline-alkali land in the Yellow River Delta;

(5) Study on optimization of crop ecology and agroecosystem in saline and alkaline land in the Yellow River Delta of formation of good quality in wheat and maize.

2. The ecological protection mechanism of Yellow River Delta wetland

The Yellow River Delta wetland has important ecological functions, but the ecological environment is fragile. Proposals are expected to be focusing on the development and utilization of the resources in the region and the protection of the ecological environment, and carry out research on multi-scale ecosystems to provide scientific and technological support for the development and protection of wetlands in the Yellow River Delta. Main research areas include:

(1) Study on ecological restoration mechanism of soil pollution in the Yellow River Delta;

(2) Restoration of degraded ecological system of plantation in Yellow River Delta;

(3) Study on wetland degradation and ecological protection mechanism in the Yellow River Delta;

(4) Study on the reconstruction of typical estuarine ecosystem and its effects on resources and environment in the Yellow River Delta.

3. Shandong offshore environment and ecology

Focusing on the major needs of offshore marine ecology and environmental protection and marine development in Shandong Province, proposals are expected to conduct in-depth studies on the marine geological environment, the evolution of coastal ecosystems and disaster prevention and control, and provide scientific support for the ecological development of the offshore environment and the rational development of resources in Shandong Province. Main research areas include:

(1) Characteristics, dynamic mechanism and environmental effects of topography and geomorphy evolution in the Yellow River Delta;

(2) Behavioral processes and environmental effects of the costal belt and coastal pollutants in Shandong Province;

(3) Human activities affecting the sea environment and ecological processes and their regulatory mechanisms;

(4) Study on the occurrence and control mechanism of typical disasters in Shandong coastal zone;

(5) Study on the evolution mechanism and exchange of typical ecological environment carbon sinks in Shandong offshore region;

(6) Underground water-sea water interaction and its water resources and environmental effects.

4. Mineral resources with Shandong characteristics

Shandong Province and its offshore areas are rich in mineral resources, which mean great potential in future development. Focusing on the formation mechanism and efficient and safe mining of special mineral resources such as Shandong offshore gold mine, underground brine, oil and gas, etc., proposals are expected to study the basic theory of resource formation mechanism and exploration technology, provide scientific and technological support for the rational development of resources and industrial development. Main research directions include:

(1) The formation mechanism of mineral resources in Shandong Province;

(2) Key technologies for the exploration and exploitation of mineral resources in Shandong Province.

5. Exploration and utilization of marine living resources

Focusing on the key technical bottlenecks in the transformation and upgrading of the marine bio-industry, proposals are expected to develop and utilize strategic resources of

polar, ocean and deep-sea marine life, and develop biological products with high added value and independent intellectual property rights, drive the overall improvement of the high value of marine living resources in Shandong and even in China. Main research directions include:

(1) Basic and applied research on the high-value conversion of marine biomass;

(2) Discovery of marine active lead compounds and drug creation;

(3) Microbial life processes and resource utilization in extreme marine environments.

6. Marine environmental monitoring technology

Focusing on the common requirements of oceanographic observations of different characteristics of marine environment in complex marine environment, aiming at the implementation of major projects of "transparent ocean", proposals are expected to develop new theories, new technologies and new methods suitable for observation, information extraction and analysis of different characteristic targets, and develop related key core technology research. Main research directions include:

(1) New ocean observation technology for "transparent ocean";

(2) Real-time observation technology for deepwater cultivation;

(3) Real-time online monitoring technology for ecological environment in Shandong coastal waters.

III. Marine Engineering and Marine Materials

1. Marine materials

Various types of materials in the marine environment are the basis for marine development and protection. Proposals are expected to be focusing on the needs of key basic materials for engineering construction and resource development in the marine environment, to carry out basic research on the design, preparation, and application of new materials for marine engineering equipment, marine engineering construction, marine monitoring, and resource utilization, and to effectively solve the bottleneck that constrain the development of marine equipment and the development of marine engineering and the use of marine resources. Main research areas include:

(1) High-performance metal materials and their marine environmental adaptability;

(2) Design and preparation of high-durability marine engineering materials;

(3) Marine anti-corrosion and anti-fouling materials and their applications;

(4) Marine analysis sensor instrument key materials;

(5) Desalination low-pressure high-efficiency membrane materials and components.

2. Marine engineering

The complex and varied marine environment has brought huge challenges to the construction of marine projects. Proposals are expected to be focusing on the needs of marine engineering construction in Shandong Province, and carry out research on the basic application of modern engineering technology in subsea tunnels and coastal engineering. Main research areas include:

(1) Subsea tunnel construction and operation safety technology;

(2) Coastal engineering environmental disasters and countermeasures for disaster prevention and mitigation;

(3) Efficient construction and control of deepwater oil and gas wellbore;

(4) Marine structural safety and risk analysis.

3. Marine equipment

The level of marine development equipment reflects the strength of the nation's marine development. Proposals are expected to be focusing on the major demand for marine equipment and the development of key common technologies, such as offshore oil and gas exploration, efficient use of marine renewable energy resources, and seawater desalination, and provide support for mastering marine development and marine resource utilization equipment core technologies, and break through the bottleneck of independent design and manufacturing. Main research areas include:

(1) Key technologies for offshore oil and gas exploration platforms;

(2) Deep sea carrying and operating equipment;

(3) Key technologies for manufacturing deep ocean flexible pipe;

(4) Seawater desalination core device and equipment;

(5) Key technologies for renewable marine energy capture, supply, and transmission;

(6) Key theory and core technology of ship power exhaust gas treatment;

(7) Research on key technologies of long-range unmanned ships and underwater vehicles.

NSFC-Liaoning Joint Fund

The NSFC-Liaoning Joint Fund is jointly established by NSFC and the Liaoning Provincial Government for the period from 2015 to 2019. It aims at making full use of the guiding role of the National Natural Science Fund, attracting and gathering a group of talented scientists, solving major scientific issues and key technological problems in the industrial development of Liaoning, improving innovation capabilities of Liaoning and promoting the revitalization of old industrial base.

In 2019, the NSFC-Liaoning Joint Fund calls for proposals of Key Program in 5 priority research areas. Average funding (direct costs) for each project will be 2.5 million yuan for 4 years. The NSFC-Liaoning Joint Fund is open to all Chinese researchers. Qualified researchers all over the country are welcome to apply for this fund according to the research scope and requirements listed in this *Guide*.

I. Fine Chemical Engineering and Catalysis

(1) New method and mechanism of catalytic cascade synthesis of drug active molecules;

(2) Application basis of high-efficiency selective catalytic hydrogenation/ dehydrogenation technology;

(3) Basic research on the industrialization of the oil production by directional pyrolysis of coal/oil shale;

(4) Basic research on the application of high-performance photosensitizer dyes;

(5) Basic research on catalytic purification of $PM_{2.5}$ and $PM_{2.5}$ precursors in diesel exhaust gas;

(6) Applied basic research on the high-added value and green conversion and utilization of C5 cycloolefine.

II. New Materials

(1) Control of trace elements and impurities in metallurgical process and the impact of trace elements and impurities on material performance;

(2) Basic research on the high-efficiency utilization of metallic resources exclusively or highly reserved in Liaoning;

(3) Strengthening and toughening mechanism of metallic materials;

(4) Key technology of preparation of special composite coatings;

(5) High-efficiency and low-cost electrocatalytic materials for fuel cells;

(6) Ultra high wear resistant rubber materials for a new generation of radial tire;

(7) Slag systems and thermodynamic properties of rare-earth steel;

(8) Rheological forming and dynamic mechanical behavior of amorphous composites.

III. Advanced Equipment Manufacturing

(1) Technology and methods of precision polishing for complex surface components;

(2) Manufacturing theory and methods of key large forgings for advanced compressor;

(3) Spatial error transmission mechanism and high-accuracy compensation method for computerized numerical control machine tools;

(4) Precision forming mechanism and performance control of difficult-to-cut complex alloy components;

(5) Design theory and methods of the self-adaptive shock resistance function of mining support equipment;

(6) Theory and methods of the processing of ultra-precision ceramic ball bearings;

(7) Continuous heat treatment and microstructure design of high-grade special steel plate;

(8) Theory and technology of computerized numerical control processing of integrated centrifugal compressor impeller;

(9) Theory and methods of the design of multifunctional subsea pipeline robot;

(10) Failure mechanism of key components of ultra-high voltage transformer;

(11) Thermo-mechanical coupling mechanism and regulation methods in the processing of super large rolling bearings;

(12) Control of solidification structure and casting defects for super large and complex Titanium alloy components.

IV. Information Technology

(1) Edge computing technology and its application for the Industrial Internet;

(2) Intelligent sensing and safety monitoring of major equipment and infrastructure;

(3) Intelligent sensing, management and optimization of the energy system;

(4) Human-machine collaborative decision making technology in the industrial environment;

(5) Intelligent information processing technology and its application in multimedia communication and medical imaging;

(6) Key technology and methods of human-machine collaborative translation;

(7) Micro- and nano-manipulation of living cells and test method.

V. Bio-Medicine

(1) Structure optimization, structure-activity relationship and pharmacological mechanism of drugs for specific targets in in digestive system tumor metastasis;

(2) Molecular targets and pharmacological mechanism for the treatment and prevention of neurodegenerative diseases;

(3) Therapeutic materials in Liaoning folk medicine for frequently-occurring diseases in northern region of China and the link between prescription, disease, syndrome, therapeutic materials and curative effect;

(4) Stem cell treatment of infertility induced by reproductive organ injury and the underlying mechanism;

(5) Mechanism of endogenous homeostatic regulation of myocardial cell injury and repair;

(6) Pathogenesis of immune-related skin diseases and the regulatory effect of physical factors.

NSFC-Zhejiang Joint Fund for the Integration of Industrialization and Informatization

The NSFC-Zhejiang Joint Fund for the Integration of Industrialization and Informatization is jointly established by NSFC and the Zhejiang Provincial Government for the period from 2015 to 2019. It aims at attracting and gathering talented scientists across the country, solving major scientific issues and key technological problems related to the integration of industrialization and informatization in the social, economic and scientific & technological development in Zhejiang National Demonstration Zone of Integration of industrialization and informatization and neighboring regions, and promoting the scientific and technological development and the building of talent teams in the region.

In 2019, the NSFC-Zhejiang Joint Fund for the Integration of Industrialization and Informatization calls for proposals of Key Program in 4 priority research areas. Average funding (direct costs) for each project will be 2.1 million yuan for 4 years. The joint fund is open to all Chinese researchers. Qualified researchers are welcomed to apply for this fund according to the research scope and requirements listed in the *Guide.*

I. High-End Industrial Automation

Proposals are expected to take the opportunity of developing a new generation of artificial intelligence and digital economy, respond to new demands and new challenges emerging from the integration of industrialization and informatization in trillion-market industries such as information economy, energy conservation and environmental protection, high-end equipment manufacturing and new materials, etc., aim at the goals of high quality, high efficiency, energy conservation, cost reduction, high safety and reliability and environmental protection, and focus on basic theories and key technologies of intelligent automation. The goal is to lay a solid foundation for manufacturing enterprises to develop their nerve center, decision-making center and security barrier, and facilitate the transition

from “made in Zhejiang” to “created in Zhejiang”.

Priority research areas:

(1) Key technologies of operation and maintenance and intelligent management of large manufacturing equipment/complex industrial products;

(2) Theory and key technologies of clustered interaction and control for multiple robot collaboration.

II. Intelligent Manufacturing

Proposals are expected to respond to the needs of trillion-market industries such as information economy, energy conservation and environmental protection, high-end equipment manufacturing and new materials, aim at improving the quality and efficiency of Zhejiang manufacturing industry, focus on the trend of developing a digitalized, networked and intelligent manufacturing industry, and make breakthrough in key theories and technologies of the autonomous, controllable and deep integration of artificial intelligence 2.0 and materials, design, manufacturing, assembling, operation and maintenance. The goal is to facilitate the development of intelligent manufacturing industry, especially the internet-based products, enabling tools, work unit/shop/factory/industry and cloud service of intelligent manufacturing, and to improve the overall intelligence level of Zhejiang manufacturing industry.

Priority research areas:

(1) Basic theory and key technology of the design and manufacturing of lightweight components;

(2) Theory and key intelligent control technology of multi-material 3D printing;

(3) Key technology of intelligent sensing materials and devices;

(4) Advanced aerodynamic numerical simulation theory and optimization method for aerocrafts;

(5) Basic theory and key technology of soft continuum robots.

III. Industrial Cyber-Physical System

For the reason that Zhejiang has numerous small and medium enterprises and industrial data is dispersed and characterized by heterogeneity, uncertainty, correlative coupling and complexity in spatial and temporal distribution, proposals are expected to focus on basic theories and key technologies of industrial cyber-physical system and comprehensively improve the intelligent level of industrial production of Zhejiang.

Priority research areas:

(1) Basic theory and key technology of hybrid brain-computer interface system;

(2) Key technology of the sensing environment testing platform for unmanned systems;

(3) Architecture design tools and methodology for a new generation of neural network processor;

(4) Distributed autonomous learning theory and methods for network-based intelligent sensing.

IV. Smart City

Proposals are expected to respond to the major needs of the building of smart cities

and the sustainable development of cities in Zhejiang, focus on basic theories and key techniques of smart city for which major breakthroughs are strongly needed, use the internet, big data and other information and communication technologies to improve the levels of decision-making and city management, build up the smart city management and service network systems based on big data, cloud computing and the Internet of Things, and provide technical support to the industrialization of smart city.

Priority research areas:

(1) Theory and method of intelligent circuit cognition and learning for the ternary human-cyber-physical universe;

(2) Meta-learning theory and methods for enormous unlabeled video data in urban environment;

(3) Method of processing complex non-image bio-medical data and its application;

(4) Intersection between artificial intelligence and big data generated by a new generation of clinical proteomics.

NSFC-Shanxi Joint Fund for Coal-Based Low-Carbon Technology

The NSFC-Shanxi Joint fund for Coal-Based Low-Carbon Technology is jointly established by NSFC and the Shanxi Provincial Government for the period from 2015 to 2019. It aims at attracting and gathering talented scientists across the country, solving major scientific issues and key technological problems of coal-based low-carbon energy in Shanxi, promoting S&T development and talent team building in the region.

In 2019, the Joint Fund calls for proposals of Key Program in 7 priority research areas. Average funding (direct costs) for each project will be 2.9 million yuan for 4 years. The joint fund is open to all Chinese researchers. Qualified researchers all over the country are welcomed to apply for this fund according to the research scope and requirements listed in the *Guide*.

I. Coal Chemical Industry

(1) Scientific issues of the coking process of high sulfur coal and the diverse utilization of coke;

(2) Scientific issues of conversion and utilization of coking coal derivatives;

(3) Scientific issues of value-added utilization of Fischer-Tropsch synthetic products;

(4) Product engineering of conversion of methanol to chemicals;

(5) High-efficiency capture and recycling of CO_2 from coke oven smoke;

(6) Mechanism of directional conversion of chemical chains of coal-based fuels and reaction path regulation.

II. Ecological Restoration of Mining Area

(1) Ecological degeneration mechanism of metal mining area, ecological restoration method and key technology;

(2) Soil-microorganism-vegetation synergistic mechanism and its ecological service effect on reclaimed coal mine area;

(3) Mechanism of biodiversity restoration and ecological function maintenance in mining areas of arid and semiarid regions;

(4) Mechanism of water damage of abandoned mine and related ecological restoration and utilization;

(5) Key technologies of protection and high-efficiency utilization of underground water in coal mining area.

III. Coal and Coal Bed Methane Mining

(1) Low yield mechanism of coalbed gas well and key technology to increase gas production;

(2) Occurrence mechanism of coal bed methane and evaluation of geological conditions for commingled production;

(3) Mechanical properties of rocks in deep reservoir of coal bed methane and controlling factors;

(4) Basic theory and key technology of accurate detection of the temperature point of spontaneous combustion in the stopping process of coal mining;

(5) Method and key technology of characterization of deep reservoir of coal bed methane.

IV. New Materials

(1) Basics of the preparation of high-performance fiber/resin composite materials;

(2) The structure-activity relationship and service performance of carbon-resin-based composite materials in rigorous environment;

(3) New forming method and technology of shell structure by magnesium-based metal composite plates;

(4) Electrode materials for a new generation of secondary cells.

V. Energy Conservation and Environmental Protection

(1) Basics of the whole process treatment of refractory organic wastewater and sludge with high salinity;

(2) Scientific basis of thermal conversion of coal gangue;

(3) Comprehensive utilization of coal gangue/steel slag/desulfurized gypsum;

(4) High-efficiency solid-liquid separation and sewage treatment in coal washing process;

(5) Research on direct fuel cells using coal byproducts as the fuel;

(6) Key materials and application of low-cost hydrogen fuel cells based on hydrogen in coal chemical industry.

VI. Coal Machinery

(1) Basic theory and key technology of precise guidance of tunnel boring machine;

(2) Basic research on intelligent super excavator for mining;

(3) Key digital component for underground high water-based hydraulic pressure system.

VII. Coal-Fired Power and New Energy

(1) Distributed/centralized energy storage of power system with large scale of new energy;

(2) Power system architecture and intelligent control of the multi-energy complementary, distributed, and cooling-heating-power combined microgrid network;

(3) High-efficiency, low-cost and clean utilization of sludge and low-calorific value coal in urban area;

(4) High-efficiency and high-quality utilization of waste heat in coal-fired power plants.

NSFC-Guangdong Center for Big Data Research

NSFC and the Guangdong Province jointly set up Center for Big Data Research since the signing of agreement in 2015. It aims at making full use of the guiding role of NSFC and data and computation resources in Guangdong Province, lead the basic research in the big data field over the country, to promote the development of big data development.

This project focuses on smart city construction, targets at areas of smart traffic, smart medicine and health, smart security, smart disaster prevention, smart finance, smart education and smart management, and gathers talents all over China to solve major scientific and technological issues in big data research.

This project will be based on Tianhe-2 super computer, emphasizing on interdisciplinary research and collaboration, and encourage cooperation between institutions specialized in big data research with universities and research organization in Guangdong Province.

Application for the following areas will be accepted.

I. Center Project

Funding Area: Research on basic theory and key technologies of discrete intelligent manufacturing based on industrial big data

Aiming at the major demand of big data analysis in discrete intelligent manufacturing industry, proposals are expected to, on the basis of the national supercomputing Guangzhou Center Tianhe-2 supercomputer, establish the knowledge representation, extraction and recognition theory of industrial big data, design discrete manufacturing process optimization method, research Intelligent collaborative control technology between multi-agency and multi-equipment, analyze production decision-making strategies of discrete intelligent manufacturing, build a security system for industrial control networks, and establish an intelligent service big data platform to improve the informationization, intelligence and safe operation level of discrete manufacturing, promote the transformation and upgrading of discrete manufacturing, ensure the safe operation of industrial control systems, and verify the application in the production line of hundreds of discrete manufacturing enterprises. Main research areas include:

1. Research on theory and method of discrete manufacturing knowledge

automation based on industrial big data

Proposals are expected to deeply excavate the operational experience of skilled operators related to the production line of discrete manufacturing enterprises, the massive parameters of equipment operation and operating environment information, and carry out knowledge expression, knowledge extraction and knowledge recognition for industrial big data above PB level, and construct the theory and method of discrete manufacturing knowledge automation. To realize replacement of the intelligent operation of discrete manufacturing equipment with the manual operation, to build a large data mining engine on the Tianhe-2 supercomputer, and to realize the knowledge expression, knowledge extraction and knowledge identification of the industrial big data of the discrete manufacturing enterprise production line.

2. Research on optimization process of discrete manufacturing process based on industrial big data

Proposals are expected to set up an industrial Internet industry platform for specific discrete manufacturing industries, and deeply explore big data information for specific discrete manufacturing process parameters, equipment status, product quality, production management, etc., build a specific process knowledge map and knowledge base, research on theories and methods for process product evaluation, fault diagnosis, autonomous self-healing, process optimization, and build a big data mining analysis engine for specific processes on the Tianhe-2 supercomputer to achieve hundreds of specific processes domain optimization control.

3. Research on intelligent cooperative control of discrete manufacturing equipment based on industrial big data

In order to achieve orderly collaborative production and global collaborative optimization between equipment, proposals are expected to, in view of the discrete manufacturing equipment on the production line of discrete manufacturing enterprises, build an industrial Internet of Things to interconnect equipment, design collaborative control and communication strategies, enable intelligent collaborative operations between heterogeneous equipment and different subsystem sub-production lines, and finally achieve global intelligent collaborative optimization scheduling of discrete manufacturing processes. The intelligent collaborative control system for the discrete manufacturing industry will be built on the Tianhe-2 supercomputer to realize the intelligent collaborative production operation of the entire production line of discrete manufacturing enterprises.

4. Research on discrete manufacturing intelligent decision method and system based on industrial big data

Considering the intelligent operation analysis and intelligent decision-making for discrete manufacturing enterprise production lines, proposals are expected to study discrete manufacturing process data association methods based on industrial big data, establish discrete manufacturing equipment performance prediction model, construct discrete control process scientific regulation decision-making mechanism, and clarify a multi-step ordered decision sequence tree of the discrete manufacturing enterprise production line, build an intelligent decision system based on industrial big data above PB level on the Tianhe-2 supercomputer, and realize automatic real-time fine-tuning of discrete manufacturing equipment parameters of enterprise production lines.

5. Research on network security theory and application of discrete manufacturing control based on industrial big data

For the information security of industrial control networks of discrete manufacturing enterprises in the era of industrial big data, proposals are expected to study the security characteristics of discrete manufacturing networks based on industrial big data and the internal information exchange strategies of control networks driven by security events, and establish a continuous attack dynamics model between the internal subsystems of the control network, construct a real-time monitoring and distributed screening mechanism for discrete manufacturing Internet data, and study the perceptual early warning and self-repair technology of discrete manufacturing control networks. To build a security control system for discrete manufacturing industrial control network on Tianhe-2 supercomputer, and realize discrete manufacturing enterprise industrial control network and industrial big data security.

6. Building a discrete manufacturing intelligent service platform based on the Tianhe-2 supercomputer

Bringing together the aforementioned research results for the analysis and processing of big data in discrete manufacturing industry, proposals are expected to, by relying on the Tianhe-2 supercomputer platform and industry cloud platform, create a unified software platform and programming interface that supports rapid application function development, build a discrete manufacturing intelligent service platform based on industrial big data, realize real-time sensing of device parameters and key technology verification, and improve the intelligent service level of discrete manufacturing industry. Combined with the characteristics of the discrete manufacturing enterprises in Guangdong Province, the results will be formed into systems and equipment, and application demonstration and verification will be carried out. These results will be carried out and promoted in the alliance enterprises.

II. Key Program

Funding Area One: Basic theory and key technologies of big data management analysis for government governance

The project is driven by the application needs of government governance big data, taking public behavior data as the starting point, and emphasizing the three main directions of government governance, namely, promoting social credit system construction, public policy analysis and decision-making, and social stability risk assessment. Based on the National Supercomputing Guangzhou Center Tianhe-2 supercomputer, proposals are expected to study the key technologies of government support based on big data, including the sharing and integration of government multi-source heterogeneous data, large-scale behavior knowledge map management and analysis, key technical issues in the transformation of big data to big knowledge such as government governance big data analysis and forecasting supported by deep learning, explore the government governance theory and mechanism based on big data, and carry out demonstration application of government governance big data. Main research directions include:

Research on big data sharing and fusion technology of government governance

Based on the multi-source, heterogeneous, heterogeneous, dynamic, massive, and island characteristics of government big data, proposals are expected to study basic theories and methods of large-scale distributed heterogeneous data sharing, integration and integration, including government data sharing mechanism and blockchain-based Key

technologies such as trusted shared databases, collection and integration of government governance big data, entity identification of large-scale data, cross-system entity links and associations, and real-time maintenance of semantic associations between dynamic data, so as to solve the problems faced by government big data integration and integration with behavioral data as the core. To propose an effective knowledge dynamic fusion solution, by relying on the Tianhe-2 supercomputer platform, develop and implement government big data integration tools, and support the application of government governance big data.

Funding Area Two: Time-space perspective and intelligent control of urban geological environment based on big data

Under the unified framework of geoscience system science, and based on the Tianhe-2 supercomputer platform, proposals are expected to carry out research on theories, methods and key technologies of geological science big data integration application, establish a prototype of urban geological environment spatiotemporal perspective and intelligent control system, and promote demonstration in typical cities. The main research directions include:

1. Intelligent monitoring, simulation, control and early warning of urban water environment

In view of the space-time perspective and intelligent control requirements in urban water resources and water environment, proposals are expected to study water resources assessment based on geological big data, monitoring of backup water source, protection and water environment restoration, and application model of intelligent monitoring, control and early warning for water source pollution, seawater intrusion and submerged water seepage; to research and establish a data link model for water source intelligent monitoring, control, pollution source tracking, early warning and emergency, and a prototype system for water resources and water environment decision support software that can be used in actual operation. The proposal should analyze and verify the application of the large-scale multi-scale 3D geological model of typical cities in Guangdong on the Tianhe-2 supercomputer.

2. Intelligent monitoring, simulation, control and early warning of urban soil pollution

Focusing on the spatio-temporal perspective of soil pollution in high-speed development of large cities and the significant demand for intelligent control, proposals are expected to specifically study the characteristics of geochemical field in urban areas, the temporal and spatial regularity of urban soil pollution under different utilization modes, human health risk assessment and soil safety rating based on soil intake rate, and data chain application model for multi-source heterogeneous static and dynamic monitoring of soil pollution based on flux and other models; research and establish a practical technical system and series of data models for urban soil intelligent monitoring, simulation, control and early warning, and realize the big data analysis and application verification of the massive nodes of the experimental area based on the national standard layout of 1:50,000 to 11 million soil, geochemistry, atmospheric deposition, hydrological census and monitoring points by use of the Tianhe-2 supercomputer.

Funding Area Three: Deep integration and risk prevention and control of the urban intelligence and disaster prevention big data

Focusing on the strategic needs of the development of safety and disaster prevention in the Pearl River Delta, the Yangtze River Delta and the Beijing-Tianjin-Hebei mega-cities, proposals are expected to carry out in-depth analytical research on the integration of major engineering facilities, service functions, regional environment and human activities, and break through multiple disaster-perceived forecasts and major Projects such as precision management and control, underground pipeline network risk inference, disaster prevention large-scale scenario deduction and regional catastrophic control, etc. The project should implement big data correlation analysis of urban smart disaster prevention on the Tianhe-2 supercomputer and conduct demonstration in provincial cities. The main research directions include:

1. Life-long disaster prevention and semantic correlation risk decision of urban underground pipe network system

Identification of associated risk characteristics of underground pipe network system in megacities, multi-source unstructured data slice deduction analysis of urban underground pipe network, big data visualization and safety and reliability of the operation and maintenance inference of urban multi-pipe network system, and early warning and emergency response decisions abrupt disaster risk of urban underground pipe network. Based on the Tianhe-2 supercomputer platform, a big data visualization analysis system for multi-pipe network systems of thousands of nodes and cities covering 10,000 kilometers or more should be built, and integrated application demonstration should be carried out in one city.

2. Fusion analysis, scenario deduction and emergency decision of the urban disaster prevention big data

Urban operation safety long-term monitoring and early detection methods for abnormal signs, emergency prediction and early warning technology based on real-time monitoring and long-term data mining, multi-scale and inter-domain deduction theory and method for typical emergencies, urban areas under multi-disaster coupling environment with large-scale rapid calculation and analysis of catastrophic processes, catastrophic control theory of physics-information-social ternary integration, regional large-scale emergency evolution law, emergency decision theory and simulation analysis platform. Based on the Tianhe-2 supercomputer system, cross-regional operational safety and disaster prevention early warning decision big data simulation platform to develop integrated city covering 50 km^2 or above, and conduct demonstration in two cities.

Funding Area Four: Basic theory and key technology research of education big data analysis and application

Facing the great demand of China's development from a populous country to a talented country, focusing on the development strategy of “promoting the integration and innovation of information technology and education” and “building education and culture big data”, aiming at the analysis and application of big data in education management, teaching content and teaching method and teaching evaluation and in the whole process of education, gathering rich educational big data. Relying on the Tianhe-2 large-scale computing platform, proposals should realize the scientificization of education management decision-making, the individualization of teaching content and teaching methods, and the precise development of educational evaluation combined with high-performance computing

technology to carry out basic theory and key technology research of education big data analysis and application from macro, meso and micro levels. Main research directions include:

Education systematic monitoring and evaluation, intelligent decision simulation and application research based on Tianhe-2 supercomputer

In order to promote the transformation of empirical decision-making in traditional education management to data-based intelligent decision-making, proposals should study the systematic monitoring and evaluation technology of education management based on big data, conduct correlation analysis and mining of education basic data, and provide a global view of education management and scientific decision-making in education management; conduct research on computational pedagogy theory of pedagogical management, decision-making, implementation, and evaluation process based on big data; research on large-scale educational resource allocation simulation and parallel optimization technology based on Tianhe-2 supercomputer, provide data support for optimal allocation of educational resources, promote the scientific allocation of educational resources, and support more than 100,000 user-scale simulations and verify related technology on the Tianhe-2 supercomputer; the research focuses on the dynamic monitoring and early warning technology of student growth based on big data, integrates, analyzes and processes the multi-dimensional data of students, and conducts all-round monitoring, timely warning and intervention on the growth process of students, and more effectively promotes the individual growth and development of students. Relevant data needs to be deployed to the Tianhe-2 supercomputer, and service systems such as systematic monitoring and evaluation, large-scale simulation and intelligent decision-making should be built to carry out application research.

NSFC-Shenzhen Robotics Research Center Project

The NSFC-Shenzhen Robotics Research Center Project is jointly established by NSFC and the People's Government of Shenzhen Province (Robotics Research Center Project) from 2016 to 2020. It aims at giving full play to the guiding role of NSFC, jointly solving the cutting-age issues and key technology problems in robotics research, and promote the sound and rapid development of robotic industry.

The Robotics Research Center Project calls for proposals of Integration Projects and Key Projects from the following priority areas. The average direct funding of integration projects is 12 million yuan per project for four years; the average direct funding of key projects is 3 million yuan per project for four years. Any eligible scientists and technicians over the country are encouraged to submit applications in accordance with research scope and requirements listed in this *Guide*.

I. Integration Project

1. Unmanned water and air coordination sea surface patrol system

In the context of autonomous patrol monitoring missions around the complex sea surface environment of the coastal zone, proposals should meet the needs of all-weather sea patrols to achieve control and coordination of long-haul, wide-area, multi-heterogeneous water and airborne unmanned systems. Main research contents include:

(1) Key technologies for the identification and location of small targets in high-altitude and long-distance seas. The method of identifying and locating weak targets at sea under complex weather conditions should be studied to realize the tracking observation of drones on large-scale sea targets.

(2) Key technologies for stability control and path optimization of unmanned aerial vehicles under strong airflow disturbance. The UAV stability control method and flight path optimization method under the strong airflow disturbance in the coastal area should be studied to realize the stable and precise flight of the UAV.

(3) Key technologies for multi-source multisource information fusion sensing and path planning control. The multi-source information fusion and path planning methods of unmanned boats should be studied to realize reliable obstacle avoidance, track optimization and autonomous target tracking of unmanned boats under complex sea conditions.

(4) Key technologies for unmanned aerial vehicles/unmanned boats to cooperate with precision and independent take-off and landing. The collaborative precision and autonomous take-off and landing technology of unmanned aerial vehicles/unmanned boats in unstable sea environment should be studied to realize accurate docking and energy supply of drones on unmanned boats.

(5) Integration and demonstration application of water and air coordination sea surface patrol unmanned system. Coordinated patrols of drones/unmanned boats should be carried out in coastal zones to monitor, identify and track multiple targets in the area, and complete demonstration applications such as maritime warning, expulsion and rescue.

The integration project should include the above five research contents, and carry out in-depth systematic research on the unmanned patrol system with the coordination of water and air under the complex sea surface environment of the project theme. The research results include papers, monographs, patents and display systems.

2. Intelligent construction robot for assembled building

Focusing on the major scientific issues of intelligent and efficient construction of robots in complex building environments, proposals should carry out basic research on concrete prefabricated parts (PC components) manufacturing, 3D efficient printing technology, component field assembly technology, building quality inspection and multi-robot collaborative construction, and provide theoretical basis and technical specifications for intelligent construction robots made for prefabricated buildings. Main research contents include:

(1) PC component prefabrication technology and large-scale large-load robot control method. The key technologies configuration and control of PC component manufacturing robot should studied to meet the requirements of large stroke and large load operation, and realize the prefabrication of typical PC components such as shear walls, laminated plates and stairs.

(2) 3D efficient printing methods and techniques of building components. To research on 3D printing methods and robotic systems for complex building components to achieve efficient and accurate printing of a wide range of building component materials.

(3) Assembly and construction robot positioning and control methods. To study key

technologies such as sensory positioning, operation control and human-machine cooperation of assembly and construction robots in complex construction environments to realize the installation of typical building components.

(4) Building quality intelligent mobile detection technology and robot operation specifications. Proposals should research on key technologies such as intelligent measurement and work scene recognition for building construction quality, and research on new mobile detection robots to test construction quality so as to form the operation standard.

(5) Robot collaborative construction technology and system integration application. Proposals should research on robot intelligent construction reengineering process and multiple single-task robot collaborative working methods in complex construction environment, and carry out demonstration application of robot intelligent construction.

The integration project should include the above five research contents, and carry out in-depth and systematic research on the key technologies of the project-based building-type intelligent building robots. The research results include papers, monographs, patents and display systems.

3. Intelligent rehabilitation robot for limb motor function reconstruction

Proposals should focus on the intelligent rehabilitation robot system reconstructed by limb motor function, and conduct research on common key technologies such as motion nerve information detection, motion intention recognition, human-computer interaction control and high-performance chip design, and realize system integration and clinical validation of multi-functional prosthetic and limb function rehabilitation robots. Main research contents include:

(1) Flexible sensor detection and reconstruction methods for motor neural information. Proposals are expected to research on flexible wearable sensing arrays and signal reconstruction methods to achieve non-invasive measurement and enhanced reconstruction of multi-source motor signals.

(2) Fusion of multi-source motor neural information and motion intent recognition method. The fusion method of multi-source motor neural information should be studied to realize real-time and accurate recognition of limb movement intentions.

(3) Human-machine mutual adaptation learning and intelligent control methods for limb motor function reconstruction. The control method of the limb movement function rehabilitation robot and the human-computer mutual adaptation learning strategy should be studied to realize the intelligent and flexible interaction and coordinated control between the human and the robot.

(4) Key technologies for acquisition, analysis and control of motion neural information. Proposals should research on specialized chips for intelligent rehabilitation robots, and efficiently realize the functions of acquiring and processing motion information, intention recognition, and intelligent control.

(5) Integration and clinical verification of limb motor function rehabilitation robot system. Taking into consideration of needs of patients with limb loss and dysfunction, proposals should study the multi-functional prosthetic and limb function rehabilitation robot system to carry out clinical application verification and rehabilitation effect evaluation.

The integration project should include the above five research contents, and carry out in-depth and systematic research on the basic theories and key technologies of the intelligent rehabilitation robots based on the theme movement function of the project. The

research results include papers, monographs, patents and display systems.

II. Key Project

1. Robot basic component

In face of the development of the robot industry, proposals should study the scientific issues in the design and manufacturing of basic components such as drivers, reducers, controllers, sensors, and end effectors. Main research directions include:

(1) Key technologies for new high reliability, long life robot reducers;

(2) Robotic flexible body precision transmission theory and key technologies;

(3) Key technologies for driving and controlling integrated robot motors.

2. Robot of common support technology

Focusing on robotic perception, human-computer interaction, judgment and decision-making, and execution control, the common support techniques and methods needed for robot system integration and application should be studied. Main research directions include:

(1) Flexible wearable sensing interacts naturally with human-machine;

(2) New three-dimensional visual perception of robots;

(3) Multi-degree of freedom large stroke micro-nano control and detection.

3. Industrial robot

Focusing on the strategic needs of high-tech manufacturing in Shenzhen, proposals should study the key technologies of high-precision and intelligent industrial robots, adapt to flexible, fast and accurate new manufacturing modes, and promote the popularization of industrial robots. Main research directions include:

(1) Key technologies for high-performance industrial robot control;

(2) Online robotic health monitoring and evaluation methods for industrial robots.

4. Medical robot

Focusing on the wide-ranging needs of intelligent robots in the field of medical services in Shenzhen, proposals should focus on key technologies for various types of robots such as assisted diagnosis, surgery, and rehabilitation. Main research directions include:

(1) Robot-assisted medical ultrasound examination and three-dimensional imaging;

(2) Robot for detecting vital signs;

(3) Specialized medical surgical robots;

(4) Hand function rehabilitation training robot;

(5) External limb function enhancement robot.

5. Special robot

In order to meet the extensive needs of machines to replace people's operations under special conditions, proposals should study the key technologies of robots required in the fields of aerospace, marine engineering, energy and power, and security and disaster relief. Main research directions include:

(1) A large-scale complex dynamic scene security robot;

(2) Auxiliary robot for fire-fighting operations;

(3) High performance throwing robot;

(4) Leak detection mobile robots in the petrochemical industry;

(5) Digitalization of human motion and sports training robots.

Tianyuan Fund for Mathematics

Tianyuan Fund for Mathematics is a special fund to integrate collective wisdom of mathematicians, explore funding method that suits the unique features of mathematics, and make China a strong country in mathematics. This fund supports researchers to conduct research according to the features and need of mathematics, foster young talents, promote academic exchange, optimize research environment, spread mathematical culture and thus strengthen creativity of China in mathematics. The fund mainly provides the following 5 types of funding in 2019.

1. Tianyuan Center of Mathematics

The main objective of the Tianyuan Youth Center of Mathematics is to set up a platform for cooperative research and academic exchange. Focusing on several topics and interdisciplinary areas, the project shall foster research talents through various types of academic activities, and promote research in various branches of mathematics and interdisciplinary studies in China.

This project aims at frontier areas and important directions in mathematical research, and supports various academic exchange activities all over China, including summer schools and training of young teachers of mathematics. Applicants decide the project title. Please include the significance, scope, plan, and background of the proposed activity, and possible collaborators in the application.

We plan to fund 4 projects in 2019, including re-application and new applications (1 project). We plan to fund 1 extended funding project with 12 million yuan for 4 years. The others will be 3 million yuan per project for 1 year.

2. Tianyuan Exchange Program

The exchange program support high level academic exchange activities. It aims at promoting in-depth level exchange and cooperation on hot spot of mathematical problems. Each program should invite world renowned mathematicians, in the form of lectures and workshop and discussion sessions.

The program should be organized by 3 to 5 organizers, who should be world famous mathematicians in the area. Applicant should be a full time

working mathematician in China, and have written consent of the organizers. Each program may only invite up to 50 participants and the duration is limited to 1 week.

The applicant may decide the topic of the application, and provide detailed information such as scientific significance, contents and objectives of exchange, and the time and name list of the participants. The funding will be 300,000 per project.

3. Tianyuan Visiting Mathematicians Program

This program aims at promoting a balanced development of mathematical research in China by supporting talented young mathematicians in less developed regions in China to work with leading mathematicians in China. The hosting institution should have good mathematical background.

Requirement on application:

(1) Joint application. Application should be submitted jointly by the visiting mathematician and the host. The visiting young mathematician should be from less developed regions and born after January 1, 1980, and the host mathematician should be national famous mathematician with international influence. The applicant should provide detailed information such as scientific significance, contents and objectives of exchange. The visiting time should not be less than 9 months.

(2) Please include a letter of promise as a supplement to the application. The letter of promise should include the terms of visiting, including salaries, working conditions and evaluations.

(3) Please include an agreement as a supplement to the application. The visitor and host should sign the agreement on contents, funding and sharing of the right of intellectual properties.

The funding will be 200,000 yuan per project for the host and 100,000 yuan per project for the visitor.

4. Special lectures on mathematics, high level workshops

Special lectures are organized for postgraduate students focusing on one or several related themes so as to introduce frontier topics in mathematical research. Lectures could include basic courses and special courses with large audience lasting for 3 weeks. Application should provide teaching outline, teaching contents and name list of the lecturers.

High level workshop programs mainly support research groups of high level and excellent mid aged and young mathematicians to sponsor workshops

on clear topics and important international mathematical issues. At least one review paper should be published after the workshop, and proceedings or papers are highly recommended.

Each project will be funded with 200,000 yuan.

5. Mathematical culture and knowledge dissemination

This category of funding provides support to publications of popular mathematical books, including domestic and translated foreign books, so as to raise the interest of primary and middle school students on learning mathematics and understanding of mathematics by the public; the publication of national influential journal related to mathematical culture, dissemination of mathematics, mathematical education and mathematical modeling, so as to improve journal quality and impact on the public; the important national activities of mathematical dissemination by universities, research institutes, science associations and mathematical society above provincial level.

The funding is for one year, and will be direct cost funding only.

Special Fund for Research on National Major Research Instruments

The Special Fund for Research on National Major Research Instruments aims to encourage and foster the exploratory research and development of instruments with creative ideas, and major research instruments and equipment with original creative ideas, which should be based on frontier of science and national needs and guided by scientific targets, so as to provide new means and tools for scientific research and enhance indigenous innovation in China.

Projects funded by the Special Fund for Research on National Major Research Instruments comprise of departmental recommendation projects and free application projects.

Funding for Projects of Special Fund for Research on National Major Research Instruments in 2018

Unit: 10,000 yuan

	No. of applications	No. of awards	Direct cost	Average funding for direct costs
Departmental recommendation	51	3	22,863.62	7621.21
Free application	601	86	60726.94	706.13

The funding period for projects of the Special Fund for Research on National Major Research Instruments is 5 years, and in general the number of collaborating institutions in one project should not exceed 5.

1. Eligibility for applicants

Applicants for the Special Fund for Research on National Major Research Instruments should:

(i) Have the experience of conducting basic research;

(ii) Have senior professional position (title).

Post-doctors, postgraduate students, researchers without home institutions, and researchers whose home institutions have not been registered at NSFC are

not eligible for application.

2. Requirements for application

(1) For free application projects in 2019, applicants may submit research proposals via their home institutions. The budget cap for direct costs is 10 million yuan per project.

(2) For departmental recommendation projects in 2019, the following 14 departments are entitled to recommending projects of the Special Fund for Research on National Major Research Instruments: Ministry of Education, Chinese Academy of Sciences, Ministry of Natural Resources, Ministry of Industry and Information Technology, Ministry of Ecology and Environment, Ministry of Agriculture and Rural Affairs, National Health Commission, China Earthquake Administration, State Administration for Market Regulation, China Meteorological Administration, State Oceanic Administration, China Academy of Engineering Physics, Equipment Development Department and Logistic Support Department of Central Military Commission. In 2019, the budget for direct costs of the departmental recommendation projects of the Special Fund for Research on National Major Research Instruments should be no more than 10 million yuan per project.

3. Notes on application

(1) Applicants are advised to read this *Guide* carefully and prepare research proposals in accordance with the Outline of Preparation of Applications of the Special Fund for Research on National Major Research Instruments. Please choose the "Special Fund for Research on National Major Research Instruments" from the funding categories, and choose "free application" or "departmental recommendation" under the subcategory of funding. Applicants are advised to clarify the details if they are carrying out projects which have some links with the current application. Explanation of the similarities and differences in research contents between the ongoing project and the current application should be presented.

(2) For applicants and participants with senior academic positions (titles), the number of applications plus ongoing projects of the Special Fund for Research on National Major Research Instruments as well as the Special Fund for Research on National Major Research Instruments administered by the Ministry of Science and Technology should not exceed one in total.

(3) Projects of the Special Fund for Research on National Major Research Instruments are funded by way of cost reimbursement, so applicants are advised to make their budget requests in an objective and practical manner according to the real costs of the development of instruments.

Appendix

Contact Information of NSFC Departments and Bureaus

<table>
<tr><th colspan="3">Department</th><th>Tel</th><th colspan="3">Department</th><th>Tel</th></tr>
<tr><td colspan="3">Department of Mathematical and Physical Sciences</td><td></td><td rowspan="4">Division of Interdisciplinary Research</td><td>Biophysics and Biochemistry</td><td>62329246</td></tr>
<tr><td colspan="3">Division of General Affairs</td><td>62326910</td><td>Biomaterials, Imaging and Tissue Engineering</td><td>62329221</td></tr>
<tr><td colspan="3">Division of Mathematical Sciences</td><td>62327178</td><td rowspan="2">Molecular Biology and Biotechnology</td><td rowspan="2">62329221</td></tr>
<tr><td colspan="3">Division of Mechanics</td><td>62327179</td></tr>
<tr><td colspan="3">Division of Astronomy</td><td>62327189</td><td rowspan="3">Division of Environment and Ecology</td><td>Ecology</td><td>62329321</td></tr>
<tr><td colspan="3">Division I of Physical Sciences</td><td>62327181</td><td rowspan="2">Forestry and Grassland Science</td><td rowspan="2">62329573</td></tr>
<tr><td colspan="3">Division II of Physical Sciences</td><td>62327182</td></tr>
<tr><td colspan="3">Department of Chemical Sciences</td><td></td><td rowspan="2">Division of Agriculture and Food Sciences</td><td>Basic Agriculture and Crop Sciences</td><td>62327193</td></tr>
<tr><td colspan="3">Division of General Affairs</td><td>62326906
62327057</td><td>Food Sciences</td><td>62326919</td></tr>
<tr><td>Division I</td><td>Synthetic Chemistry</td><td></td><td>62326902</td><td rowspan="3">Division of Agricultural Environment and Horticulture</td><td>Plant Protection</td><td>62328882</td></tr>
<tr><td rowspan="3">Division II</td><td>Catalysis and Surface/Interface Chemistry</td><td></td><td rowspan="2">62327035</td><td rowspan="2">Horticulture and Plant Nutrition</td><td rowspan="2">62327197</td></tr>
<tr><td rowspan="2">Chemical Theory and Mechanism</td><td rowspan="2">62327035</td></tr>
<tr><td rowspan="3">Division of Agricultural Animal</td><td>Animal Husbandry</td><td>62329105</td></tr>
<tr><td>Division III</td><td>Materials Chemistry and Energy Chemistry</td><td></td><td>62327167
62327170</td><td>Veterinary Science</td><td>62329585</td></tr>
<tr><td rowspan="3">Division IV</td><td>Chemical Metrology</td><td></td><td>62327173</td><td colspan="3">Department of Earth Sciences</td></tr>
<tr><td>Environmental Chemistry</td><td></td><td>62327075</td><td colspan="2" rowspan="2">Division of General Affairs and Strategic Planning</td><td rowspan="2">62327157
62327531</td></tr>
<tr><td>Chemical Biology</td><td></td><td>62327169</td><td>Division I</td><td>Geographical Sciences</td><td>62327161</td></tr>
<tr><td colspan="3">Department of Life Sciences</td><td></td><td rowspan="2">Division II</td><td>Geology</td><td>62327652</td></tr>
<tr><td colspan="3">Division of General Affairs</td><td>62329352
62327200
62326916</td><td>Geochemistry</td><td>62327166</td></tr>
<tr><td rowspan="3">Division I</td><td>Microbiology</td><td></td><td>62327194</td><td rowspan="3">Division III</td><td>Environmental Geosciences</td><td>62327159</td></tr>
<tr><td>Botany</td><td></td><td>62329135</td><td rowspan="2">Geophysics and Space Physics</td><td rowspan="2">62327619</td></tr>
<tr><td>Zoology</td><td></td><td>62327194</td></tr>
<tr><td rowspan="3">Division II</td><td>Genetics and Bioinformatics</td><td></td><td>62327213</td><td>Division IV</td><td>Marine Sciences</td><td>62327675</td></tr>
<tr><td>Cell Biology</td><td></td><td>62329240</td><td rowspan="2">Division V</td><td rowspan="2">Atmospheric Sciences</td><td rowspan="2">62327654</td></tr>
<tr><td>Developmental Biology and Reproductive Biology</td><td></td><td>62329170</td></tr>
<tr><td rowspan="3">Division of Biomedicine</td><td>Immunology</td><td></td><td>62329341</td><td colspan="3">Department of Engineering and Materials Sciences</td></tr>
<tr><td>Neurosciences &Psychology</td><td></td><td>62329253</td><td colspan="2">Division of General Affairs</td><td>62326887
62326884</td></tr>
<tr><td>Physiology and Integrative Biology</td><td></td><td>62329341</td><td rowspan="2">Division of Materials Science I</td><td>Metallic Materials</td><td>62328301</td></tr>
<tr><td colspan="3"></td><td></td><td>Organic Polymer Materials</td><td>62327138</td></tr>
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Department		Tel
Division of Materials Science II	Inorganic Non-metallic Materials	62327144
Division of Engineering I	Metallurgy and Mining	62327136
Division of Engineering II	Mechanical Sciences and Manufacturing	62328356
Division of Engineering III	Engineering Thermal Physics and Energy Utilization	62327135
Division of Engineering IV	Architectural Engineering, Environmental Engineering and Civil Engineering	62327142
Division of Engineering V	Electrical Science and Engineering	62327131
	Hydro Science and Marine Engineering	62327137
Department of Information Sciences		
Division of General Affairs and Strategic Planning		62327140
Division I	Electronics and Information Systems	62327147
Division II	Computer Sciences	62327807
Division III	Automation Sciences	62327149
Division IV	Information Devices and Optics	62327143
Department Management Sciences		
Division of General Affairs		62326898
Division I	Management Science and Engineering	62327156
Division II	Business Management	62327152
Division III	Macro Administration and Policy	62327155
	Economic Science	62326660
Department of Health Sciences		
Division of General Affairs		62328991 62328941
Division I	Breath, Blood	62327215
	Cycling	62328962
Division II	Digestive, Urinary, Endocrine, Eye, ENT, Oral sciences	62328790 62329153
Division III	Neurological, Psychiatric, Geriatric Medicine	62327199
Division IV	Reproductive, Perinatal, Neonatal, Medical Immunology	62327207

Department		Tel
Division V	Medical Imaging, Biomedical Engineering, Special Medicine, Forensic Medicine	62327198
Division VI	Medical Microbiology and Infectious Diseases, Movement Disorders, Trauma, Burns, Surgery, Severe Acute Medicine, Laboratory Medicine, Rehabilitation Medicine	62329131 62328775
Division VII	Oncology I	62326924
	Oncology II	62329157
Division VIII	Skin, Preventive Medicine, Science Endemic, Occupational Medicine, Radiology	62327195
Division IX	Pharmacology	62327212
Division X	Traditional Chinese Medicine	62328634
	Chinese Materia Medica, Integration of Traditional Chinese Medicine and Western Medicine	62328552
Bureau of Planning		
Division of General Affairs		62326980
Division of Programs		62327230 62325557
Division of Talent Fostering		62328623 62325562
Division of Interdisciplinary Sciences		62327015 62328484
Bureau of Finance		
Division of Budgeting		62326585 62328485 62326460
Division of Fund Accounting		62326760 62328485 62327225
Bureau of International Cooperation		
Division of Planning		62326943
Division of Asian, African and International Organizations Affairs		62325449 62326998
Division of American and Australasian Affairs		62325377 62325544
Division of European Affairs		62325309 62327014
Office for Hong Kong, Macao, and Taiwan Affairs		62326934
Service Center of Administrative Affairs		
General Office		62327218
Department of Publication		
General Office		62327204
Sino-German Center for Science Promotion		
Operator		82361200