特別推進研究　新規研究課題要点一覧（English）

Title of project	Economic Analysis of Intergenerational Issues
Head Investigator Name	Noriyuki Takayama, Hitotsubashi University, Institute of Economic Research, Professor
Abstract of Research Project **Number of Researchers : 5** **Term of Project: 2006-2010**	This project makes both theoretical and empirical analyses of intergenerational issues from an economic point of view. It addresses pension, health care and employment problems in the context of the population aging/decline. It clarifies current and future intergenerational situations of economic well-beings, examines cohort-by-cohort motivations to mitigate intergenerational conflicts, deepens conceptual understanding of intergenerational equity, and provides a new analytical framework to overcome a dilemma between equity and efficiency of intertemporal resource allocation. It also conducts the Japanese version of health and retirement studies.

Title of project	Semiconductor Nanowire Electronics by Selective-Area Metal-Organic Vapor Phase Epitaxy
Head Investigator Name	Takashi Fukui, Hokkaido University, Graduate School of Information Science and Technology, Professor
Abstract of Research Project **Number of Researchers : 5** **Term of Project: 2006-2010**	In semiconductor nano-technology research and development fields, bottom-up-type fabrication techniques for semiconductor nano-structures have been most intensively investigated to overcome the technological limits of conventional top-down-type techniques used in the present silicon LSI industries. The purpose of this project is to develop a fabrication technology for semiconductor nanowires using our unique selective-area metal-organic vapor phase epitaxial growth technique, which is a combination of the bottom-up-type fabrication techniques with the top-down-type ones. The semiconductor nanowires have been attracted much attention as building blocks for future semiconductor nano-electronics because of possible high integration of the nano-devices and novel one-dimensional electronic properties. The realization of "semiconductor nanowire electronics" by our project possibly leads to a drastic technological brake-through in a future semiconductor industry.

Title of project	Study of quark-gluon structure of hadrons with a large polarized target
Head Investigator Name	Takahiro Iwata, Yamagata University, Faculty of Science, Associate Professor
Abstract of Research Project **Number of Researchers : 4** **Term of Project: 2006-2009**	It has been believed for a long time that the origin of the nucleon spin is the quark spin. Recent experiments have made it clear that the contribution of the quark spin to the nucleon spin is less important. The question about the origin of the nucleon spin still remains. According to QCD theory which describes interactions of quarks, the gluon spin may play an important role to give the nucleon spin. We study the contribution of the gluon spin to the nucleon spin in the international collaboration, COMPASS, at CERN with a polarized target and a high energy polarized beam.

特別推進研究　新規研究課題要点一覧（English）

Title of project	Strongly correlated quantum phase associated with charge fluctuation
Head Investigator Name	Terutaka Goto, Niigata University, Institute of Science and Technology, Professor
Abstract of Research Project **Number of Researchers : 5** **Term of Project: 2006-2010**	Localized spins of magnetic ions embedded in metals interact with conduction electrons. This coupling leads to a "Kondo singlet", where the localized magnetic moment is entirely screened by conduction electrons. After a milestone work of forty years ago by J. Kondo for describing resistivity minimum, the Kondo effect revealed remarkable evolution relating to heavy Fermion and anisotropic superconductivity in strongly correlated electron physics. The charge fluctuation associated with localized electron and ionic motion may also couple to the conduction electrons. This coupling dominated by the charge fluctuation leads to quadrupole Kondo and multi-channel Kondo effects. In this regime, there are expected exotic phenomena of strongly correlated quantum phases, which are considerably different from that in the spin dominated Kondo effect. In the present research, we investigate non-Kramers doublet of localized 4f-electron system, off-center oscillator in clathrate compound and vacancy orbital in crystalline silicon. And we pursue strongly correlated quantum phases due to coupling of the charge fluctuation to conduction (valence) electrons. The charge fluctuations associated with 4f-electron, off-center oscillator and vacancy possess distinct symmetry and thereby couple to elastic strains of ultrasonic waves. Employing the ultrasonic measurements, we study the strongly correlated quantum phases due to the charge fluctuations.

Title of project	Formation of Quark Matter and Photon Physics
Head Investigator Name	Toru Sugitate, Hiroshima University, Graduate School of Science, Professor
Abstract of Research Project **Number of Researchers : 6** **Term of Project: 2006-2010**	The LHC accelerator at CERN will open a new window to study de-confined quark dynamics at extreme conditions such as a large quantity of quarks and gluons in a boiling soup at temperature of about 10 trillion degrees under a little baryon density. Such a quark soup, which may be existed in a few micro-seconds after the Big Bang, can be created by means of a heavy-ion collision injecting its total energy of peta-eV (equivalent with energy one million times the mass of a proton at rest) into a tiny volume of nuclear size. Investigating through photon channels on how the matter cools down as expanding its volume and finally be materialized, we would reveal the nature of primordial Universe.

Title of project	Qubus Quantum Computer
Head Investigator Name	Yoshihisa Yamamoto, Principles of Informatics Research Division, Professor
Abstract of Research Project **Number of Researchers : 4** **Term of Project: 2006-2010**	We will study the qubus quantum computer consisting of cavity QED nodes connected by coherent state communication bus. The first experimental system is a single ^{19}F donor impurity embedded in a ZnSe microcavity. A donor bound electron (spin) forms a two-level system (qubit) and, together with a donor bound exciton, a three-level lambda system is provided. This matter-qubit in a monolithic microcavity forms a cavity QED node. Alternatively, a single ^{31}P donor is embedded in a monolithic Si microcavity. Those semiconductor cavity QED nodes are connected by coherent optical pluses to implement two qubit gates. The second experimental system is a Josephson junction flux qubit enclosed in a microwave circuit cavitiy, which is connected by coherent microwave pluses.

特別推進研究　新規研究課題要点一覧（English）

Title of project	Material Innovation for the Age of Life Science - Creation of Soft and Wet Materials
Head Investigator Name	Jian Ping Gong, Hokkaido University, Faculty of Science, Professor
Abstract of Research Project Number of Researchers : 4 Term of Project: 2006–2010	In this century of life science, for improving the quality of life, it is imperative to create novel soft and wet materials, which can be really applicable to our body as alternative organs. In order to design novel polymer gels having both excellent mechanical properties and rich functions, we try to obtain many hints from ordered / complex / hierarchical structure in actual organs, like as blood vessel, cartilage, tendon, etc. We adopt suitable techniques of chemosynthesis and/or biosynthesis to create them and investigate their mechanical properties, features of interface, and transport phenomena. Then, we also apply them as biomaterials. Finally, we hope to create a new scientific field of soft and wet matter in future.

Title of project	Gene Manipulation of Huge DNA by Super Artificial Restriction Enzyme
Head Investigator Name	Makoto Komiyama, The University of Tokyo, Research Center for Advanced Science and Technology, Professor
Abstract of Research Project Number of Researchers : 3 Term of Project: 2006–2010	The importance of technology to manipulate huge DNA (e.g., genome DNA) has been rapidly increasing. However, naturally occurring restriction enzymes are insufficient for the purpose. If any target gene can be freely cut out of genome DNA and it can be introduced into predetermined position of genome DNA, these technologies should show overwhelming effects on various fields such as medical care, biotechnology, and species improvements. In this research, DNA cutting technique that we recently developed is further improved, and new chemical tools (super artificial restriction enzymes) that can selectively cut huge DNA at the desired site are constructed. Furthermore, these tools are used to develop new molecular biology and biotechnology that have no limitation in DNA size.

Title of project	Development of environment-conscious synthetic reactions: construction of reaction coordinate-response catalyst
Head Investigator Name	Tsutomu Katsuki, Kyushu University, Graduate School, Faculty of Sciences, Professor
Abstract of Research Project Number of Researchers : 4 Term of Project: 2006–2009	Today, most of useful compounds can be synthesized with high selectivity and chemical yield by using high-active reagents and sophisticated catalysts. From the viewpoint of environmental conservation, however, introduction of reactions that consume less materials and less energy and produce less side products is strongly desired. The aim of this study is to construct a catalyst that can change its structure and function in conjunction with the reaction coordinate of the desired reaction, to activate stable but atom efficient reagents such as molecular oxygen and to realize highly selective and ecologically benign functionalization that is comparable to biological one in any respects.

特別推進研究　新規研究課題要点一覧（English）

Title of project	Study of ultra-high speed and ultra low energy consumption system LSI constructed by balanced full CMOS.
Head Investigator Name	Tadahiro Ohmi, Tohoku University, New Industry Creation Hatchery Center, Professor
Abstract of Research Project Number of Researchers : 5 Term of Project: 2006-2008	Information appliances which become the mainstream in the field in information and communication technology in the 21st century essentially require very small, very high performance and very low energy consumption system LSI embedded with digital, analog and RF (radio frequency) circuits. The purpose of this research is the creation of the over 10GHz operation system LSI embedded with digital, analog and RF circuits constructed by the balanced CMOS on the silicon surface using the radical reaction based semiconductor processes technologies, such as atomic order flat interface of the gate insulator and the silicon, and the drastically decreased series resistance of the source and drain electrode that is three orders of magnitude lower than that of the current technology.

Title of project	Next Generation Super High Density Ferroelectric Data Storage Using Scanning Nonlinear Dielectric Microscopy Technique
Head Investigator Name	Yasuo Cho, Tohoku University, Research Institute of Electrical Communication, Professor
Abstract of Research Project Number of Researchers : 3 Term of Project: 2006-2010	With the advance of information processing technology, the importance of high-density data storage is increasing. Studies on thermal fluctuation predict that magnetic storage, which plays a major role in this field, will reach a theoretical limit in the near future, and thus a novel high-density storage method is required. Ferroelectrics can hold bit information in the form of the electrical polarization direction of individual domains. Moreover, the domain wall of typical ferroelectric materials is as thin as the order of a few lattices, which is favorable for high-density data storage. Therefore, we will study next generation ferroelectric high-density data storage based on scanning nonlinear dielectric microscopy to achieve the considerable progress towards the realization of ferroelectric technology for data storage.

Title of project	Generic Methods for Knowledge-based Semantic and Contextual Processing in Natural Language Understanding
Head Investigator Name	Junichi Tsujii, Graduate School of Information Science and Technology, University of Tokyo, Professor
Abstract of Research Project Number of Researchers : 4 Term of Project: 2006-2010	Everyday language is inherently intertwined with knowledge and meanings that are not directly observed in surface sequences of words. The same meanings are often expressed by different linguistic expressions, while similar expressions sometimes denote very different meanings. The project is to develop basic technologies for processing such intricate relationship between language and meanings. In particular, we are interested in bootstrapping approach of knowledge and grammar acquisition. A high performance GRID environment for such research will also be developed.

特別推進研究　新規研究課題要点一覧（English）

Title of project	Sub-10nm hard X-ray focusing and application to nanoscopy/spectroscopy
Head Investigator Name	Kazuto Yamauchi, Osaka University, Graduate School of Engineering, Professor
Abstract of Research Project **Number of Researchers : 5** **Term of Project: 2006-2010**	Advances in synchrotron radiation facilities have been accelerating the progress of various X-ray analysis methods. Nanofocused X-rays are indispensable because they can provide the high spatial resolution and high sensitivity. A focusing system with Kirkpatrick-Baez mirrors is the most promising device from the viewpoints of high efficiency and large aperture. To date, we have established the fabrication system for the hard X-ray mirror, by developing new surface figuring and testing methods of nanometer-order accuracy. By using an ultraprecisely figured mirror, we realized sub-50nm hard X-ray focusing. The aim of this project is the realization of sub-10nm hard X-ray focusing. In order to further increase the performance of X-ray mirrors, we are planning to develop new technologies such as at-wavelength metrology and additional processing methods. A sub-10nm hard X-ray focusing system will be developed and applied to X-ray nanoscopy/spectroscopy.

Title of project	Studies on the mechanism of neural and behavioral sex determination by the *Drosophila fruitless* gene
Head Investigator Name	Daisuke Yamamoto, Tohoku University, Graduate School of Life Sciences, Professor
Abstract of Research Project **Number of Researchers : 3** **Term of Project: 2006-2010**	The major aim of this study is to establish the causal relationship between a particular gene, its function in the cell and the behavioral outcome at the organismal level. We use *Drosophila melanogaster* as an animal model that allows experimental manipulation of complex behavior. In particular, we focus our attention on the *fruitless* gene, the mutation of which induces male-to-male courtship. We elucidate the entire neural network responsible for the generation of sexual behavior. We further explore the molecular basis for the *fruitless* action in the construction of the neural network by identifying the target genes and cofactors of Fruitless.

Title of project	The Mechanism of Intracellular Transport and Kinesin Motors, KIFs : Structure, Function, Dynamics and Regulation
Head Investigator Name	Nobutaka Hirokawa, University of Tokyo, Graduate School of Medicine, Professor
Abstract of Research Project **Number of Researchers : 12** **Term of Project: 2006-2010**	Cells transport proteins as various kinds of membranous organelles, protein complexes, and mRNA with a large protein complexes along microtubule rails to their own destinations. This intracellular transport is fundamental not only for various important cellular functions, but also for significant phenomena such as brain wiring, development, higher brain functions, left-right determination and suppression of tumorigenesis. In this project we will elucidate structure and function of new kinesin superfamily motor proteins, KIFs and their functional significance in a whole body using molecular cell biology and molecular genetics. We will also solve the question how KIFs move on the microtubules by biophysics, cryo-electron microscopy and X-ray crystallography. Thus, the fundamental problem in life science, the mechanism of intracellular transport will be uncovered and we will get insights in causes and pathogenesis of related diseases and also design principle of new nano-machines.

特別推進研究　新規研究課題要点一覧（English）

Title of project	Mechanism of emergence of new influenza viruses and their control
Head Investigator Name	Yoshihiro Kawaoka, University of Tokyo, Institute of Medical Science, Professor
Abstract of Research Project **Number of Researchers : 2** **Term of Project: 2006-2010**	The spread of H5N1 avian influenza viruses in Asia, Europe, and Africa and their ability to cause fatal infection in humans have raised serious concerns about a global influenza pandemic. Although more than 200 people have been infected with H5N1 influenza A viruses, human-to-human transmission is rare. However, once these viruses acquire the ability to efficiently spread among humans, a devastating pandemic is inevitable. In this project, we will therefore study the mechanisms which would support the ability of H5N1 avian influenza virus to efficiently transmit among humans. The information obtained from these studies will be critical in the prevention of prevent future pandemics. We reported the isolation of an H5N1 virus from a Vietnamese girl that is resistant to the anti-influenza drug oseltamivir, an inhibitor of viral neuraminidase. This drug has been identified as a crucial measure in the prevention of a pandemic. Thus, we will characterize drug-resistant H5N1 viruses and study the mechanism of their emergence. The data obtained from these studies will provide guidance for determining the appropriate use of neuraminidase inhibitors. Finally, we will analyze the packaging mechanism of the influenza viral genome. Understanding the means by which virus particles are formed will identify targets for new anti-influenza drugs.

Title of project	Spatiotemporal control of cell functions by Rho GTPases; mechanisms and physiological roles
Head Investigator Name	Shuh Narumiya, Kyoto University, Graduate School of Medicine, Professor
Abstract of Research Project **Number of Researchers : 1** **Term of Project: 2006-2010**	Cell functions such as adhesion, migration, proliferation and division are regulated by spatiotemporal control of signal transduction pathways and are elicited by reorganization of the cytoskeleton such as filamentous actin and microtubules. Rho GTPases are key regulator of the cytoskeletal reorganization. In this project, we will focus on actions of Rho GTPases, and elucidate spatiotemporal control mechanisms that operate in the above cell functions. We will further investigate both in vitro and in vivo how such control mechanisms are utilized in the body, and how their derangement leads to generation of various diseases including cancer.

Title of project	Molecular Clocks to Biological Rhythms
Head Investigator Name	Hitoshi Okamura, Kobe University, Graduate School of Medicine, Professor
Abstract of Research Project **Number of Researchers : 4** **Term of Project: 2006-2010**	Space flight in 20th century enabled human to see earth from outside. Primitive organisms appeared on earth got cyclic energy from the sun, and using this cyclicity, they evolved internal time system, the biological clock. This system is the basic feature of life even in human. We have worked the suprachiasmatic nucleus, the center of biological clock in mammals over the past 25 years, and clarified the various aspects of the molecular and cellular mechanisms of clock genes in this nucleus. In the present study, we investigate the multidimensional complex structure constituting central oscillator, oscillation conducting systems, and peripheral cellular oscillators. “Time” is a bridge between single genes and the living organism as a whole. Further, we will try to uncover the clock-related diseases such as sleep-awake disturbances, metabolic syndrome and carcinogenesis. We are happy if these trials help to improve the life style in 21th century on the wave of biological rhythms.