# NINS

National Institutes of Natural Sciences

SINCE APRIL 2004

2013

National Astronomical Observatory of Japan

National Institute for Fusion Science

National Institute for Basic Biology

National Institute for Physiological Sciences

Institute for Molecular Science

Okazaki Research Facilities

Center for Novel Science Initiatives

Inter-University Research Institute Corporation

**National Institutes of Natural Sciences**

http://www.nins.jp/

# NINS

National Institutes of Natural Sciences

SINCE APRIL 2004

## CONTENTS

# Message from the President

Inter-University Research Institute Corporation
National Institutes of Natural Sciences
President
**Katsuhiko SATO**

## Aiming for Further Progress in the Natural Sciences

The National Institutes of Natural Sciences (NINS) is an inter-university research institute corporation comprised of the National Astronomical Observatory of Japan (NAOJ), the National Institute for Fusion Science (NIFS), the National Institute for Basic Biology (NIBB), the National Institute for Physiological Sciences (NIPS), and the Institute for Molecular Science (IMS). An inter-university research institute is a type of world-class organization unique to Japan. In response to the research community, it has been organized as a core base to provide a center for collaboration and external use by researchers across Japan. In addition, NINS has been advancing leading-edge and interdisciplinary research as a center of excellence and has been active in promoting activities which develop new research fields, and construct new fields in the investigation of nature. As its core, the Center for Novel Science Initiatives has been established. Along with the Department of Brain Sciences and Department of Imaging Science which have been already underway, the new Department of Astrobiology was set up in this fiscal year. Presently, many planets outside our solar system have been identified, and these include many potential terrestrial planets. NINS has two research institutes for biological subjects, NIBB and NIPS, and a research institute for the universe, NAOJ. Taking advantage of this, NINS has decided to promote and support the new interdisciplinary research field of "Astrobiology". With this, we look forward to the expansion of this research field community in Japan and to the further development of research.

Many universities and research institutes in the Tohoku district and North Kanto were devastated and suffered great damage by the Great East Japan Earthquake that took place two years ago in March 11. Of these, the loss of biological genetic resources dealt a serious blow to the life science research of universities. Supporting and helping the research activities of devastated universities is the responsibility of NINS as an inter-university research institute corporation. NINS conducted activities to support the early recovery of research and education activities and to maintain research resources. NIBB launched the "Inter-University Bio-Backup Project for Basic Biology" (IBBP) to back up biological genetic resources at universities, etc. last fiscal year. This past March, the "NIBB IBBP Center" which will become a key part of IBBP was completed and the germplasm preservation of animals and plants, microorganisms, cultured cells, etc. was begun. This way, NINS will be able to back up biological genetic resources at universities, etc. and to make a significant contribution to avoid the damage or loss due to an unanticipated accident, disaster, etc.

NINS received the high commendation of "made good progress" in the annual evaluation of the National University Corporation Evaluation Committee and a lot of our notable work about the improvement in the quality of education and research received recognition. Last fiscal year, the "NINS External Evaluation Committee" which is composed of researchers in related areas together with researchers in other fields such as cultural studies and intellectuals in the mass media business was established to get a detailed evaluation of NINS' activities from the outside. NINS received a lot of valuable advice on the creation of new fields, the fostering of young researchers, gender equality, the whole concept of the headquarters of NINS, health and safety, graduate education, etc. It is our desire to improve the organization and operation of NINS using examples from the advice on the further promotion of gender equality, etc.

Now and in the future, NINS would like to further develop the results of our research endeavors, to create new sciences in the 21st century by carrying out cutting-edge academic research in various fields of the natural sciences including astronomy, energy science, life science, and material science, and by developing advanced new fields which overcame the barriers that exist between different fields, and to contribute to society.

We are grateful for your continuous support of our vision.

# What is an Inter-University Research Institute?

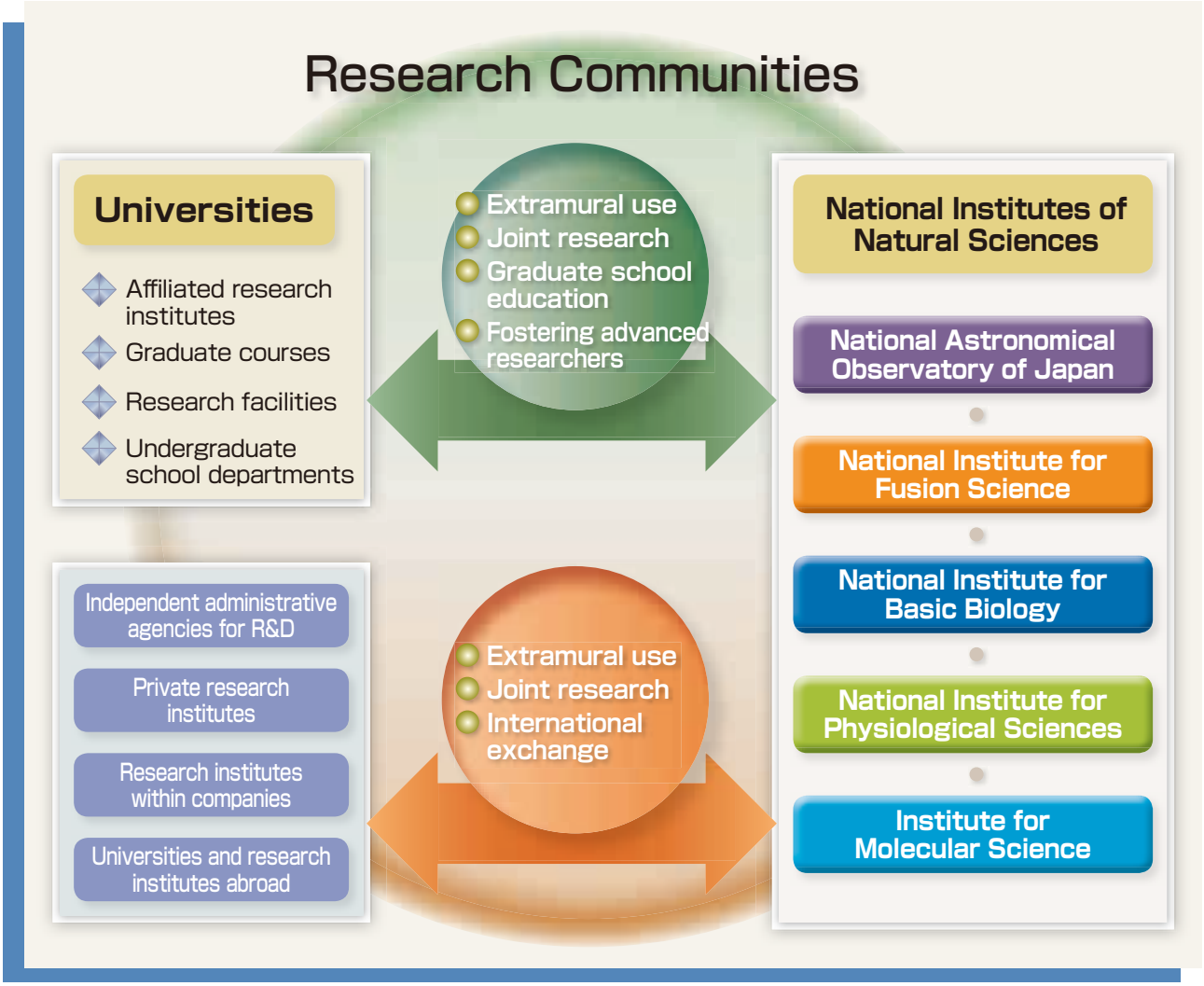
## The World's Leading Research Institutes in Japan

The National Institutes of Natural Sciences (NINS) consists of five inter-university research institutes: the National Astronomical Observatory of Japan (NAOJ), the National Institute for Fusion Science (NIFS), the National Institute for Basic Biology (NIBB), the National Institute for Physiological Sciences (NIPS), and the Institute for Molecular Science (IMS). In addition to playing a leading role in its respective research field, each institute has a collaborative relationship with NINS with the common goal of creating an interdisciplinary and international research base.

An inter-university research institute is a "research institute operated by the research community," a type of world-class organization unique to Japan. The inter-university research institute was organized as a core base to provide a place for joint research and extramural use by researchers across Japan. One such institution originated as the Research Institute for Fundamental Physics (Yukawa Hall) in Kyoto University, which was opened to the community in 1953 in response to requests from theoretical physicists throughout Japan.

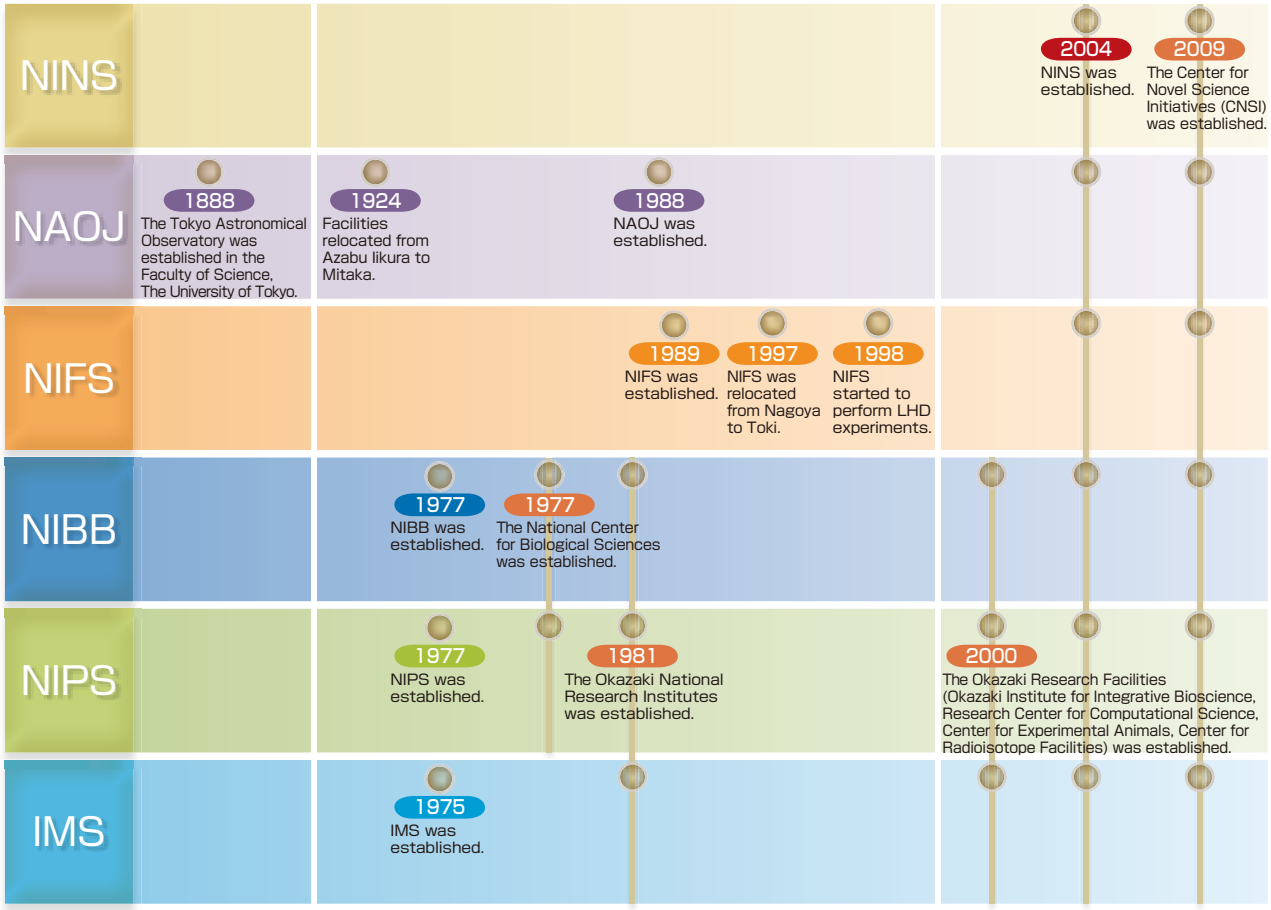
An inter-university research institute not only promotes pioneering studies on important research issues, but also provides opportunities for cutting-edge researchers throughout Japan to gather and engage in activities aimed at exploring future academic fields and creating new principles. New concepts of extramural use such as "joint usage of large-scale facilities" and "improvement of the intellectual foundation of academic materials" were later added to the original concept. While the research community's own management policy has been firmly maintained, many inter-university research institutes that do not belong to a specific university have been created.

While maintaining its uniqueness and diversity, each institute makes a great contribution to the development of academic research in Japan as a Center of Excellence in its respective research field. Together, they also serve as an international core base to promote cooperation and exchange with research institutes and researchers abroad.

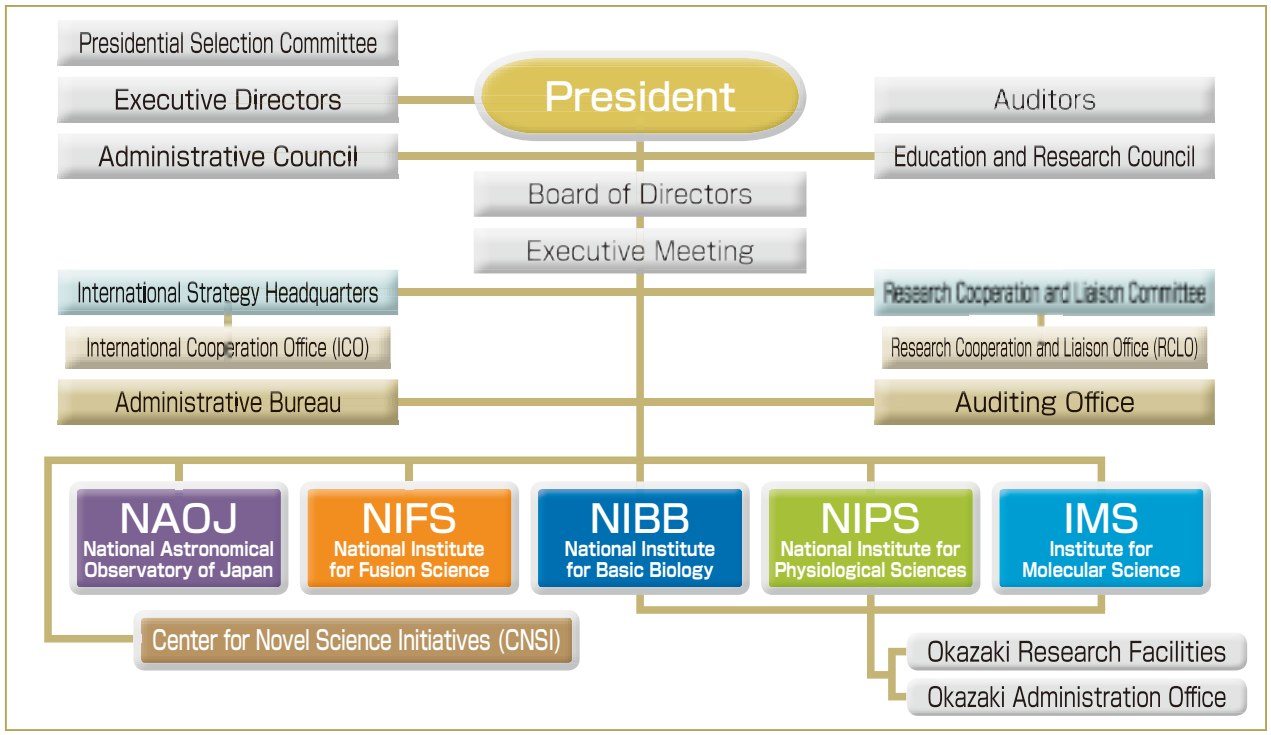


# History & Organization

## History




## Organization



## NAOJ National Astronomical Observatory of Japan

Spiral pattern on a protoplanetary disk observed with Subaru telescope

NAOJ is the national center of astronomical research in Japan. It aims at developing astronomy and related sciences by promoting the open use of its state-of-the-art observation facilities such as the Subaru Telescope, organizing various joint-research programs, and encouraging versatile international cooperation.

## NIFS National Institute for Fusion Science

The LHD maintains high temperature plasmas in steady state.

NIFS conducts collaborative research into the basic science of high-temperature plasmas and fusion engineering. Our collaborators from all over the world use computer simulations and experiments on the Large Helical Device (LHD) as their leading projects in order to realize “a sun on the earth,” controlled fusion, which is a new, safe, and environmentally friendly energy source.

## NIBB National Institute for Basic Biology

The Medaka Bioresource Facility provides various strains and mutants of medaka to researchers worldwide.

The earth is filled with living organisms exhibiting various forms and demonstrating shapes and behaviors adapted to diverse environments. NIBB, in collaboration with outside researchers, studies the essential phenomena underlying the characteristics and abilities that animals and plants have acquired over the long course of evolution.

# National Institute for Physiological Sciences

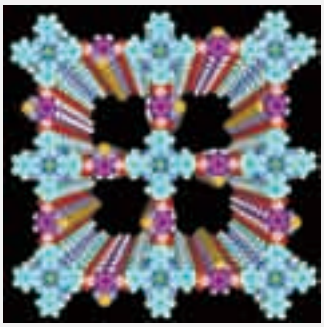
NIPS

NIPS' goals are to uncover the mechanisms by which the human body functions. This is the basis of medical science and links to clarifying the pathophysiology of various diseases. Presently our focus is on brain science as the main part of "body and mind" research. Furthermore, as a national center of physiological research, the institute provides facilities and research staff for collaborative studies to scientists from universities and research institutes.

The reconstructed 3D image of the human brain from fMRI data, color-coded according to function

# Institute for Molecular Science

IMS



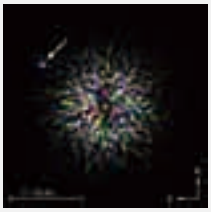
Stacked column-like polymer with novel functions

The aim of IMS is to investigate fundamental properties of molecules and molecular assemblies through both experimental and theoretical methods. Since its inception, IMS has made its facilities available to the worldwide scientific community, with a policy which has fostered many joint programs involving IMS scientists.

## Center for Novel Science Initiatives (CNSI)

A neuronal network of the cerebral cortex, as observed in a living mouse, visualized under two-photon microscopy

Visualization of computer simulation of colliding galaxies (Simulation data: Takayuki Saitoh)



Exoplanets are promising astronomical targets for searching life in space. (Arrow indicates the planet.)

Expanding research methods and inter-disciplinary exchange in natural sciences research is on the cusp of giving birth to new fields of research. NINS established the Center for Novel Science Initiatives (CNSI) and has been promoting research in the following three departments: the Department of Brain Sciences, Department of Imaging Science, and Department of Astrobiology. CNSI is promoting the expansion of new creative research communities and research that is linked to academic development.

## Okazaki Research Facilities

The Okazaki Research Facilities consists of four centers: the Okazaki Institute for Integrative Bioscience, the Research Center for Computational Science, the Center for Experimental Animals, and the Center for Radioisotope Facilities. These facilities are intended for the common use of NIBB, NIPS, and IMS.

Spiral Galaxy NGC 6946

# National Astronomical Observatory of Japan

Director General
Masahiko HAYASHI

Astronomy is one of the oldest yet most active sciences. This fact alone means that humans possess the fundamental desire to seek their origins and the reason for their existence through the understanding of the universe. Since the establishment of the Big Bang Theory of the universe in the 20th century, astronomers have been striving to describe the dynamics of the evolution of the universe from material production, the generation of stars and planets, and the creation of life forms up to the birth of human beings. The 21st century will be the era for us to search the planets and for life outside the solar system.

NAOJ continuously seeks to develop new methods of observations to gain a deeper understanding of the objects and phenomena in the universe such as the Earth, solar system objects, stars, galaxies, clusters of galaxies, and the expanding universe. We hope to play a key role in establishing a new paradigm of nature.

## ALMA

ALMA (Atacama Large Millimeter/submillimeter Array) is a partnership project among Europe, North America, and East Asia (Japan and Taiwan) in cooperation with the Republic of Chile to operate an international radio astronomical facility on the 5,000-meter Chilean plateau. NAOJ is leading the construction and operation of ALMA. By combining signals obtained by 66 antennas, ALMA will unveil mysteries in the universe such as the formation of galaxies that are 13 billion light years away from us, the formation of stars and planets, and the synthesis of organic molecules. Full-scale observation started in FY2012 and ALMA's unparalleled sensitivity has provided us with new insights into mysteries of planet formation and galaxy evolution.

Parabola antennas located at the ALMA-Array Operations Site (5,000-meters above sea level) in Chile (Copyright ALMA(ESO/NAOJ/NRAO), W.Garnier(ALMA))

## Subaru Telescope

The Subaru Telescope is our flagship observation facility. It is an 8.2-meter optical/infrared telescope located at the top of Mauna Kea of Hawai'i Island in the U.S. Its open use since 2000 has produced a number of excellent achievements from the discovery of the farthest galaxies and the observation of proto- and baby galaxies up to the mechanisms of proto-planetary systems.

The uniquely shaped enclosure of the Subaru Telescope located at the top of Mauna Kea of Hawai'i Island (Altitude: 4,200-meters)

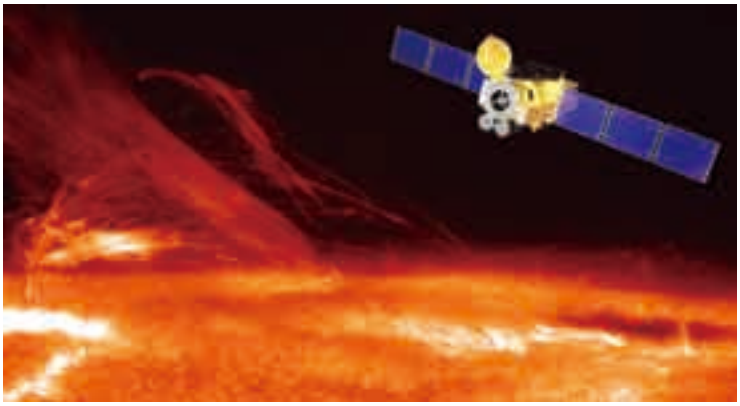
## Nobeyama Radio Observatory (NRO)

The NRO boasts a 45-meter antenna with the highest sensitivity in the millimeter wavelength. The radio telescopes excel in discovering interstellar molecules and black holes as well as revealing the evolution and structure of the universe.

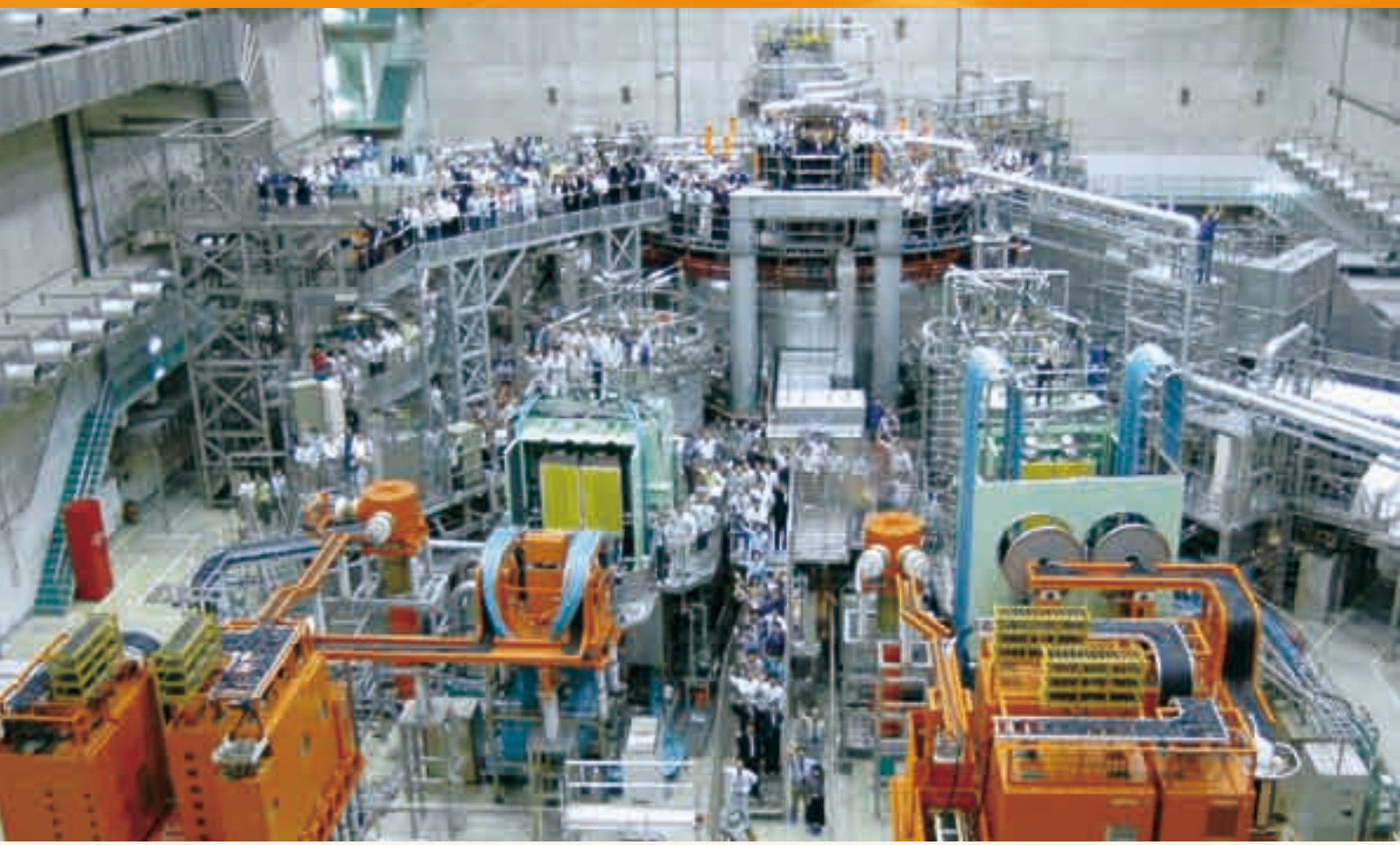
45-meter antenna

## *Hinode*, a solar observational satellite

The *Hinode* (Solar-B), launched on September 22, 2006, is a highly sophisticated observational satellite. Its optical and x-ray telescopes and extreme-UV imaging spectrometer can obtain detailed images and spectra of the sun from the photosphere to the upper corona. NAOJ aims to uncover the formation of the corona and the origin of solar magnetic fields and coronal activities as well as to understand the processes of stellar plasma.



Artistic impression of the solar physics satellite *Hinode* and an image of a dynamic chromosphere taken by the Solar Optical Telescope on *Hinode* (Copyright NAOJ/JAXA)



Large Helical Device (LHD)

# National Institute for Fusion Science

Director General
Akio KOMORI

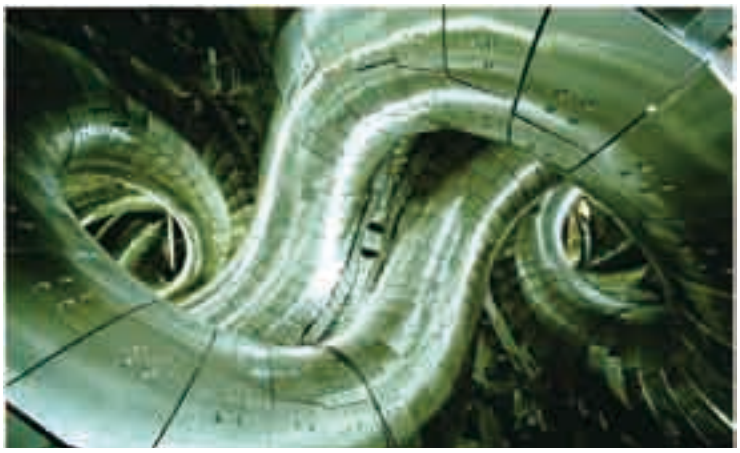
NIFS considers its research to actualize fusion energy as one of the "big sciences" in Japan and strongly promotes academic research in this critical area.

By consuming fossil fuels, human beings have established an industrial world with highly-advanced technology and science. But it turns out the effort has generated a huge amount of carbon dioxide and begun imposing a serious impact on the global environment. Besides, the reserves of these fuels are not unlimited. The current power generation system using the reactions of nuclear fission still faces challenges such as the high-level of radioactive wastes and the doubtful safety of the system, which came to light after the March 11th disaster in Japan. On the other hand, as the global population continues to grow, energy consumption also increases proportionately. Under such circumstances, the research of safe, eco-friendly energy for the future is placed at the top of the agenda in the modern world. Supposing that we would actualize a fusion reaction, an energy source of the sun and stars, on the earth, it would mean that humans will have secured a perpetual source of energy, since deuterium, the fuel for a fusion reaction, is abundantly available in seawater. Also, utilizing low-activation materials will make the materials of reactors reusable, leading to the realization of a "Recycling Society" in its truest sense.

NIFS carries out active collaborative research with domestic and international universities, as well as research organizations. While fostering the next generation of excellent human resources, NIFS will continue to actively promote fundamental research in fusion plasmas with a view to the actualization of safe, eco-friendly fusion energy in the near future.

## Research on high-temparature steady-state plasma utilizing the Large Helical Device

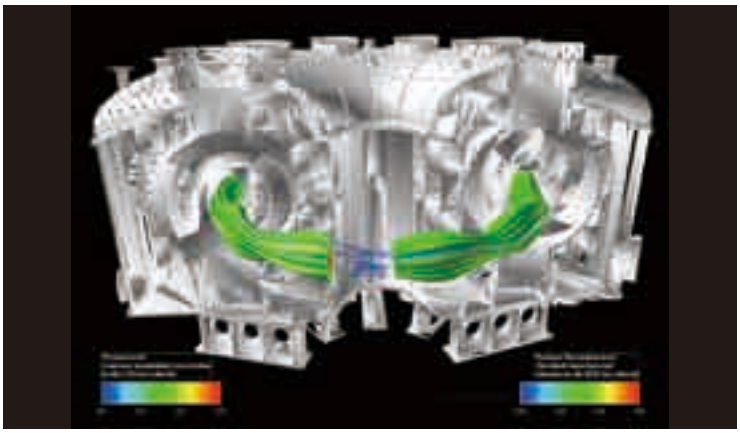
Large Helical Device (LHD) project employs the world's largest superconducting helical coils based on the heliotron magnetic configuration that was originally developed in Japan. The objectives are to conduct research into the physics of high-temperature steady-state plasmas and their related science and engineering, and to promote academic research aimed at the future actualization of a fusion reactor. Plasmas with temperatures of 100 million degrees have been produced several thousand times a year, providing many opportunities for a variety of scientific collaboration.



LHD vacuum vessel

## Numerical simulation research project

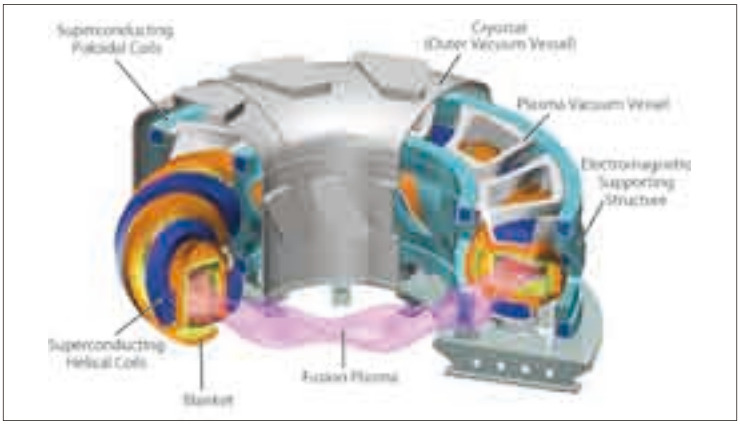
Computer simulation research is indispensable in studying plasmas that have strong nonlinearities causing a variety of complexities. Using a large-scale computer simulation system, this project aims at systematizing plasma physics, clarifying the physical mechanisms of various phenomena in fusion and related plasmas. Complexity science is also explored to support such systematization. The final goal of the project is to numerically simulate fusion reactors.



MHD simulation of LHD plasma

## Fusion engineering Research

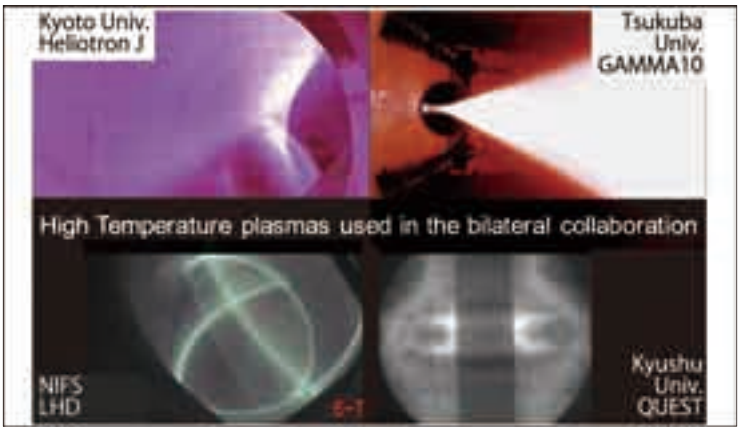
The research focuses on both the detailed design of an LHD-type fusion energy reactor and various engineering challenges to make it possible to construct a fusion reactor. Researches on key components in fusion reactors, such as the superconducting coil system, long-life blanket, low-activation materials, first wall and divertor, are carried out, while maintaininng consistency with the reactor designs.



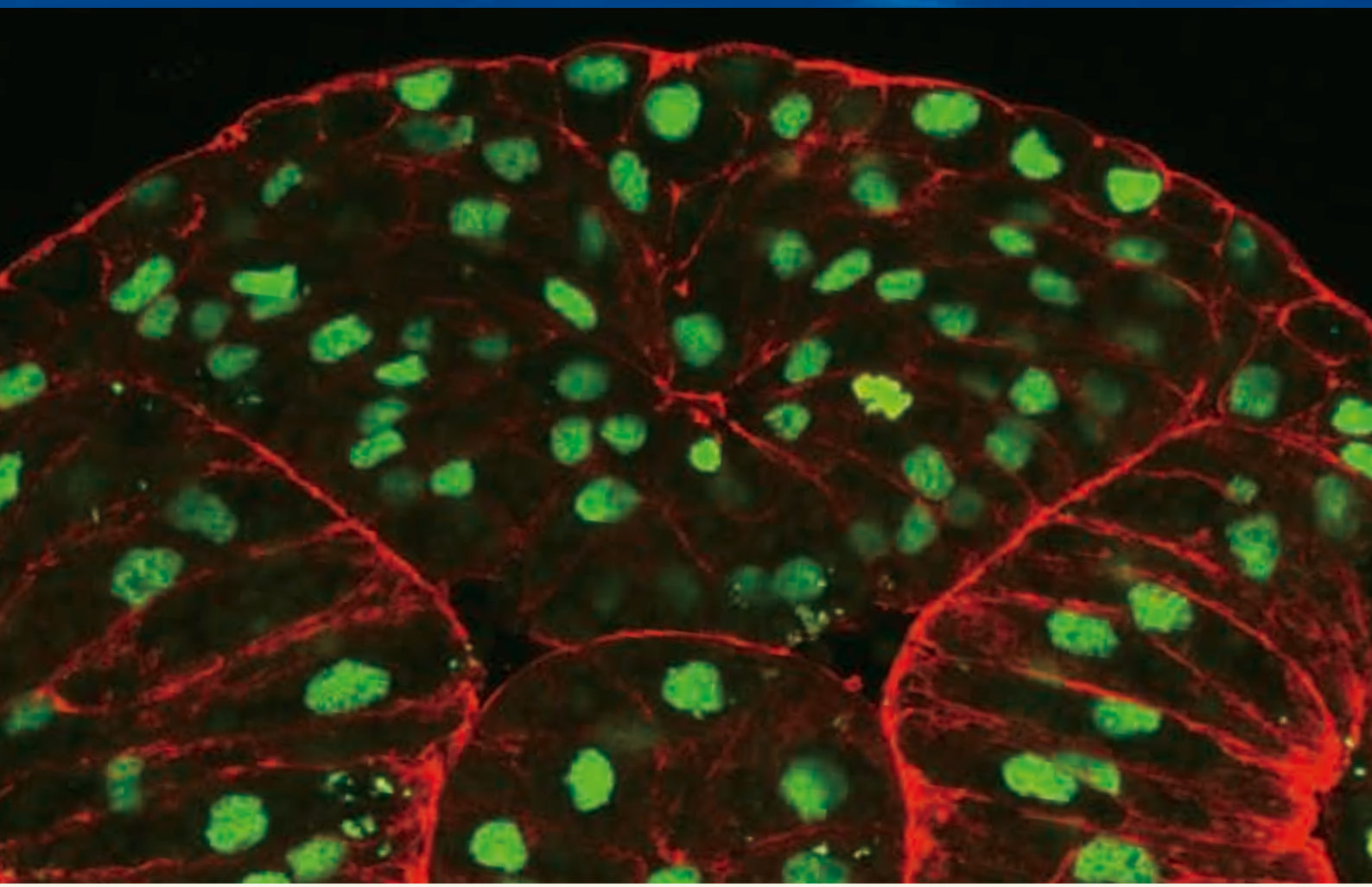

Helical-type fusion reactor FFHR

## Cooperative Research with Universities

The cooperative relationship between NIFS and universities allows us to make good use of plasma devices. By effectively sharing our LHD and other university-owned experimental facilities, we investigate the physics of steady-state ultra-high-temperature plasmas, and also work to meet engineering requirements for the realization of a fusion reactor. Providing plenty of interactive opportunities at the forefront of fusion study, collaborative activities also help yield excellent young researchers including graduate students.




High temperature plasmas in bilateral collaboration (Kyoto Univ., NIFS, Tsukuba Univ., Kyushu Univ.)



A cross sectional view of a frog embryo forming organs

# National Institute for Basic Biology

Director General
Masayuki YAMAMOTO
Term of Office : October 1, 2013 –

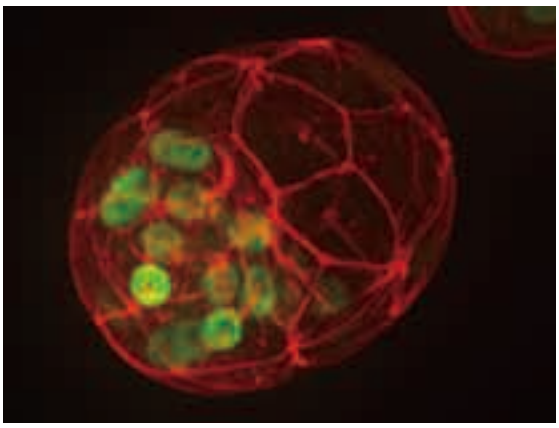
Deputy Director General
Mikio NISHIMURA
Term of Office :
April 1, 2013 – September 30, 2013

Among the innumerable celestial bodies in our universe, the earth appears unique in that it is filled with a variety of living organisms. Over the course of 4 billion years of evolution, animals and plants have acquired diverse forms as well as astonishing abilities and continue to survive on this remarkable planet through the propagation of their offspring. Living organisms are believed to have evolved by increasing the genetic information inherited from their ancestors and by changing the functions of those genes. We believe increased knowledge of the intricate processes of life and the adaptation mechanisms of living organisms will lead to solutions to many of the problems facing us, such as our planet's worsening environment.

To understand the survival strategies of organisms we study the basic principles common to all creatures, and the mechanisms that enable diversity and allow life to adapt to changing environments, by using model organisms in collaboration with worldwide researchers. In order to grow high quality experimental organisms and to enable state of the art data analyses we maintain the "NIBB Bioresource Center" and the "NIBB Core Research Facilities", and work to continually improve our collaborative facilities. Also, in order to prevent the loss of important biological resources during natural disasters, we began operations as the core center of the "Inter-university Bio-Backup Project". As an inter-university research institute NIBB supports the progress of diverse fields of biological research in collaboration with universities and institutes throughout the world.

## Understanding the shape of life

All the organisms on Earth, including all the multitudes of various plants and animals, have specific shapes based on their species. How is it that from the simple single celled ovum all of these complicated forms can arise? We focus on the functions of genes, the movement of cells, and intracellular signaling to study development, using arabidopsis, moss, frogs, and mice. We also study how the cells that create new life in future generations, eggs and sperm, are formed using drosophila, medaka, and mice.



Cell differentiation in a mouse blastocyst

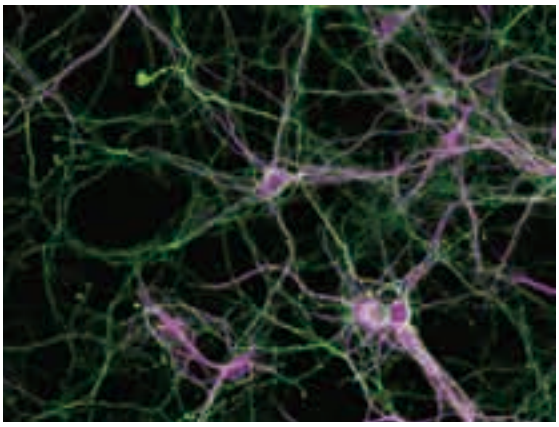
## Mechanisms for adapting to a changing environment

Living creatures have the ability to accurately sense changes in their surrounding environment and adapt appropriately. We focus our research on proteins that act as sensors for detecting environmental changes, like photo-receptors and hormone receptors. We are also engaged in exploring the interactions between organisms known as 'symbiosis'. We use Next Generation Sequencers that can examine changes in vast numbers of genes, and mass spectrometry equipment that can comprehensively analyze proteins. In addition we have introduced environmental control systems that allow precise control over levels of light, humidity, $CO_2$, and temperature. This equipment is used in collaborative research by both Japanese and international scientists from around the world.

The NIBB Bioresource Center's plant environmental control system

## Discovering the form and functions of the brain

The brain and nervous system act as the control tower of an animal. We study the functions of the brain using a variety of methods such as examining the composition of the nerves involved in sight, the actions of the neurons involved in memory, the neuronal circuits that determine behavior, etc. We also study the evolution of the brain to understand how we ourselves, humans, came to possess our higher brain functions.

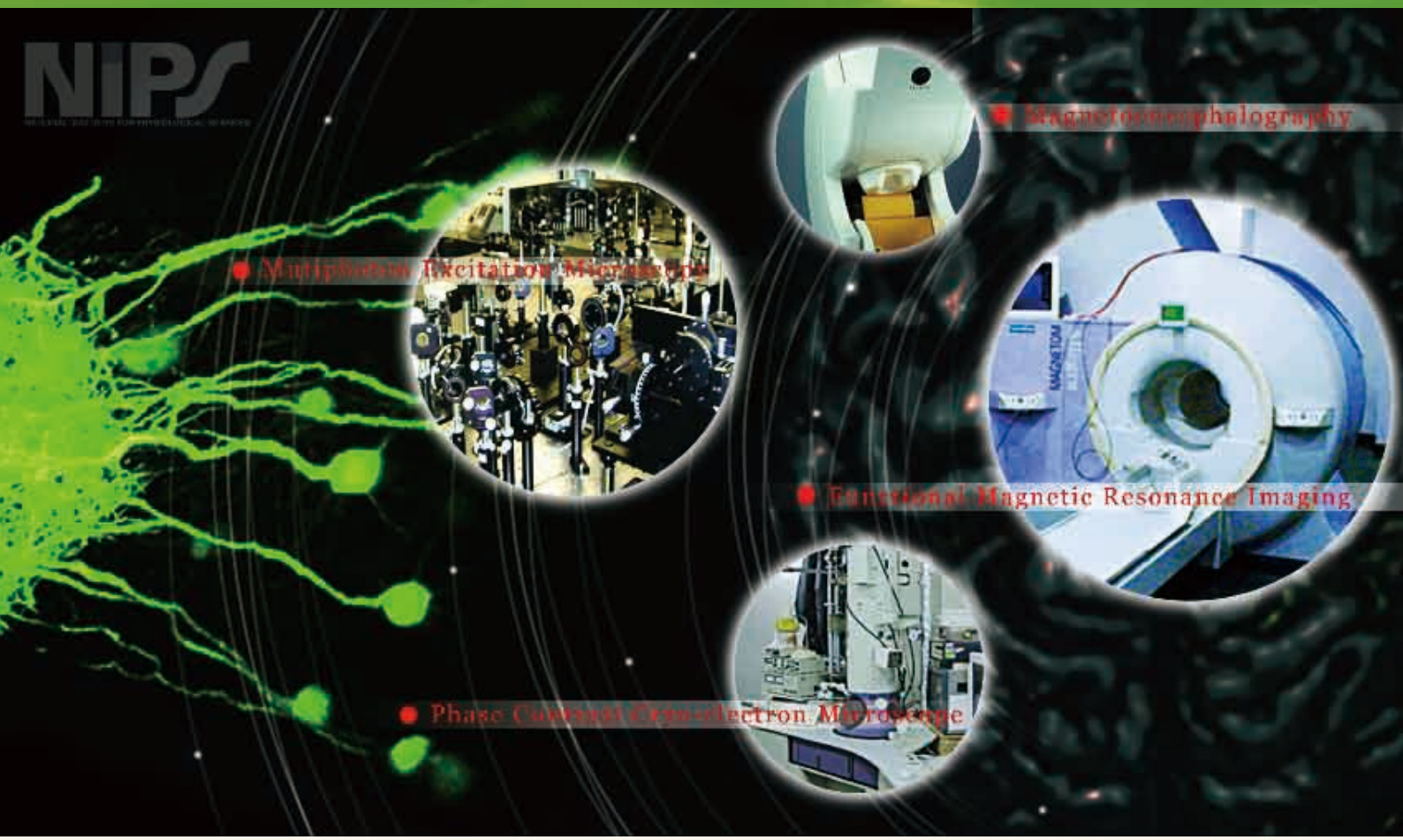


Primary cultured neurons from mouse brain

## Research resources and education

In recent years the field of biology has advanced quickly through focused research on model organisms that are well-suited to study. As the core institution for the National Bioresource Project Medaka, as well as a sub-center for morning glory research, NIBB collects, preserves, and provides important biological resources to other institutes. In order to achieve wider, greater understanding of fundamental biological phenomena, NIBB is constantly working towards the development of new model organisms, as well as holding International Practical Courses to promote and disseminate advanced experimental techniques. Furthermore, NIBB is also actively involved in education through our Ph.D program, striving to give quality education to those students who will become the next generation of researchers.

International Practical Courses for research on Medaka and *Physcomitrella patens*




Specialized equipments and large-scale facilities for joint researches to promote brain science

# National Institute for Physiological Sciences

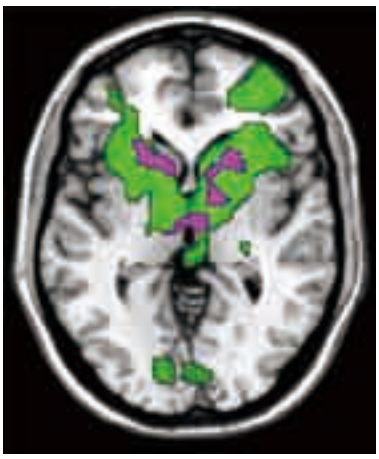
Director General
Keiji Imoto

NIPS' mission is to conduct research at the forefront of physiological science by examining the living body at various levels of organization, thus leading to a holistic understanding of the functioning of the human body. Recent progress in life sciences has been truly remarkable, and there have been tremendous developments especially in molecular biology and genetic engineering. Non-invasive imaging techniques have also become very useful for clarifying the physiological functions of the human body. Recently, NIPS has been mainly focusing on brain science, and it is now considered to be one of the best brain research institutes not only in Japan but also in the world.

With the key phrase "Elucidation of the Functioning of the Human Body," NIPS is performing cutting-edge research in multiple fields involving not only physiology but also biochemistry, molecular biology, morphology, cognitive science, and medical engineering. NIPS provides its facilities and expert staff to domestic and foreign scientists for collaborative studies.

## Exploring the higher functions of the human brain

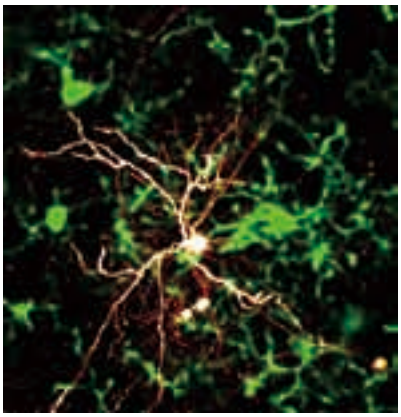
NIPS is promoting research on the higher functions of the human brain including language functions and value judgments, and interpersonal relationships, as well as perception, cognition, and motion. To measure brain activity, we utilize functional brain imaging instruments including functional MRI (fMRI) scanner and near-infrared spectroscopy (NIRS) scanner for detecting local circulation and energetic metabolic changes in the brain, and magnetoencephalography (MEG) for detecting higher temporal resolution of brain electrical activity, with the goal of attaining a dynamic and comprehensive understanding of the higher functions of the human brain.



Activity of the striatum subjected to monetary reward (green) and social reward (red)
When being praised by other people, the brain's reward system (striatum) reacts as when making money.

## Investigating neural circuit activities in the brain

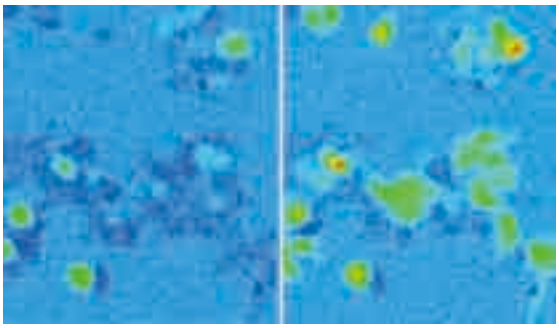
The direct recording/imaging of neuronal activity *in vivo* is a powerful technique to understand how neuronal circuitry functions in brain. Recently, we applied various genetically modified techniques for manipulating specific neural circuit activities of mice and macaque monkeys to elucidate their functions. In addition, we are working to determine the pathological condition of the neurological disorder by means of disease-model animals with Parkinson disease or epilepsy.



Bioimaging of the brain cortex of a mouse expressing DsRed (red fluorescence protein) on nerve cells and GFP (green) on microglia

## Clarifying the mechanisms underlying body homeostasis and its development

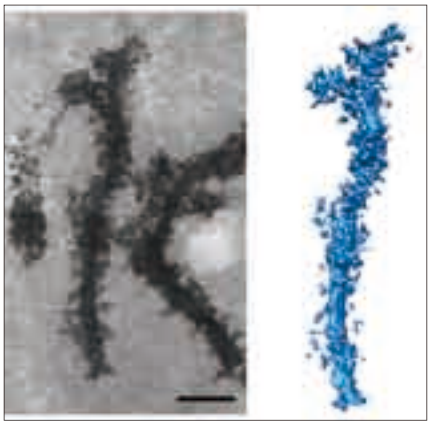
We are studying the mechanisms underlying body homeostasis and its development. Various molecules, complicated cellular and organ functions, and interaction with neural activities are key factors of the homeostasis such as maintenance of cell size, body temperature, and body balance. The basic research provides the scientific basis of health guidelines as well as evidences for better understanding of the disease.



Painless expressing cultured cells respond to higher temperature (40 degree Celsius, in right panel) to increase intracellular calcium concentration (light color)

## Developing and applying novel research techniques for medicine, physiology, and neuroscience

To study medicine, physiology, and neuroscience in a systematic manner from molecules to individuals, we are developing novel research techniques for collaborative researches. For example, we developed dual fMRI system for simultaneous recordings of the brains of two individuals when the individuals are communicating with each other. We provide advanced electromicroscopy and laser microscopy for collaborative researches. We also provide valuable research resources such as virus vector, transgenic mouse and rat, and macaque monkeys to domestic researchers in Japan.



We successfully created a 3D reconstructed image of neural dendrites by using medical/biological high-voltage electromicroscopy.

# Institute for Molecular Science

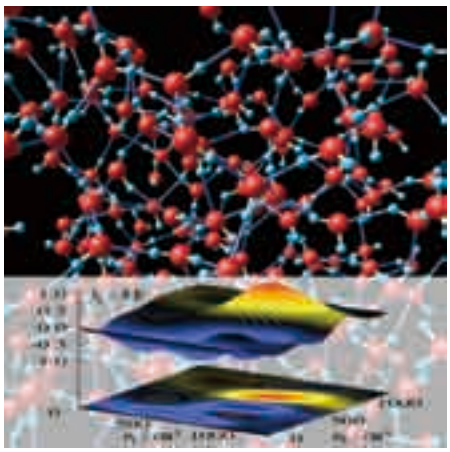
Director General
Iwao OHMINE

Almost all substances—including water, air, and living bodies—are made up of molecules, and their natures are closely related to the structures and functions of molecules constituting the materials. Molecular science is a fundamental discipline that gains, via experimental and theoretical investigations, deeper insights into the interactions between molecules and into chemical reactions that cause transformation of molecules. By finding novel characteristics of molecules and molecular assemblies, and by synthesizing new materials with desired properties and functionalities, molecular science provides invaluable clues to resolving future energy and environmental crises. By doing so, the research field will contribute to building new scientific and technological tools which are indispensable for realizing a sustainable society. As a Center of Excellence in molecular science, on which a wide range of research fields are based, the IMS encourages concepts and methodologies to be uniformly applied in a variety of scientific fields.

IMS' main research areas are theoretical and computational molecular science, photo-molecular science, materials molecular science, and life and coordination-complex molecular science. In each area, the frontiers of science are being explored by independent research groups led by professors or associate professors who take full initiative in original research activities. The IMS has also been continuing efforts to further promote molecular science all over the world by supporting various collaborative research programs in which many researchers in Japan and abroad fully utilize IMS' state-of-the-art facilities and by constructing a solid cooperative network with research centers in East Asia.

## Drawing vivid figures of molecules by theory and computation

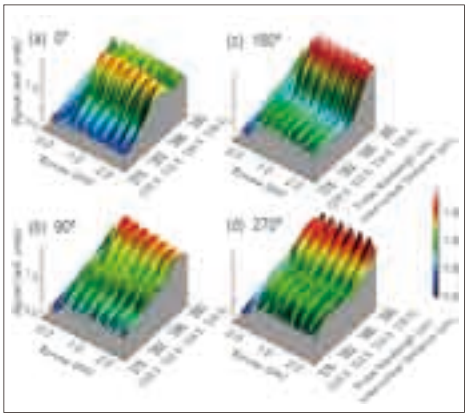
Behaviors of molecules and molecular assemblies are governed by the fundamental laws of physics, i.e., quantum mechanics and statistical mechanics. In the area of theoretical and computational molecular science, new theories and concepts are constructed on the basis of these fundamentals in physics. Large-scale calculations are carried out utilizing high-performance computers to achieve truly microscopic descriptions of various phenomena appearing in the real world and to predict the novel properties and functionalities of materials. In addition, IMS has been contributing to national projects on development and application of next-generation supercomputers, as a core center to elucidate the microscopic mechanisms of self-organization and functionalities in bio-molecules and nano-scale assemblies.



Theoretically predicted liquid structure of water and 2D infrared spectrum associated with intermolecular vibration of water

## Using light to capture lively figures of molecules

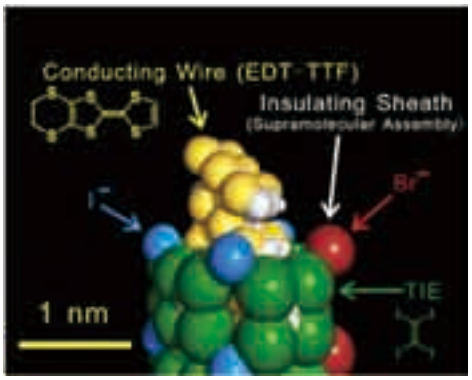
Light is one of the most valuable tools for detailed experimental examination of the characters of molecules and molecular assemblies. No field—from material science to bioscience—can proceed without utilizing light. In the area of photo-molecular science, highly active investigations are performed to develop light sources with unsurpassed performance such as the synchrotron radiation facility, which generates intense light in a wide frequency region from X-ray to terahertz, and microchip lasers, which are quite compact but still have surprisingly high output. These light sources are utilized for studies on the properties, functionalities, and reactivities of materials. This research area establishes the foundation for a wide range of fields in science through cutting-edge research on photo-molecular science, including the real-time probing of ultrafast structural changes of molecules, direct optical microscopic imaging of nanometer-scale assemblies, and precise quantum control of molecular motion and reactions.



Spatiotemporal images of molecular vibration, actively tailored by precisely controlled ultra-fast laser pulses

## Designing molecules at nanometer scale

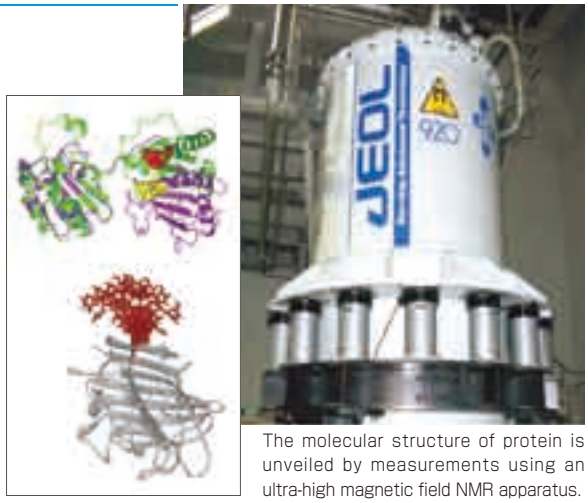
For synthesizing valuable compounds without undesirable by-products and creating new materials with novel functionalities, it is necessary to take precise control of molecules and molecular assemblies. In the area of material molecular science, active researches are in progress to develop synthetic technologies for various chemical compounds with atomic-scale precision and to construct methods for well-designed molecular assemblies. These researches are expected to lead to findings of heretofore undiscovered chemical and physical phenomena at the nanometer scale and contribute to other fields in science and technology such as information, communication, and energy-conversion processes.




Molecular wire with one nanometer diameter created from combined molecules

## Learning from biological functionalities to develop waste-free chemical reactions

Various biological functionalities in living bodies are closely correlated to the behavior of molecules. In the area of life and coordination-complex molecular science, various advanced methods of research have been developed in the field of molecular science, e.g., state-of-the-art thermometric and spectroscopic measurements including nuclear magnetic resonance (NMR). These methods are extensively applied in conjunction with molecular biologic technologies such as genetic modification to studies on the structure and functionalities of proteins, which play an important role in living bodies. Active research is also underway on the development of efficient light-energy conversion to chemical energy and innovative organic synthesis free from unwanted byproducts.




The molecular structure of protein is unveiled by measurements using an ultra-high magnetic field NMR apparatus.

# International Hubs for

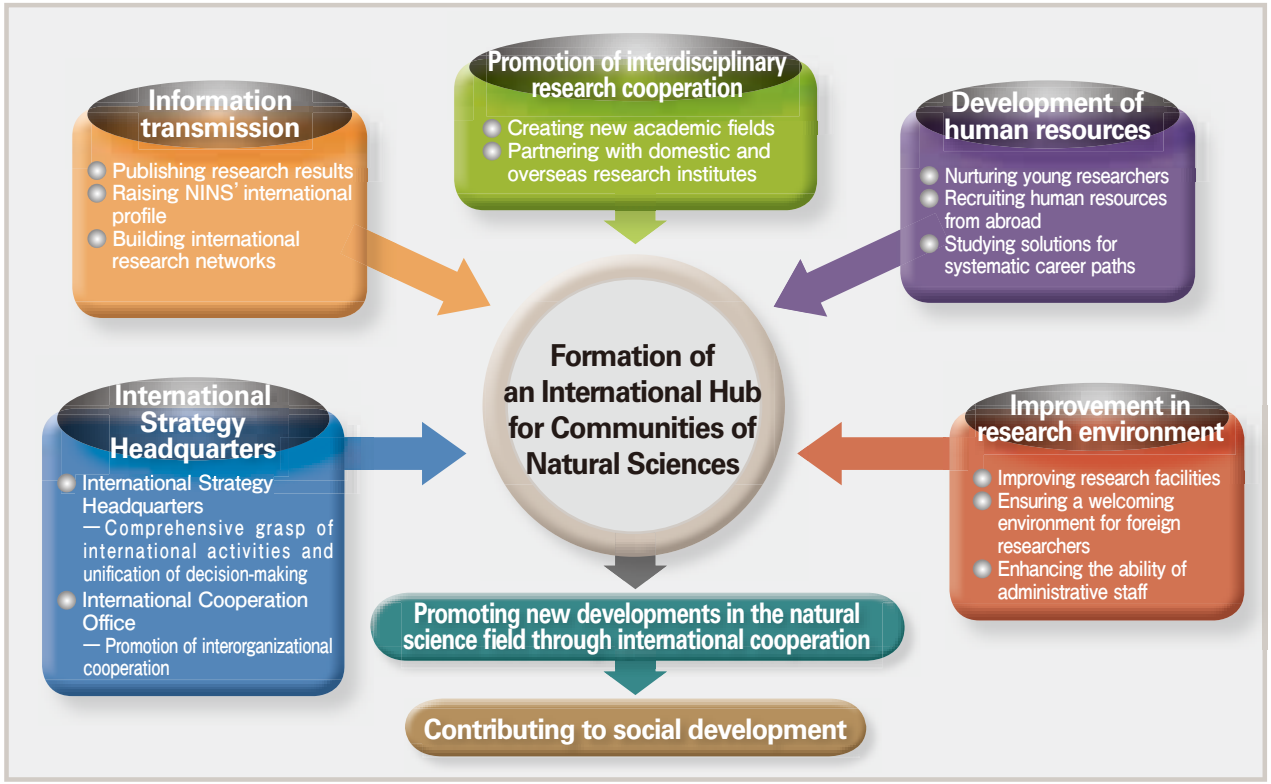
## International Strategy

In response to diversification of research and accelerated scientific progress in natural science, it is getting more essential to promote research through a new type of cooperation that crosses both national borders and academic fields.

NINS consists of the five institutes: NAOJ, NIFS, NIBB, NIPS, and IMS. NINS has not only been supporting international efforts that they are making to become hubs in their own fields, but also been trying to establish a cross-disciplinary hub that connects researchers on different fields in an international framework.

With an eye toward "the formation of an international hub for natural sciences researchers", and helped by researchers' communities, the International Strategy Headquarters in NINS are managing the members' international activities in a matrix manner — organizing them both horizontally and hierarchically, to bring about a scientific innovation. In 2012, the headquarters drew up a concrete plan titled "NINS International Strategy Action Plan". By implementing this, we will strengthen NINS' functions to secure its place as an international academic centerpiece.

### NINS' International Strategies




Visit by Prof. A.J. Stewart Smith, Dean for Research, Prof. Edwin L.Turner of Princeton University

Opening ceremony of the ALMA telescope built through international cooperation

# Natural Sciences Research

## Main contracting research institutions with NINS


# Research Cooperation

NAOJ, NIFS, NIBB, NIPS, and IMS are Japan's Centers of Excellence in academic research in their respective fields. Since its inception, NINS has aimed at creating new research fields through the coordination of the inter-disciplinary activities among these five research institutes and promotion of collaborations with universities for the formation of new research communities.

NINS established CNSI in 2009 with the two fields of Imaging Science, created from interdisciplinary collaborative activities among the five institutions, and Brain Science, for the promotion of a national inter-university network in the field of brain science. In addition, CNSI established a new research field in 2013 with an eye toward the creation of a new field in astrobiology which is drawing increasing attention with the advances in astronomy these days and a flurry of new discoveries which indicate the possible presence of life. NINS has been extending the community of creative researchers, and continues to support the promotion of research that facilitates the further development of academic field with CNSI at the core.

Furthermore, under the leadership of the president, NINS is deploying various efforts including the fostering of young researchers, the strengthening of international cooperation, the program for cross-disciplinary study by young researchers with an eye toward the promotion of interdisciplinary collaboration, and the program for international research collaborator exchange aimed at research promotion and interdisciplinary exchange through the implementation of flexible collaborative research with overseas research institutes, etc.

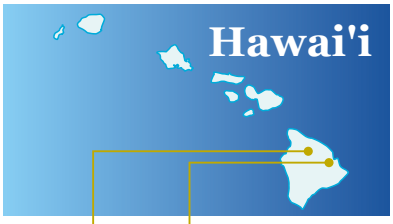
NINS
National Institutes of Natural Sciences
SINCE APRIL 2004

Inter-University Research Institute Corporation
National Institutes of Natural Sciences

# Facilities

Japan

- Department of Helical Plasma Research Rokkasho Research Center, NIFS
- Mizusawa VLBI Observatory, NAOJ
- Ine Laboratory, NINS
- Norikura Observatory, NINS
- Nobeyama Radio Observatory, NAOJ
- Nobeyama Solar Radio Observatory, NAOJ
- **NINS 【Head Office】**
- Center for Novel Science Initiatives
- **NAOJ**
- **NIFS**
- **NIBB**
- **NIPS**
- **IMS**
- Okazaki Research Facilities
- Okayama Astrophysical Observatory, NAOJ
- Subaru Telescope, NAOJ




- NAOJ Chile Observatory


## National Institutes of Natural Sciences (NINS)

2F 4-3-13 Toranomon, Minato-ku, Tokyo 105-0001, Japan
Phone +81-3-5425-1300 FAX +81-3-5425-2049
URL http://www.nins.jp/english/

## National Astronomical Observatory of Japan (NAOJ)

2-21-1 Osawa, Mitaka, Tokyo 181-8588, Japan
Phone +81-422-34-3600 FAX +81-422-34-3690
URL http://www.nao.ac.jp/E/

## National Institute for Fusion Science (NIFS)

322-6 Oroshi-cho, Toki, Gifu 509-5292, Japan
Phone +81-572-58-2222 FAX +81-572-58-2601
URL http://www.nifs.ac.jp/index.html

## National Institute for Basic Biology (NIBB)

38 Nishigonaka, Myodaiji, Okazaki, Aichi 444-8585, Japan
Phone +81-564-55-7652 FAX +81-564-53-7400
URL http://www.nibb.ac.jp/en/

## National Institute for Physiological Sciences (NIPS)

38 Nishigonaka, Myodaiji, Okazaki, Aichi 444-8585, Japan
Phone +81-564-55-7700 FAX +81-564-52-7913
URL http://www.nips.ac.jp/eng/

## Institute for Molecular Science (IMS)

38 Nishigonaka, Myodaiji, Okazaki, Aichi 444-8585, Japan
Phone +81-564-55-7418 FAX +81-564-54-2254
URL http://www.ims.ac.jp/