Major Research Plan

Following the principle of definite objective, stable support, integration and refinement and leap - forward development", Major Research Plan focuses on key basic scientific issues with strategic importance to the country and major frontiers in the areas arranged on the basis of the capability and advantages of the country to form groups of projects with relatively identical objectives for assembling innovative research resources in order to realize the leap-forward development in certain key areas.

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

Researchers who are working in post-doc stations or graduate students are not qualified to apply.

Major Research Plan provides three types of projects for application, namely, the Fostering Project, Key Project and Integrated Project. Proposals shall be written in accordance with the requirement for Major Research Plan and outlines for proposals of Major Research Plan projects, provided with the features of interdisciplinary research, and emphasized on the contributions to solving key scientific issues and fulfilling the overall goals of the Major Research Plan concerned. Please select “Major Research Plan” for the column of the funding type in the form of proposal, and Fostering Project, Key Project, or Integrated Project for the column of sub-type in the form of proposal, and the titles of the Major Research Plan concerned in the annotation. Proposal is not accepted in case of incorrect selections or without any selections.

Funding for Fostering Project, Key Project of the Major Research Plan is equivalent to the average level of General Program and Key Program respectively. Duration of funding is determined by the expert group of each Major Research Plan according to the actual need. Collaborating units may not exceed 2.

Please refer to the detail information in the sections of each Major Research Plan.

Studies on the Destruction of North China Craton

This Major Research Plan aims to understand and reveal the significance of the Craton destruction to the formation of the continents and the interaction among the Earth’s

spheres through the investigation of North China Craton destruction, and to further provide new ideas and scientific bases for the strategic prediction of resources and the precaution of earthquake hazards.

I. Scientific targets

From the viewpoint of the Earth's system sciences, by integrating observations, experimental and theoretical achievements made by new and high technologies, prospecting methods and analytical approaches of modern earth sciences, mathematical and physical sciences and information sciences, the Plan is (ⅰ) to understand the temporal-spatial distribution, processes and mechanism for the destruction of North China Craton; (ⅱ) to investigate the characters and structures of different spheres in the Earth's interior and their interactions; (ⅲ) to determine the effects of cratonic destruction on shallower spheres and their control mechanisms for mineral resources, energy sources and disasters; and (ⅳ) to further improve our understanding of the formation and evolution of the Earth's continents.

II. Key scientific issue

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

III. Funding principles and key research areas in 2011

This Major Research Plan is approaching to its mid-stage. Based on the decision of the Steering Group, the key funding areas and implementation during the mid- and late stages are (ⅰ) to strengthen integrated research with moderate number of new projects; (ⅱ) to enhance the construction of scientific data center; and (ⅲ) to actively carry out various academic exchanges in order to efficiently promote interdisciplinary collaboration and substantial cooperative research.

1. Funding principles in 2011

(1) Research focusing on key scientific issues of the Plan;
(2) Innovative research with new ideas;
(3) Interdisciplinary research and international cooperation.

2. Key research areas in 2011

(1) Comprehensive integration of geological structure according to the disciplinary trends and the implementation of the Plan;
(2) Linkage between biological evolution and the destruction of North China Craton;
(3) Numerical simulation of the destruction of North China Craton;
(4) New methods to deepen the studies on scientific issues.

IV. Notes on applications

Total budget of this Major Research Plan is 150 million yuan. The estimated period is 8 years, and projects are funded mainly in the first 5 years. In 2011 the budget will be about 12% of the total (18 million yuan). The funding for "Key Projects" is 2 million yuan per project, and the number of projects and actual funding amount will be determined according to application and actual need of the proposed research. The project will last 4 years.

The applications are accepted and processed by the Department of Earth Sciences.

Key Basic Scientific Issues in Near Space Aircraft

The development of near space vehicle is related to the national security and peaceful use of space. It is one of the key issues of space technology in the world, and reflects the comprehensive strength of the country. This Major Research Plan will focus on key scientific issues in near space vehicles, through interdisciplinary research, to improve China's innovative capability in the research on near space vehicles and to establish the foundation for technology innovation in the development of near space vehicles in China.

I. Scientific targets

With the focus on key basic scientific issues of mid- to near space (altitude 30-70 kilometers) hypersonic long range maneuverable vehicle, the study may achieve the following targets in the areas of aerodynamics of near space flight environment, advanced propulsion theory and methods, super light materials and structures, thermal prediction and protection, intelligent autonomous control theory and methods for hypersonic aircraft, etc.: (ⅰ) To develop the innovative theory and methods for solving key scientific issues in near space vehicle and provide the basis for theory and methods in the research and development of relevant technology concerned in China; (ⅱ) To make innovative breakthroughs to some extent in the development of technical methods to improve the indigenous capability of the country in relevant areas for leap-forward development of technologies concerned; (ⅲ) To foster a team of outstanding researchers with the theoretical and indigenous innovative capabilities working in the area and promoting the establishment of a number of interdisciplinary basic research platforms to support sustained development of technology in the field of near space vehicle in China.

II. Overall arrangement and funded projects

Following the principle of "definite objective, stable support, integration and refinement and leap- forward development", this Major Research Plan aims at organizing farsighted

and interdisciplinary research focusing on key basic scientific issues of near space aircraft. The total budget is 150 million yuan for 8 years. Project and funding will be arranged in the first 5 years. Funding is given to three types of projects, namely, “Fostering Project”, “Key Project” and” Integrated Project”

1. Proposals, which have innovative ideas at the initial stage and need some time for further exploration, will be supported in the form of Fostering Projects for 3 years with not less than 500 thousand yuan per project, and as high as 800,000 yuan for experimental research. Some funded projects which have acquired good progress, will be given extended funding based on the expert panel’s decision.

2. Proposals with good research foundation, clear and important scientific issues for further exploration and characteristics of interdisciplinary studies, will be supported in the form of Key Projects” for 4 years with about 3 million yuan per project.

3. Proposals having decisive roles in achieving overall objectives of the research plan will be supported in the form of Integrated Project based on achievement made in previous Fostering Projects and Key Funding projects. The funding will be provided with 2.5 million yuan per project for 3 years.

Since initiated in 2007, this Major Research Plan has funded 21 Key Projects, 93 Fostering Projects and 1 Integrated Project with total funding of 129 million yuan in the following four key scientific areas, namely, aerodynamics of near space flight environment, advanced theory and method of propulsion, light and high heat resistant material and structure, and thermal response prediction and thermal protection, and theory and methods for hypersonic vehicle intelligent autonomous control.

III. Research directions in “Integrated Project” in 2011

2011 is the last year of application for this Major Research Plan. According to the funding plan and overall development, the expert panel has decided not to accept applications for Fostering Project and Key Projects in 2011, so as to focus on funding Integrated Project and make special effort to achieve the expected objectives of this Major Research Plan. Integrated Project should focus on scientific issues, and make integrated research on the basis of achievement made in the previous Fostering Projects and Key Projects.

Two projects of Integrated Project, with funding of 5 million yuan for 3 years are planned to be funded in the following directions:

1. Integrated research on supersonic combustion, flow and heat transfer process

The research should focused on interaction of inlet flow and combustion in combustion chamber, interaction between combustion process, combustion flow field and nozzle flow, interaction between combustion and heat transfer process, and combustion process control for providing design method and basis for improvement of scram jet performance.

2. Studies on coupling mechanism of flight attitude and aerodynamic forces and coordinated control

Aerodynamic loading and flight attitude have close coupling for near space hypersonic aircraft. While making attitude control, aerodynamic control must be achieved. Through research on the coupling mechanism of flight attitude and aerodynamic forces and its characteristics, aircraft aerodynamic models for coupling of flight attitude and aerodynamic forces could be developed,, and the theory of multi-target integrated control and method of application should be explored for accomplishing the coordinated control of coupling of flight attitude and aerodynamic forces, so as to achieve long range maneuverable flight.

IV. Notes on applications

Applicants are advised to read carefully relevant sections in this Guide to Programs and make proper selections on research topics.

The applications are accepted and processed by the Department of Mathematical and Physical Sciences.

Single Quantum State Detection and Its Interactions

Since the establishment of quantum mechanics, the understanding about the laws in the micro cosmos has been gradually deepened and the development of modern science and technology hence has been greatly promoted. Up to now, the understanding has been confined to a large extent in the sense of statistics, in particular, research on the precision measurement of single quantum state and its interactions is still at initial stage, which affects the development of contemporary physics with quantum mechanics as its central part, and other disciplines concerned as well. In recent years, along with the development of the experimental precision and control technology, some of single quantum state system may be established and the physical characteristics could be directly detected. Therefore, great breakthrough may be fostered in the research concerning single quantum state and its interdisciplinary development with information, material, energy and

chemistry.

Single quantum state refers to quantum state of single particles in the quantum system, such as single photon, single electron, single atom, single molecule and sub particles in condensed matter, etc., and macro quantum state formed by multi-particles (such as Bose-Einstein condensed state, super conductivity or super fluid quantum state). This Major Research Plan aims at developing relevant materials and systems by physical and chemical means, constructing single particle quantum state and macro quantum state and detecting directly its quantum state and quantum effects so as to understand the property of quantum state and basic laws of quantum process, develop new techniques of constructing quantum devices and means of quantum detection, explore potential applications in information and energy technology, promote the development of basic research of China in the fields of physics, chemistry and information technology, and solve some basic science and key technology issues with national strategic significance.

I. Scientific targets

To develop physical and chemical methods and technology for relevant materials and systems, construct high quality quantum structures as well as new precision detection methods for understanding the mechanism of relevant phenomena and processes at single quantum state, and to discover several novel quantum effects through the measurement of single quantum state and study of interaction between quantum states;

To provide solid physical basis for the application of quantum effect in the studies on major scientific issues in information technology, energy and environment, and farsighted knowledge for substantial and sustained development of national economy and security;

To form gradually the Chinese school with international reputation and foster a high level research team, especially a number of outstanding young scholars engaging at experimental science for promoting the competitiveness and position of experimental science in China.

II. Key scientific problems

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. Key funding research areas in 2011

In 2011, scientists are encouraged to select specific scientific issues to conduct innovative research in the following areas:

1. Construction of single quantum state system

Construction of single electron state, single photon state, single self spin state, single molecular vibration and rotating quantum state, and orbit quantum state, etc. and preparation of relevant materials. New phenomena and new effects of super cold atomic and super cold molecular systems.

2. New principles and methods of precision detection of single quantum state

The principles and technology of spectrum and spectroscopy for high resolution, high sensitivity of time, space and energy at single atomic and single molecular scale; spin-resolved energy spectrum, wave spectrum and scanning probe and other integrated detection methods; single molecule vibration, rotation and measurement and control and ultra fast dynamics of self spinning single quantum state.

3. Coupling between quantum states and interaction with environment

Coupling in confined system and preparation and measurement of entanglement quantum state; chemical reaction and the selection and control of energy transfer channels of different molecular quantum states; the integration and coherence control of qubits; the generation, transportation and interaction of surface plasmon with single quantum state; control of single quantum state in the outfield.

4. Macro quantum effect in condensed state matter

Exploration of new phenomena and new effects in macro quantum state, preparation and characterization of new types of macro quantum system; competition of multi ordered state and quantum phase change, quantum Hall effect and topological excitation; new quantum effect and quantum transport of surface/interface single quantum state.

5. Modeling and numerical computation of quantum state interaction

Basic laws and theory of single quantum state and interaction; theoretical model and computational method related to single quantum state preparation, measurement and characteristics, and new computational method beyond single particle approximation.

A total budget of 150 million yuan for this Major Research Plan will be provided for 8 years. The research projects will be proposed and funded within the first five years. In 2011, the budget is about 40 million yuan. The average funding for Key Project is 3.5 million to 4 million yuan per project for 4 years, and the funding for Fostering Project is 800,000 yuan for 3 years.

In 2010, 65 proposals were received for the Plan, among which 45 proposals are for Fostering Project and 20 proposals for Key Project. After panel evaluation, 7 Key Projects and 15 Fostering Projects were funded with a total funding of 31 million yuan.

IV. Principles of project selection

(1) New concepts and methods of material preparation and measurement focusing on single quantum state system based on experiments
(2) Theory and simulation that can greatly promote the development of experimental work in China
(3) Reasonable technical route with creative academic ideas
(4) Good background and working accumulation related to research
(5) Important roles in accelerating the overall development of the Major Research Plan and understanding of key scientific problems

V. Notes on applications

The applications are accepted and processed by the Department of Mathematical and Physical Sciences.

Structural Design and Controllable Preparation of Function Oriented Crystal-state Materials

Crystal-state materials are the sum of long-range ordered solid materials, which have the following features: stable ordered structure, clear relation of structure and efficacy, diversified essential properties, enriched physical intension and easy compound and regulation. Studies on crystal state materials focus on the functional orientation and material development needed for special performance by structural design and controllable preparation.

I. Scientific targets

The Major Research Plan is to explore the functional elements that decide macro-properties of crystal-state materials and their integrated ways in the space, to develop the theory of functional elements and to deepen the understanding of the functions of materials and natures of functional elements, based on the internal relations between macro-properties (optic, electric, magnetic and complex property) and micro-structures (electron, molecule and aggregation) of crystal-state materials. It is also to conduct research and applied work on the design, synthesis, preparation and characterization of functional crystal materials and to provide new theories, methods and

material systems for realizing the structural design and controllable preparation of crystal-state materials guided by function, as well as to promote the development of relative disciplines.

In order to realize the above targets, applicants should give full play to the superiority of intercrossing and cooperation of multi-disciplines, such as chemistry, physics, materials and information sciences, lay stress on innovation and research in the cutting edge areas, and foster talents and research teams with international reputation so as to make great contributions to the national economy and social sustainable development.

II. Key scientific issues and key funding research areas in 2011

Three key scientific issues will be focused as follows: key functional elements which decide the properties of crystal-state materials, the relationship between macro-properties and micro-structures of crystal-state materials, and the design principle and the controllable instruments for the preparation of crystal materials based on the functional elements.

In 2011, key research areas will be funded as follows:

1. Functional elements, structure-activity relationship and its law of crystal-state materials

Focusing on the structural features of functional elements in the crystal-state materials, the following research work will be encouraged:

(1) To establish and develop new theoretical methods, to calculate, simulate and predicate the structures and properties (such as magnetic, electronic and optical properties) based on multi-levels and multi-scales for exploring the origin of functional features and key functional elements in the crystal-state materials.

(2) To reveal the interaction (such as covalent bond, ionic bond, coordination bond, hydrogen bond and weak mutual action, etc.) of the functional elements (electron, atom, ion, molecule, group, domain structure and phase structure, etc.) in crystal-state materials and the relationships between crystal-state materials and their properties (including optic, electric, magnetic and complex function), for exploring the relationships between macro-symmetry and property of crystal-state materials.

(3) To study systematically the assembly, modification and regulation of optic/electric/magnetic properties of crystal-state materials, to observe the physical echo of relative systems under outside disturbance (e. g. magnetic, electric, optic, thermometric, force field, etc.), for probing the basic issues, such as electron transportation, magnetic order, conversion of energy, etc and finding the regulative and controllable means in application.

2. Design of new function oriented crystal-state materials

To design and synthesize new crystal-state materials according to the relationship and laws between structure and property, the following research work will be encouraged:

(1) To develop the methodology of "molecular engineering" and "crystal engineering" based on the theory of functional elements and materials system, and to carry out the study on the computational materials science for guiding the design of materials.

(2) To design and synthesize the materials system with key functional elements and special structure, and to study their features, such as non-linear, laser, luminescence, electric, magnetic, composite property, etc., for revealing the relationships between structure and property as well as finding new functional crystal-state materials.

3. Controllable preparation and characterization of new crystal-state materials

To develop new methods of synthesis, preparation and characterization, the following research work will be encouraged:

(1) To develop the assembly method and technique of functional elements and the preparation of new functional materials by the structural optimum and tailoring of functional elements, and to realize the strengthening and composition of function by the controllable growth of crystal-state materials with special structures achieved by means of regulative and controlling structure.

(2) To develop new synthetic methods under extreme conditions, especially the preparation technique of sub-stable phase crystal-state materials, film and interfacing structural materials.

(3) To establish new surveying and characterizing means of functional elements and their materials, with focus on the techniques of *in-situ*, in time, micro-area structural materials, as well as the characterization of crystal-state materials. It is encouraged to carry out the study of property and mechanism of crystal-state material in the state large scientific facilities concerned.

4. New function oriented crystal-state materials

Based on the research superiority in the areas concerned in China, and the above-mentioned research issues, studies will be encouraged in the following areas:

(1) Optic and luminous materials: to study the laser and non-linear optical materials with new wave band and of new structural type, sunlight and upper conversion luminous materials, and optical and luminous materials based on coordinated compounds and artificial micro-structures, etc.

(2) Electric and magnetic functional materials: to study non-metal crystal-state materials of new structures with electric and magnetic functions, especially photoelectric, piezoelectric and magnetic materials, etc.

(3) Complex system and functional composite materials: to study the functional and composite functional materials in the complex systems with the interaction between electric charges, self-spin, orbit and lattices, especially non-conventional superconductor

materials, new magneto-electric resistance materials, huge thermoelectric materials, photo-electric conversion materials, photo-functional composite materials, etc.

III. Requirements to applicants and funding scales in 2011

In 2010, 135 proposals were accepted for the Plan, of which 28 proposals were for Key Projects, 97 for Fostering Projects and 6 proposals were not in keeping with the requirement. The proposals cover 15 disciplines in 4 departments. 8 Key Projects and 29 Fostering Projects were funded, with a funding of 19.30 million yuan and a funding of 14.2 million yuan, respectively.

These projects basically reflect the scientific targets and research directions assigned in the Plan. However, some of the proposals lacked the combination of theory and experiment, the crossing and fusion between different disciplines and the exploration of functional elements, structure/efficacy relation of crystal-state materials as well as their laws, so failed to incarnate the "function-oriented and structural design" requirement.

In 2011, it is required that proposals must stress the functional orientation and structure design requirement, further strengthen the crossing and fusion between disciplines of chemistry, materials, physics and information, encourage the closely combination of theory and experiment and deepen the exploitive study on the functional element's structural characteristics of crystal-state materials. Applicants should take notice of the difference from other Major Research Plans, such as "Controllable self-assembly system and its functionality" etc. Proposals for nano-materials will be not accepted because other special funds were provided, such as the Major Research Plan of "Research Basis on Nano-science and Nano-technology".

The Plan will provide two types of funds in terms of Key Project and Fostering Project which differ in their respective requirements and funding intensity. Proposals with creative idea, larger challenge but lacking relative work basis will be funded by Fostering Project. Among those with features of crossing disciplines will take priority. Proposals which have excellent research backgrounds and working experience as well as clear scientific issues and interaction between chemistry and other disciplines will be funded by Key Project. Meanwhile researchers with different disciplinary backgrounds are required for the composition of the research team. All proposals should meet the requirement to the function orientation and structure design.

In 2011, about 30 Fostering Projects will be funded with more than 0.5 million yuan each for 3 years and 8 Key Projects will be funded with about 2.5 million yuan each for 4 years. The total budget for the Plan is 35 million yuan this year.

IV. Principles of project selection

In order to realize the overall targets of the Plan, the following studies will be encouraged:
(1) Exploratory studies with original creative ideas and/or unique features;
(2) Studies on the key scientific and technical issues closely related to the overall target;
(3) Intercrossing and cooperative studies among chemistry, mathematics and physics, materials, information discipline, etc;
(4) Studies with the participation of overseas excellent scientists.

The applications are accepted and processed by the Department of Chemical Sciences.

Fundamental Research on Nanomanufacturing

Nano-manufacturing sciences are the basis to support their applications of nanoscience and nanotechnology. This Major Research Plan focuses on the frontiers of fundamental research on nanoprecision manufacturing, nanoscale manufacturing, and multi-scale manufacturing to meet key strategic needs of the national development, explore interaction mechanisms and transforming laws of the energy-motion-structure-property when manufacturing processing size shrinks from macro-scale to micro-scale, establish fundamental theories, processes and equipment principles of nano-manufacturing and foster excellent researchers in the area, as well as to promote original creativity and achieve results with Important international impact.

I. Scientific targets

Through the interaction and merging of related disciplines, such as mechanical engineering, physics, chemistry, biology, materials science and information science, the Plan aims to explore the novel nano-manufacturing methods and processes based on physical/chemical/biological mechanisms; to reveal the size-dependent phenomena and interfacial effects during nano-scale/nano-precision manufacturing, molding, modification, and multi-scale manufacturing; to illustrate the mechanisms of materials structural transformations and formation laws of device functions; to establish high-precision characterization and measurement methods during nano-manufacturing; to develop novel nano-manufacturing techniques and equipment mechanisms, and to provide a theoretical basis for nano-manufacturing repeatability and volume production.

II. Overall arrangement for the plan

By following the principles of limited goals, stable support, integrated improvement and leap-forward development", the Plan focuses on two types of key fundamental scientific

issues in the area of nano-manufacturing: (ⅰ) topics related to major strategic demands of national development; and (ⅱ) major scientific frontiers in the area.

The Plan is expected to last 8 years with a total budget of 150 million yuan. Proposals will be accepted mainly in the first five years for three types of funds, including Fostering Projects, Key Projects, and Integrated Projects as following:
(1) Three-year Fostering Project provides support for fundamental research proposals with innovative ideas in the frontiers of nano-manufacturing;
(2) Four-year Key Project provides support for proposals with significant innovative ideas, important research value and solid research background, as well as good potential of great breakthroughs;
(3) Four-year Integrated Project provides more financial support for innovative proposals with sound background that will make significant contributions to the achievement of the overall objectives. The call for proposal will be properly arranged during the late stage of the Plan.

III. Principles of project selection

All projects under the Plan shall meet the following criteria:
(1) The projects should incarnate the key strategic needs of the national development in frontiers of nano-manufacturing fundamentals with emphasis on the characteristics of nano-manufacturing;
(2) The projects should focus on the scientific issues and key technologies in nano-manufacturing. Interdisciplinary proposals are encouraged. Proposals for Key Projects should involve merging and collaboration of inter-disciplines such as mechanical engineering, physics, chemistry, biology and information science to develop novel mechanisms, methods, technologies and processes for nano-manufacturing; Proposals for Fostering Projects should give emphases on the innovation of academic ideas;
(3) Indigenous exploratory research is encouraged with priority;
(4) Concrete international cooperation is encouraged.

IV. Areas and directions of funding priority in 2011

1. Nano-scale manufacturing based on physical/chemical/biologic principles

Novel nano-manufacturing methods and processes on nanostructure formation, machining, modification and assembly, and the performance evolution laws of structures and devices during the process of nano-manufacturing.

2. Nano-precision manufacturing of macrostructures

Novel principles, methods and processes of nano-precision of macrostructures, atoms/molecules transportation mechanisms，surface/interfacial effects during

nano-manufacturing, and nano-precision surface treatment theories.

3. Nano/Micro/Macro (multiscale) manufacturing

Novel principles and methods of multi-scale manufacturing, interfacial behavior and multi-field regulation during multi-scale manufacturing, and arrangement, control and integration of multi-scale structures and devices.

4. Precision and measurements of nano-manufacturing

Nano-scale measurement trace and error evaluation, nano-manufacturing precision design theories, the measurement and characterization of nanostructure physical properties, such as geometric parameters and mechanical properties, etc.

5. Novel principles of nano-manufacturing equipment

Micro-perturbation, non-linear dynamics and response distortion, modes of energy conversion and process controls during nano-manufacturing, novel drive and control of nano-precision motion.

V. Funding profile of 2010

In 2010, 159 proposals from 78 institutions were submitted on nano-manufacturing, including 128 Fostering Projects and 31 Key Projects. 24 proposals were rejected after preliminary evaluation. 135 proposals were sent for peer review. Through peer review and panel evaluation, 42 proposals were funded with a total funding amount of 37 million yuan, including 7 Key Projects with 15.60 million yuan and 42 Fostering Projects (including 1 proposal converted from Key Project to Fostering Project) with 21.40 million yuan.

VI. Funding scale in 2011

This Major Plan was formally initiated in 2009. Proposals will be accepted in 5 years and funded in forms of “Fostering Project” and “Key Project”. Projects with better innovative or promising ideas，but need to be further investigated will be funded as “Fostering Projects” with a funding level of no less than 500,000 yuan per project. The projects focusing on the experimental research will be funded with about 800,000 yuan per project. Interdisciplinary projects with better research basis and accumulations, and distinct key scientific issues requiring further systematic investigation will be supported as “Key Project”; the funding is about 3 million yuan per project.

In 2011, proposals for both Fostering Projects and Key Projects can be submitted, the funding will be 43 million yuan in total for about 40 fostering projects for 3 years and 6~8 Key Projects for 4 years.

The applications are accepted and processed by the Department of Engineering and Materials Sciences.

Research on the Unconventional Emergency Management

With unconventional emergency management as the research object, this Major Research Plan encourages multi-disciplinary collaboration among management science, information science, psychological science, etc., focuses on information processing and evolution modeling for unconventional emergencies, unconventional emergency decision-making theory, and psychological reactions and behavior patterns of individuals and groups under emergencies, and integrates research results by means of the integration platforms established in the Plan. Unconventional emergencies are defined in this Major Research Plan as those devastating emergencies that are marked by salient complexity and potential secondary-derivative hazards, and cannot be sufficiently predicted and coped with by conventional management practices.

I. Scientific targets

This Major Research Plan is aimed at the formation of incisive understanding of the underlining laws governing key procedures such as monitoring, early-warning and response decision-making in unconventional emergency management through relevant multi-disciplinary observation, experiment, theoretical innovation and integration, as well as at providing scientific methods. The construction of "scenario-reply"- based theoretical system of unconventional emergency management, the enhancement of independent innovation ability in emergency management science and technology, and the establishment of a scientific national emergency management system (including emergency platform/response planning system) are also encouraged in order to provide suggestions and references for the government decision-making in scientific, efficient and orderly response to non-conventional emergencies. Researchers are encouraged to nurture intercrossing disciplines in emergency management science, to foster innovative talents, and to play a key role in the international arena of emergency management science.

II. Key scientific issues

1. Information processing and evolution modeling of unconventional emergencies

With respect to the premonitory and the massive, heterogeneous, real-time data during the process of unconventional emergencies, research should focus on scientific issues

concerning the collection, data analysis, dissemination, visualization, and sharing of information. Theoretical and methodological research on the nontraditional (such as data-driven or computational experiment based, etc.) complex modeling of the evolution of unconventional emergencies is also expected.

2. Unconventional emergency oriented decision-making theory

Studies on theoretical methods for whole-course dynamic assessment, analysis and decision-making in on-site unconventional emergency response decision-making, studies on organizational design, operation and evaluation theories and methods for emergency preparation system, decision-making and command systems, rescue/implementation system, and resource mobilization system, studies on the design of emergency response platform, preplanning system, and training methods, studies on comprehensive decision support theories and methods for multi-event coupling and scenario construction, and theories and methods for the integration of hardware and software systems.

3. Individual and group psychological and behavior responses under emergencies

Study on the psychological mechanism (cognitive, emotional, mental attitude, demand, etc.) of the major participants （managers, rescue workers and the general public) as individuals under stressful emergencies, as well as laws and structural features of group behavior under emergencies.

III. The establishment of the integrated platforms

1. Research on the unconventional emergency dynamic simulation computing experiment system

Based on the complex system theory, methods and techniques, and the whole-course scenario oriented at unconventional emergency occurrence, evolution and development, transformation process, a dynamic simulation calculation and experiment system is to be established to construct a software planes and related project two-way interaction network for an integrated simulation environment that can provide high performance, openness, extensibility and customization. The system, which is integrated research achievements concerned of the emergency management by a standardized way, may support on-line information of real-time monitoring, collection, storage, analysis and online information dynamic improvement simulation model, people - computer collaborative calculation experiment, dynamic visual display and interaction in network, and deal with unconventional disaster assessment, situation assessment, the evaluation of the effectiveness about the measures and emergency response plan, and mental training of related persons. The system can be academically used as an experimental tool for long-term theoretical research and as an auxiliary technical reference tool in application for online monitoring and warning and emergency decision making.

2. Research on the emergency response planning system

The emergency response planning system should be developed in the background of research on the unconventional emergency under the guidance of the system engineering theory and methodology. The system, which is aimed at the creation of the international advanced theory and technology for the unconventional emergency response planning and focused on the four core issues of risk assessment, preparation system, response planning system and the operation system, presents the network environment insuring the two-way interaction between software and related project and integrating innovation achievements from research, technology and application to provide the theoretical foundation and technical guidance for the emergency response planning system. The system should academically explore the connotation and structure of unconventional emergency, technically support the basic functions and operating environment in the open platform of the emergency response planning system, and practically make use of research results and technologies in the national emergency preparation and response planning system for improving its operability.

3. Research on the platform for emergency response system

Based on public security S&T and information technology and emergency management process, the platform for emergency response system including hardware and software will be established for providing information processing, process evaluation, comprehensive judgment, decision making and other basic functions. In accordance with two scientific issues on monitoring and warning of unconventional emergency and decision-making, the network environment, which is provided for two-way interactions between the software planes and related project, should be constructed for comprehensive research on indicators of model, data, case, and psychological behavior and their regular patterns. This system should be able to integrate and validate research results, and provide decision making for emergency response as a comprehensive platform in practice. Research achievements, which is an open comprehensive research platform and integrated with the national emergency response system, could not only support theoretically and technically the national emergency response platform system, but also provide a sharing platform for basic research.

IV. Priority research areas in 2011

This Major Research Plan will invite proposal only for the Key Project in 2011. The proposal for the Key Projects should exhibit innovative academic ideas and research value, which are able to make contributions to the overall scientific targets of the Plan, and enjoy a sound research basis and experiences. The priority will be given to interdisciplinary research in the funding for Key Project. Around 5 projects for Key Projects are planned for funding in 2011, with an average funding intensity of 1.8 million

yuan per project, and the duration of the Key Project will be 3 years. The priority research areas are as follows:

1. Technique and system of "Internet of Things" for active perception and emergency command of the unconventional emergencies event

The research focuses on the experimental system of "Internet of Things" for active perception of unconventional emergencies and emergency command, including active perception mechanism, spatio-temporal database technique for sensor history data and real-time perception data, anomalies detection and early warning technology for emergencies events, technique for real time positioning, dynamic tracking and dynamic planning of emergency resources, and the integrated command mechanism for emergency response based on spatio-temporal logic and scheduling.

2. The social calculation method for online emergency perception, early warning and crisis information navigation of unconventional emergency events

Unconventional emergencies online crisis information of active perception, early warning and navigation social calculation system, including online crisis information extraction, filtration, standardization and spatial-temporal database technology, multi-source crisis information intelligent analysis and situation judge, dynamic crisis information spread with online interactive mechanism, online - offline abnormal symptom of early detection and early warning technology, people - machine interactive dynamic crisis information navigation and online collaboration, group dynamic design and optimization oriented at the online crisis command and control.

3. The Cloud service system and key technologies oriented to unconventional emergency management

The research focuses on the cloud service system to provide rapid acquisition, storage, calculation and analysis regarding to the mass of heterogeneous data in the physical and network perception from unconventional emergency events, and realize high computing power, huge storage capacity, better stability and security of the unconventional emergency response management platform by spatiotemporal data management, a distributed parallel storage and cluster computing required in the on-line emergency response for exploring the emergency response management model based on the new cloud service system.

4. The social psychology research and management intervention on the psychology and behavior under the unconventional emergency

Research focuses on the psychology influence law in all kinds of group under the unconventional emergency; stress behavior characteristics of different social group under

the unconventional emergency; influences of cultural differences, the regional differences, ethnic differences on the risk cognition and decision-making behavior; dynamic assessment and management strategies for different kinds of victims' behavior and demand; psychology education, the changing method and the improving model for group behavior .

5. Group psychological reaction characteristics, evolution and management intervention under the emergencies

Research focuses on the rule of the public psychology and behavior reaction over various kinds of emergencies, analyze the various factors influencing public emergency responses and the model of the group reaction to emergency events, as well as the difference and generality of group psychological reaction over different types of events, including perception, emotions, attitudes and actions response patterns, and in particular the possibility, complexity, self-organization pattern of all kinds of malignant masses event spreading into group reaction. The research can provide the scientific basis for maintaining social stability and public security and enhance the governance capability.

V. Selection criteria

(1) In coincidence with requirements of *The Guide to Program* and contribution to the integration platform;
(2) Emphasis on the close combination with unconventional emergency management practices;
(3) Interdisciplinary research among management, information and psychological disciplines;
(4) Focus on Chinese characteristics and case study on important events;
(5) Innovative research ideas focusing on the core scientific issues under this Major Research Plan;
(6) Contribution to the overall targets of the Plan and the exploration of core scientific issues;
(7) Good academic background, sound research basis and experiences, and potential Breakthroughs in near future.

The applications are accepted and processed by the Department of Management Sciences.

Integrated Research on the Eco-Hydrological Process of the Heihe Basin

By choosing the Heihe Basin as a typical study area, this Major Research Plan is, from

system point of view, aiming to establish a research platform for scientific observation and experiment, data collection and modeling simulation in China for exploring the processes and mechanism of interaction between ecosystem and hydrological system in inland watersheds, and establishing the eco-hydrological process model and decision making system for water resource management to improve the research abilities on analysis and prediction about the inland watershed's hydrological, ecological and economic system evolution, and provide the fundamental theories and S&T support for water security, ecological security and sustainable development of the economy in inland watersheds.

I. Key scientific issues

The Major Research Plan focuses on the following five key scientific issues:

(1) Plant water use efficiency in arid environment and its adaptive mechanism to water stress. This research is to recognize the unique form of water use pattern of the plant formed in long-term adaptation to arid climates, understand the characteristics of the hydrological cycle at different spatial scales, and analyze the water use processes of plant individual, population, community, ecosystem and the plant's adaptive mechanism to water stress.

(2) Mechanism of interactions between surface water and groundwater and its eco-hydrological effects. This research is to understand the circulation nature, exchange processes and water quality evolution between surface water and groundwater, and recognize the basic characteristics of the hydrology, water resources and water environment in arid zones and their impact on regional ecological processes.

(3) Mechanism of eco-hydrological processes at different scales and scale conversion methodologies. This research is to understand the interactions between hydrology and vegetation spatial patterns in arid inland watersheds, investigate the interaction mechanism of eco-hydrological processes at different scales, and develop and improve the scale conversion technologies and methodologies.

(4) Response mechanism of watershed eco-hydrological processes to climate change and human activities. This research is to understand the historical evolution of human activities, spatial mode of action and intensity, develop the methodology of converting human factors into spatial parameters, and establish the watershed ecology, hydrology and economy coupled models.

(5) Methodological and technological synthesis of experimental observation and data simulation. This project is to formulate the research platform that integrate observation, experiment, and data simulation at basin scale, improve field observation and research network based on the overall concept of watershed, and establish the scientific issue oriented research platform that takes watershed as a unique system and aims at the simulation of eco-hydrological processes.

II. Scientific targets

Through the establishment of the "integrated and water-centered eco-hydrological research platform" which links the research components like observation, experiment, simulation, scenario analysis and decision making, the Plan aims to reveal the interaction nature of eco-hydrological processes at the scales of plant individual, community, ecosystem, landscape and watershed, characterize the response mechanism of eco-hydrological processes to climate change and human activities in inland watersheds, develop the conversion methodologies of different eco-hydrological scales, establish the watershed ecology, hydrology and social economy coupled models, improve the understanding for water resources formation and transformation mechanism in inland watersheds, and improve the regulatory ability of sustainability so as to push the watershed eco-hydrology research in China forward in the advanced position in the world.

III. Overall arrangement of the plan

This Major Research Plan chooses the Heihe River basin as the research area, and arranges research projects according to the above-mentioned overall objectives and ideas of the Plan. The duration of the Plan is 8 years with a total budget of 150 million yuan. The projects were initiated in 2010, and carried out in the first 5 years. Fostering Projects and Key Projects will be funded this year and the Integrated Projects will not be funded at present.

1. Fostering Project (3-year study, not less than 500,000 yuan per project)

The funding is targeted at those proposals of basic research with innovative academic ideas on the advanced ecological, hydrological and human dimension issues specific to the Heihe basin.

2. Key Project (4-year study, not less than 2000,000 yuan per project)

(1)The funding is targeted at those proposals with significant innovative academic ideas on the basin's ecological, hydrological and economical processes and their interactions, carried out by teams with significant research achievements or research background in the basin, which are expected to achieve important breakthroughs;

(2) The aerial remote sensing on data collection and environmental parameter study that can support the integrated eco-hydrological study in the Heihe basin;

(3) Research on the design and development of the integrated models, data assimilation of watershed land surface and spatial decision making systems for watershed resource management.

IV. Selection criteria

Proposals for the Plan should meet the following requirements:
(1)Basic research with innovative ideas focusing on eco-hydrological and related issues in the Heihe basin;
(2)Intensification of characteristics of interdisciplinary and systematic projects, focusing on the overall objectives of the Major Research Plan;
(3) Concrete international cooperation is encouraged.

V. Key funding research areas in 2011

According to regional characteristics of the Heihe basin and the goals of the Plan, research areas were designed in three regions, i.e. upper reaches, oasis in middle reaches and desert in downstream. The eco-hydrological modeling and decision making for the whole basin are to be achieved via the watershed integration. Four major research areas are listed below:

1. Ecological pattern, process and hydrological effects in upper reaches

The observation and experiment work is mainly concentrated in two small watersheds, i.e. Dayekou and Mafengou. Representative and typical observations are to be conducted taking into account the glaciers, snow cover, frozen soil, alpine shrub, frost, grassland, slope, etc. The scientific objectives are to study the scale transformation methods of eco-hydrological factors based on process-based observations and simulation models, to build a distributed eco-hydrological model of the upper reaches. The following research directions should be focused on:
(1) Snow distribution in mountain areas, snowmelt runoff observation and modeling;
(2) Spatial variation of hydrological properties of soil and its impact on hydrological processes;
(3) The effects of typical human activities on ecosystem structure and productivity.

2. Structure, function and water cycle of artificial oasis in middle reaches

Research in middle reaches stress on the transformation between surface water and ground water, aims to understand the eco-hydrological process of artificial oasis, and investigate the hydrological processes and their ecological functions between desert and oasis. It is focused on the water cycle observations of main crops at the irrigation district scale for establishing SPAC model of main crops and eco-hydrological process model at oasis landscape scale, investigating the impact of industrial development and urbanization on regional water balance, conducting water-economic modeling, and developing decision making systems. The following research directions should be focused on:
(1) Eco-hydrological process of oasis-desert landscape structure and its effects;
(2) Influence of agricultural land use change and water-saving irrigation on oasis water

requirement and its eco-environmental effect;
(3) Assessment methods of agricultural water use efficiency at different scales;
(4) Scenario analysis of water demand to industrial and urban development and its policy effects;
(5) Establishment and simulation of eco-water-economic model.

3. Eco-hydrological effects and ecological water demand of desert oasis in downstream

Research is mainly concentrated in downstream, focusing on the physiological and ecological characteristics of desert plants and their interaction processes with hydrology, understanding the mechanism, analyzing the water demand of natural oasis (riparian forest and terminal lake), simulating the groundwater dynamics, and integrating water demand of socio-economical systems. The following research directions should be focused on:
(1) Water use efficiency of plants in arid environment and its adaptive mechanism to water stress;
(2) Evolution of terminal lakes, change process of wetland structure and ecological water demand;
(3) Mechanism of atmospheric water vapor uptaking by desert plants and their adaptation mechanism.

4. Eco-hydrological process and water management at watershed scale

The scientific objectives are to strengthen observations and experiments, simulation tools and data interchange platform, to construct eco-hydrological integration framework of watershed which is centered on eco-hydrological modeling and decision support for water resource management. The following research directions should be focused on:
(1) Modeling ecosystem processes and simulating eco-hydrological parameters;
(2) Integrated RS experiment, environmental parameters inversion and data products of the Heihe Basin;
(3) Comparative study of water resource management in the Heihe Basin and Murray-Darling Basin.

The applications are received and processed by the Department of Earth Sciences.

Deep Sea Process and Evolution of the South China Sea

Deep sea process is the breakthrough point of today's ocean science frontiers and earth system science. The South China Sea is the largest marginal sea in the Western Pacific and also in low latitudes. Combining the modern deep sea process with its geological

evolution in the South China Sea, the program will reveal the evolution pattern of the marginal sea and its effects on submarine resources and macro environment through one case study.

I. Scientific objectives

The overall framework of scientific objectives is to explore the deep sea basin by utilizing a series of new techniques, to reveal the deep sea process and evolution, and to re-construct the "life history" of the South China Sea, thereby a systematic research model for studies on evolution of marginal seas can be established. Detailed objectives are listed below:

(1) Rediscover the seafloor spreading history and the pre- and post- evolution of the South China Sea by re-measuring magnetic anomaly stripes and studying volcanic seamount chains;

(2) Reveal the evolution of bottom current to verify the evolution history of the South China Sea and the response to the sea level change by observing the modern deep sea process and analyzing deep sea sediments;

(3) Discover the deep biogeochemical process and evolution in the South China Sea by deploying submarine hydrological observation and analysis;

(4) Investigate resource and environment effects of the deep sea process evolution of the South China Sea based on the above research approaches.

II. Key scientific issues

Research contents include three temporal-scale deep sea processes with a focus on the northern South China Sea:

(1) The deep sea process of the basin formation (~10^6 a scale): the major part of the program, including the pre-seafloor spreading, duration of the seafloor spreading, and the post-seafloor spreading, with emphasis on the "duration of the seafloor spreading";

(2) The deep sea process during the sea-level change (~10^4 a scale): to reconstruct the environmental evolution history of the marginal sea during glacial-interglacial cycles by utilizing the sensitivity of semi-closed sea basin of the South China Sea to the sea level change;

(3) The deep sea process from the modern observation (~10^0 a scale): the basis to understand the geological scale variation, including deep water circulation, bottom sediment transport, and submarine biogeochemistry observations.

The key scientific issues include:

1. Age and process of the seafloor spreading

2. Time and cause of the volcanic seamount chain activities

3. Response of the deep sea sedimentation process to sea basin evolution

4. Variation of the bottom current and sediment transport mechanism
5. Development and effect of carbonate platforms
6. Distribution and effect of submarine overflows and down-hole fluids
7. Deep sea carbon cycle and the function of microorganism
8. Biogeochemical background of deep sea energy resource formation

III. Key funding research areas in 2011

During the first two years, the program will emphasize on projects of field investigation and observation facility deployments in order to organize cruises for launching current process *in situ* observation as soon as possible. At the same time, some exploratory projects will be supported. Key Project will be the main funding type. The support for the Integration Project will be based on the research progress of the program. Some Fostering Project will be supported to encourage exploratory studies with creative scientific ideas and research values but in need of further investigation.

Funding priorities in 2011:

(1) Investigate time and cause of volcanic seamount chain activities by sampling and analyzing volcanic rocks in deep sea areas;
(2) Explore sedimentation response to sea basin evolution by deeply studying the stratigraphy of both deep sea and surrounding continents;
(3) Investigate deep water current and sea water property by long-term observation and sampling;
(4) Investigate bottom sediment transport process and submarine overflows by observation and sampling;
(5) Investigate deep sea carbon cycle and the function of microorganism by various analysises and observations;
(6) ther studies with creative scientific ideas.

The above mentioned investigations at sea require technical preparation and experiments. Before launching the large scale work, some preparatory studies should be considered.

IV. Notes on applications

Total budget of this Major Research Plan is 150 million yuan. The estimated period of this plan will be 8 years, and projects will be funded mainly in the first 5 years.

In 2011 the budget will be 30 million yuan. The funding intensity for the Fostering Project will not be less than 600,000 yuan per project for 3 years, and for the Key Projects will not be less than 2.2 million yuan per project for 4 years. The number of projects and actual funding amount will be determined according to application and

actual need of the proposed research.

The applications are received and processed by the Department of Earth Sciences.

The Regulation Network and Molecular Mechanisms of Malignant Transformation of Nonresolving Inflammation

The nonresolving inflammation and its related malignant cancer are the major research contents of this Major Research Plan program. This program aims to give full play to the characteristics and advantages of multi-interdisciplinary subjects including medical sciences, life sciences and information sciences, to introduce the integrity of systems biology and the research strategy for information technology, as well as the concept of translational medicine, to focus on the network regulation and molecular mechanisms underlying malignant transformation of nonresolving inflammation, to discover the nature of how inflammation contributes to carcinogenesis, and to develop new strategies for early clinical diagnosis, prevention and intervention.

In 2010, 201 applications were received, which included 15 Key Projects，186 Fostering Projects, and 6 applications refused due to failing to meet the format requirements.

Applications in 2010 have the following shortcomings: focus on the diseases without malignant transformation; failing to reflect the process of malignant transformation of nonresolving inflammation; and investigators following the classical strategies of molecular biology instead of those of multi-interdiscipline, systems biology and information technology. Furthermore, few applications were received on the second (the regulatory network and hub in the malignant transformation of nonresolving inflammation) and third (the novel research methods for the malignant transformation of nonresolving inflammation) core scientific issues.

Applicants should refer to the Guide to Major Research Plan program “The regulation network and molecular mechanisms of malignant transformation of nonresolving inflammation” in 2010 for detailed information of research background, research direction and research projects to be funded.

I. Scientific objectives

The scientific objects of this Major Research Plan program in 2011 will be focused on following points: to give full play to the characteristics and advantages of

multi-interdisciplinary subjects including medical sciences, life sciences and information sciences, to introduce the integrity of systems biology, and the research strategy of information technology, as well as the concept of translational medicine, to develop new technologies and methods consistent with clinical pathological features and the process of diseases, to focus on the relationships among host, micro-environment and malignant transformation of inflammation, to reveal the molecular mechanisms underlying the transformation of nonresolving inflammation to malignant tumors, and to validate the application of the hub involved in the transformation as a marker or target for prediction and diagnosis of cancer or drug development through genetic modification or treatment with small molecule chemicals/drugs.

II. Core scientific issues

1. The molecular mechanisms underlying the malignant transformation of nonresolving inflammation

2. The regulation network and key hub in the malignant transformation of nonresolving inflammation

3. The novel research methods for the malignant transformation of nonresolving inflammation

III. Key funding research areas in 2011

This Major Research Plan program will continue to focus on the three core scientific issues and strengthen the research funding to related researches on the second and third core scientific issues.

1. The molecular mechanisms underlying the malignant transformation of nonresolving inflammation

The research is aiming to develop an experimental research system simulating human diseases, identifying and confirming incentives of the malignant transformation of nonresolving inflammation, and clarifying the molecular mechanisms underlying the transformation via surrounding the complicated regulation networks of the malignant transformation. Referring to the shortcomings of applications in 2010, it is suggested that the investigators should pay more attention on the dynamic regulation networks and systemic integration at different levels rather than on the classical strategy of molecular biology.

2. The regulation network and hub in the malignant transformation of nonresolving inflammation

In view of the features of regulation networks in the malignant transformation of nonresolving inflammation, the research should be mainly focused on how to integrate

various methods of genomics, proteomics and bioinformatics, how to monitor the dynamics of the parameters obtained, how to analyze the molecular events involved in the regulation networks, how to find the hub in the networks， and clarify the structural location and functions of the hub during the transformation of nonresolving inflammation to tumor, as well as how to explore the mechanisms of multi-dimensional regulation.

3. The novel research methods for the malignant transformation of nonresolving inflammation

It is one of the keys for investigating relationship between inflammation and cancer to build a nonresolving inflammation regulation network based on clinical pathogenesis. Special attention to the complexity of living organisms, nonlinear dynamic characteristics of life processes, feedback of biology systems, redundancy and structural stability and random process of molecular interactions and other characteristics is critically required. It is also necessary to pay close attention to dialectical relationship between adjustability and robustness in the dynamic networks of inflammation and tumor from the perspective of cybernetics at the same time. It is important to develop new technologies and methods for promoting the study of clarifying network regulation and the mechanisms underlying the malignant transformation of nonresolving inflammation.

IV. Notes on application

In 2011, the funding for this Major Research Plan program is approximately 40 million yuan and 50 Fostering Projects and 4 Key Projects will be supported.

This Major Research Plan program mainly funds two types of projects, i.e.: the Fostering Project (average 600 thousand yuan per project for 3 years) and the Key Project (average 3 million yuan per project for 4 years). Fostering Project is arranged for applications which provide relatively high innovation or a good symptom to solving key issues but need to be further explored. Applications with a solid base and accumulation of research, clear key scientific issues and need in-depth and systematic investigation could be granted as Key Project. The combination and intercrossing of research teams in different disciplinary backgrounds must be reflected in the application on academic idea, research contents and research team.

The applications are received and processed by the Department of Health Sciences.

Fuel Proliferation and Transmutation in Advanced Nuclear Fission Energy

Energy and environment are the foundations of human existence and development. Along with the progress of modernization, nuclear energy is gaining increasing attention for many governments. By March 2009, nuclear energy has provided about 16% of electricity for the world. China has also made the policy of developing nuclear power. It is estimated that by 2020, the percentage of nuclear power in terms of total power generation in China will increase from 2% to 7%. Rapid development of nuclear power in China has presented opportunities as well as challenges to relevant basic science disciplines. Generally speaking, scientific foundations of China for advancing nuclear energy development and relevant engineering projects are still weak. Within the funding scope of NSFC, giving more support on basic research in major fundamental scientific issues in nuclear energy areas has important strategic significance. This Major Research Plan is therefore initiated for this consideration.

I. Scientific targets

Overall scientific targets

Focusing on major national needs, research status in China and the world, and national medium and long term plan for energy development, following the principle of "definite objectives, stable support, integration and refinement and leap-forward development", and conduct innovative research in areas of nuclear fuel proliferation and transmutation for making major breakthroughs.

Exploring and developing new mechanisms, new methods, new technologies and new materials in the advanced nuclear fission energy system, fostering and expanding high level research teams for achieving world leading results.

Supporting the third generation of nuclear power development and making the research on the fourth generation of nuclear power in China among the leading position in the world, and providing scientific basis and technology accumulation and talents resources for the development of Chinese nuclear industry with creative and proprietary technologies.

Specific scientific targets

1. New phenomena, new mechanisms, new methods and new technologies in nuclear fuel proliferation and transmutation

(1)Deeply understand the physical, chemical and nuclear properties of actinides, especially complex properties caused by 5f electron structure, and develop new reaction

channel and mechanism related to nuclear fission;
(2)Explore new methods of nuclear fission proliferation and transmutation, develop new mechanisms, new schemes of long lifetime, high radiation waste transmutation, and optimize means of nuclear fission proliferation and transmutation;
(3)Develop mechanism of separation of uranium-thorium-plutonium and sub actinide and important fission products, and solve or partly solve the separation problem of important nuclide.

2. Basis of nuclear energy application
(1) Develop basic methods of new types of recycle of nuclear fuel and key technologies and methods for ADS design;
(2) Develop relatively complete relational data bases and computational methods for nuclear fuel proliferation and transmutation;
(3) Develop new separation technologies for nuclear fuel proliferation and transmutation system;
(4) Develop new types of nuclear fuel, structural functional materials and separation materials.

II. Key scientific issues

According to requirements, key scientific issues should be focused on fundamental, strategic and pioneering themes, the research concerned should be concentrated on the nuclear fuel proliferation and transmutation in advanced nuclear fission energy system, strengthen experimental studies and the combination of theory and practice, and develop new mechanisms, as well as coordinate closely with the national medium and long term plan for nuclear energy development. The following three key scientific issues are proposed:

1. Nuclear fuel and its nuclear process in advanced nuclear fission energy system
Key studies are focused on the neutronics and neutron economy in nuclear fuel system, proliferation process of U-233 etc., and its relevant nuclear reaction parameters and mechanisms, and preparation, characterization and mechanisms of new types of nuclear fuel. Key issues also include complex physical chemical behaviors of actinides with 5f electron structure.

2.Basic behavior of nuclear fuel in combustion process in advanced reactors and its proliferation and transmutation
Key studies are focused on the reactor coupling of ADS and relevant reactor physics and thermo engineering; physical basis and key technologies of strong beam proton acceleration; reactor physics, the reactor thermo engineering and coupling of fast reactor and advanced thorium reactors; new mechanisms and theoretical simulation of advanced

nuclear fuel proliferation and transmutation; new technologies of nuclear detection; design, preparation and characterization of new nuclear structural functional materials.

3. New method and new mechanism of post treatment of spent fuel

Key studies are focused on the physical chemical behavior, new types of separation material, new separation method of high concentration plutonium and other key long lifetime radioactive nuclides and sub actinides; and basic scientific problems of dry post treatment.

III. Implementation

This Major Research Plan support projects in the form of the Fostering Project and Key Project. These two types of projects have different funding intensities and research targets. For proposals, which provide innovative ideas and research merit at the initial stage but need to be further investigated, could be supported in the form of the Fostering Project. For proposals， which provide with innovative ideas and research merit and good research foundation and accumulation, and may make big contributions to the overall target of this Major Research Plan, could be supported in the form of "Key Project".

IV. Selection criteria

To ensure achieving the overall objectives, this Major Research Plan encourages:

(1) Exploratory studies with original creative ideas and special features;

(2) Studies on key technologies closely related to the overall objectives;

(3) Interdisciplinary research between mathematics and physics, chemistry and materials;

(4) Collaboration with outstanding overseas scientists.

V. Key funding research areas in 2011

In 2011, Fostering Project and Key Project will be funded in the following areas. Applicants may choose one or several areas for your proposals. There is no need to cover all areas for the Fostering Project and Key Project. Applicants may decide the project name, scientific targets and specify and give detailed targets for Key Project, technical scheme and related budget.

A. Nuclear fuel in advanced nuclear fission energy system and its nuclear process

1. Research area for Key Project

Studies on cycling nuclear parameter for nuclear fuel such as thorium and uranium and neutronics

Main research contents: theoretical model for nuclear reaction related to nuclear fuel proliferation and transmutation, sub-actinide nuclides neutron absorption cross-section; nuclear reaction mechanism and nuclear decay property of several long lifetime radioactive heavy nucleus; data base of relevant nuclide evaluation parameters for thorium and uranium cycling, various relevant database for neutron reaction and fission yield of relevant fission nuclei and fission yield nuclei such as thorium and uranium cycling; theory, method and program for reactor neutronic analysis using nuclear data.

Expected targets: to obtain some new key nuclear data in nuclear fuel cycling such as thorium and uranium, develop reliable system for nuclear cycling nuclide data evaluation, understand nuclear reaction mechanism and decay property for several long lifetime radioactive heavy nuclei of nuclear fuel cycling. The application should give clear targets to be achieved.

2. Research areas for Fostering Projects

(1) Composition, structure, characterization, function and mechanism of new types of nuclear fuel;

(2) New methods of efficient extract and purification of nuclear fuel;

(3) Nuetronics of new types of nuclear fuel system and complex physical chemical behaviors of actinide having 5f electron structure;

(4)New mechanisms and theoretical models of advanced nuclear fuel proliferation and transmutation;

(5) Basic research on uranium and plutonium metal oxides and metal fuel.

B. Basic behavior of combustion in nuclear fuel reactor and its proliferation/ transmutation

1. Research areas (the first area) for Key Project

Time and space related reactor physics, reactor thermo engineering and coupling of sub-critical reactors

Main research contents: mechanism of neutron position, energy, distribution and neutron value affecting 3-D stable neutron fluence rate in sub-critical reactor; spallation neutron distribution model and transient response and mechanism of affection on sub-critical reactor, and basis and method of selection of extreme transient process in the model; factors and degree of influence on sub-critical reactor safety in transient process; temporal and spatial distribution and variation of power and neutron fluence rate,

influence and mechanism of transmutation actinide and long lifetime fission product on sub-critical reactor safety.

Expected targets: a number of innovative research results on neutron fluence, transient response and safety factors for sub critical reactors, and develop reliable safety evaluation parameters and standard for sub critical reactors. The application should give clear targets to be achieved.

2. Research areas (the second area) for Key Project

Key technologies and methods for ADS strong proton beam accelerator

Main research contents: particle dynamics of strong beam transportation, beam loss and beam discharge improvement; advanced beam diagnosis technology and RAMI technology; low discharge, high beam strength, high stability and reliability proton source; prototype cavity and high power coupler development and experimental measurement.

Expected targets: a number of innovative research results on key technology and method of ADS accelerator, and scientific basis and research method for application of ADS in nuclear fuel proliferation and transmutation. The application should give clear targets to be achieved.

3. Research area (the third area) for Key Project

Laws of evolution and mechanisms of material micro structure in nuclear energy environment

Main research contents: radiation damage of deep burn up nuclear fuel element structure materials and its influence on structure, mechanical property and long term stability; the laws and mechanism of material micro structure evolution and phase stability under extreme conditions such as strong radiation, high temperature, high stress and strong erosion, interface chemical and structural evolution, mechanical property evolution; material radiation effect in high dosage atomic displacement and under the combined influence of hydrogen and helium and generation, shift and annihilation of radiation defects in materials and nano interface evolution dynamics; multi temporal and spatial level modeling and computer simulation of material carrier particle radiation effect in multi systems.

Expected targets: to make substantial progress in laws of evolution and mechanism research on material micro structure in nuclear energy environment, and set up foundation for preparation of nuclear energy material; develop lab scale new materials having application prospect in nuclear energy system with own intellectual property rights. The application should give clear targets to be achieved.

4. Research areas for Fostering Projects

(1) Reactor physics, reactor thermo engineering and coupling of thorium base fuel molten salt reactor;

(2) Differentiation of fission products of various types of nuclear fuel in reactor combustion process and its mechanism;

(3) Studies on types and property of spallation target in ADS accelerator and coupling place in reactor, and basic process of long lifetime nuclide ADS proliferation;

(4) Design, synthesis and characterization of new types of high temperature resistant, erosion resistant, radiation resistant and long lifetime materials;

(5) New types of nuclear detection and nuclear probe.

C. New methods and new mechanisms of post treatment of burn-up fuel

1. Research areas (the first area) for Key Project

Physical and chemical process of new methods of post treatment of burn-up fuel

Main research contents: chemical behavior and mechanism of high concentration plutonium solution, auto radiolysis effect and its influences on behaviors such as dismutation, hydrolysis, deposit and polymerization of plutonium solution, special chemical behavior and mechanism of extraction, transfer and storage process of high concentration plutonium solution in post treatment technology; important theoretical basis and key technological problems in dry post treatment method for burn-up fuel; erosion resistant structural material and property in extreme conditions (strong radiation, high temperature and high halogen concentration).

Expected targets: to obtain a number of innovative research results for key issues of chemical behavior and extraction behavior and mechanism of high plutonium concentration solution and dry post treatment, provide scientific basis for efficient and safe recycling of high concentration plutonium in post treatment process, and set up foundation for the development of dry post treatment method. The application should give clear targets to be achieved.

2. Research areas (the second area) for Key Project

New separation methods and safe treatment of sub-actinide, long lifetime fission products related to transmutation

Main research contents: develop new method of sub actinide, long lifetime fission products related to transmutation, and study its mechanism; according to the need of burn-up fuel treatment and disposal of high radiation waste in China, conduct basic research and farsighted research.

Expected targets: achieve a number of results on chemical behavior and mechanism for

separation of sub-actinides and long lifetime radioactive fission product related to transmutation, and provide scientific basis for major national need such as burn-up fuel treatment and disposal of high radiation waste in China. The application should give clear targets to be achieved.

3. Research areas for Fostering Project

(1) New post treatment methods for thorium based fuel;
(2) Studies on chemical types, migration behaviors and mechanisms of key radioactive nuclides in post treatment of burn-up fuel;
(3) New types of separation materials (ion solution, super molecular identification material and nano materials) in post treatment of burn-up fuel.

VI. Funding plan for 2011

In 2011, 18 Fostering Projects with a funding intensity of not lower than 700,000 yuan per project for 3 year and 5 Key Projects with a funding intensity of about 3 to 6 million yuan per project for 4 years will be funded. Total budget for 2011 is about 36 million yuan.

The applications are received and processed by the Department of Mathematical and Physical Sciences.