



National Natural Science Foundation of China: Funding excellent basic research for 30 years

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The National Natural Science Foundation of China (NSFC) was established on 14 February 1986, and marks its 30th anniversary in 2016. NSFC is an institution directly under the jurisdiction of the State Council of China and manages the National Natural Science Fund. In accordance with the government's strategies and plans for the development of science and technology, NSFC is responsible for directing, coordinating and making effective use of the National Natural Science Fund to support basic research and stimulate free exploration, identify and foster scientific talent, and promote progress in science and technology (S&T) and the socioeconomic development of the nation.

As one of the five blocks of centrally financed S&T programmes of the new S&T system reform in China, NSFC is responsible for supporting basic research and frontier exploration, fostering talents and teams, and promoting interdisciplinary research. NSFC will develop its strategic position, expand support for scientific exploration, encourage innovation,

strengthen interdisciplinary integration and meet the needs and expectations of scientific talents. NSFC is the major strategic support for innovation and for enhancing innovation-driven development.

NSFC is located in the Haidian district in Beijing and funds more than 2,200 universities and research institutes. It has eight departments: mathematics and physical sciences; chemical sciences; life sciences; earth sciences; engineering and materials sciences; information sciences; management sciences; and health sciences. Subject divisions are set under the science departments, covering all fields of natural sciences, as well as engineering sciences, medical sciences and management sciences. Since it was founded, NSFC has adhered to the principle of peer-review, in which it has relied on experts, promoting broad inclusiveness, supporting excellence, and ensuring justice and fairness. NSFC has strived to improve its operating mechanisms to be scientific and democratic, inspire fair competition and encourage innovation. NSFC has a well established governance structure, which consists of four coordinated parts: decision-making; implementation; monitoring; and consultation. NSFC forms the governance system with the National Fund Regulations as its core, which includes organizational management regulations, programme management regulations, funding management regulations and supervision regulations.

Over the past 30 years, the National Natural Science Fund has increased from 80 million renminbi (RMB) in 1986 to 24.87 billion RMB in 2016, an increase of 310 times. From 1986 to 2015, NSFC has used 161.4 billion RMB from the National Natural Science Fund to support a total of about 390,000 projects of various kinds. Meanwhile, NSFC also actively expanded its financing channels. Taking the 12th Five-Year Plan period (2011–2015) as an example, it attracted a total of 1.745 billion RMB of funds from other sources.

NSFC has become the main channel supporting the development of basic research in China and is a key contributor to the prosperity of basic research. For example, during the 12th Five-Year Plan period, both the

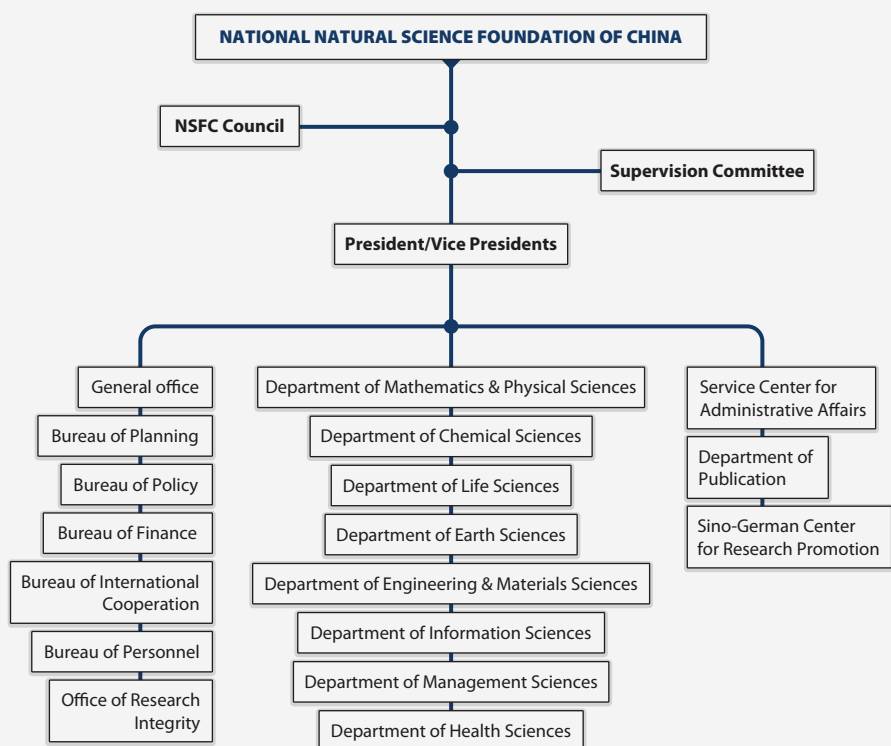


Figure 1 | The overall structure of the National Natural Science Foundation of China.

quantity and quality of Science Citation Index (SCI) papers by authors from mainland China have increased significantly, and this is an area in which NSFC has played an important role. From 2011 to 2015, 619,973 SCI papers published by authors from mainland China were supported by NSFC. The proportion of SCI papers by authors from mainland China supported by NSFC also significantly increased, from 50.23% in 2011 to 62.1% in 2015. In 2014, 5,505 SCI papers published by authors from China appeared in influential international journals – 3,060 of those papers had received funding from NSFC. In recent years, all winners of the National Natural Science Award in China have received support through NSFC. The 2015 first prize winner achievement ‘Multiphoton entanglement and interferometry’ from researchers at the University of Science and Technology of China (USTC) received 32 grants; the 2013 first prize winner ‘Iron-based Superconducting’ was a study from the Institute of Physics of Chinese Academy of Sciences and USTC, which has been funded by NSFC for 20 years.

NSFC grants supported both Chinese scientific achievements among the Top Ten Scientific Achievements of the Year as reported in the journal *Science*. Moreover, NSFC supported the Chinese scientists in the list of Ten Scientific Figures of the Year, reported by *Nature* magazine. The Birth of Birds study listed in the Top Ten Scientific Achievements of 2014 by *Science*, and researcher Chen Hualan listed among the Ten Scientific Figures of the Year by the journal *Nature* in 2013 have both been constantly supported by NSFC grants.

The innovation-driven development strategy is China’s most important national strategy for the coming years. In May 2016, the government of China published the Outline of the National Strategy of Innovation-Driven Development, which maps out three major steps to promote the country’s innovation-driven development. It pledges three steps: 1) build China into an innovative country by 2020; 2) place China among the international leading innovation countries by 2030; 3) make China become one of the world powerhouses of scientific and technological innovation by 2050. NSFC — which is the major strategic support for fostering innovation and supports the national strategic goals — published the 13th Five-Year Development Plan for National Natural Science Fund in June 2016, which aims to promote basic science in China and encourage innovation.

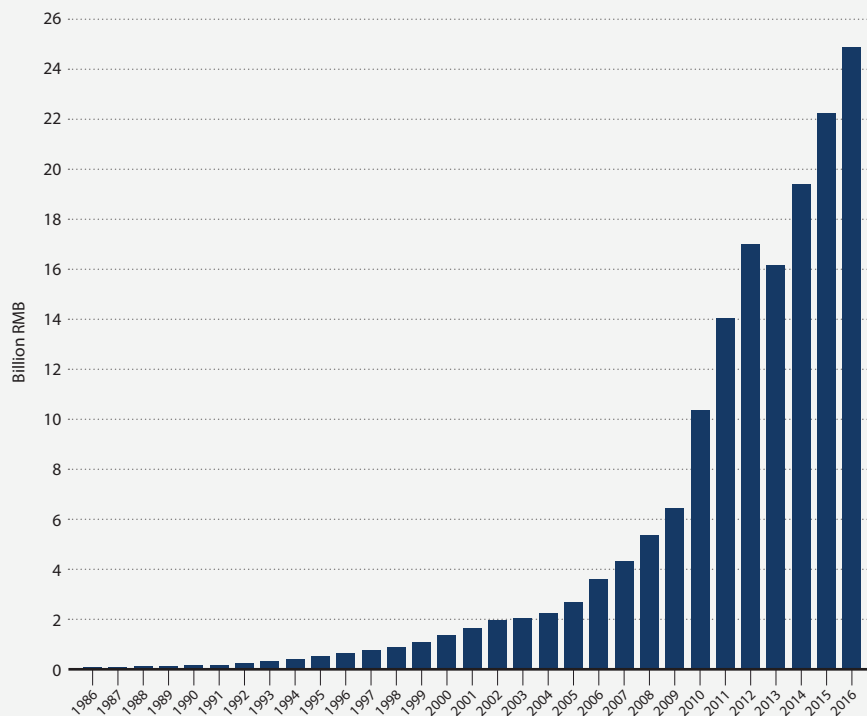


Figure 2 | Budget of the National Natural Science Foundation of China from 1986 to 2016 (billion renminbi (RMB)).

The strategic development plan

The strategic development plan of NSFC during the 13th Five-Year Plan period is mainly reflected as establishing the strategic orientation of ‘three concentrations’, which refers to: concentrating efforts on forward-looking deployment, on scientific breakthroughs and on precise management. These points can be summarized as follows:

- Concentrating efforts on forward-looking deployment requires NSFC to plan for the long term, support cutting-edge scientific research, cultivate new disciplinary growth points, focus on major scientific issues affecting long-term development and industry transformation, carry out preliminary research for the deployment of major national science and technology projects, and nurture the next generation of basic research personnel to provide the knowledge base and talent pool for national economic and social development.
- Concentrating efforts on scientific breakthroughs means that in key scientific fields in which China has accumulated the expertise to make breakthroughs, NSFC should provide more resources to encourage scientists to undertake research tasks.
- Concentrating efforts on precise management means that NSFC should integrate funding patterns, optimize the

review process and establish strategic guidance mechanisms to reflect the disciplinary differences, the scientific evaluation system and funding management mechanisms to enhance efficiency and performance.

The three parallels

Clarifying the strategic objectives of the ‘three parallels’ refers to the following: parallel in total volume; parallel in contribution; and parallel in groundbreaking research. The parallel in total volume by 2020 is to achieve a parallel position in the total volume of the fund and its outcome with developed countries, with a robust disciplinary system laying the basis for China’s transition to an innovative country. Parallel in contribution by 2030 is to increase Chinese scientists’ landmark and milestone contributions and form several academic schools led by Chinese scientists in the global science arena, pushing China into the frontier of innovation. Parallel in groundbreaking research by 2050 is to make major original breakthroughs in world science, achieve major innovation that leads and supports socioeconomic development, establish a number of leading scientific centres that occupy the forefront of scientific disciplines, and provide academic support for China to become a powerful S&T innovator. The system

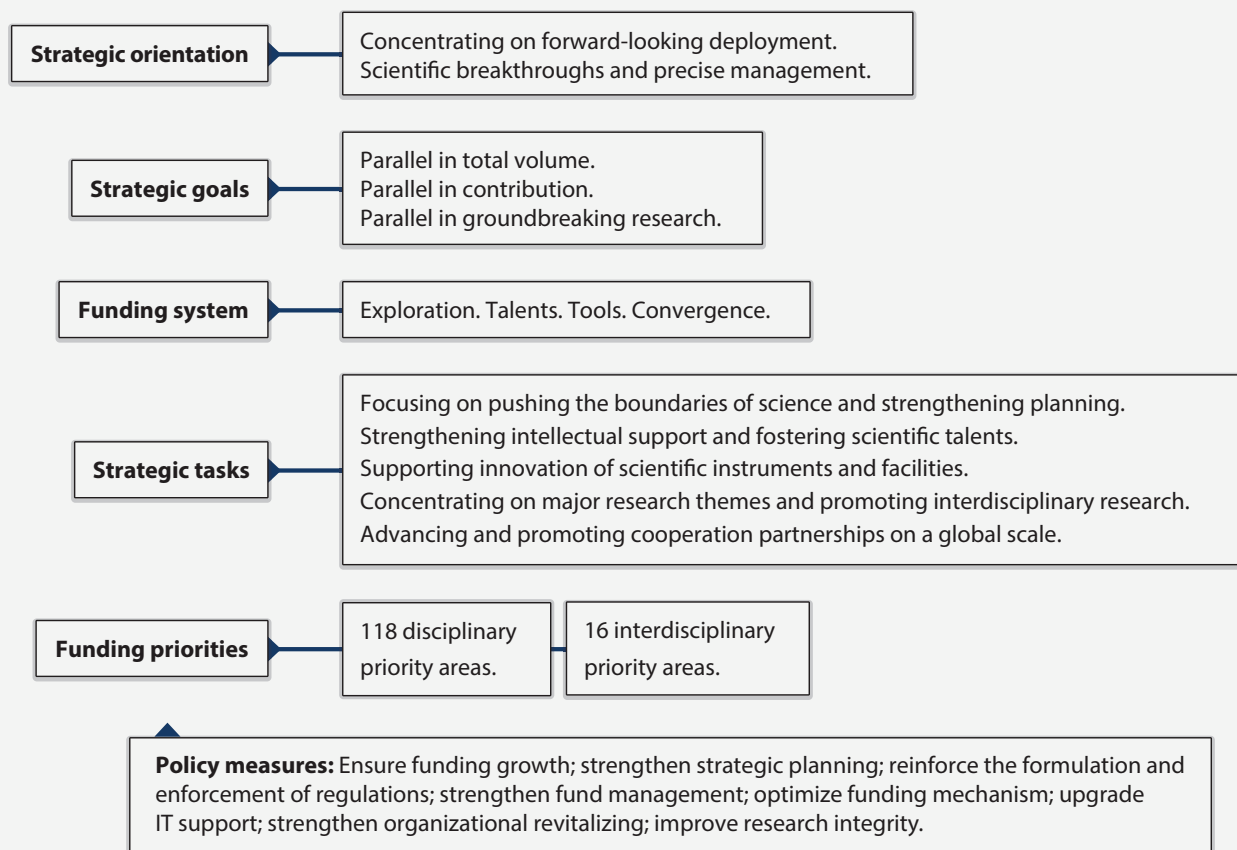


Figure 3 | Overview of the 13th Five-Year Development Plan of the National Natural Science Fund.

of the three parallels is an accumulating, gradual process that will vary according to the different stages of national innovation. The indicators for the progress of the three parallels by 2020 are presented in the plan as follows:

Constructing a 4-in-1 funding system of exploration, talents, tools and convergence

NSFC has shifted its categories of programmes from three series — research programmes, talent training programmes, and research-supporting programmes — to the current four series of programmes — exploration, talents, tools and convergence. Programmes for exploration include the General Programme, the Key Programme, and the International (regional) Joint Research Programme. Programmes for talent include the Young Scientists Fund, the National Science Fund for Distinguished Young Scholars and the Science Fund for Creative Research Groups. Programmes for tools include the Research Programme of National Major Research Instruments and Facilities. Programmes of convergence include the Major Program, the Major Research Plan, Programmes of Joint Funds and Programmes of the Fundamental Science Center.

Implementing five strategic tasks

NSFC will promote the five tasks that will contribute to facilitating the funding system (exploration, talents, tools and convergence) and international cooperation.

Task 1: Focusing on pushing the boundaries of science and strengthening planning. The General Programme will emphasize free scientific exploration and original innovation to promote balanced, coordinated and sustainable disciplinary development. The Key Programme will focus on the key frontiers and will combine with strategic needs, coordinate with disciplinary development, integrate innovation resources and nurture breakthroughs in key areas. NSFC will establish special mechanisms for the assessment and management of high-risk, high return, and exploratory research projects.

Task 2: Strengthening intellectual support and fostering scientific talents. NSFC will optimize its supporting system to research talents and teams, improve the stability of the grant mechanism for a spectrum of support toward talents of different ages, and continue to increase efforts to support young researchers, post-doc researchers, female scientists, ethnic minorities and talents from overseas. It will

encourage and support graduate students to participate in basic research.

Task 3: Support innovation of scientific instruments and facilities and strengthen environmental support for scientific research. Guided by scientific objectives, NSFC will encourage and foster the research and development of exploratory research instruments with original academic thought to provide novel means and powerful tools for scientific research. It will take the initiative to strengthen cohesion and coordination with other national instrument development programmes to improve the innovation capability of scientific research instruments.

Task 4: Concentrating on research themes and promoting interdisciplinary research. The Major Programme will focus on scientific frontiers and national needs, overcome scientific challenges and promote innovation-driven development. NSFC will continue to implement the Major Research Plan, supporting long-term research, strengthening integration and promoting scientific development. NSFC will pilot the Programme of the Fundamental Science Centre to pool advantageous resources, promote subject crossing and attract high-calibre scientists. NSFC will strengthen



Figure 4 | Indicators of the strategic goals.

strategic research on disciplinary development, explore funding projects as a group and enhance the exchange and integration of research results. It encourages the natural sciences, humanities and social sciences to intersect, and supports educational research. NSFC will bring the guiding role of the Joint Funds into play to direct social resources in promoting cooperation between research and industry, and the innovation capability of and the innovation capability of industries and the provinces of China.

Task 5: Advancing and promoting cooperation partnerships on a global scale. To adapt to the new requirements of China's diplomatic strategy, NSFC will take advantage of global scientific resources and will promote strategic cooperation, build up an open innovation environment and fully enhance the level of globalization of the funding and management of the science fund. NSFC aims to strengthen links with major international scientific organizations, establish offices in developed countries, and promote cooperation and exchanges with foreign agencies.

Deploying funding priorities

NSFC presented the developmental strategies for 18 disciplines listed as mathematics, mechanics, astronomy, physics, chemistry,

nanoscience, life science, earth science, resources and environmental science, space science, marine science, materials science, energy science, engineering science, information science, data and computing science, management science, and medicine in the 13th Five-Year Plan period (2016–2020). NSFC proposed 118 disciplinary priority areas and 16 interdisciplinary priority areas in the 13th Five-Year period.

Implementing eight policy measures

NSFC will guarantee the steady progress of the science fund through the following: ensuring funding growth; strengthening strategic planning; reinforcing the formulation and enforcement of regulations; strengthening funds management; optimizing funding mechanism; upgrading IT support; strengthening organizational revitalizing; and improving research integrity.

- **Funding growth.** Accounting for the possibility of state financial input, NSFC will improve the justification mechanisms for budget application, fully display the grant performance, and strive to increase the financial investment in the science fund. It will also actively expand strategic cooperation with local government,

business and industry sectors, promote civil–military integration, and elevate enthusiasm for basic research.

- **Strategic planning.** NSFC will improve the consultation system and expand its function as a think tank, to work with relevant agencies to support the development of national high-end think tanks, to enhance the strategic consulting partnership with foreign think tanks and establish extensive contacts.
- In terms of the formulation and enforcement of the National Natural Science Fund regulations, which is legally required to fulfill the Government by Law Construction Program (2015–2020), and to promote the legalization of funding and management, NSFC will promote the revision of National Science Fund regulations, improve legislative mechanisms, carry out legal assessments, implement the dissemination of the regulation, construct the legal review mechanism for major decision-making and improve the counsel system.
- **Fund management.** NSFC will improve fund management according to the S&T system reform, improve indirect costs compensation mechanisms by establishing a ratings system based on organizational credit, and formulate indirect cost verification measures

linked to credit rating. NSFC will establish and improve hierarchical accountability mechanisms covering project decision making, management and implementation, and increase the punishment for violations. It will also establish a funds management credit system, and improve auditing and other means to carry out inspection checks.

- **Funding mechanism management.** To adapt to the need for disciplinary development, NSFC will adjust the application codes, strengthen construction of the review experts database, improve review quality control mechanisms, improve the project evaluation criteria, and establish screening and evaluation management model towards high risk, innovative non-consensus projects, transformative research projects and interdisciplinary research projects. NSFC will improve project management and will optimize the application, evaluation, implementation, monitoring and other project management processes, pay more attention to the late-stages of project management and simplify management procedures to avoid frequent evaluation to protect research time. NSFC will strengthen performance management to construct a scientific, efficient, open and transparent performance evaluation system. It will improve the scientific achievement reporting system and organize innovation achievement exhibitions. Researchers will be encouraged to conduct research projects for the understanding and popularization of science.
- **IT support.** NSFC will strengthen information management, including promoting paper-free applications, upgrading infrastructure, integrating data resources, optimizing business processes, integrating service platforms, improving interactive experiences, expanding shared scope, strengthening information security and institutional repository construction, and improving the national S&T management information system. In addition, NSFC will enhance its information services, including improving its IT system, security system, operation and maintenance system, and personnel support system. NSFC will construct six function platforms: the shared services platform; task application platform; knowledge service platform; basic data platform; cloud platform for personalized management; and infrastructure platform.
- **Revitalizing the organization.** NSFC will build a highly efficient, coordinated and efficient service-oriented organization,



Figure 5 | The National Natural Science Foundation of China building.

strengthen the institutional and managerial talent group, actively and steadily promote organizational reform and improve the personnel management system. It will also strengthen the database of reviewers, implement conflict-of-interest measures, privacy and credit management.

- **Research integrity.** First, NSFC will safeguard research integrity and will streamline the management system, which attaches equal importance to education, supervision and punishment. It will implement the research integrity management system, bearing zero tolerance in cases of misconduct and a one-vote veto for any research integrity issues in the review and evaluation process. NSFC will strengthen its ethics research and will build the management, organizational and regulation systems for ethical control. Second, NSFC will foster an innovative culture to build respect for science, fairness and transparency, and create a positive cultural environment for original innovation. It will improve research evaluation mechanisms, construct a classified evaluation system taking into account quality, contribution and performance to prevent profit-oriented tendencies. NSFC will also try to construct a healthy review culture in promoting academic critiques and exchanges, as well as a fair, transparent, and democratic cultural ecology that shows respect for science, tolerance of failure, and encouragement for exploration and innovation.

NSFC's institutional development vision — 'Be a friend of the scientist' — strives

to make NSFC as an excellent funding agency with a fair assessment system, rich performance returns, a global vision, efficient service management, a pool of resources and diverse grants diversity to achieve world-class standards in management and provide organizational support for China's scientific excellence.

NSFC will hold a more active attitude to assimilate into the global science system. Currently, NSFC has signed 85 Cooperative Agreements or Memoranda of Understanding with partners in 40 countries and regions, and has plans to expand and deepen collaborations in the future. NSFC will support international scientific cooperation, attract talented scientists and promote communication. It will expand the scale of the young foreign scholars funding programme, and explore the establishment of foreign research projects to support and encourage universities and research institutions to invite world-class experts to China for collaborative research. It will explore investment in international research centres and strengthen partnerships with research teams across the world. It will support basic research taking place in countries associated with the Belt and Road Initiative, which is a development strategy that promotes collaboration between China and countries across Eurasia. NSFC is willing to work with international scientific funding agencies to create an open innovation environment to support Chinese and foreign scientists to jointly respond to global scientific challenges and to serve human civilization and progress. ■