Title of project	Basic Surveys and Simulation Exercises for a Grand Design of Future Higher Education System
Head Investigator Name	Motohisa KANEKO, The University of Tokyo, Graduate School of Education, Professor
Abstract of Research Project Number of Researchers: 23 Term of Project: 2005-2009	With the rapid structural changes in the economy and society, Japan needs to redefine its higher education system. Construction of such a grand-design requires a solid empirical basis and logical examinations on policy instruments. This project aims at responding to such needs through three sub-projects: 1) large-scale surveys on high school students, college and university students and adults on their attitudes and experiences towards higher education and its relevance to their needs; 2) international comparisons on financing and governance of higher education institutions: and 3) identification of policy alternatives and simulation exercises of their consequences.

Title of project	Establishing a new framework for realizing effective transnational business litigation
Head Investigator Name	Kawano Masanori, Nagoya University, Graduate School of Law, Professor
Abstract of Research Project Number of Researchers: 3 Term of Project: 2005-2009	In our globally expanding market society legal disputes become transnational in character. In the international business disputes there are many difficult problems to which litigants and courts would face. One of the most serious problems is how to get information on foreign legal matters. We do not have now an appropriate and effective method to get them.In this project we are going to establish a *personal network of internationally admitted distinguished legal scholars* for exchanging and discussing matters concerning not only fundamental structures of procedural and substantial frameworks but also actual legal issues of respective countries. In this research we would like to establish a new way for comparative study of commercial litigation.

Title of project	Comprehensive studies of global greenhouse gas cycles in the atmosphere, terrestrial biosphere and oceans
Head Investigator Name	Takakiyo Nakazawa, Tohoku University, Graduate School of Science, Professor
Abstract of Research Project Number of Researchers: 13 Term of Project: 2005-2009	To cope with global warming, it is indispensable to predict and control future concentration levels of greenhouse gases in the atmosphere, which is achieved by understanding their global cycles. In this study, the concentration and isotopic ratio distributions of major greenhouse gases, carbon dioxide, methane and nitrous oxide over a geographically wide area are elucidated using various observation platforms, and their variation histories are reproduced by analyzing past air preserved in polar ice sheets. In addition, we also estimate global budgets of anthropogenic greenhouse gases, as well as examine causes of variations of the relevant gases and their emission and destruction processes, using global cycle models.

Title of project	Development of superefficient entangled-photon sources, detectors and entanglement recovery protocol
Head Investigator Name	Keiichi Edamatsu, Research Institute of Electrical Communication, Tohoku University, Professor
Abstract of Research Project Number of Researchers: 10 Term of Project: 2005-2009	Recent progress of quantum info-communication technology attracts much attention. Entanglement, the non-local property of quantum systems, plays a central role of the novel quantum info-communication technology. This research project aims at the development of generation, detection and control techniques of entangled photons toward the practical quantum info-communication technology. Specifically, we focus on the following subjects: 1) development of superefficient entangled-photon sources and detectors, 2) generation and control of entangled photons in semiconductors, and 3) development and demonstration of entanglement recovery protocol, which is indispensable to long-distance quantum communication.

Title of project	Silicon CMOS Photonics
Head Investigator Name	Kazumi Wada, The University of Tokyo, Department of Materials Engineering, Professor
Abstract of Research Project Number of Researchers: 1 Term of Project: 2005-2009	Si LSIs together with optical communication networks have been the building blocks of the internet society. To achieve higher figure of merit, a strong demand exists on monolithic integration of electronic and photonic devices on a Si chip. Challenging issues are that photonics requires various kinds of devices based on various material platforms. To emulate Si LSIs that only consist of transistors, the current trend for integration is to reduce “material diversity of photonic devices”, thereby utilizing huge benefits of Si CMOS-compatibility of materials and processes. The present research project “Si CMOS Photonics” pursues a more fundamental solution, i.e., to unify photonic functions into novel CMOS device(s) and to simplify integration with reducing “device diversity of photonic devices”.

Title of project	Development of Functional Nanospace Chemistry with Mesoporous Inorganic Materials
Head Investigator Name	Masakazu Iwamoto, Tokyo Institute of Technology, Chemical Resources Laboratory, Professor
Abstract of Research Project Number of Researchers: 8 Term of Project: 2005-2009	Although a lot of studies on nanometer-sized pores (nanopores) have been carried out in the world after the synthesis of mesoporous silica (MPS), most of them are based on the high surface areas or the large pore diameters. The objectives of the present study are to develop novel chemical functions by using mesoporous inorganic materials. The research can be divided into three fields; the environmentally benign catalysis in the nanopores, the creation of new functions in the pores, and the preparation of photo-responsible mesopores and their application. At present, the asymmetric oxidation of sulfide on Ti-MPS and the generation of acidity due to the formation of nanopores can indeed be recognized. In addition, the conversion of ethene to propene is newly established on Ni-MPS.

Title of project	The Chemistry of Unsaturated Compounds of Heavier Main Group Elements: Pursuit of Novel Properties and Functions
Head Investigator Name	Norihiro Tokitoh, Kyoto University, Institute for Chemical Research, Professor
Abstract of Research Project Number of Researchers: 7 Term of Project: 2005-2009	There has been much interest in the chemistry of unsaturated bonding systems containing heavier main group elements from a viewpoint of heavier analogues of organo-π-electron systems such as polyacetylenes and PPV. Although it is difficult to synthesize and isolate such heavier organo-π-electron systems due to their inherent extremely high reactivity, it has been demonstrated that they can be handled as stable compounds by taking advantage of kinetic stabilization. The purpose of this project is the synthesis and elucidation of the properties of novel extended organo-π-electron systems containing heavier main group elements in pursuit of novel physical properties from the viewpoint of developing new functions.

Title of project	Basic Study of Space Weather Prediction
Head Investigator Name	Kazunari Shibata, Kyoto University, Graduate School of Science, Kwasan and Hida Observatories,Professor, Director
Abstract of Research Project Number of Researchers: 11 Term of Project: 2005-2009	Space environment around the Earth has often suffered from violent space storms, so that serious damages have occurred on artificial satellites, telecommunication, power distribution grids, etc. Even the health of astronauts may be in danger by energetic particles from solar flares. In order to escape from these damages and danger, we need to develop space weather prediction. The purpose of this project is to develop a physical model of solar-terrestrial phenomena and space storms as a basis of space weather prediction, by resolving fundamental physics of key phenomena from solar flares and coronal mass ejections to magnetospheric storms under international cooperation program CAWSES (Climate and Weather of the Sun-Earth System).

Title of project	Molecular structure and vibrational dynamics studied by Terahertz radiation spectroscopy
Head Investigator Name	Keisuke Tominaga, Kobe University, Molecular Photoscience Research Center, Professor
Abstract of Research Project Number of Researchers: 5 Term of Project: 2005-2009	One Terahertz (THz) corresponds to 33 cm^{-1}, and this frequency region exists between microwave and light. There have been a number of spectroscopic studies in this far-infrared frequency region. In spite of that, this region has been called as an unexplored frequency region. Recently, there has been rapid development in technologies of generation and detection of THz radiation. The theoretical formalism to analyze the far-infrared spectra has been also developed. In this study researchers of THz technology and molecular science cooperatively stimulate each other to perform development and construction of new apparatus and measurements on various kinds of molecules and materials to understand natures of molecular interactions and dynamics of molecules in condensed phases. We aim to develop a field of “THz molecular science”.

Title of project	Research for Hybrid System comprised Laser Super Cavity and Off-Axis Parabolic Reflective mirrors toward International Linear Collider
Head Investigator Name	Junji Urakawa, Inter-University Research Institute Corporation, High Energy Accelerator Organization, Accelerator Laboratory, Professor
Abstract of Research Project Number of Researchers: 10 Term of Project: 2005-2009	The technologies for the storage of pulsed laser into optical cavity and the laser focusing by off-axis parabolic (OAP) reflective mirrors are applied to the development which will realize the generation of 1mJ/10psec-pulse laser beam with high repetition rate of 357MHz. We demonstrated the peak-power storage more than 1000 into the 42cm optical cavity comparing injected peak-power of the laser. On the other hand, several experiments have showed a few micron laser focusing to make good collision efficiency with electron beam. We also generated the 56MeV γ-ray of 2.0×10^7/30psec based on Compton scattering.We proposed the hybrid system comprised laser super cavity with high reflective plane mirrors and off-axis parabolic reflective mirrors to realize sub-micron meter laser focusing at the center of the optical cavity. This compact super optical cavity will be applicable to γ–γ collider and to the generation of high quality photon beam for various research applications.

Title of project	Regulation mechanism of biomineralization based on interaction between organic matrices and inorganic crystals
Head Investigator Name	Hiromichi Nagasawa, Graduate School of Agricultural and Life Sciences, The University of Tokyo, Professor
Abstract of Research Project Number of Researchers: 4 Term of Project: 2005-2009	Various organisms from bacteria to vertebrates have mineralized hard tissues called biominerals, and the mineralizing function is called biomineralization. Biominerals contain a small amount of organic materials, which are believed to be essential for biomineralization, although the mechanism remains unknown. This research aims at clarifying the biomineralization mechanism using some representative biominerals by analyzing the mode of interaction between organic materials and inorganic crystals, thereby displaying the common mechanism underlying each biomineralization. Through this research, we would like to establish a new interdisciplinary research area by combining advanced bioscience with mineralogy.

Title of project	Function and regulatory system of water transporting aquaporin channels
Head Investigator Name	Sei Sasaki, Tokyo Medical and Dental University, Department of Nephrology, Professor
Abstract of Research Project Number of Researchers: 4 Term of Project: 2005-2009	Body water homeostasis is essential for survival of mammals. Water transport occurs through specialized channels called aquaporin (AQP). Impairment of AQP function causes various water balance disorders. Among the AQP family, some members have other functions than water transport. We are going to clarify the various functions of AQP family using the cell culture system and gene targeting mouse models. Intracellular regulation of aquaporin should be precise and dynamic to maintain strict regulation of water balance. We will clarify the molecular mechanisms of intracellular trafficking of AQP focusing on AQP-binding protein complex.

Title of project	Osteoimmunology
Head Investigator Name	Hiroshi Takayanagi, Tokyo Medical and Dental University, Department of Cell Signaling, Professor
Abstract of Research Project Number of Researchers: 4 Term of Project: 2005-2009	The crosstalk between the immune and skeletal systems or the interdisciplinary field called “osteoimmunology” has attracted much attention in recent years. Receptor activator of NF-κB ligand not only plays an essential role in the physiological induction of osteoclasts but also plays an important role in inflammatory bone destruction. Furthermore, nuclear factor of activated T cells (NFAT) c1 has been identified as a master transcription factor for osteoclastogenesis and signaling through immunoglobulin-like receptors has shown to be essential for the induction of NFATc1. Based on these epoch-making achievements, we aim to understand the molecular mechanism underlying the regulation of the skeletal system by the immune system comprehensively. We believe that the results will contribute to the establishment and development of the new research field, osteoimmunology.

Title of project	Analyses of the photosynthetic oxygen evolving system that sustains the global environment - Reaction mechanisms, acquisition and succession processes
Head Investigator Name	Mamoru Mimuro, Kyoto University, Graduate School of Global Environmental Studies, Professor
Abstract of Research Project Number of Researchers: 5 Term of Project: 2005-2009	Oxygen evolution by photosynthetic organisms supplies electrons from water molecules, and is the most fundamental process for energy conversion. Approximately 2.7 billion years ago, cyanobacteria acquired the oxygen evolving system. This system was finally succeeded by higher plants, and sustains the global environments and all lives on the earth. The oxygen evolving system is a unique electron transfer system operating under oxidation potential higher than +1.0V; it requires the specific mechanism for stabilization of reaction intermediates. Acquisition, reaction mechanism, and succession of the oxygen evolving system are subjects to be studies urgently for full understanding of the energy conversion and sustainability of global environments. We will adopt a unique method that is lined by the analysis on the “intermediates of evolutionary steps” of three unique cyanobacterial species.

Title of project	New insights into the photosynthetic electron transport networks
Head Investigator Name	Toshiharu Shikanai, Graduate School of Agriculture, Kyushu University, Associate Professor
Abstract of Research Project Number of Researchers: 4 Term of Project: 2005-2009	The light reactions of photosynthesis convert light energy to NADPH and ATP, which are utilized by living organisms. The process is often depicted by the linear electron transport from water to $NADP^+$, but the more complex reactions are involved in the chloroplast. Although light energy is essential for photosynthesis, excessive light energy causes the generation of reactive oxygen species. To cope with the fluctuating light environments, electron transport pathway has several branches. Especially, photosystem I cyclic electron transport is a key regulator by maintaining the proper ATP/NADPH ratio and also by regulating the dissipation of excessive light energy. Our knowledge is still limited on this network of electron transport. In this research program, we will develop the new insight of research by combining recent techniques of molecular genetics and biochemistry.

Title of project	Activation of stem cells and neurogeneis in adult brains:their regulatory mechanism and visualization
Head Investigator Name	Hideyuki Okano, Keio University School of Medicine, Department of Physiology, Professor
Abstract of Research Project Number of Researchers: 3 Term of Project: 2005-2009	We have previously demonstrated that adult brain contains neural stem cells, using the RNA binding protein Musashi1 as a marker. This finding suggests that activation of endogenous neural stem cells in addition to cell transplantation can be a strategy for neural regeneration. However, the mechanisms for maintenance and activation of the neural stem cells in the adult brain are largely unknown. In this project, we will study molecular mechanisms regulating the maintenance and activation of adult neural stem cells as well as their involvement in the dynamic regulatory mechanisms of brain homeostasis, which will be useful information to develop novel therapies for neural diseases.

Title of project	Unraveling molecular mechanisms to recreate 3D organ architecture
Head Investigator Name	Kiyokazu AGATA, Kyoto University, Graduate School of Science, Department of Biophysics, Professor
Abstract of Research Project Number of Researchers: 1 Term of Project: 2005-2009	To make regenerative medicine a reality, the fundamental questions of “how stem cells form functional organs and tissues” must be pursued. To achieve this, understanding “polarity” during development and regeneration, or the mechanisms of positional information is crucial. Investigating the molecular mechanisms of how stem cells recognize each other and develop polarity and positional information during regeneration is the theme of our research. More specifically, we employ the highly regenerative planarian, which has stem cells distributed all over its body, as a model organism to elucidate how organs such as the brain and pharynx regenerate in function and form from stem cells, and take these findings to endeavor the regeneration of mammalian organs.

Title of project	Biomedical application of gas biology through multidisciplinary approaches
Head Investigator Name	Makoto Suematsu, Professor and Chair, Department of Biochemistry, School of Medicine, Keio University
Abstract of Research Project Number of Researchers: 6 Term of Project: 2005-2009	H_2, CH_4, CO and NH_3……Such gases are mementos produced upon creation of our universe that constitute a primitive source of life. Humankind is one result of evolution generated from the source of life. In this program of Grant-in-Aid for Creative Research Science, we challenge to establish *gas biology* for deciphering the role of gases in maintaining homeostasis of biological systems. To understand how gases elicit enzyme and cellular responses, integration of multidisciplinary approaches is essential: computer-assisted, high-throughput technology for grabbling metabolome (informatics of small molecular metabolites as a whole), advanced physicochemical technology for structural biology and multifunctional bioimaging analyses of organ microcirculation in vivo are such technologies. Final goal of the project involves application of basic knowledge on *gas biology* to medicine.

Title of project	Comprehensive Studies toward Synthesis of Glycoproteins
Head Investigator Name	Yukishige Ito, RIKEN,Synthetic Cellular Chemistry Laboratory, Discovery Research Institute, Chief Scientist and Director
Abstract of Research Project Number of Researchers: 3 Term of Project: 2005-2009	Glycosylation is an important modification of proteins. Structures of the sugar portion of glycoproteins (glycans) are highly diverse. Their relationship with various biological and medical phenomena, such as protein folding, transport and degradation, cell differentiation, immune response and malignant transformation. In order to reveal the functions of glycoprotein, comprehensive studies toward synthesis of glycoprotein glycans will be conducted. Glycoproteins derived from biological sources are heterogeneous in most cases. Chemical synthesis of glycoproteins is expected to be powerful in order to understand their functions precisely, however still being an unprecedented challenge. To achieve that, various approaches will be investigated to aim the first total synthesis of biologically active glycoproteins.

Title of project	Chemical proteomics to reveal interaction between chemicals and proteins at angstrom level
Head Investigator Name	Hiroyuki Osada,RIKEN, Discovery Research Institute, Chief Scientist
Abstract of Research Project Number of Researchers:7 Term of Project:2005-2009	In order to understand dynamic biological system, it is necessary to analyze the interaction between bioactive small molecules (ligands) and their target proteins (receptors). This approach is so-called “Chemical Proteomics”, and we challenge the following subjects. Detection technique for interaction between a ligand and its receptor and a rapid analyzing system for a structure-activity relationship will be developed. Combining X-ray crystallography and NMR analyses, the interaction between a ligand and its receptor will be elucidated. The results elucidated above will be confirmed by rational modification of the ligand as well as amino acid substitution of the receptor. Chemical proteomics is expected to contribute to drug discovery and understand the biological system.