Major Research Plan

Following the principle of "definite objective, stable support, integration and refinement and leap- forward development", focusing on key fundamental scientific issues in national strategy interests and major scientific frontier, and taking full use of the capability and advantages of the country, 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.

Applicants should meet the following eligibilities:
(1) Having experience of undertaking basic research projects;
(2) Bearing a senior academic position.

Post-docs in station and graduate students are not eligible to apply.

The Major Research Plan is framed with three 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 give the titles of the Major Research Plan in the annotation. Proposal is not accepted in case of incorrect selections or without any selections.

Funding for Fostering Program project, Key Program project of the Major Research Plan is quivalent to the average level of General Program and Key Program respectively. 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 Integrated Program project will not be counted in limitations

of total number of NSFC funded projects applied and undertaken for senior academic title holder, and the collaborative organizations involved may not exceed 5, and main participants must be the actual contributor to the Integrated Program project, and total number of main participants may not exceed 9.

Destruction of the North China Craton

This Major Research Plan aims to study on the destruction of the North China Craton for understanding and revealing the significance of Craton destruction in the continental formation and evolution as well as the earth layer interaction, so as to provide new ideas and scientific basis for strategy prediction in resource and earthquake prevention.

I. Scientific objectives

From the viewpoint of Earth system sciences, by highly integrating the detection means of modern Earth sciences, mathematical and physical sciences, and information sciences, as well as the observation, experimental and theoretical achievements made by cutting-edge technologies, the Plan is (i) to understand the temporal-spatial distribution, processes and mechanism for the destruction of the North China Craton; (ii) to investigate material properties and structure of different spheres in the Earth's interior and their interactions inCraton destruction; (iii) to determine effects of Craton destruction on shallower spheres and their control mechanisms for mineral resources, energy and disasters, and (iv) to further promote the cognitive level on the formation and evolution of the Earth's continents.

II. Key Scientific issue

The key scientific issue of this Plan is the destruction of the Craton.

III. Research direction in 2014 and principle for proposal screening

The Plan has been to the later stage, the steering group of experts decided that the key funding and implementing direction during this period is (i) to strengthen the research integration with rather less stress on launching new projects; (ii) to enhance the construction of scientific data center; (iii) to actively carry out various forms of academic exchange, effectively promote cooperative and substantial collaborative research.

1. Key research directions

(1) Comprehensive integration research according to discipline development trend and the implementation of the plan
(2) Exploration on different viewpoints
(3) New method exploratory researches for a better understanding of scientific problems

2. Research priorities

(1) Centering around the core scientific issue of the Plan
(2) Exploratory researches with different concepts and ideas
(3) Pay special attention to substantive disciplines, encourage international cooperation

IV. Notes to Application

(1) Applicants should carefully read this guidelinebefore preparing the application. The proposal should be in accordance with the implementation of the principle of the Major Research Plan and discuss the scientific problems closest to the "Guide", and the contribution to the key scientific issue and the overall targets of the Major Research Plan must be indicated. The goal and content of application should focus on the key scientific issues of the Major Research Plan, highlight the limited objectives, and emphasize the research on innovation and frontier problems of basic science. Proposals which do not meet the requirements of the guideline will not be accepted.
(2) Applicants can determine the project name, research contents, research approach and budget according to the specific scientific problem to be solved, based on the understanding of approved projects and summarizing the domestic and foreign achievements, as well as defining the new breakthrough and how to reach.
(3) "Major Research Plan" in the funded categories of applications must be selected in the application form, "Key Program" in the column of sub-category and "Research on Destruction of the North China Craton" in the annotation (application that the above choose is not accurate or not selected will not be accepted). Appropriate application code according to the actual contents should also be indicated.
(4) The duration of the Major Research Plan is 8 years with a total budget of 200 million yuan. The main task of project initiation has been completed since 5 years ago. In the year of 2014, 16 million yuan will be provided to Key Programs and 12 million yuan to 1Integrated Program, both of them will be a period of 4 years. .

(5) The Department of Earth Sciencesis responsible to accept the applications.

Single Quantum State Detection and Its Interactions

This Major Research Plan aims at developing relevant novel materials and artificial systems by physical and chemical means, constructing single particle quantum state and macro quantum state and detecting relevant quantum effects. It is to explore the property of quantum state and basic laws of quantum process, develop techniques of constructing quantum devices and means of quantum property detection, explore potential applications of single quantum state techniques in information and energy technology, promote the development of basic research in the fields of physics, chemistry and information technology in China, and solve some basic science and key technology issues with national strategic significance.

I. Scientific goals

To develop physical and chemical methods and technologies for relevant materials and systems, construct physical structure and systems that displays fully quantum effects, develop new methods of precision measurement, and understand and reveal the mechanism of relevant phenomena and processes at single quantum state. To discover several novel quantum effects through the measurement of single quantum state and study of interaction between quantum states, and set up solid foundation for applications of major technologies such as information processing, energy and environment;

II. Key scientific issues

1. Physical and chemical preparation of relevant materials and the construction of single quantum system
2. Property and precision detection of single quantum state system
3. Quantum state and environment, and interaction between quantum states
4. Modeling and numerical computation of quantum state interaction

III. Application and funding in 2013

In 2013, 22 applicationswere received, of which 3 were for Key Program project, 6 for Fostering Program project, and 7 for Integrated Program

project, and 6 for extended funding. After peer review, 2 Key Program projects, 1 Fostering Program project, 5 Integrated Program projects and 6 extended funding projectswere fundedwith atotal funding of 28 million yuan.

IV. Key funding research areas in 2014

The year of 2014 is the 6th year of implementation since this Research Plan has been launched. 25 million yuan will be provided in 2014 for Integrated Program and Extended Funding projects. NSFC plans to extend the funding for projects with good results and give additional funding to Integrated Program projects with good progress, and give support to the projects showing potentials of making breakthrough.

1. Integrated Program

Target of integration:

(1) Projects already funded by this Major Research Plan;

(2) Projects recommended by the expert group of this Major Research Plan (at least two letters of recommendation from members of the expert group).

Research Directions of Integration in 2014:

(1) Preparation and detection of topological quantum state

By using of composite structures of topological insulator and super conductor to explore the generation of topological super conducting state, and form and control Majorana fermions; by means of the electric field, magnetic field and surface/interface engineering to regulate surface state and fraction quantum Hall state of topological insulator.

(2) Single quantum state control and de-coherence mechanism of atomic system

Explore physical mechanism of single quantum state preparation and coherence control of atomic (ion) system, and study thede-coherence of single quantum state of atomic system caused by environment and the schemes to solve the problem.

(3) Detection, regulation and laws of variation in high pressure conditions of macro quantum state

Study the size, interface and pressure effect of macro quantum state, and explore the property and laws of single particle excitation of macro quantum state especially near the quantum critical point.

(4) Electron entanglement and inferred single photon diction in semiconductor nano lines

Study the properties and control method of electron entanglement for understanding the basic laws of entangled quantum state, as well as to explore and design semiconductor structures having up-conversion functions, and develop new ways of precision inferred photon measurement.

2. Fostering Program (Extended Funding)

Applicants of the Fostering Program (Extended Funding) projects should be the PI's of the Fostering Program and Key Program projects of this Major Research Plan which will be ended by 2014 and 2015.

V. Notes to Applications

(1) Please read this guide carefully before writing the application.

(2) In 2014, this Major Research Plan only accepts applications for Integrated and Fostering Program (Extended Funding) projects.

(3) In 2014, this Major Research Plan is planning to fund about 4 projects of Integrated Programs with average funding of 4 to 5 million yuan per project for 3 years; average funding for Fostering Program (Extended Funding) projects is about 500,000 to 600,000 yuan per project for 2 years.

(4) Integrated Program project should focus on limited targets and key areas, and emphasize on their contributions to the overall objectives and the key scientific issues of this major research plan. Please give details of the following: (ⅰ) main progress made recently on relevant areas of integration; (ⅱ) research contents, targets and technical indices of possible breakthrough; (ⅲ) a promise to share research materials, basic data and experimental platform that are needed to achieve overall scientific objectives and interdisciplinary integration.

The Fostering Program (Extended funding) is to promote in-depth research based on existing projects, so a further description of the research contents and results to be achieved is needed.

(5) Please select the proper application code.

(6) To strengthen academic exchange among the project group, NSFCwill hold an annual seminar of the funded projects every year, and various relevant academic workshops when needed. The PI's of the funded projects have the obligation to attend such seminars and workshops.

(7) Integrated Program project is not counted into the program limitation issued by NSFC. The main participants should be the substantial

contributors to the Integrated Program and shall not exceed 9 people in total.

(8) The Department of Mathematical and Physical Sciences is responsible to accept the application.

Basic Algorithms for High Performance Scientific Computation and Computable Modeling

Scientific computation is one of the important S&T progress in the 20th century, and, with the invention of electronic computer, it has been developed very fast and widely used. Scientific computation has become the third method in scientific research along with theoretical studies and experimental research, and an important means of promoting major scientific discoveries and S&T progress. Nowadays, scientific computation is regarded as an important indicator for a nation's S&T competitiveness and key factor in S&T innovation and development. Solutions of many scientific problems in major national needs requires basic algorithm of scientific computation and computable modeling. The launch of this Major Research Plan is, within the funding scope of the National Natural Science Fund, to strengthen research on important and basic scientific issues in scientific computation, design efficient basic algorithm and develop computable model with practical demand on precision so as to reduce computation complexity and task, improve significantly the capability of computer to solve scientific and engineering problems and meet the increasing demand from applications.

The Plan will provide further support for scientific research on scientific computation in frontier areas and major needs, promote coordinated development of hardware and software for scientific computation, leverage intercrossing and merging of mathematics with other disciplines, foster groups of high level talents in scientific computation, and achieve leapfrog development of scientific computation as well as scientific and technological development.

I. Scientific goals

Focusing basic algorithm and computable modeling, conduct researches on common efficient algorithm of scientific computation, computational modeling based on mechanism and data, and evaluation of problem driven high performance computation and algorithm, promote the development of

high performance scientific computation in China, and provide key support for numerical simulation technology and method for solving bottle neck problems in scientific frontiers and national needs.

(1) Make innovative and systematic achievements in common efficient algorithm research, and, in particular, breakthroughs in construction, basic theory and parallel realization technology of high fidelity and high efficiency discrete method, nonlinear eigen value algorithm and optimization method of complex targets of partial differential equations.
(2) In areas of computable modeling and high performance computation, focusing on solving problems of modeling related to multi process coupling, data driven and model-data integration, develop practical computable model, and achieve large scale numerical simulation by efficient use of several hundred thousand processor cores.
(3) In promotion of disciplines and talent fostering, gather and foster large number of innovative talents in scientific computation with versatility on international frontier, develop a number of high level interdisciplinary research teams, and make remarkable progress in scientific computation in China.

II. Key scientific issues

1. High efficiency common algorithm of numerical computation

(1) Construction and analysis of high efficiency high precision schemes for differential equations
(2) Fast method for complex data processing
(3) Optimizing method for uncertain and complex object functions

2. Mechanism and data based computable modeling

(1) Coupling and analysis of typical physical models
(2) Sparse representation of super high dimensional data
(3) Mixed modeling of mechanism and data

3. Problem-driven high performance computation and algorithm evaluation

(1) Numerical simulation and algorithm evaluation in multi physical process coupling conditions
(2) Computation and algorithm evaluation based on data extraction and analysis
(3) Computation and algorithm evaluation by model and data complementation

III. Key funding direction of research project in 2014

The year of 2014 will be the 4th year of this Major Research Plan to accept applications. According to the overall planning, the Plan will be funded in the forms of the "Key Program project", "Fostering Program project" and "Integrated Program project". "Integrated Program project" will be selected from excellent projects funded previously in the "Fostering Program project" and "Key Program project", so as to provide good foundation for integration in the later phase of the Plan. Applications not closely related to the following directions will not be accepted. The total budget for 2014 is about 35 million yuan.

Key Program project (funding not less than 3 million yuan per project for 4 years)

1. Basic Algorithms

To solve nonlinear coupled problems of multi scale, multi model in large scale numerical simulation of real multi physical coupled problems, and to overcome the difficulties such as scalability and computation efficiency of algorithms in super parallel computers, it is necessary to carry out researches on the efficient algorithms for complex coupled problems, so as to provide algorithm and theoretical support for large scale numerical simulation of real problems.

Main research contents are:

(1) Studies on the efficient computation method for nonlinear coupled problems. It is to study the high precision discrete method for nonlinear coupled partial differential equations and fast algorithm for discrete algebraic equations, develop relevant solver, and solve numerical algebraic equations of real problems with high efficiency and high precision using several tens of thousands cores.

(2) Basic algorithm for nonlinear partial differential equations. It is to solve partial differential equations with high nonlinearity or small parameters having clear scientific and engineering applications, study large time step, self-adaptive spatial temporal algorithm, and nonlinear iteration method, develop new computation method and post treatment techniques, and develop relevant theory of algorithms.

2. Efficient realization of generic algorithms

By using the special properties of 100 PF hetero parallel computer systems, studies should be focused on the efficient realization of generic algorithms, and develop library of high efficiency basic algorithms and programs on Chinese made 100 PF computers.

Main research contents are:

(1) The efficient realization of generic algorithms for100 PF computers. It is to study the programming and parallel computing environment for leveled architecture (system-node-processor-core) of tens of thousands to several million cores, data organization and transmission, key algorithm such as self-adaptive process dispatch, and massive hetero thread load balance, develop practical algorithm package for large scale multi core E level computing systems.

(2) For important application areas (such as quantum chemistry and new drug synthesis, material genetic engineering, climate and environmental system and weather forecasting) and major technology equipment, it is to study high efficiency realization of basic algorithm and computable models, develop high efficiency basic algorithm library and programs package in relevant areas, and demonstrate with examples of applications.

3. Computable modeling for important scientific areas

The studies on design principles of bio network and computing modeling of bio network may not only quantitatively describe the interactions between bio molecules and cells and of their complex behaviors, but also reveal basic molecular process and laws of information processing in life systems such as growth, development, aging and diseases of organisms. Information assimilation is a key step in weather forecast and climate prediction, therefore study on the high efficiency mathematical method for information assimilation may provide important support to improve weather forecasting and climate prediction.

Main research contents are:

(1) Design principles of bio functional modules and computable modeling of bio systems. It is to study the general conditions, quantitative laws and principles of complex bio systems. Research focuses on the development of algorithms such as computing modeling of bio systems, bio network structure and network simulation, at levels of cell (e.g. neurons), molecules and bio network, discover “design principles”, “quantitative laws” or “properties of high dimensional data and information processing” of bio functional module and network module, and explain the laws of dynamic variation and important bio processes.

(2) Study on mathematical methods of assimilation of climate prediction materials. For typical initial value problems such as ciliate prediction, it is to develop high efficiency mathematical optimization method in

information assimilation schemes, introduce new scheme of data assimilation, break the bottle-neck of high dimensions, great amount of computation or poor sample representation in data assimilation schemes, overcome some key mathematical problems such as low estimation of background error covariance and flux dependence, so as to make highly efficient assimilation of multiple source observation data; verify the new assimilation scheme in major applications such as climate prediction.

Fostering Program projects (funding about 700,000 yuan per project for 3 years)

1. Testing algorithm and realization on E level computers
2. Model reduction and algorithm in quantum chemistry, quantum physics computing
3. Uncertainty quantified method in numerical simulation of real complex systems
4. Computable coupled modeling and algorithms in climate prediction
5. Computable modeling and algorithm explorations for hard to compute real problems

Integration directions (funding for 4 years)

1. Basic algorithms
2. Computable modeling
3. Physical phenomena in extreme conditions
4. Bio information and diseases
5. High efficiency realization of generic algorithms

IV. Priorities for funding

To achieve the overall objectives of this Major Research Plan, it is required that researchers in different areas to form their research team for application (research team formed with members in the areas of algorithm, problem and software is encouraged). Priorities will be given to applications with the following features:

(1) Exploratory studies with innovative ideas and special features.
(2) Studies merging modeling, algorithm and numerical simulation.
(3) Practice of mathematics in interdisciplinary research and difference from existing methods.

V. Notes to Applications

(1) Please read this guide carefully before writing the application. Research

topic must be selected in accordance with the research directions designed for 2014, and within the key scientific problems, and emphasize should be on contributions to the overall objectives and the key scientific issues of this research plan, especially the integration of algorithm and practical problems. Application that fails to comply with this guide will not be accepted. Applicants are requested to illustrate the difference, relevance, and distinction between the application and other already-funded national programs such as National Basic Research Program of China ("973" Program) and National High-Tech R&D Program ("863" Program).

(2) Please select the proper application code: select "Major Research Plan" for funded categories, choose one of "Fostering Program", "Key Program", or "Integrated Program" for sub-category. Fill the title "Basic Algorithms for High Performance Scientific Computation and Computable Modeling" in the annotation. Proposals without proper code selections will not be accepted. Application code selection should be made in accordance with the research contents.

(3) To strengthen academic exchange among the project clusters, NSFC will organize an annual seminar of the funded projects every year, and various relevant academic workshops. The PI's of the funded projects have to attend such seminars and workshops.

The Change of the Tibetan Plateau Land-Atmosphere Coupled System and Its Effects on Global Climate

The Tibetan Plateau (TP), as an important factor controlling atmospheric circulation, provides a profound impact on global climate change through global momentum, energy/water cycles. In accompany with the deepening research of global climate change, the TP's land-atmosphere coupled system with the increasing significance of its impacts on global climate has become a research frontier in the international community of climate and the Earth system science. The research on the TP's influences upon disastrous weather and climate change in China will improve the ability of disastrous weather forecast and climate prediction.

I. Scientific goal

This Major Research Plan is designed to reveal the mechanism of the TP's impacts on the global climate and climate change, to improve the regional

and global weather/climate prediction capability, move the atmospheric research in China on the Tibetan Plateau into the world arena, forester a group of leading scientists and stand in the advanced research teams, and to make greater contribution to the sustainable socio-economic development.

The overall target of this Major Research Plan is to understand the TP's land-atmosphere coupling process, the cloud-precipitation and water cycle processes and the troposphere-stratosphere exchange process over the TP, develop the TP's database and assimilation system, improve the numerical models of regional and global climate systems, and reveal the mechanism of TP's impacts on regional and global energy/water cycles.

II. Key scientific issues

The key scientific issues to be addressed in this Major Research Plan are how the TP's land-atmosphere coupled system influences the Asian and global climate system? ThisPlan will be focused on the following 3 critical scientific issues:

1. The regulation of the TP topography in the global atmospheric circulation

It is to investigate the land surface process and land-air interactions over the TP; dynamic effects of multi-scale topography of the plateau and their impacts; and topographic effects of the plateau on the general circulation.

2. Impacts of the changing TP's land-air coupled system on global energy/water cycles

It is to explore cloud precipitation physics and atmospheric water cycle over the TP; linkage of energy to water cycle over the TP and its impacts; mechanism of impacts of the plateau's land-air coupled processes on monsoons, energy/water cycles; collaborative influences of the TP and oceans on regional and global climate changes; and interactions of troposphere and stratosphere over the TP.

3. Mechanism of influences of the TP's land-air coupled system on disastrous weather and climate in China

The research will be focused on the mechanism of the influences of the TP's land-air processes on disastrous weather in China; impacts of multi-sphere interactions on Asian monsoons and droughts/floods in China; impacts of the TP on global monsoons and climate anomalies; and the key techniques for weather and climate system models, physical processes, data re-analysis

and data assimilation.

III. Key research directions and priorities in 2014

Key research directions include

(1) Multi-source information fusion, land-atmosphere system (land) data assimilation and data reanalysis over the TP
(2) Studies on numerical model of TP's land-atmosphere coupled system (complex topography treatment, parameterization of physical processes)
(3) Mechanical and thermal forcing of multi-scale TP-topography
(4) The macro- and micro- characterization of TP-cloud-precipitation physics
(5) Mechanism of impacts of TP's land-atmosphere coupled process on global and regional energy/water cycles
(6) Troposphere-stratosphere interaction over the TP
(7) Collaborative effects of the TP and oceans on East Asian monsoon change
(8) Mechanism of TP's influences on the disastrous weather and droughts/floods
(9) Features and mechanism of the TP climate change

The Priorities for funding in 2014:

(1) The research projects solving the core scientific issues
(2) Encouraging the explorative research with innovative concepts
(3) A special attention to the substantive interdisciplinary studies and the international collaboration projects

IV. Notes to Application

(1) Before filling in the Project Application Form, applicants should carefully read the guidelines. The theme selected in the Project Application Form should conform to the implementation principles set for this Major Research Plan, and description should be given to the scientific issues that are most relevant to the guidelines, including potential contributions to solve the key scientific issues and achieve the overall objectives of this Major Research Plan. The objectives and contents given in the Project Application Form should target to the key scientific issues of this Major Research Plan, highlight the limited goal and emphasize specific research on innovative points and frontiers of basic scientific issues. Any applications that do not conform to the guidelines will not be accepted.

(2) Targeting to specific scientific issues to be addressed, applicants may freely identify a project title, research contents, a research scheme and the corresponding fund required in support of the research work by clarifying the point for making a new breakthrough and innovative concept(s) based on analyses of research findings that are available nationally and internationally.
(3) Be sure that a corresponding Application Code should be selected according to the specific content of the research project to be applied for. 'Major Research Plan' is selected in the 'Funding Categories' column of the Project Application Form, 'Fostering Program Project' or 'Key Program Project' in the 'Subcategory Description' column, and 'the Change of the Tibetan Plateau Land-Air Coupling System and Its Effects on Global Climate' in the 'Explanatory Note' column. Any applications with incorrect or blank will not be considered.
(4) To achieve the overall scientific target of the Major Research Plan, and to meet the need for multi-disciplinary integration, applicants should make a commitment to abiding by the relevant regulations concerning data and data management. To avoid duplicate investments, those who have also involved in other research project(s) should elaborate on differences from and linkages to the National Basic Research Program of China (or 973 Program) and relevant research projects funded by other sources.
(5) The total fund for this Major Research Plan in 2014 is approximately 40 million yuan. For those projects, which have shown innovative research concepts and encouraging early-stage findings, and still need further exploratory research work for an extended period, will be funded through the 'Fostering Program ' with the duration of 3 years with the average funding level of about 1 million yuan per project. For those projects, which have demonstrated sound research groundwork and accumulations, and have proposed an in-depth systematic research on well-defined and innovative but important scientific issues, will be funded through the "Key Program" with the duration of 4 years with the average funding of approximately 4 million yuan per project.
(6) The Department of Earth Sciences is responsible to accept applications.

Regulatory Mechanisms of Vascular Homeostasis and Remodeling

Cardio-cerebrovascular diseases (coronary heart disease, hypertension, stroke, and pulmonary ypertension), pathologically characterized as vascular

remodeling due to vascular dysfunction and damage-repair abnormality, constitute the No.1 killer to people's health. The morbidity rate in China of cardio-cerebrovascular diseases is ascending yearly. Urgent need for dramatic improvement of diagnosis, treatment and prevention has emerged as crucial medical and social issue. The obstacles to solving this major problem include lack of deep understanding of pathological and molecular mechanisms accountable for abnormal vascular structure and function, shortage of novel interventional targets, and scarcity of more efficient therapeutic strategies. Therefore, an intensive study on the maintenance of vascular homeostasis and remodeling is of pivotal importance to prevention and treatment of vascular-associated diseases.

Homeostasis is the important physiological foundation of organic live activities. The blood vessel is an integrative organ composed of endothelial cells, smooth muscle cells, and fibroblast cells. The blood vessel senses the changes of the inner microenvironment, integrates those signals via intercellular crosstalk, produces local bioactive factors, and thus enables itself to adaptive alteration structurally and functionally. Vascular remodeling, namely the structure changes of blood vessel, is an active process involving cell proliferation, death, migration, and extracellular matrix turnover etc. This process largely depends on the integration of growth factors, vascular active substances and hemodynamics. Vascular remodeling is not only an adaptive physiological process to maintain vascular homeostasis, but also a common vital pathological process of many vascular diseases. Tons of cutting-edge scientific disciplines are involved in this area such as metabolism, oxidative stress, inflammation, biological active substances, genetics, epigenetic etc. Nevertheless, interdisciplinary research strategies connecting the canonical disciplines (e.g. physiology, pathology, cellular biology, genetics and biochemistry) and the cutting-edge technologies (e.g. omics, biological genetic engineering, bioinformatics and imaging) are desired to fully elucidate the underlying mechanism of vascular homeostatic and remodeling.

I. Scientific goals

Financial support will be provided for basic research on the common scientific problems of major cardio-cerebrovascular diseases, especially the regulatory mechanism of vascular homeostasis and remodeling. Researchers are encouraged to use interdisciplinary techniques of molecular biology, pathophysiology, molecular imaging, omics, bioinformatics, biomechanics, chemistry, and material science to elucidate the important signaling cascade

and network of vascular homeostasis and remodeling during physiological and pathophysiological states. The long-term goal is aimed to reveal the underlying mechanisms of major cardio-cerebrovascular diseases, to uncover early stage diagnostic molecular biomarkers, and to identify the therapeutic targets.

II. Key scientific issues

What are the key dynamic regulatory networks and hubs during vascular homeostasis and remodeling and how do they work?

III. Key research directions

1. **Signaling Cascade, Regulatory Network and the Rule of Dynamic Change of Vascular Homeostasis**
   The plan mainly funds researches covering cell signaling cascades, gene/protein expression/modification, dynamic change of bioactive inducer/inhibitor/metabolites, the regulatory network and the pivotal nodes during transition from homeostasis to vascular remodeling. The studies involving systemic biology are encouraged.

2. **Pathological Mechanisms of Intrinsic and Extrinsic Environmental Factor Induced Vascular Homeostasis Disruption and Remodeling**
   The Plan also funds researches elucidating how inflammation, stress, metabolism, biological active substances and biomechanics disturb the balance of vascular injury-repair. Applicants are encouraged to explore regulatory network of vascular injury-repair, the molecular mechanisms, the cell-cell interactions, the cell-extracellular matrix interactions, and the phenotype transition of cells in response to microenvironment stimuli, the cell differentiation and the dynamic process of vascular remodeling. The final goal is to find early interference targets. Joint applications between clinicians and biologists are encouraged.

3. **Cutting-edge Technology, Methodology, and Working Model for Vascular Homeostasis and Remodeling Research**
   The funding scope also covers researches that take advantage of new progress of interdisciplinary research, aim to develop new technologies, methods, and working models (such as animal models that mimic human vascular diseases), molecular imaging techniques to real-time observe gene, protein and metabolite products during vascular injury-repair process, bioinformatics resource, database and analytical platform of

vascular remodeling, and novel cutting-edge techniques involving biomechanics, nanotechnology, biodegradable material, stem/progenitor cell directional differentiation, and tissue printing to study vascular homeostasis and remodeling.

IV. Notes to Application

(1) This Major Research Plan guideline aims to strategically lead the current researches and efficiently integrate them into aproject cluster. Applicants are required to propose subject, scientific aim, research contents, relevant technologies, and corresponding research funding according to guideline. The relevance of proposed study to the guidelines is required to be proposed. The application that fails to meet the criteria of guidelines will not be accepted for evaluation. In order to avoid repeated funding, the applications are required to clarify the distinctions and connections to other funded projects on state level.

(2) Please select Major Research Plan for Application funding category, Fostering Program for Subcategory, Vascular Homeostasis and Regulatory Mechanisms for annotation. The application that fails to select the category will not be accepted for further evaluation. Correct application code is needed according to the application contents. Special requirements for Fostering Program and Key Programare the same as those in the guidelines for General Program and Key Programof the Department of Health Sciences.

(3) An overview of application and funding in 2013: 2013 was the first year that this Major Research Plan started. Totally 177 applications were accepted, including 30 Key Program projects and 147 Fostering Program projects. On the whole, most applications in 2013 were still using traditional molecular biology strategy to perform single molecular researches, although only a few take advantage of systematic biology technique to study the regulatory network, as well as limited applications involve interdisciplinary elements. Part of applications lack relevant preliminary experiment data supporting the central hypothesis. A couple of applications lack in-depth mechanism exploration. One or two applications fail to meet criteria of the Major Research Plan guidelines. In 2014, applications covering disciplinary, in-depth mechanistic, systematic biological, cutting--edge technological researches are strongly encouraged.

(4) In order to promote the academic exchange, to boost the formation of the project clusterand to improve the multidisciplinary interaction and integration, scientific symposium will be held annually.Flexible scientific

workshops will be taken place occasionally. Principle investigators funded by this Plan are under obligation to participate in the academic activities organized by the Steering Group of Experts and Administration Group of the Plan.

(5) This Major Research Plan will provide 47,000,000 yuan in 2014. 25 Fostering Program projects and 8 Key Program projects will be funded. Applications with creative research strategy or promising preliminary experiment data but in need of further exploration are allocated as Fostering Program, with 3-year period of funding and an average intensity of 1,000,000 yuan per project. Applications that boast sound research base and massive work accumulation, propose important and novel scientific problems, and start deep and systematic researches are encouraged as Key Program, with 4-year period of funding and an average intensity of 3,000,000 yuan per project.

(6) The Department of Health Sciences accepts the applications.

Precision Measurement Physics

Precision measurement physics is the basis and frontier of modern physics development, and the result of integrating scientific exploration and precision measurement techniques, and plays the critical role in meeting national needs on relevant precision measurement. Based on atomic, molecular and photonic research, this Major Research Plan is aiming to construct new system of highly stable precision measurement at special target of precision measurement physics, explore new concept and new principles of precision measurement physics, develop higher precision measurement method and technology, improve precision of measuring basic physical parameters and test the range of application of basic physical principles at higher precision level.

I. Scientific goals

Overall scientific goal

It is to further improve research capability of China in precision measurement, promote development of precision measurement physics, increase China's international influence in precision measurement physics, and reach leading level in basic physical constant measurement and basic physical quantities. Provide key concept, method and technology basis for national needs such as navigation and positioning, time keeping, resources exploration, national defense, etc. Build up a high-leveled research team for the country.

Specific scientific target

It is to improve existing experimental system for higher measurement precision; construct new system of atomic and molecular cooling, propose new principles and new method for atomic and molecular cooling for precision measurement; break the standard quantum limit in measurement, reach the international leading level in noise compression; make the uncertainty in time frequency measurement reach to the level of 10^{-18}, time frequency comparison and transfer precision higher than 10^{-19}; make measurement value of more physical constants enter CODATA; and achieve international leading results in verification of physical laws such as equivalent principle and Newton's reverse square law, etc.

II. Key scientific issues

1. Principles, method and technologies of measurement breaking the standard quantum limit
2. New principles and method breaking the existing atomic frequency standard precision
3. New mechanism and technology breaking the atomic precision control and molecular cooling

III. Application and funding in 2013

In 2013, 70 applicationswere received, of which 13 were Key Program projects, 57 Fostering Program projects. After expert review, 4 Key Program projects, 10 Fostering Program projectswere funded respectively with atotal funding of 28 million yuan.

IV. Key funding areas in 2014

In 2014, this Major Research Plan will focus on key scientific issues and support projects in the form of "Fostering Program" and "Key Program". Applications with explorative and new ideas will be funded in the form of "Fostering Program" and applications with original ideas, sound research accumulation and prospects of making breakthroughs will be funded in the form of "Key Program". NSFC is planning to provide 25 million yuan for integrated program and extended projects. This Major Research Plan will last for 8 years, and the main task and funding of the Plan will be completed in the first 5 years. In 2014 it is to allocate total funding of 45 million yuan, and the research directions are listed below.

Key Programs

Applicants may choose full or part of the contents in each research direction. The main research directions are:

1. Studies on quantum correlation measurement exceeding standard quantum limit

Main research contents include:

(1) Precision quantum measurement based on quantum correlation systems such as photon and atoms: it is to construct multi particle (photon or atom) self-spin compression or entanglement. By using of the quantum correlation or non-linear interactions between particles, it is to demonstrate measurement precision exceeding standard quantum limit on phase change for reaching or breakingthe Heisenberg limit.

(2) New principles and new method of quantum precision measurement: it is to explore other new principles and new method of multi particle quantum correlation and quantum measurement that may break the standard quantum limit, including but not limited to new means such as quantum weak measurement to realize amplification of weak signals and quantum feedback control technology, and use experiment to demonstrate the increased resolution of small phase and quantum signals. Research target is to realize measurement that breaks the standard quantum limit, and achieve the world leading level in noise compression.

(3) Development of quantum correlation precision measurement technology: by means of quantum correlation system and principles such as photon and atom, it is to develop relevant precision measurement technology with high precision, high sensitivity and high resolution, including but not limited to new quantum interferometer, gravimeter and magnetometer, so as to achieve higher precision measurement of various physical quantities (such as time, frequency, gravity, magnetic field, velocity, temperature, etc.) and quantum state and quantum operations.

2. Studies on principles and methods of precision measurement based on super cold atoms and molecules

Main research contents:

(1) Preparation of super cold molecules (including molecules and ions) system and principles and method for precision measurement; it is to develop the applied method of special energy level properties peculiar to molecules (chiral, polarization and near degeneracy doublet) in precision measurement physics;

(2) Precision spectrum and super fine structure of diatom and dimolecule, precision measurement of highest confined state order in base state

diatom and dimolecle, as well as the calibration of relevant low energy impact properties.

Research target is to develop new system of atomic and molecular cooling, and reach international leading level.

3. High precision testing of basic physical laws

Main research content:

(1) High precision experimental verification of Newton's reverse square law, high precision experimental testing of equivalent principle;

(2) High precision verification of quantum electro dynamics (such as experiment of hydrogen or hydrogen like atomic spectrums, measurement of hydrogen or hydrogen like atomic spectrum and computation of quantum electro dynamics, Lamb shift experiment and computation for correlative systems);

(3) It is to explore new physical quantity or interaction of time inversion and parity violation (such as high precision measurement of electron, neutron and atomic electric moment, new interaction force between spin polarized atoms and non-polarized atoms in small scale), spectrum studies on low energy anti mass (such as trapped anti hydrogen atom) and comparison with corresponding mass.

Research target is aiming at international leading level to verify physical laws at higher precision or deeper level.

4. High precision measurement of physical constants and physical parameters

Main research content:

(1) High precision measurement of basic physical constants (such as Gravitational constant G, fine structure constant , Planck constant h, Rydberg constant R, Boltzmann constant k_B) and possible changes with time and space;

(2) High precision measurement of basic physical parameters (such as mass ratio of proton and electron, radius of proton's charge, eigen parameters such as charge, mass, magnetic moment, life of atom and molecules).

Research target is aiming to reach international leading level in measurementprecision, and measurement results are approved and accepted by CODATA.

5. High precision atomic frequency markers

Main research content:

By using of the trapped ion of electro-magnetic field or trapped atom of optical lattice, it is to develop complete atomic frequency marker system,

solve the physical and technical problems affecting the uncertainty and stability of atomic frequency markers, such as reducing the impact of atomic movement and interactions on quantum jump spectrum line, high precision detection of high quality quantum jump spectrum line, reduce the impact of quantum projection noise on the property of atomic frequency marker, reduce the impact of environmental factors on the properties of atomic frequency marker, and break the standard quantum limit to improve the performance of atomic frequency marker, etc. Research objects are included as atomic and ion systems other than calcium, strontium, aluminum.

Research target is tostudy atomic frequency markers at uncertainty levels of 10^{-18}through precision measurement and comparison.

Research direction of the Fostering Program

Addressing issues in precision measurement physics, it is to carry out studies in frontier areas of new physical system, new principles, new methods and new technologies for special problems in precision measurement physics. Applications should identify clear scientific problems, new physical ideas and specific ways of solving the problem. Projects with good research results, clear and important scientific issues to be further studied may receive continued support through the Key Programs or Integration Programs in the later stage.

Main research directions are:

1. Noise production and reduction in precision measurement physics
2. New principles of high precision atomic frequency marker
3. High precision transport and comparison of time frequency
4. Studies on precision atomic molecular spectrum line
5. New principles and new method of quantum measurement
6. Principle and method of ultra-cold atomic molecular precision measurement
7. New method of high precision verification of basic physical laws
8. New method of high precision measurement of physical constants and physical parameters
9. Studies on key unit technology of precision measurement physics

V. Criteria in program selection

(1) Research contents should meet the requirement of this guide, and research and experiments should be creative, and focused on scientific problems in precision measurement physics based on atomic, molecular

and photonic techniques.

(2) Exploratory studies will be encouraged in frontier areas, and give preferential support to research on new ideas, new systems, new methods and new technologies in precision measurement physics.

(3) Studies should be mainly focused on high precise experiment, and pay its attention to the combination of theory and experiments, and research targets should be in reflection of higher measurement precision.

(4) It is encouraged to the multi and interdisciplinary research, especially between mathematic, physics, information and geosciences.

(5) International joint research is encouraged.

VI. Notes to Applications

(1) Please read this guide carefully before writing the application. This plan is aiming to form a research project cluster. Applications should have clear key scientific issues, and close relations with the problems given in this guide, and emphasize on contributions to the overall objectives and the key scientific issues of this plan. Applications which fail to meet these requirements will not be accepted. In order to avoid repeated funding, the applications are required to clarify the distinctions and connections to other funded projects from other sources if there is any.

(2) "Major Research Plan" in the funded categories of applications should be selected in the application form, "Key Program" in the column of sub-category and “Precision Measurement Physics “in the annotation. Application that the above content is not accurately provided or not selected will not be accepted. Appropriate application code according to the actual contents should also be indicated.

(3) To fulfill the overall goal of the plan, the awardees are requested to abide by relevant regulations on data management and sharing.