

## II. Key Program

NSFC's Key Program projects mainly support in-depth, systematic and innovative researches that are integrated with the national demand and the frontier areas of international research, in key areas which have good research basis and accumulations or there are new growth points of research disciplines. As a principle, Key Program projects should have limited objectives, limited research scope and clear goals, pay attention to the intercrossing of disciplines and make full use of the existing major scientific research bases. In general, one project can only be undertaken by one institution. Collaborators are allowed only if absolutely necessary, with the limitation of no more than two. Research length is usually 4 years (unless specified otherwise). In the *Guide to Program*, Key Program projects are introduced by each department, including research areas, application requirements and special notifications. Applicants are also asked to read the foreword and the beginning section of General Program description in each department for the overall introduction and funding policies.

### Department of Mathematical and Physical Sciences

Key Program projects are introduced in sections of each scientific division, including notification and requirements. When applying for Key Program projects listed as key reviewed projects at the panel review meetings, applicants should give oral presentation at panel review meetings.

In the Eleventh Five-Year Plan period, in order to encourage competition, promote the generation of projects with innovative ideas, the Department will announce more project areas than projects and research directions to be funded, and let the research directions guide applicants to choose research topics. Key Program projects are determined mainly based on the funding priority areas proposed in the study report of disciplinary strategic development in the Eleventh Five-Year Plan period, so as to plan the overall development of disciplines.

In 2006, the divisions of mathematics and physics II will announce topics and research contents, and the divisions of mechanics, astronomy and physics I will specify research areas and let applicants to choose their own research topics and contents.

In 2006, the Department plans to fund about 38 Key Program projects with a total funding of 68 million. Details are given in sections of each division. Please note that according to the management regulations of Key Program projects, the number of research units applying

for the same Key Program project cannot exceed 3.

## **Division of Mathematics**

In 2006, 8 Key Program projects are to be funded with an average funding of 1.3 million yuan per project.

### **1. Representation theory of group and algebra**

Research contents:

- 1) Representation theory of finite modules, algebraic group representation theory and associative algebra representation theory, and modern derivative domain theory;
- 2) Using Hall algebra as a bridge to investigate the deep relationship of Quiver representation and trigonometry category with quantum group and Lie theory, to develop effective models of geometric representation, to investigate the representation of algebraic group, quantum group and relevant finite dimensional algebra, and to further enrich the Kazhdan-Luszig theory.

### **2. Manifold topology**

Research contents:

- 1) Effective algorithm of computing homological ring and Chow ring related to Lie group and homogeneous space;
- 2) Computation of stable homotopy groups, cobordant theory and K-theory;
- 3) Hyperbolic structure of 3-manifold, knot invariant theory and incompressible surfaces and related problems.

### **3. Studies on several problems in the renormalization theory of homomorphic mapping**

Research contents:

- 1) Characteristics description and parametric expression of renormalization transformation of homomorphic mapping;
- 2) Dynamics of transformation of integer function and algebraic renormalization;
- 3) Ergodic theory of homomorphic mapping;
- 4) Methods and relevant problems in dynamical systems of integer function theory.

### **4. Nonlinear elliptic and nonlinear parabolic equations**

Research contents:

- 1) Qualitative theory of nonlinear elliptic and nonlinear parabolic equation(s);
- 2) Analysis of “blow up” phenomenon and singular sets;
- 3) Nonlinear elliptic and nonlinear parabolic equation and relevant couple equations in

natural sciences, engineering and social sciences.

### **5. Geometric invariants in string theory**

Research contents:

- 1) Mirror image symmetry hypothesis;
- 2) Homological relation of quantum on K-equivalent algebraic manifold;
- 3) String Orbifold theory;
- 4) Relative Gromov-Witten invariant;
- 5) Localization techniques;
- 6) Open string and gauge field theory.

### **6. Bioinformatics and optimal methods**

Research contents:

- 1) Problems in genetic engineering;
- 2) Prediction of protein structure and molecular connection;
- 3) Biological objects at system level;
- 4) Relevant problems of bio-information processing.

### **7. Several frontier problems in fractal geometry**

Research contents:

- 1) Basic structures of fractals;
- 2) Analysis of repeated fractals;
- 3) Partial differential equations of fractals;
- 4) Some problems related to the application.

### **8. Mathematical theory, algorithm and application of self-adaptive processing of non-equilibrium signals**

Research contents:

- 1) Convergence and complexity of self adaptive empirical module decomposition of signals, and two dimensional generalization and related theory, algorithm and application;
- 2) Nature of inner module function and its relation with Hilbert transformation;
- 3) Time frequency distribution: mathematical foundation of Hilbert spectrum and its application;
- 4) Intrinsic relation between empirical module decomposition and multi-scale analysis.

### **9. Linear and nonlinear numerical algebraic problems in scientific computation**

Research contents:

- 1) Efficient algorithm and solutions for linear and nonlinear equations;

- 2) Numerical solution of inverse algebraic eigen values;
- 3) High precision algorithm of higher order algebraic equations;
- 4) Numerical methods of nonlinear least square problems;
- 5) Numerical methods for eigen values of structural matrices.

## **Division of Mechanics**

Applicants can propose freely project titles, research contents, plans and funding in the following research areas. In 2006, 8 to 11 projects in the Key Program will be supported with an average funding of 2 million yuan per project.

1. Dynamical, vibration and control problems in major equipment;
2. Experimental studies on nonlinear dynamic properties of mechanical systems;
3. Multi-scale mechanical behavior and across scale relation of materials;
4. Mechanical problems of intelligent materials and structure and multi-field coupling effects;
5. Mechanical behavior of material and structure under abnormal environment;
6. Dynamical mechanical behavior and penetration resistant mechanism of materials;
7. New concept and new methods of turbulent structures;
8. Flow properties and mechanism of hypersonic cavity objects;
9. Ultra high temperature gas flows;
10. Dynamic models of abnormal particle multiphase flows;
11. Biomechanical studies related to the cause and cures of human diseases;
12. New theory and new methods of computational mechanics;
13. New methods and new techniques of experimental mechanics.

## **Division of Astronomy**

Key Program projects in the Division of Astronomy are based on the priority areas proposed for the Eleventh Five-Year Plan period. Applicants may choose freely the project titles, research contents, plans and funding according to key scientific problems to be funded. Priority areas might change each year mainly depending on the distribution of Key Program project areas that have been funded. In 2006, the Division defines the following 3 areas, and plans to fund 3 to 5 projects with an average funding of 2 million yuan per project.

### **1. Galactic cosmology**

Key scientific problems include:

- 1) Measurement of cosmological parameters, in particular, physical properties of dark matters, equation of state of dark energy and content, distribution, composition and properties of dark matter and dark energy, and observable phenomenon of residuals from early cosmic evolution;
- 2) Formation of various celestial bodies and structures in the universe, key physical process

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- of formation of structures;
- 3) Formation and evolution of galaxies, relation between the growth of super large mass black holes and the formation of stars in the host galaxy, especially the feedback process and its effects;
  - 4) Radiation, structure and evolution of active nucleus of galaxy.

### **2. Formation, evolution and eruption of stars**

Key scientific problems include:

- 1) Formation and early evolution of stars, especially the observation and theoretical studies on the formation of large mass stars and large scale formation of stars in galaxy;
- 2) Star structure and evolution and star atmosphere, late evolution of stars and compact celestial bodies and relevant high energy phenomenon;
- 3) Structure and evolution of the Galaxy and the observation and theory of formation, evolution of outer planets in solar system.

### **3. Astrometry and celestial mechanics**

Key scientific problems include:

- 1) Theory and methods of astrometry and celestial mechanical development and the study of multi-band astronomical reference frame;
- 2) Planet and star system dynamics, including the structure and dynamic process in planet;
- 3) Natural and artificial celestial dynamics of the solar system;
- 4) Application of astronomy and astrometry in the study of the Galaxy;
- 5) Astrogeodynamics.

## **Division I of Physics**

Key Program projects in the Division I of Physics are based on the priority areas proposed for the Eleventh Five-Year Plan period. Each year only part of them will be announced depending on the disciplinary development, distribution of Key Program project areas that have been funded before and budget available. In 2006, the Division plans to fund 8 to 11 projects, with an average funding of 2 million yuan per project. Applicants may propose directly project titles and specific research contents according to the areas to be funded.

### **1. Quantum transport phenomenon, self spin quantum phenomenon, super fine spectrum and interference optical properties of confined quantum systems**

#### **2. Physics of new functional materials**

- 1) Physical properties of new artificial microstructure materials doped with Mott insulator and wide gap semiconductor materials;
- 2) Physics of efficient luminescent and photoelectric conversion materials;

- 3) Physical properties of new magnetic functional materials and their heterogeneous structures;
- 4) Physical properties of organic solid and organic/inorganic hybrid materials.

### **3. Novel phenomena in relevant electronic systems**

- 1) Superconductivity mechanism of non-conventional superconductors and physical abnormality at normal state;
- 2) Special physical properties of strong relevant electronic systems, metal/insulator conversion and quantum phase change;
- 3) New physical problems in 2-D interactive electronic systems.

### **4. Physical properties of soft matter systems**

- 1) Physical properties and laws of micro fluid flow;
- 2) Physical properties of particulate matter;
- 3) Nonlinear physical phenomena in complex system and exploration on physical laws.

### **5. Computation and simulation of matter structures and properties**

- 1) Computational design and prediction of physical properties of new functional materials;
- 2) Computer simulation of properties of matter structures in complex systems and at extreme conditions;
- 3) New methods of material design and prediction of physical properties.

### **6. Cold atomic and molecular physics and applications**

- 1) Physical properties of cold atomic and molecular systems;
- 2) Interaction of light and cold atoms and molecules and its applications;
- 3) Atomic optics and atomic interference;
- 4) Micro cavity quantum electrodynamics.

### **7. Complex interactions in atomic and molecular systems**

- 1) Atomic and molecular properties under special environments (high temperature, dense and strong fields, etc.) and collision dynamics;
- 2) Relevance effect, super excitation state and quantum multi-body procedure control in molecules;
- 3) Physical properties and dynamics of size related clusters.

### **8. Generation, propagation and control of noise**

- 1) Noise and vibration control theory in fluid-solid coupled systems;

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- 2) Theory and methods of active control of structure sound;
- 3) Intelligent acoustic materials, low frequency sound wave absorption and isolation;
- 4) Theoretical models and computational methods of fluid dynamic noise;
- 5) Prediction models of environmental noise field.

### **9. Principle of high precision physical measurement technology and key equipment**

- 1) Principle of high spatial and temporal resolution, high sensitivity characterization technology and development of key equipment;
- 2) Measurement and control of single atom and molecule.

## **Division II of Physics**

In 2006, the Division plans to fund 8 to 10 projects, with an average funding of 1.9 million yuan per project. The following are titles and research contents of Key Program projects proposed.

### **1. Complex system dynamics based on complex network and studies on statistic behaviors**

Research contents:

- 1) Micro description of transport dynamics on technical network such as the Internet; quantitative description and increase strategy for network information transmission capability; optimal design of network structure and efficient management, strategy for disaster resistance and attack resistance of network systems;
- 2) Network cascade dynamic model, study network overall topological structure and effect of grid local dynamical cascade behavior, various synchronization behavior of network and control strategy of network synchronization performance;
- 3) Taking reproducing statistical characteristics of real complex system as an object, it is to propose complex system model with network structure, including biological network model, earthquake model, economic statistic model, self-organization evolution model of complex adaptive system, and dynamics and statistical physics of synergic, gaming and coexistent behavior of these complex network models.

### **2. TeV energy zone physics**

Research contents:

- 1) In-depth exploration on ways of discovering Higgs particle, super symmetry and super symmetrical particles on high energy collider, and their properties;
- 2) Other new physics models beyond the standard models;
- 3) Exploration and validation of new physical models by using the experiments to measure accurately the properties of top quark;

- 4) Computation and precision measurements of higher order radiation correction in standard models;
- 5) Proposing significant research topics for the experimentalists in China in cooperation with them.

### **3. Development of spectrum simulation system for the study of hadron physics on HIRFL-CSR**

Research contents:

- 1) Developing event generator related to hadron physics on HIRFL-CSR in Lanzhou, providing the cross-section of generation, momentum distribution and spatial distribution of final state particles in related physical processes;
- 2) Developing simulation system framework, standard and software platform;
- 3) Developing simulation software for each sub-detection systems, describing in detail the geometric structures of detectors in each part, material media, relations and transportation of particles;
- 4) Some main physical objectives in detectors and the optimization of detector design;
- 5) The relationship between physical signals and various background signals, and the analysis of the feasibility of main physical objectives using developed CSR simulation software system;
- 6) Simulation system software needed by the physical analysis of future experimental data.

### **4. Hard probe signal generated by quark matter and collective effect**

Research contents:

- 1) Interaction between molecules in high energy region and high temperature, high density quark matters;
- 2) Collective expansion property of quark matters;
- 3) Hadron theoretical models of quark matter.

### **5. Key physical and technological problems of ultra short pulse hard X-ray source based on Thompson scatterings**

Research contents:

- 1) Physical process of the interaction between ultra short and ultra strong laser beam and high luminescent electron beams;
- 2) Generation, transport and focusing properties of ultra short and ultra strong laser, including its stability and measurement repeatability;
- 3) Generation, acceleration, compression, transportation and property measurement of high luminescent ultra short electron beam;
- 4) Synchronization technology for experimental study of scattering interactions of electron beam and laser beam;
- 5) Theoretical prediction and experimental measurement of photon generation amount in Thompson scattering.

### **6. New methodologies for the detection of narcotics and explosives**

Research contents:

- 1) New principles and methods of detecting drugs and explosives;
- 2) High performance X-ray detection method, high speed 3-D imaging technology and analysis technology for dangerous materials;
- 3) New scattering detection methods, using low energy, small dosage X-ray detecting narcotics and explosives hidden in human bodies;
- 4) Development of fast and accurate narcotic and explosive detection systems.

### **7. Theoretical and experimental studies on the effect of spatial electric charges in hadron accelerator**

Research contents:

Using domestic experimental facilities, according to the specific situation of high-density proton accelerator in construction, it is to conduct theoretical and experimental studies on the methods to increase beam density, such as spatial electric charge effect resulting from linear and nonlinear increase of beam emission rate and particle loss mechanism, etc., and ways to overcome such effects.

- 1) Generation, neutralization and injection technology of high luminescent, direct current and continuous wave negative hydrogen beams;
- 2) Spatial electric charge effect and beam loss mechanism in high density linear accelerator and beam transportation;
- 3) Comprehensive experimental techniques in the central region of high density cyclic accelerator and high frequency instability problems caused by high beam flow loading and high frequency digital control technologies;
- 4) Spatial electric charge effect in high-density synchrotron and beam loss control in injection, high frequency capture and acceleration process of beams.

### **8. Time resolution technique of synchrotron radiation and its applications**

Research contents:

- 1) Synchrotron radiation pump-probe temporal resolution experimental techniques, key techniques including the synchronization and delay techniques of laser pulse and synchrotron radiation pulse, fast optical switch and fast spectrum reading techniques;
- 2) Experimental methods of synchrotron radiation temporal resolution, achieving high temporal resolution (micro second to nano second) refraction, scattering or spectroscopic application in experiments;
- 3) Validation of technologies and methods of temporal resolution experiments in real application.

**9. Interaction of low pressure, multi-frequency plasma and material surface**

Research contents:

- 1) Mechanism of generating low pressure plasma using multi-frequency, multi-electrode excitation discharge, and the effect of frequency coupling on the generation, confinement and transport of plasmas;
- 2) Experimental measurement and numerical simulation of matching the effect of different frequencies and power, and regulation behavior by energy and angles of ions hitting on chip surface;
- 3) Physical models of interaction between the discharge plasma and chip surface in providing scientific basis for the optimization of parameters in plasma etching and synthetic membrane materials.

**10. Physical properties of fast Z pinch plasma**

Research contents:

- 1) Development of theoretical models for the generation and development of filament loading fast Z pinch implosion plasma and X-ray radiation process, and related computer programs of numerical simulation;
- 2) Experimental studies on the physical process and radiation characteristics of formation, implosion and instability of single and double filament fast Z pinch plasmas, and matching conditions for pulse power driver and loading;
- 3) Advanced diagnosis techniques of X-ray background and X-ray characteristic spectrum tracer, exploring diagnosis techniques using fusion neutron diagnosis and plasma temperature, etc.;
- 4) Development of loading preparation techniques for fast Z pinch experimental studies, such as super fine and uniform metal filament loading, deuterate polymer fiber loading, etc.

**Interdisciplinary Key Program Projects****1. Super fast and super strong optical physics (with the Department of Information Sciences)**

- 1) Generation of atto second laser and ultra fast phenomena;
- 2) Optical physics of relativistic strong filed;
- 3) Extremely nonlinear optical phenomena of ultra short pulse;
- 4) Transport of ultra fast and ultra strong laser in media.

**2. Micro-nano scale photonics (with the Department of Information Sciences)**

- 1) New photon crystals and its integration and quasi phase matching;
- 2) Light transmission and control beyond refraction limit;

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- 3) Phenomena of cavity quantum electro dynamics in photon crystals;
- 4) Surface plasma excimer physics.

### **3. Quantum information physics (with the Department of Information Sciences)**

- 1) Physical problems on quantum information storage, transport, cloning, identification and measurement;
- 2) Physical realization of quantum bit, quantum entangle generation and measurement, principles and methods of quantum relay;
- 3) New principles and new methods of quantum computation.

### **4. New acoustic energy exchanger and arrays (with the Department of Information Sciences)**

- 1) Acoustic energy exchanger array and modeling of acoustic fields;
- 2) New acoustic energy exchange materials and wide band, high sensitivity and large power acoustic energy exchanger;
- 3) Acoustic sensor such as MEMS and optical fiber;
- 4) Acoustic surface wave transducer measuring physical, chemical and biological quantities;
- 5) Energy exchange mechanism and technology for non-contact acoustic detection (electro magnetic ultra sound, laser ultra sound and electronic ultra sound).

## **Department of Chemical Sciences**

During the Tenth Five-Year Plan period, there has been a major increase both in the number and funds of Key Program projects. From 2001 to 2005, 122 key Program projects were funded (not including those in the Major Research Plan). In 2006, the Department will publish guides and accept proposals in 40 research areas, and will support about 36 research areas from them based on competition. The funds for the following Key Program projects are in the range of 1.2 to 2.4 million yuan per project, while the actual amount will be determined according to the specific conditions. The duration of each project is generally four years unless stated otherwise.

### **Division I of Chemical Science**

1. Metal-organic molecular functional materials;
2. Synthesis and performance of inorganic solid materials with complex mixed-valence;
3. Chemical basis of homogeneous preparing oxide-base functional materials;
4. Research on molecular magnetic materials;
5. Coordinated chemistry or inorganic solid chemistry freely proposed by the applicants;
6. Methodologies of system separation and determination of complex samples;
7. New methods of multi-dimension, multi-scale and multi-parameter analysis and

- measurement;
8. New methods and techniques in the omics analysis;
  9. Analytical methods and techniques orientated to the national security and human health.

## **Division II of Chemical Science**

1. Catalytic reaction of chiral organic small molecules;
2. Organic synthesis methodologies on the basis of chemical bond activated;
3. Acting mechanism and environment behavior of new type pesticides;
4. Some new methods of chiral supported catalysts;
5. Whole synthesis of several oceanic natural products with biological activity;
6. Design, synthesis and property of novel organic conjugated molecules;
7. Reaction chemistry of organic compounds involved rare earth metals;
8. Synthesis and acting mechanism of cyclopeptides compounds;

## **Division III of Chemical Science**

1. Theoretical research on molecular recognizing mechanism and of transfer processes of protons and energy in the biological systems;
2. New type of host-guest complex materials with mesopore as well as the regulation and control of their heterogeneous catalytic properties;
3. Basic research on non-zeolites solid-acid catalysts with high-performance;
4. Tectonic rules of ordered combiner of amphipathic molecules as well as their application in related areas of life sciences;
5. Super-fast kinetics of chemical reaction in non-adiabatic process as well as its theory;
6. Basic research of preparing hydrogen gas using imitative enzyme by solar energy;
7. Fundamental studies of electrochemical super-capacitor with high specific energy and related with it;
8. Molecular regulating mechanism of shift of energy and electrons in the photosynthetic bio-systems;
9. Chemical thermodynamics of equilibrium state or non-equilibrium state in the complex systems.

## **Division IV of Chemical Science**

1. Functional shell-type polymers;
2. Synthesis of new alkyne polymers as well as their structures and properties;
3. Motion, conformational switching and mechanism of polymer chains in the pre-crystallization;
4. Basic issues of CO<sub>2</sub> copolymers;
5. Design and adsorption mechanism of functional polymers with high-selective adsorbed and separated bioactive substances;

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6. Environmental behavior and interfacing reaction of air particles and the effect to health;
7. Shift and conversion rules of persistent toxic organic pollutants in soils and their influence to underground water;
8. Biochemical reaction of rare-earth elements and their intervention to chemical processes in cells.

### **Division V of Chemical Science**

1. Science and engineering foundation of key technologies in the areas of biological and medical engineering;
2. Key chemical engineering basis on high effective clean utilization of fossil energies and control of their green gases emission;
3. New theories and technologies of the reinforcement and integration of processes;
4. Scientific and technical bases of green and environmental chemical engineering;
5. Chemical engineering basis on the preparation and application of advanced functional materials;
6. Basic problems of chemical engineering in the development of renewable resources and the cyclic utilization of resources.

## **Department of Life Sciences**

The Key Program is an important component in the funding structure of NSFC. Aiming at problems in the project selection and application processes in the past, such as long period of project planning, limited research scope, insufficient linkage with other projects supported by NSFC, the Department has tried a model of combining conditional free applications (FA) with application in designated areas (DA) for the last 3 years, and based on this background and considering the different characters of each division, the Department adjusts properly the Key Program supporting plan in 2006 in the applications of DA and FA, and there are 6 divisions which only receive applications of DA and do not receive the “conditional” FA. Applicants should read the support plan of each division in 2006 listed below carefully and in detail, and correctly fill in the corresponding application code lined out in each division when applying. They will not be evaluated unless the applications of Key Program projects follow the funding plan published in the *Guide to Program*. The application requirements for DA and FA Key Program projects to be noticed are listed below:

### **1. Key Program projects in designated areas**

For designated areas, applicants should propose research titles and compose application texts in reference to the guidelines issued by the Department in 2006. In the column of “Annotations” on the basic information table of the application form, applicants should write down applied research areas.

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## 2. Key Program projects for conditional Free Application (FA)

Applicants who have achieved great progress, such as new discoveries, new theoretical hypotheses and new techniques and methods with important scientific significance, and need intensive support to further the research, can apply directly for (Conditional Free Application) Key Program projects. Applicants for this category should specify with “Free Application Key Program Projects” in the column of “Annotations”. Moreover, a statement with about 800 words on the important innovative progresses achieved is required in addition to the routine application text for free applications. On this statement, the applicant should elaborate the concrete content of the important innovative progress; important result concerning the progress achieved and papers published in international academic periodicals, by providing the details of author’s name, paper titles, publication dates, publication’s issuing number, page number, etc. For papers representing the “achieved important progress” of the application, they must be published in recent years, and the applicants must be the first author or corresponding author.

**3. Applicants for Key Program projects** (including applications in reference to designated areas and conditional free applications) are required to annex the first pages of five representative papers attached to the application texts.

In view of the problems existing in the previous applications for Key Program projects, the Department particularly reminds the applicants in 2006 to avoid any cases listed below. Otherwise, the proposals will be rejected in the format examination:

- 1) Application which does not specify the research area or “free application” in the column of “Annotations” of the basic information table in the application text;
- 2) For Free Application Key Program, the applicant does not provide the statement with about 800 words of the achieved important innovative progress;
- 3) In case of the Free Application Key Program, the applicant cannot provide enough materials to prove that important progress has been achieved, or the papers are not recent publications, or the applicant is not the first author or corresponding author;
- 4) Applications with research contents overlapping obviously with that of the projects already funded by the National “973” Plan, “863” Plan, or NSFC Major Program and Key Program.
- 5) To apply free application Key Program projects on the subjects which do not accept conditional FA in 2006 (such as agricultural science, animal husbandry, veterinary science and aquatic science, preventive medicine, basic clinical medicine I and II, traditional Chinese medicine, and Chinese materia medica).
- 6) Applicants who are working abroad and could not put most of his/her time and energy to work in China.

In addition, in view of the problems existing in the previous applications and examination, the applicants should pay attention to the following details when composing their application texts:

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- 1) In the column of resume, detailed information concerning the applicant and members of the group is needed, such as employment, education, projects funded before, results of fulfillment and related papers. Papers published and in press should be listed separately. As for the papers published, it is necessary to list all the authors, titles of the papers, publication dates, periodical numbers and page numbers, and books, abstracts of papers and conference papers should also be listed separately.
- 2) The applicant is required to explicitly present the earlier groundwork related to this application, the experimental evidences for the new suppositions and new hypothesis, and papers published. As for those who have not yet published papers, they are required to present the related experimental data, such as photos, paradigms and so on.
- 3) The research plan, technological processes and methods in the application texts are import items for experts to evaluate the feasibility of the project. Therefore, the applicant should present an application text with a precise experiment plan and correct technological route to avoid curtness and vague by all means. It is suggested that there should be one scheme in reserve in case of some key technique scheme failed. Such scheme will be also reviewed.
- 4) The applicant applying for projects which have already been funded by the National “973” and “863” Plans and NSFC Key Program or Major Program should present the differences between them in the application text.
- 5) Concerning proposals touching upon medical ethnics, the applicant should give the certification of ethic committee from his/her host institution or college, or from the superior administration. As for the research using genetically modified organisms, the proposal should give its source, and if it needs donation from other laboratory, the certification from the laboratory is needed.
- 6) For the application concerning international cooperation or team members sojourning abroad, it should offer the agreement or protocol for the international cooperation, or the affirming certificate by the members sojourning abroad.

For such applications which do not meet the demand of filling in proposals, or do not offer materials needed, the Department will not fund them.

In 2006, the Department will allocate 110 million yuan to support about 76 Key Program projects, of which 46 are DA projects and 30 are conditional FA projects. The average funding will be not lower than 1 million yuan per project. So the applicants should offer reasonable budget clearly according to the real necessity of study. Moreover, the duration of Key Program projects is 4 years in general.

The supporting plan and designated areas for Key Program in each division in the Department of Life Sciences in 2006 are as follows:

### **1. Microbiology (4 projects)**

Designated area: Basic research relating to important pathogenicity bacteria (2 projects).  
Free applications: 2 projects.

**2. Botany (4 projects)**

Only free applications are accepted.

**3. Ecology (3 projects)**

Designated area: Bio-rehabilitate mechanisms of damaged ecosystem (2 projects).

Free application: 1 project.

**4. Forest science (3 projects)**

Designated area: Basic research of forest development (1 project).

Free application: 2 projects.

**5. Biochemistry, biophysics and molecular biology (5 projects)**

Only free applications are accepted.

**6. Genetics and development biology (4 projects)**

Designated area: Non-coding RNA and its function (2 projects).

Free application: 2 projects.

**7. Cell biology (4 projects)**

Designated area: Molecular mechanism study of cell movement (2 projects).

Free application: 2 projects.

**8. Immunology (4 projects)**

Designated area: Basic research of immune tolerance (2 projects).

Free application: 2 projects.

**9. Neuroscience and psychology (4 projects)**

Designated area: Mechanisms study of cognizance (2 projects).

Free application: 2 projects.

**10. Biomedical engineering (3 projects)**

Designated area: Theory and methods of acquiring and resolving biomedical information (2 projects).

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Free application: 2 projects.

### **11. Agricultural science (4 projects)**

Designated area:

- 1) Mining of excellent gene resources and research of important properties of “small crops” (other food crops except rice, wheat and maize) (2 projects);
- 2) Basic research of crop products safety (2 projects).

### **12. Animal husbandry and veterinary science and aquatic science**

Designated area:

- 1) Mechanisms of zoonose infect and spread crossing species between human and animals or between animals (2 projects);
- 2) Basic research of important breeding freshwater fish resources (2 projects).

### **13. Zoology (4 projects)**

Designated area: Cell and molecular basis for the development of animal procreate and development (2 projects).

Free application: 2 projects.

### **14. Physiology and pathology (6 projects)**

Designated area: Pathogenesis of relating diseases of non-infectious inflammation (3 projects).

Free application: 3 projects.

### **15. Preventive medicine (4 projects)**

Designated area:

- 1) Mechanisms of damage caused by environmental chemical pollutants (2 projects).
- 2) Pathogenesis and pathogeny of chief endemics (2 projects).

### **16. Basic clinical medicine I**

Designated area:

- 1) Collection of important disease pedigree and related basic research (2 projects).
- 2) Basic research on the occurrence and prevention of defects of vision system and common diseases (2 projects).

### **17. Basic clinical medicine II**

Designated area:

- 1) Basic research of early diagnosis of malignancy (2 projects).
- 2) Basic research on the occurrence and prevention of important oral diseases (2 projects).

### **18. Materia medica and pharmacology (4 projects)**

Designated area: Basic research of drug resistance (2 projects).

Free application: 2 projects.

### **19. Traditional Chinese medicine and Chinese materia medica (4 projects)**

Designated area:

- 1) Mechanisms of special connection between acupoint and the target organs (2 projects).
- 2) Pharmacodynamics of truly curative effect Chinese traditional medicine including compound (2 projects).

## **Department of Earth Sciences**

Key program projects, funded through open competition under the *Guide to Programs*, are an important part of the funding system of NSFC. Since 2002, the Department of Earth Sciences announces guidelines of Key Program projects according to the major issues in the priority funding areas. In addition to these guidelines, applications can be submitted for Key Program projects if they are related to key issues in scientific frontiers and have made important progress in the previous projects.

Within the following specified areas, applicants are free to determine the research topics, goals, technical approaches and funds needed on the basis of summarizing research work carried out both domestically and internationally and stating clearly the new breakthrough points and ways for the research.

In each proposal, applicants must state in detail their previous research work related to the applied project. Applicants must also provide their résumé and co-PIs, as well as their former projects granted by NSFC and the main results and publications.

In the proposal sheet, applicants need to fill in the relevant area in “Annotations”, and address key issues and contributions to the area. To avoid duplication in funding, applicants should state clearly the relations and differences of the research with related projects funded by other agencies. Besides Chinese, English version of the application is encouraged.

An annual workshop will be held with the participation of principal scientists for each

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research area in order to strengthen the communication and exchange of academic ideas and information, and to promote the formation of new research groups and integration of multidisciplines. Expenses for this meeting should be included in the budget of the application. For the realization of the overall scientific goals and the integration of multidisciplines, principal investigators should obey the corresponding stipulations on data and research materials.

Interdisciplinary researches have become the fertilizers for innovative ideas and original innovation. It is expected that scientists from various disciplines of earth sciences, and scientists from other research areas such as mathematics, physics, chemistry, biology, materials and engineering sciences, information sciences and management sciences jointly submit applications for the Key Program projects of the Department. The code for interdisciplinary study should be filled in on the application form.

In 2006, the total budget for Key Program projects will be around 50 million yuan for 35 projects, 1.0 to 1.8 million yuan per project on average. The research period of a project will generally be 4 years.

### **1. Global change and the Earth system**

As environmental issues become an increasing concern, research on global changes has been an international scientific activity attracting extensive attention from the governments and public all over the world. The future research will lay stress on the global carbon circulation, water circulation, food system and environment health, etc., and will highlight the strategic layout of intercrossing between natural and social sciences and global and regional interaction in the research of global changes. The main idea is to take a number of global change sensitive areas in the Eastern Asia continent, ocean and polar region as research objectives, focus on carbon-nitrogen circulation, water circulation and monsoon environment evolution, to study the ocean-continent-atmosphere interaction and the mechanism of impact of human activities on regional environment change with the viewpoint of the earth system, to acquire ways and processes of response, interaction processes, dynamic mechanisms and its future trends, and to develop global change science system for providing a scientific basis for the national standpoint on water security, ecological security, food security and international conventions.

Key scientific issues to be emphatically studied are:

1. Geochemistry circulation of marine biology, ecosystem and biodiversity;
2. Impact and responses of Asian monsoon environment system on global changes;
3. Processes of environmental changes in plateau and polar areas and its relation with the environmental changes in East Asia;
4. Interaction between land and sea and environmental evolution in estuarine coastal areas;
5. Forecast of global and regional climate and environment.

About 3 to 5 proposals will be supported.

## **2. Environment and life processes on the Earth**

The Department emphasizes the support to research in intercrossing frontier areas between earth science and life science to explore basic scientific issues targeted at historical and modern environmental influence on the life processes, life-process feedback to the environment, and the coordination of the two elements. Research contents should highlight the logical combination of the earth environment and life process. The intercrossing and permeation in research contents and methods between earth science and other related subjects are strongly encouraged, and proposals from life science and other related disciplines are welcome.

Key scientific issues to be studied include:

- 1) Form, process and mechanism of bio-radiation and bio-extinction events and the origin of biodiversity;
- 2) Terrestrial life system, biological evolution and environment change in Mesozoic and Cenozoic eras;
- 3) Origin, body evolution and survival of paleoanthropology and Pleistocene environmental change;
- 4) Environmental biogeochemical circulation and ecological effect of chemical materials;
- 5) Ecological toxicology and regional risk of poisonous pollution materials.

About 4 to 6 proposals will be supported.

## **3. Physical dynamics of weather and climate system**

The general goal of this project is to understand various weathers and climatic spatial-temporal characteristics, laws underlying the change, interrelation and physical mechanism determined by the movement rule of coupling climate system of atmosphere-ocean-continent interaction, as well as the middle-level and high-level atmospheres and various physical, chemical and biological processes impacting on these processes in the underlying surface and boundary layer, and to conduct theoretical and predication research on the climate change and living environment change based on the models of ocean-continent-atmosphere interaction with high resolution and high precision. In order to realize the above-mentioned goals, new principles, methods and equipment on atmospheric sounding should be strengthened in a long period of time in the future, including the manufacture of new sensors and platforms, and the inversion and application of satellite and radar remote sensing.

Key scientific issues include:

- 1) Physical and chimerical processes of aerosols and trace gases in climate system;
- 2) The dynamic process of meso-scale severe weather system and forecasting theory and methods;
- 3) Stratospheric processes and interaction with troposphere as well as their climatic and environmental effects;
- 4) Observational and theoretical studies of the energy and mass exchange processes between

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ground surface and atmosphere.

About 3 to 5 proposals will be supported.

### **4. Continental dynamics**

The main research goal in the area of continental dynamics is by applying multidisciplinary methods to explore the geological, geophysical and geochemical features of the continent in China, to correlate the continent with adjacent areas in Asia and other parts of the world, to understand the three-dimensional structure of continental crust-mantle system in China, to reveal the main accretion and subduction processes of continental materials, and to establish the dynamic conceptual and quantification models for the Mesozoic-Cenozoic evolution of the East Asia continent in order to provide innovative prognostication and evaluation theories for resources exploration, hazard mitigation and environment protection.

The following studies are encouraged:

- 1) To obtain reliable data or to make significant discoveries in key scientific issues by applying comprehensively new technical means such as the precise field geological observation, geophysical exploration, high-precision qualitative examination of major geological events, geochemical tracing, etc.;
- 2) To analyze all kinds of geological, geophysical and geochemical data with new thoughts and to construct conceptual models of continental dynamics and to carry out numerical simulation;
- 3) To conduct effective international and regional cooperation, to encourage particularly comparative study with relevant countries concerning the scientific goals of the projects, and to participate energetically in international competition.

Key scientific issues to be studied include:

- 1) Continental lithospheric evolution and metallogenesis in East Asia;
- 2) Tectonic transition in East China and marginal sea during Cenozoic;
- 3) The recycling of the continental lithospheric materials and the accretion and breakdown of the continent;
- 4) Tectonic processes during Cenozoic and their environmental and hazardous effects.

About 4 to 6 proposals will be supported.

### **5. Regional sustainable development**

In the field of regional sustainable development, aiming at scientific issues which play important roles in the implementation of sustainable development strategy, integrated researches will be conducted to explore the models for social, economic and ecological sustainable development in typical regions and to provide scientific bases for the regional sustainable development by focusing on the theory and methodology of regional sustainable development and with a view to the harmony among the population, resources, environment

and development.

Key scientific issues to be studied include:

- 1) Assessing theory and method for regional sustainable development;
- 2) Constraint mechanism and development models of urbanization;
- 3) Urban landscape pattern and its ecological/environmental effects;
- 4) Spatial heterogeneity of regional resources and hazard risk, and its sustainable development;
- 5) Industrial transformation and its regional effects.

About 4 to 6 proposals will be supported.

## **6. Solar terrestrial space environment and space weather**

The general goals of research on solar terrestrial space environment and space weather are: 1) to form an integral theoretical framework of chain reaction process on the space climate and to achieve important innovative progress with high international impact based on the research of space weather processes at various scales of the solar terrestrial system; 2) to establish the cause effect model of space weather events in the solar terrestrial system and to develop comprehensive forecast methods based on the physical forecast; 3) to promote extensive intercrossing and interpenetration with other disciplines, especially with mathematics, physics, information science, materials science and life science, and to conduct studies of space weather effects on human activities in an attempt to provide a scientific basis for the protection and decision making by agencies concerned; 4) to develop new concepts and new methods on space weather probing, and to put forward new plans of series satellites for space weather purpose.

Key scientific issues to be studied include:

- 1) The driven sources of space weather;
- 2) Basic processes in space plasma such as magnetic reconnection, particle acceleration and wave-particle interaction;
- 3) The coupling of magnetosphere-ionosphere-upper atmosphere and its comprehensive observation;
- 4) The composite forecast models of space weather and its modeling;
- 5) New concepts, new principles and new methods of space weather survey.

About 3 to 4 proposals will be supported.

## **7. New principles and technology on the analysis of the earth system**

It has shown by the evolution history of geoscience that the development of high technology has created significant conditions for the breakthrough of major problems in geoscience. The progress of new detection and analysis technology is always the technical guarantee for the source of innovative ideas in geoscience. Therefore, in view of the major scientific

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issues confronted when researching and developing geoscience, the exploration of new theories, methods and technologies of the observation and analysis on the earth system must be further strengthened so as to provide new methodologies for the research of fundamental problems in geoscience.

Key scientific issues to be studied include:

- 1) New principle and technology of terrestrial detection;
- 2) Technology of integration of geospace, virtual reality and simulation;
- 3) New theory and detection of technology of the atmosphere, ocean and terrestrial surface layer;
- 4) New theory and new technology of deep earth detection;
- 5) New theory of high-precision measurement and analytical methodology.

About 3 to 5 proposals will be supported.

## **Department of Engineering and Materials Sciences**

In 2006, the Department plans to support 38 Key Program projects with a total funding of up to 70 million yuan, according to the strategic planning of the Department and the funds for Key Program in the Eleventh Five-Year Plan period.

### **Division I of Materials Science**

- 1) Intrinsic brittleness of ultra-high temperature intermetallic compounds as structural materials and their strengthening and toughening;
- 2) Advanced hydrogen-storage metallic materials and their hydrogen storage mechanism;
- 3) Phase diagram, thermodynamic model and alloying principles of magnesium based alloys;
- 4) Fundamentals in metastable metallic materials (free application area);
- 5) Key scientific problems in multifunctional composite (free application area).

About 4 to 5 projects from the above topics will be supported.

### **Division II of Materials Science**

- 1) Phase-diagram, materials processing and microstructure controlling for ultra-high temperature ceramics;
- 2) Fundamental issues related to silicon-based electro-luminescence materials;
- 3) Key fundamental issues in degradable bioactive ceramics or materials for the repair and regeneration of bony tissues;
- 4) Design principle, processing and applied research on nano-carbon materials for energy

- storage;
- 5) Key fundamental issues on inorganic non-metallic materials involved in proton-membrane fuel cells;
  - 6) Fundamental issues related to inorganic non-metallic meta-materials;
  - 7) Free applications in the field of inorganic non-metallic materials;

About 4 to 6 projects from the above topics will be supported.

- 8) Basic issues of the implementation of high performance of general polymer materials and special polymer materials;
- 9) Basic issues of polymer-based composites and hybrid polymer materials;
- 10) Functional materials: basic and applied basic researches on the controllable preparation of organic polymer materials with optic, electronic, magnetic, separate and absorbable properties;
- 11) Basic research of polymer materials related to life science;
- 12) Basic research on polymer materials related to environmental science, energy resource science and resource utilization science.

About 3 to 4 projects from the above topics will be supported.

## **Division I of Engineering Science**

- 1) Resource recycling and the re-utilization of metallurgical wastes;
- 2) Basic theories and its application on green mining;
- 3) Fundamental studies on improving recovery rate of petroleum in lower penetrating layers;
- 4) Intellectualized materials preparation and forming techniques;
- 5) Control theories and techniques on ultra-fine microstructure of powder metallurgy materials;
- 6) Theory and principles of novel metallurgical reactor.

About 3 to 4 projects from the above topics will be supported.

## **Division II of Engineering Science**

- 1) Theories, methods and technological research on electromechanical facility innovation design based on resource saving;
- 2) Basic research on advanced near forming manufacturing technology with energy-saving and high efficiency;
- 3) Theories and methods of modeling simulation, running optimization and intelligent maintenance of complex mechanical system;
- 4) Basic research on micro special processing and micro facility manufacturing technology with self-innovation;

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- 5) Early damage, fracture and failure mechanisms of significant mechanical structure, theories, technologies and method research on safety running and postpone lifetime of mechanical system;
- 6) New principles and technology research on large size precise measurement on field;
- 7) Research on new principles of mechanical bionics, design theories and manufacturing methods of bio-simulation mechanics.

About 5 to 6 projects from the above topics will be supported.

### **Division III of Engineering Science**

- 1) Research on multi-dimension transport phenomenon and transport mechanism;
- 2) Research on non-equilibrium fluid thermophysical properties;
- 3) Research on diesel-engine combustion theory and combustion control;
- 4) Research on supersonic combustion and flow;
- 5) New methods and new techniques of measurement in complicated fields of thermophysical properties.
- 6) Free application of Key Program projects concerning renewable energy utilization in the field of engineering thermophysics.

About 4 to 5 projects from the above topics will be supported.

### **Division IV of Engineering Science**

- 1) Regional energy efficient buildings for residence;
- 2) Base research on the technology of water quality transform and security insurance in urban water-cycle process;
- 3) Base research on the disaster prevention of power transmission tower-line complex structure system;
- 4) Base research on the security of large-scale building for explode-resistance;
- 5) Free application in the field of “New space structure system” by the Division;
- 6) Free application in the field of “Urban transport system planning” by the Division.

About 4 to 5 projects from the above topics will be supported.

### **Division V of Engineering Science**

- 1) Marine soil's characteristics and its engineering deformation;
- 2) Characteristics and control of agro-chemical transportation and transformation in irrigation;
- 3) Deepwater mooring system of ocean engineering;
- 4) Basic research on high-performance electric actuators based on new functional materials;

- 5) Basic research on new electrical approach and mechanism for cancer treatment;
- 6) Key issues on fast discharge and load directly driven pulsed power technology;
- 7) Key issues on medium and/or high power, high-speed motor/generator systems.

About 2 to 3 projects from the above topics will be supported.

## Department of Information Sciences

The Department of Information Sciences will fund 26 Key Program projects (including interdepartmental projects to be received by the Department) in 2006. The average funding is about 1.8 million yuan per project. The actual funding for each project may vary according to the contents and objectives of the projects. Only research areas of the Key Program are given in the *Guide to Programs*, and research objectives and contents are to be determined by applicants.

### Division I of Information Science

- 1. Theory and technology of end-to-end reconfiguration in hetero wireless networks**
- 2. Basic theory and experimental platform for application of video signal processing in network environment**

Fast development of and close linkage between digital broadcast and television network, the Internet and wireless mobile network require video signal to be transmitted in multiple networks. Compression of video signal must be converted with high transparency according to the characteristics of network, and achieve best visual quality at the same frequency bandwidth. This project aims at studying video processing platform for hetero environment, and exploring natural characteristics of sensing high compression ratio by human eyes, and realizing intelligent coordination of video processing adapted to the network and physiology factors.

Main research contents:

- 1) Multi scale adaptive structures;
- 2) Optimization of gradually increased rate distortion;
- 3) Video processing technology based on active vision;
- 4) Perception based video encoding.

- 3. Theory and key technologies for the identification and analysis of high dimensional information**

Identification of higher dimensional information (i.e., image and video) is crucial to national security and public safety. This project aims at developing the theory, algorithm and key

technologies for dimensional compression for identification purposes, addressing the major national needs such as financial safety, security monitoring, etc., and developing relevant prototype verification systems.

### **4. Key technology and experimental platform for optical packet switching**

In accordance with the development of optical switching technologies and addressing the needs of next generation network services, this project emphasizes on studying optical packet switching technologies, exploring optical signal packet switching, optical marker processing, key theories and cutting edge technologies such as optical switch function for packet broadcast and net work intelligent management, and developing experimental verification and demonstration platform.

Main research contents:

- 1) Optical packet switching technology based on optical marker or new total optical packet switching technology;
- 2) Control of optical packet switching in network;
- 3) Optical switching element technology for group broadcasting;
- 4) Integrating requirements on quality optical switching network services on existing network, video media and storage regional network, develop practical prototype of typical optical packet switching network.

### **5. Theory and key technologies of real time passive millimeter wave imaging**

Passive millimeter wave imaging detection technology can work in all weather conditions and around the clock as well as penetrating non-metallic materials of certain thickness, so it has wide range of application in anti-terrorist, scenario monitoring and military intelligence. This project aims at studying the basic theory of millimeter wave radiometer focal plane array passive imaging, imaging algorithm and prototype system, so as to provide theoretical and technical support for research in the areas of millimeter wave passive real-time imaging technology.

Main research contents:

- 1) Theory and key technology of detection based on millimeter wave radiometer passive real-time imaging;
- 2) Theory and key technology of millimeter focal plane array reception and real-time imaging;
- 3) Theory and technology of radiometer imaging high resolution signal processing;
- 4) Radiation property of millimeter wave band of environment and targets.

### **6. Electromagnetic field theory and key technology of radio frequency system-in-package**

Fast development of wireless communication services requires small scale, low energy

consumption and high reliability systems. Theory and key technologies of multi-functional integrated radio frequency (RF) system-in-package (SIP), hence become hot spots in research. This project aims at providing theoretical and technical bases of system design and integration technology for radio frequency system-in-package.

Research contents involve multilayer stacking 3-D passive RF SIP element and precision modeling and parameter acquisition through connection wire; techniques of optimizing configuration and structure of connection wires to reduce RF SIP electro magnetic loss, parasitic parameter effect and electromagnetic noise, etc., the development of new EDA design methods of reducing power loss of connection wire; the study of high accuracy, high efficiency 3-D electromagnetic emulation technology and system design and integration technology; RF SIP prototype unit, and relevant theory and key technology.

## **Division II of Information Science**

### **1. System structure of highly effective parallel computer**

It is to develop new parallel computation model and storage model, design balanced consumption, and increase practical effective performance of large scale parallel computation systems in order to meet the demand of high end applications.

Main research contents include:

- 1) Re-configurable high performance computation grid system structure;
- 2) Highly effective storage system structure;
- 3) Scalable technology for large scale system;
- 4) Low power consumption design technology for large scale system;
- 5) Efficiency evaluation models and methods.

### **2. Credible mobile internet theory and application**

It is to develop theories and methods to describe effectively credible mobile internet system structure with the consideration of grid node resources, homogeneous and heterogeneous node movement behavior, to develop routing theory and protocol algorithm for mobile Internet with the consideration of the viability, scalability and security of credible network, and to study the packet broadcast protocol and algorithm in new environment in order to meet the need of next generation Internet.

Main research contents include:

- 1) Theory, protocol and algorithm of credible mobile internet routing protocols;
- 2) Packet broadcast theory and algorithm in credible internet;
- 3) Viability, scalability and security mechanism of credible internet;
- 4) Develop preliminary prototype system of credible mobile internet applications.

### **3. Key technology and evaluation methods for the safety of digital media content**

With the application of digital media as objective, this project will study methods and key technologies for the copyright protection, authentication and safety evaluation of digital media.

Main research contents include:

- 1) Encryption, authentication and digital signature methods applicable to digital transport and service;
- 2) Safe digital image, audio and video water marks, and digital water mark of geometric shape that resists geometric attacks;
- 3) Image, video and audio authentication based on fragile water mark passive image alteration, analysis and detection based on statistical analysis, content based image alternation detection tools;
- 4) Principle, technology and methods for evaluation of digital media content safety.

### **4. Digital VLSI circuit test technology**

Main research contents include:

- 1) Time delayed test technology for VLSI circuit;
- 2) Multi clock circuit test technology including instruction based CPU testing technology;
- 3) Compression and decompression node design and test arrangement.

## **Division III of Information Sciences**

### **1. Industrial process control for energy saving**

### **2. Online identification and estimation of dynamic models of movable objects**

### **3. Basic theories and methods for the detection control and operation of nanometer scale objects**

Addressing the needs of processing, assembly, etc., of nanometer scale objects, it is to study mainly the kinematical and dynamical models of objects in nanometer environment, based on the theory and methods of detection and driving technologies, non-inertial force, micro- and nano-meter scale displacement, key technologies of micro nanometer scale operation and visual interface. Research results need to be verified on micro nanometer scale operation platform or on prototype system.

### **4. Modern design theory and methods of engineering and products**

According to the characteristics of openness, coordination, heterogeneity and variability

of engineering and production design in network environment, it is to study mainly theory and methods of intelligent design based on knowledge, 3-D reconstruction theory and methods based on 2-D information, new theory and new methods of coordinated design in network environment, formalization methods for modern design software system and relevant problems. Research results should be verified in relevant systems and partly applied in the modern design of some engineering projects or production.

### **5. Key technology for underwater mobile sensor network**

Addressing problems in underwater perception and object identification, it is to study mainly the design and motion control of underwater mobile units perception system, mobile sensor network communication and information processing, mobile sensor network topological structure self organization configuration and spatial distribution control. It is needed to develop experimental platform of underwater mobile sensor network and verify results of the above-mentioned research.

### **6. Several important problems in machine learning**

Addressing common problems of machine learning in different disciplinary areas, it is mainly to study new methods of machine learning for effective processing of high dimensional data, unbalanced data of various types, processing of cost different data, data type unmarked data and structured data. Part of the research results need to be verified in application.

### **7. Basic theory and methods of highly effective, scalable video encoding and decoding**

Addressing the characteristics of heterogeneous transmission network, fluctuation of transmission bandwidth, varying terminal display type, concurrent service needs and service quality, etc., of the next generation video frequency encoding and encoding requirement, it is to study mainly the basic theory and key algorithm of wavelet based and statistical learning, scalable video encoding and decoding system structure and network transmission technologies, scalable video frequency encoding and decoding key algorithm and hardware technology. Research findings should be verified in relevant experimental systems.

## **Division IV of Information Science**

### **1. Key technology of nano scale CMOS integrated circuits**

Addressing key problems in CMOS integrated circuits after technologies now reaching the 65 nm range, it is to study mainly new principles, new structures and novel methods of integration technology related to channel engineering and grid engineering, so as to lay the foundation for developing large scale integrated circuit with proprietary intellectual property right.

### **2. Basic research on the preparation of high quality zinc oxides (ZnO) crystal**

It is to prepare high purity, low defect density and large size zinc oxide single crystals, to study the crystal growth mechanism and control technology defect form, structure and formation mechanism, and influence on epitaxial membrane.

### **3. Key technology and system of high optical fiber laser**

## **Interdepartmental Key Program projects**

### **1. High power laser emitted by vertical cavity wall (with Division I of Physics)**

It is to study related physical problems of vertical wall emitted high power laser and array module, to solve key technical problems in structure design and device production, and to develop high continuous output power and long life span laser and array modules.

### **2. Optical property and optical devices of nano micro structure materials (with Division I of Physics)**

It is to study the laws of emission, transmission coupling and nonlinear behavior of light, the abundant physical effects and contents thus induced, and on this basis to develop the design and preparation technology which may be used for nano microstructure devices.

### **3. Basic studies on ultra fast laser propulsion technology (with Division I of Physics)**

It is to study the physical mechanism of using ultra fast laser pulse propulsion, including studies on the basic physical process of interaction between ultra fast laser and matter, to develop physical models of interaction directly related to laser propulsion, to study by experimental methods the effects of laser parameters and physical properties of the object being propelled and structure parameters on energy conversion efficiency, specific impulse and momentum energy ratio, to study the feasibility of small scale, small mass propulsion and large scale and large mass propulsion, and to explore practical solutions to high efficiency laser propulsion.

### **4. Applied research on marine optical telemetry information (with Division I of Physics)**

It is to study the methods to invert distribution of marine parameters such as marine internal wave, shallow water topography and geology, under sea objects, marine bubble and halonereid using optical telemetry information such as water measurement, multi spectrum measurement, high spectrum measurement, etc., and using the methods of inversion by experimental verification to study the intrinsic relations between optical telemetry

information and relevant marine parameters, so as to promote the development of marine optical telemetry technology.

## **Department of Management Sciences**

According to the Eleventh Five-Year Plan, the Department will support 9 Key Program projects in 2006, of which, 6 by the Division I and 3 by the Division II. Each project should be completed within 4 years, and the average funding of Key Program projects supported by the Department is about 0.9-1 million yuan per project.

Key Program projects are to focus on the frontier research areas to promote the scientific development or to resolve real problems in management practice. Applicants should abstract the rules and theories of management with Chinese features.

Applicants, guided by the Guide, may compress or expand the research contents in preparing their proposals. It is not required that for a specific proposal all contents stated below have to be covered, but research should be focused on kernel topics with limited targets, trying to make original innovation. Previous research records in relevant fields will be highly considered in evaluating proposals.

The brief introduction to the Key Program projects is presented below.

### **Division I of Management Science**

#### **Management science and engineering**

##### **1. Management and optimization of urban transportation networks**

In order to forecast travel demands in Chinese cities and develop various optimization models and management technologies with respect to comprehensive urban transportation networks, the main topics are origin-destination matrix estimation, static, dynamic and stochastic traffic assignment models, city transportation network design model, transfer model between different modes, the evolution model of network flow pattern, and efficient solution algorithms. Other topics can be the methods of evaluating urban transportation systems, and the management and control technologies of alleviating traffic congestion.

##### **2. Group decision theory and methods**

Proposals are encouraged to focus on the topics such as complex and large group behavior in the context of group decision making, procedures and methods of group decision problem solving, design and choice of group decision mode, group decision process and its design,

complex and large group decision method, internet-based group decision support system, and the evaluation of group decision effectiveness including quality, effectiveness, etc..

### **3. Basic theoretic researches on organizational psychology and social security**

Based on the characteristics of mentality and behavior of the public when facing sudden crisis, it is to develop the in-depth theories of social security analysis and the intervening and coping tactics investigation. The theories should reflect the features of Chinese culture and achieve a directional significance in the sudden crisis management system in China. The main contents of research should include the risk perception characteristics of public toward crisis events, the relationship between the availability of information on crisis events and the mentality and behavior of the public, mental preparation under normal states on mentality and behavior in crisis events, a model of mental prediction when sudden crisis events outbreak, the interfering systems of sudden crisis based on the characteristics of the public mentality and behavior, and so on.

### **Business administration**

#### **1. Some fundamental issues on researches of corporate finance**

To conduct further studies on some puzzles in corporate finance with financial management practices in China, research issues include financial policy selection or determination, the assessment of financial performance and policies, internal capital market, corporate governance and financing and investment decisions, investment and performance, financial management based on value-creation, behavior finance and so on.

#### **2. Assessment theory and approaches on legal protection for investors**

This research project includes the implication of legal protection for investors and its meanings to China, the forms on legal protection for large shareholders with control power and small-middle shareholders, the relationship between corporate governance and legal protection, the relationship between legal protection for investors and financial policies, the relationship between legal protection and financial performances, and the assessment approaches for legal protections.

#### **3. Basic research on branding and brand management**

The proposal aims to promote innovative research on branding and brand management from both consumer and firm perspectives in the context of the Chinese market. Key research topics include the brand's influence on consumer behavior and its functioning mechanism, brand equity, its constituent components, determinants and evaluation models, the relationship between brand strategy and firm performance, brand management and product innovation, the competitive analysis of local and foreign brands, and the globalization of Chinese brands and their implementation strategies.

## **Division II of Management Sciences**

### **Macro management and policy**

#### **1. Farmland system reform and issues of social security concerned in the process of urbanization**

It is to study the issues facing the existing farmland systems, especially the farmland acquisition and contracting systems in the process of accelerating urbanization, including the farmland acquisition mechanism, compensation, employment and social securities of landless farmers, social security, household registration and issues related to the farmland under the existing financial and administrative systems, to explore the internal relations among urbanization, farmland system and social security system based on the empirical study, to contribute to the farmland system reform, and to find solutions to the problems of the present social security in the process of urbanization.

#### **2. Mechanisms and means of public service provision in the transformation period**

Based on the reality of multiple institutional and resource constrains of China in a transformation period, it is to further study the basic types, means and approaches of public service provision, explore the reasonable choice and innovation of specific mechanisms in providing economic and efficient public service, analyze the cooperation and division between the government and other sectors, and provide some policy suggestions on the administrative modes of public service provision and related issues.

#### **3. Intellectual property management to strengthen the ability of indigenous innovation**

Based on the innovation theories, it is to investigate China's intellectual property (IP) system, policies and management including an empirical analysis on the situation of China's IP under globalization competition, the management of IP in various forms confronted by industries, research organizations and universities in their innovation process, the evaluation of government's IP management efficiency, as well as the implementing effect of IP policy. It is argued that the inherent correlation between the IP system-policy-management and the cultivation of independent innovation ability should be examined on the ground of empirical studies so as to discover existent difficulties and advance solutions.