National Astronomical Observatory of Japan

National Institute for Fusion Science

National Institute for Basic Biology

National Institute for Physiological Sciences

Institute for Molecular Science

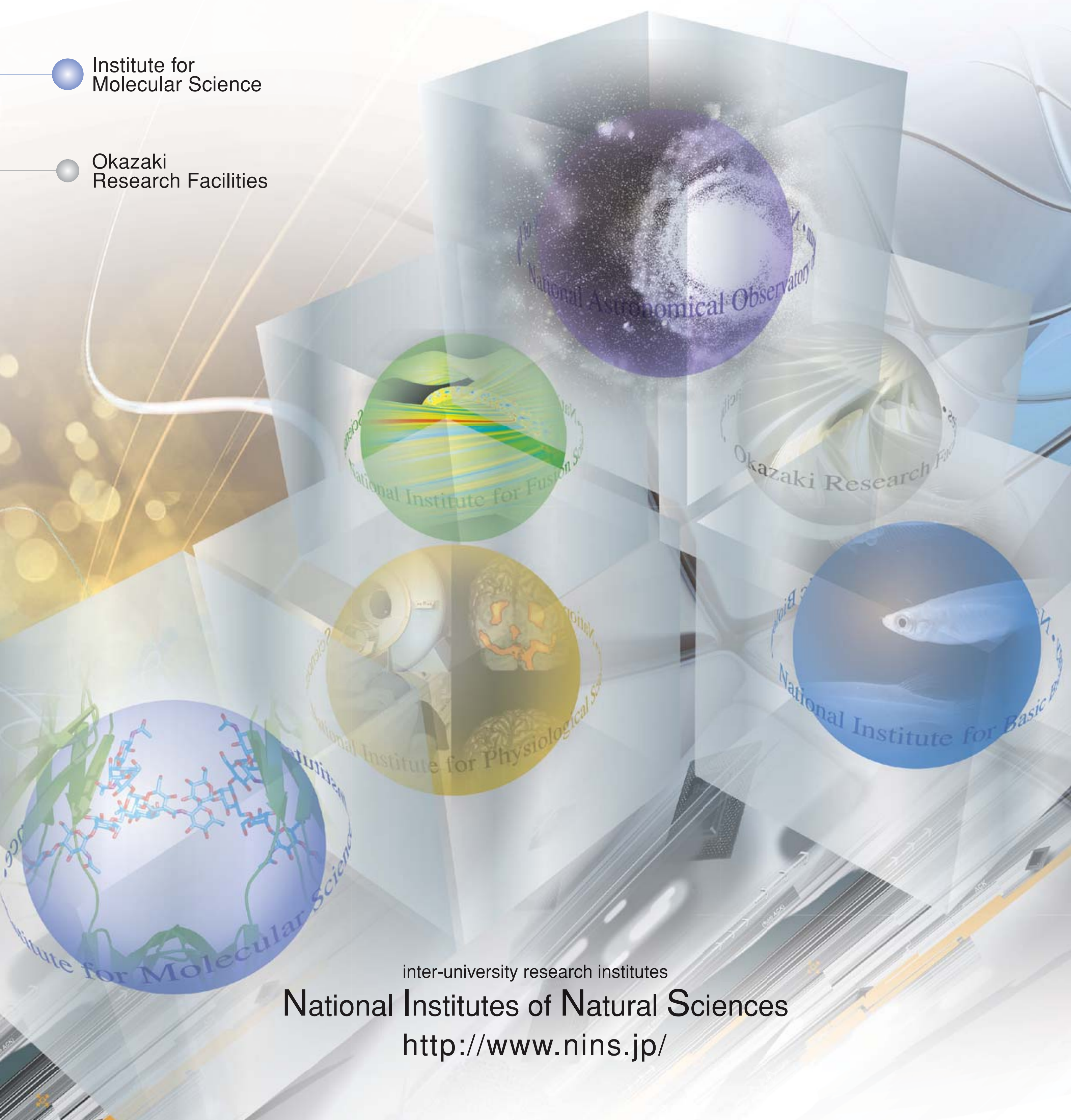
Okazaki Research Facilities

NINS

National Institutes of Natural Sciences

SINCE APRIL 2004

2008–2009



inter-university research institutes

National Institutes of Natural Sciences

http://www.nins.jp/

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Message from the President

Inter-University Research Institutes
National Institutes of Natural Sciences
President
Yoshiro SHIMURA

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, the National Institute for Fusion Science, the National Institute for Basic Biology, the National Institute for Physiological Sciences and the Institute for Molecular Science. 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. As an inter-university research institute, in addition to promoting pioneering research in key academic areas, it is anticipated that NINS will serve as a center for cultivating future academic disciplines. Ultimately, NINS' approach of "academic research aimed at excavating and exploring problems" is its main goal, rather than "scientific and technological research aimed at solving problems."

NINS aims at contributing to the further development of natural science in the five institutes, promoting cutting-edge and interdisciplinary research that makes use of related research fields of expertise. NINS has also been actively involved in cooperation and collaboration with universities and their affiliated research institutes. Furthermore, as a research center for natural science in Japan, through initiatives in exploring and uncovering problems in novel research fields and tasks in natural sciences, NINS is also enhancing human resources in each field through measures such as the education of graduate students.

In particular, with respect to research, NINS aims at improving its role and function by further promoting the area-specific research undertaken by each institute. At the same time, taking advantage of being part of a single corporation, researchers from the five institutes can collaborate to find novel fields and reveal new problems in natural science. At present, we have chosen "Imaging Science" as a common theme and are developing alliance-oriented activities among the different fields of the institutes.

In addition, as an interdisciplinary research center for natural science, NINS plans to further strengthen the collaboration between Japan and organizations in Europe, the U.S. and East Asian countries. NINS is well positioned to implement the formation of international research centers in which outstanding researchers are organized on a global scale. To practically work towards these goals, NINS has established the International Strategy Headquarters to carry out its international affairs. In this context, NINS has already concluded agreements concerning international joint research with the European Molecular Biology Laboratory (EMBL), the European Southern Observatory (ESO) and the National Science Foundation (NSF) as the first steps towards forming an international research center.

In summary, as we welcome our fifth year of operation, we can reflect on the advances in the past years and the achievements in research that already have been realized, and our vision is looking forward to tomorrow. In various areas of the natural sciences, including astronomy, energy science, life sciences, and material science, we are implementing the highest standards of research in the world. At the same time, we are overcoming the barriers that exist between different fields and are nurturing new cutting-edge research areas. Our aims are to create new concepts of academic learning and to contribute to society.

We are grateful for your continuous support of our vision.

The World's Leading Research Institutes in Japan

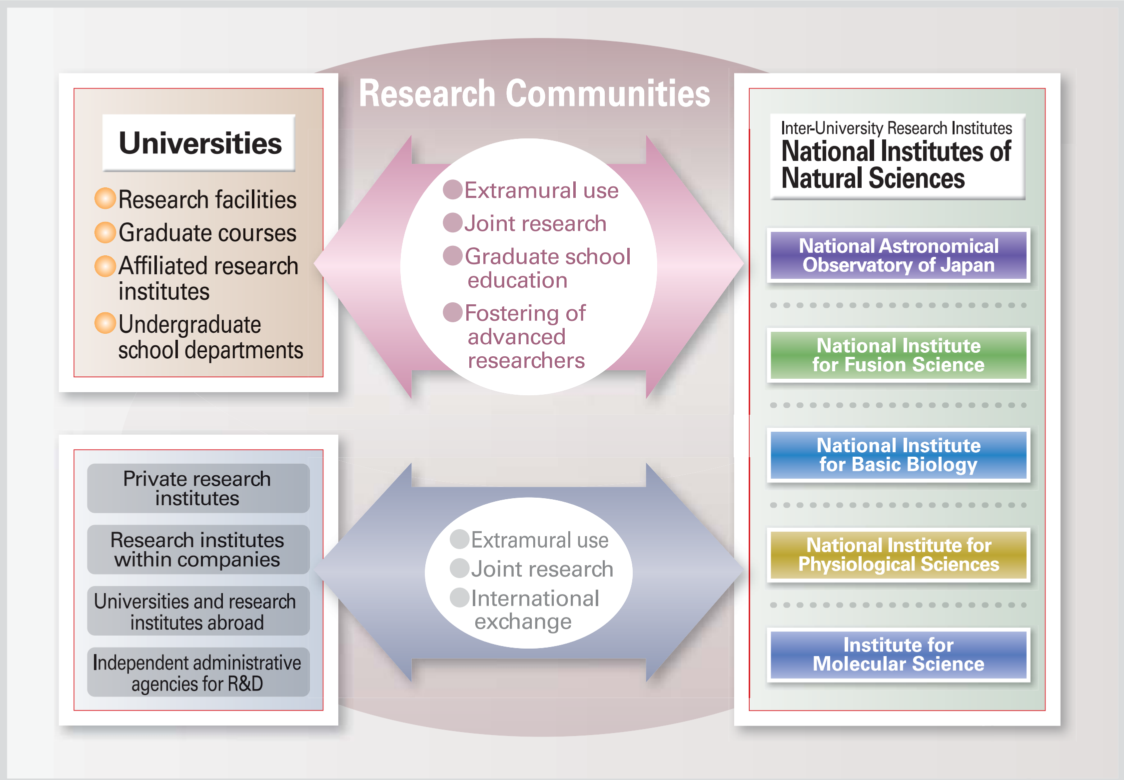
The National Institutes of Natural Sciences (NINS) consists of five inter-university research institutes: the National Astronomical Observatory of Japan (NAOJ), the National Institute for Fusion Science (NIFS), the National Institute for Basic Biology (NIBB), the National Institute for Physiological 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.

What is an Inter-University Research Institute?



History

NAOJ
- 1888 — Tokyo Astronomical Observatory was established in the Faculty of Science, University of Tokyo.
- 1924 — Relocated from Azabu Iikura to Mitaka
- 1988 — NAOJ was established.

NIFS
- 1989 — NIFS was established.
- 1997 — NIFS was relocated from Nagoya to Toki.
- 1998 — NIFS started to perform LHD experiments.

NIBB
- 1977 — NIBB was established.
- 1977 — National Center for Biological Sciences was established.

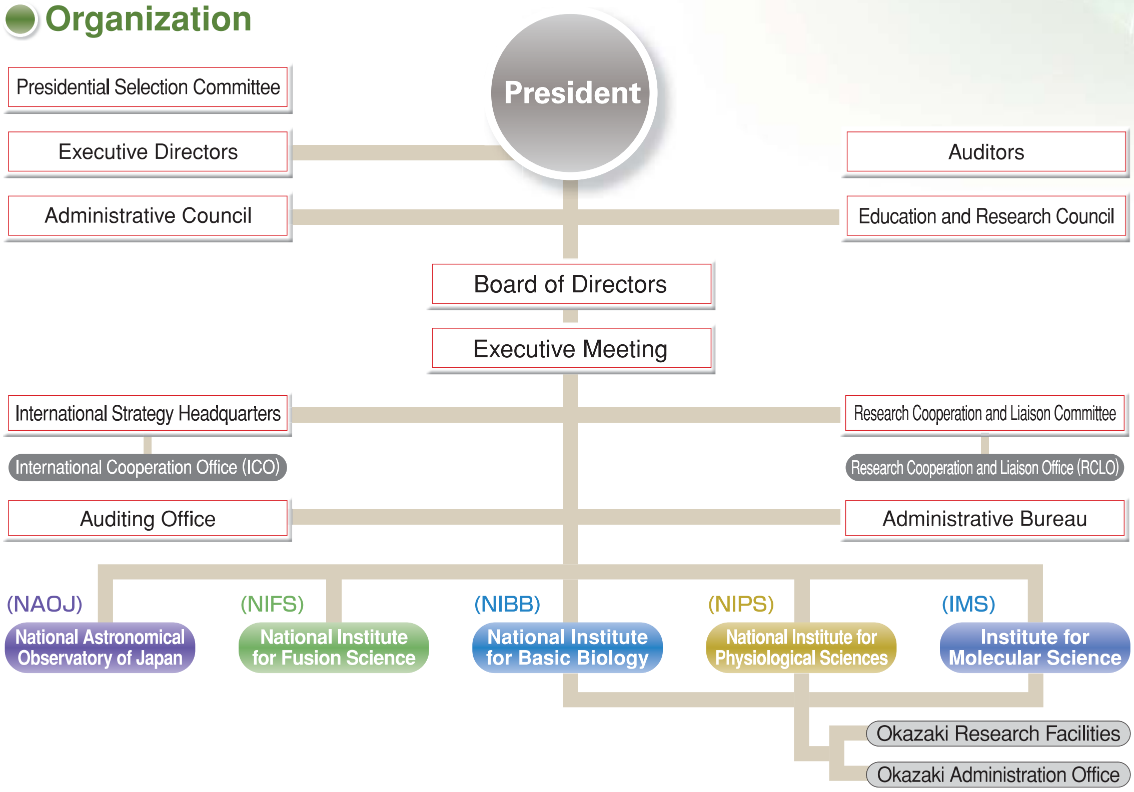
NIPS
- 1977 — NIPS was established.
- 1981 — Okazaki National Research Institutes was established.
- 2000 — Okazaki Research Facilities (Okazaki Institutes for Integrative Bioscience, Research Center for Computational Science, Center for Experimental Animals, Center for Radioisotope Facilities) was established.

IMS
- 1975 — IMS was established.

2004 — NINS was established.

History & Organization

Organization



NAOJ

National Astronomical Observatory of Japan

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.

A spiral galaxy M100 (NGC4321) as seen on a face on orientation. The central orange region of M100 has an older collection of stars.

NIFS

National Institute for Fusion Science

NIFS implements collaborative research into the basic sciences of high-temperature plasmas and reactor engineering. Researchers use computer simulations and experiments with the Large Helical Device as their leading projects in order to realize “a sun on the earth,” controlled nuclear fusion, which is a new, safe, and environmentally friendly energy source.

The Large Helical Device (LHD) maintains high temperature plasmas in steady state.

NIBB

National Institute for Basic Biology

The earth is filled with living organisms exhibiting various forms and demonstrating shapes and behaviors fitted for 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.

Digital Scanned Laser Light-Sheet Fluorescence Microscope (DSLM) introduced from EMBL as part of ongoing collaborative research activities

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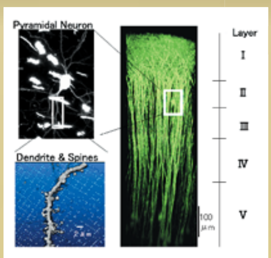
NIPS

National Institute for Physiological Sciences

NIPS' goals are to reveal the mechanisms by which the human body functions. This is the basis of medical science and links to clarifying the pathophysiology of various diseases. Furthermore, as a center of physiological research, the institute provides facilities and research staff for collaborative studies to domestic and foreign scientists.

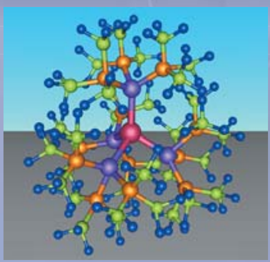


Multi-photon laser microscopic *in vivo* imaging of cortical neurons and fine structures

IMS

Institute for Molecular Science

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, a policy which has fostered many joint programs involving IMS scientists.



A nanometer-scale dendrimer (tree-like molecule) with novel functions

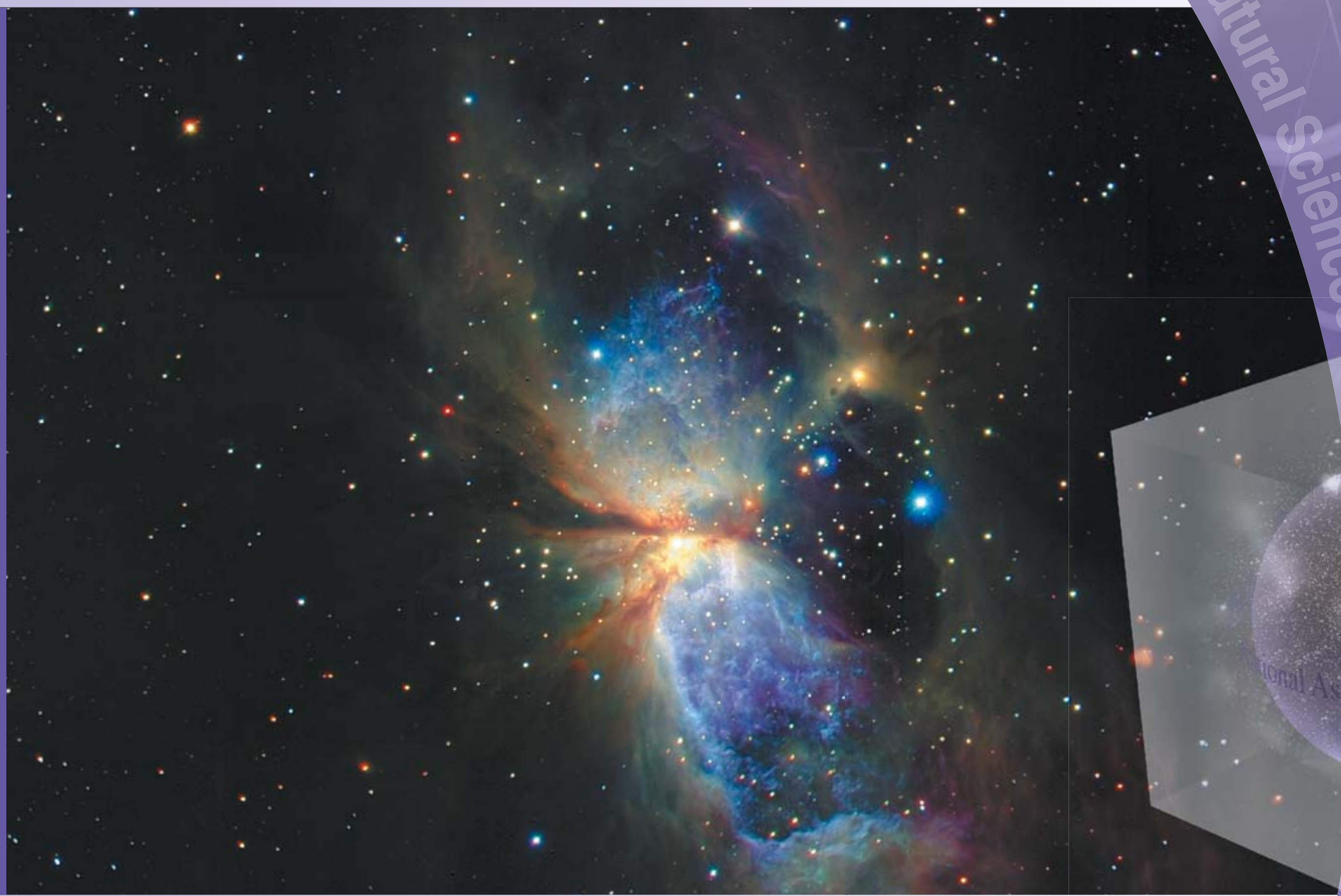
Okazaki Research Facilities

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.

NAOJ

National Institutes of Natural Sciences

National Astronomical Observatory of Japan



Director-General
Shoken MIYAMA

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 Japan, Europe and North America in cooperation with the Republic of Chile to build an international radio astronomy facility on the 5,000-meter Chilean plateau. NAOJ is leading the construction and operation of ALMA on behalf of the Japanese and Taiwanese science communities. By pointing all the antennas in unison toward a single astronomical object and combining their signals, ALMA will unveil mysteries in the universe such as the formation of galaxies at a distance of 13 billion light years, the formation of stars and planets, and the synthesis of organic molecules. Full operation is planned to start in 2012.

12-meter antennas of ALMA-Japan constructed at the ALMA Operations Support Facility in Chile

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)

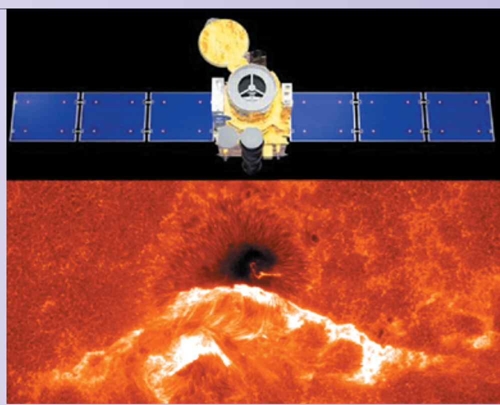
Nobeyama Radio Observatory (NRO)

The NRO boasts a 45-meter antenna with the highest sensitivity in the millimeter wavelength and a millimeter array consisting of six 10-meter antennas. The radio telescopes excel in discovering interstellar molecules and black-holes as well as revealing the evolution and structure of the universe. In Chile, the ASTE 10-meter telescope plays a world-leading role in submillimeter observations.

Nobeyama Millimeter Array (front) and the 45-meter antenna (rear)

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.

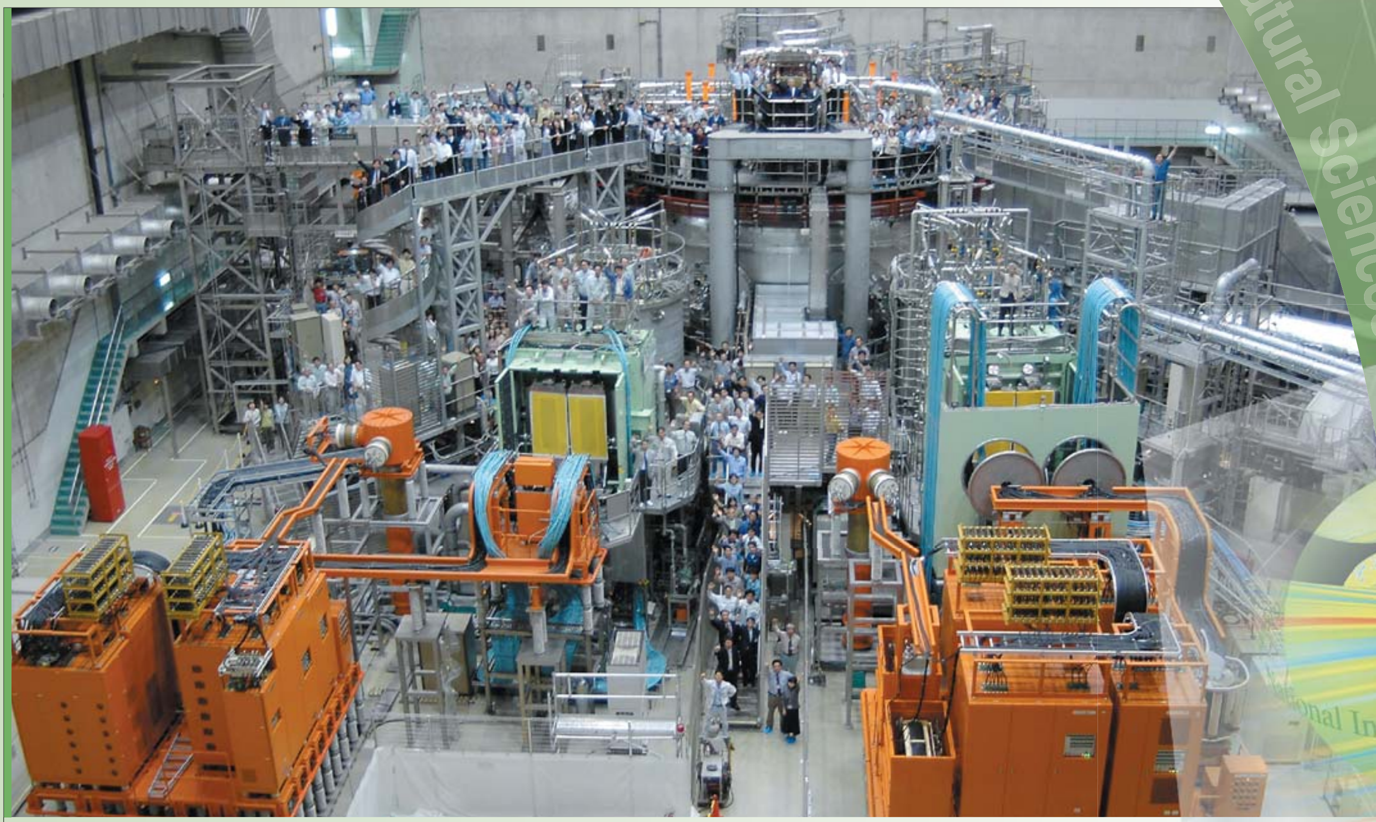


An artist's conception of the *Hinode* in its orbit and a solar flare observed in Ca II H (397nm) Copyright NAOJ/JAXA

NIFS

National Institutes of Natural Sciences

National Institute for Fusion Science



Director-General
Osamu MOTOJIMA

NIFS considers its research to actualize nuclear fusion energy as one of the major “big sciences” in Japan and strongly promotes research in this critical area.

The industry-driven, high-tech world that humans have achieved in the recent era is largely built upon energy sources such as nuclear power and fossil fuels like coal, petroleum, or natural gas. Unfortunately, heavy consumption of those fossil fuels results in generating a substantial amount of CO_2, aggravating problems in the global environment. Besides, there is a limit to our reserves. Furthermore, current nuclear power generation based on atomic fission reactions leaves serious issues, as typified by the disposal of high-level radioactive wastes, still unsolved. On the other hand, as the global population continues to grow, energy consumption also increases proportionately. Under such circumstances, the development 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 nuclear 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 nuclear fusion reaction, is contained in seawater. Also, utilizing low-radioactive materials will make major metallic materials reusable, leading to the accomplishment of cyclical-type energy in the true sense.

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

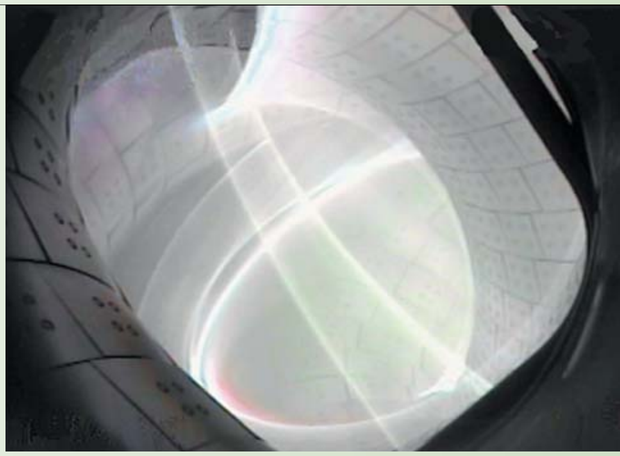
The Large Helical Device Project

The 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 steady-state high-temperature plasma confinement research and to promote academic research aimed at the actualization of a helical-type nuclear fusion reactor in the future.

The LHD vacuum vessel

Physics of high-temperature steady-state plasmas

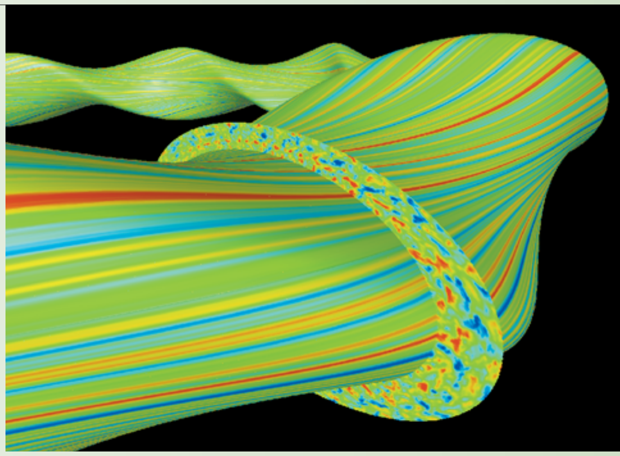
In order to clarify the physical mechanisms that define extremely high-temperature steady-state plasmas, experimental research in LHD are advanced in conjunction with bilateral collaboration in experimental devices in universities. Plasmas with temperatures of 100 million degrees have been produced several thousand times per year, allowing many opportunities for a variety of scientific research.



LHD plasma

Large-Scale Simulation Research Project

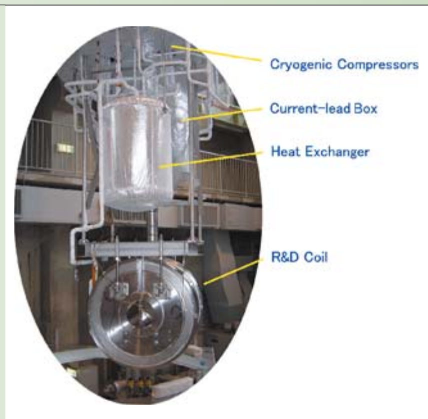
Research by computer simulation is indispensable to study plasmas that have strong nonlinearities causing a variety of complexities. Using large-scale computer simulation, this project aims at systematizing plasma physics, clarifying the physical mechanism of various phenomena in fusion and related plasmas. Complexity science is also explored to support such systematization.



Simulation of ion temperature gradient turbulence

Engineering research for realizing fusion reactors

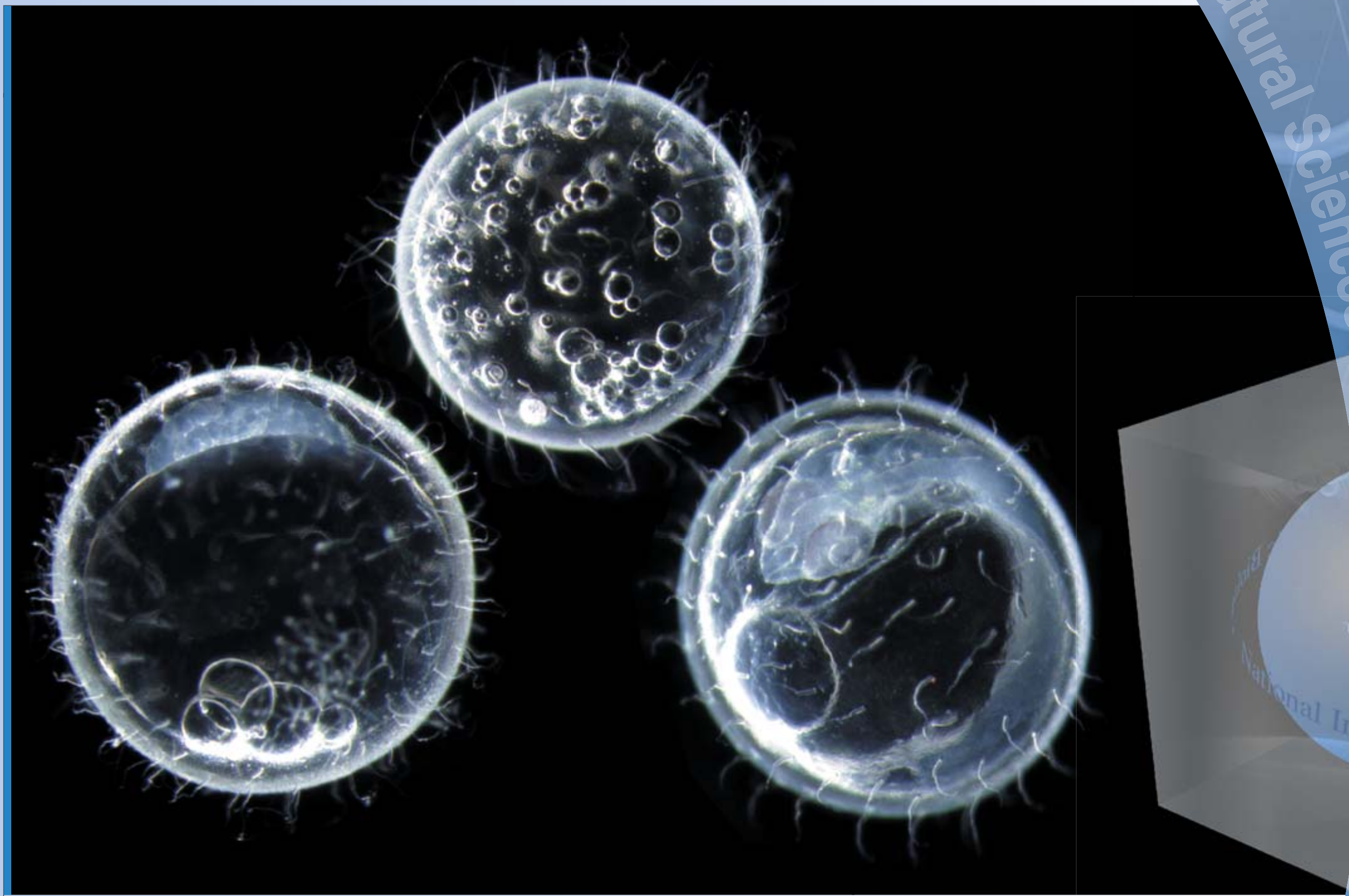
A broad range of engineering studies, such as the improvement of superconducting coils, the development of low-activating materials and advanced blankets, design studies on future fusion reactors, and investigation into the safety features of a fusion system, are conducted as an inter-university research institute in the field of reactor engineering. The returns of these achievements to industries are being promoted through collaborative research activities.



R&D superconducting magnet system with sub-cooled liquid helium

NIBB

National Institute for Basic Biology



Director-General
Kiyotaka OKADA

Among innumerable celestial bodies in the universe, the earth appears unique in that it is filled with various living organisms. After 4 billion years of evolution, animals and plants have acquired diverse forms as well as astonishing abilities and continue their existence on earth by bearing offspring. Living organisms are believed to have evolved by increasing the genetic information inherited from their ancestors and by changing the functions of genes.
To understand the survival strategies of organisms, the NIBB studies the basic principles common to all creatures and the mechanisms that enable diversity by using model animals and plants. Increased knowledge of the adaptation mechanisms of living organisms is expected to lead to solutions to our planet's worsening environmental problems.

Sequencing the genome of a moss

The ancestors of plants evolved in water and gradually advanced onto land in order to gain a new survival niche, producing a comfortable environment for animals as they did so. To elucidate the genetic evolutions necessary for plants to endure harsh ground environments such as dryness and UV irradiation, we have to sequence the genomes of many terrestrial plant species. As a result of an international collaboration that included scientists from six countries, the genome of a moss, *Physcomitrella*, was successfully sequenced. As the moss holds a taxonomical position far removed from rice or *Arabidopsis*, whose genomes have been previously sequenced, we are able to research the essential characteristics of terrestrial plant genomes.

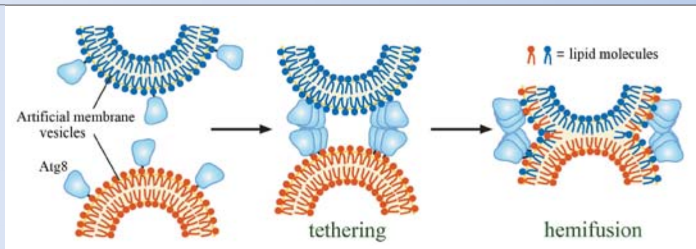
The moss *Physcomitrella*

Reproductive cells affect sexual differentiation of the whole body

Reproductive cells are the ancestors of sperms and eggs needed to pass on life to the next generation. Although the reproductive cells differentiate into sperms and eggs in the gonads, they originate in a distant part of the body and migrate into the gonads. Inhibiting this migration in medaka resulted in medaka with gonads containing no reproductive cells. The sex of individual medaka is normally determined by a combination of sex chromosomes, just like in humans. The medaka without reproductive cells, however, showed male body characteristics, including patterns of sex hormone secretions and gonad structure, irrespective of the sex chromosomes present in each fish. This result provided a new view that the reproductive cells, besides their differentiation into gametes, dictate the sexual differentiation of the whole body.

Medaka with gonads containing no reproductive cells showing male body characteristics

Mechanisms of membrane fusion, a basis of the recycling system in the cell



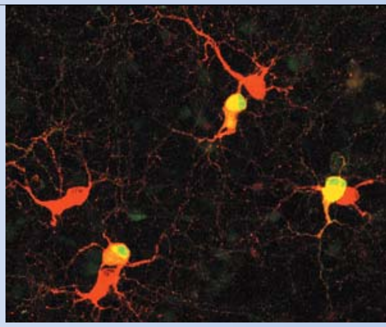
A schematic drawing of the process of hemifusion formation by the Atg8 protein (pale blue)

【Hemifusion】
A biological membrane is made up of two layers of lipid molecules. Hemifusion is an intermediate stage of membrane fusion where the outer layers of each vesicle are fused while the inner layers remain intact. "Hemi" means "half."

An intricate balance between synthesis and degradation is essential for a cell to live. "Autophagy" is a major process of degradation in which unnecessary cellular components are surrounded by a membrane and are fused with the cellular "stomach" vesicles, such as lysosomes and vacuoles. The molecular mechanisms of autophagy have been intensively studied using yeast at the NIBB. In an experiment using an artificial membrane, the Atg8 protein, an indispensable element of autophagy, was found to create a membrane configuration called "hemifusion." This is an important development as we elucidate the mechanism of membrane fusion in the process of autophagy.

Distinguishing the retinal ganglion cells

The retina of the eye, located in the same position as film in a camera, bears not only light-sensing cells but also many nerve cells (retinal ganglion cells) that analyze light patterns on the retina. The retinal ganglion cells of mammals are classified into 12 or more groups according to their morphology and the nerves from each group transfer different kinds of visual information to the brain. At early stages of development, the distinction between these groups is difficult to ascertain, and the developmental change of nerve cells has been difficult to follow. Recently, we found that a specific group of retinal ganglion cells, which convey information about light moving upward and downward in the eye, can be discriminated using a gene called "SPIG1." This is an important clue as to how the nerve circuit is formed in the retina.



A pair of retinal ganglion cells, each of which is stimulated by light moving either upward or downward in the eye, is located in the retina as a pair of cells is either expressing the SPIG1 gene (yellow) or not expressing it (red).

NIPS

National Institutes of Natural Sciences

National Institute for Physiological Sciences

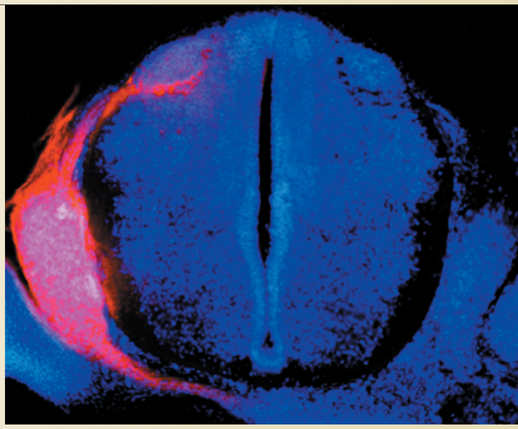
Director-General
Yasunobu OKADA

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 observation techniques have also become very useful for clarifying the physiological functions of the human body. Recently, NIPS has been focusing on brain science, and it is now considered to be one of the best brain institutes not only in Japan but also in the world.

A new interdisciplinary research center, the Center for Integrative Bioscience, was founded in 2000 in cooperation with the Institute for Molecular Science and the National Institute for Basic Biology. In addition, NIPS has launched a joint research project on biosensor molecules. Recently, we established the "Center for Multidisciplinary Brain Research" to promote brain science as an interdisciplinary multidimensional science in Japan. 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, biology, cognitive science, and medical engineering. NIPS provides its facilities and expert staff to domestic and foreign scientists for collaborative studies.

Clarifying the mechanisms underlying neural development

The researchers at NIPS are studying the development of neural systems and body homeostasis. For example, developing mammalian spinal cords are composed of several regions formed along the dorso-ventral axis and each region generates site-specific neurons and glial cells. Subsequently, the neural network is formed by directed axogenesis. These developmental phenomena are crucial for functional brain formation. Our research is focusing on examining the molecular mechanisms underlying cell differentiation and network formation.

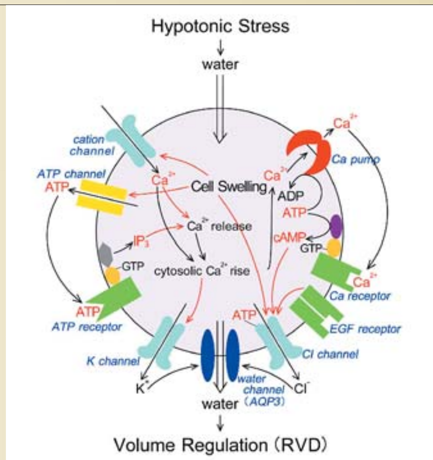


This figure shows projections of primary sensory fibers in the spinal cord by labeling DRG with red fluorescent dye.

Investigating the molecular mechanisms of cell functions

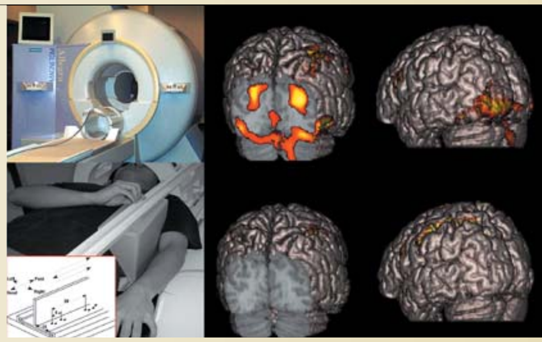
The human body is composed of over 10 trillion cells, and its survival or death is supported and determined by the functioning of these cells. NIPS is investigating the mechanisms by which cells function at the molecular level such as channels, transporters, and receptors, and the operating mechanisms of these functional molecules.

The molecular mechanism of a regulatory volume decrease (RVD). Cell swelling induces the activation of multiple receptors and channels, leading to the activation of Ca^{2+}-dependent intracellular mechanisms. The resultant KCl efflux drives water efflux, thereby restoring the original cell volume.



Exploring higher brain function

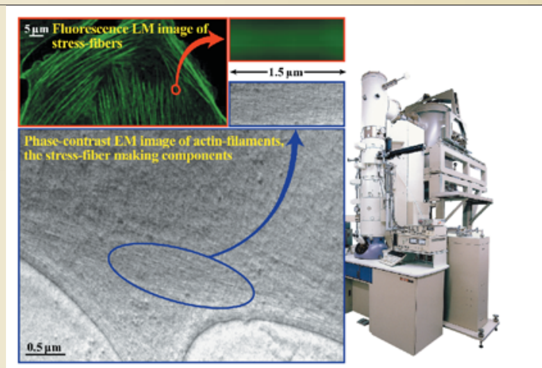
One of NIPS' research goals is to understand higher brain functions such as perception, cognition, and motor control in primates including humans. Electrophysiological techniques include single neuron recordings as well as noninvasive functional neuroimaging techniques, mainly functional MRI (fMRI) and magnetoencephalography (MEG), in combination with multimodality approaches including electroencephalography (EEG), transcranial magnetic stimulation (TMS) and near-infrared spectroscopy (NIRS).



Cortical plasticity of the blind revealed by functional MRI (upper left). Brain areas are activated by Braille tactile discrimination tasks. In the blind subject, activity was seen in the occipital lobe which includes the primary visual cortex (upper panels). In contrast, no activation of the occipital lobe was seen in the sighted subject (lower panels). This finding indicates that the visual cortex is involved in the tactile processes of the blind.

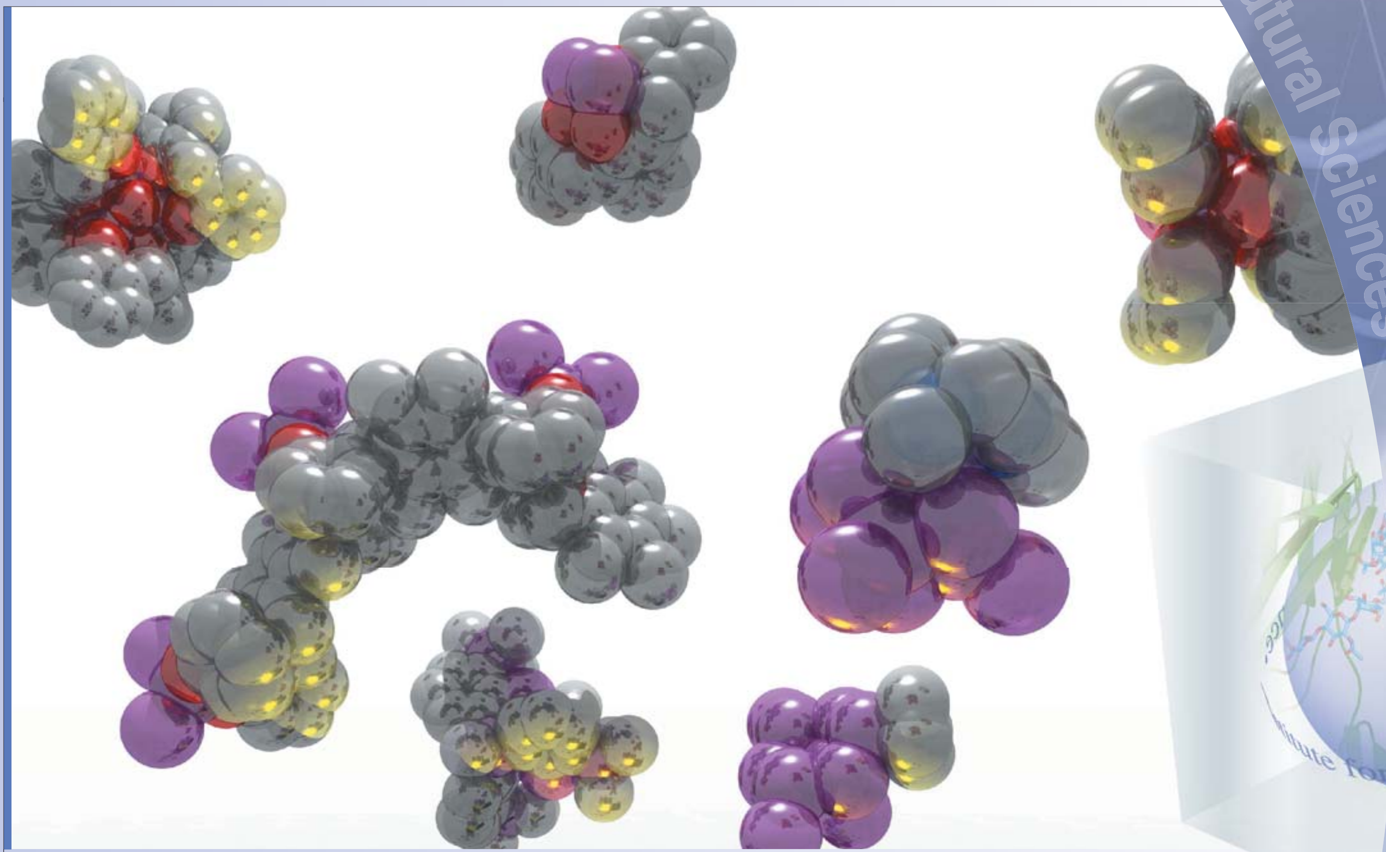
Visualizing biological functions at a nanometer scale

One of the goals of NIPS' researchers is to understand cellular functions with high spatial and temporal resolutions. Innovated phase-contrast electron microscopes, in conjunction with quick freezing or high-pressure freezing techniques, can visualize functional structures of the cell *in vivo* with a molecular resolution (1 nm). This is one of the central themes for post-genomic science and allows us to visualize the dynamics of intracellular proteins translated by gene information.



A 300kV phase contrast cryo-electron microscope (right). Fluorescent light microscopic image of phalloidin-stained intracellular stress fibers (upper left). Hilbert differential TEM image (300kV) of actin filaments wherein bundles correspond to stress fibers (lower left). Comparing resolution (upper middle).

Institute for Molecular Science



Director-General
Hiroki NAKAMURA

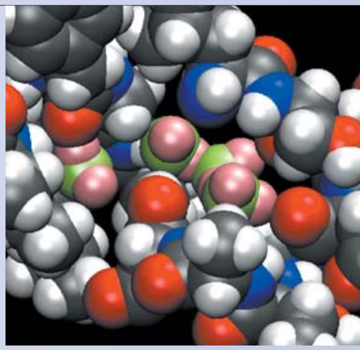
Almost all substances – including water, air, and living bodies – are made up of molecules, and their natures are closely related to the structures and functions of molecules constituting the materials. Molecular science is a fundamental discipline that gains, via experimental and theoretical investigations, 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's 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.

NAOJ
NIFS
NIBB
NIPS
IMS

Drawing vivid figures of molecules by theory and computation

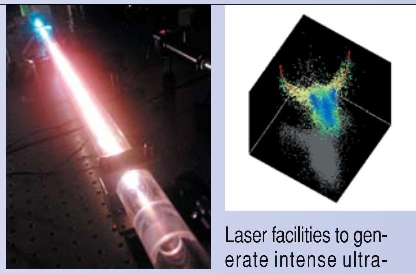
Behaviors of molecules and molecular assemblies are governed by the fundamental laws of physics, i.e., quantum mechanics and statistical mechanics. In the area of theoretical and computational molecular science, new theories and concepts are constructed on the basis of these fundamentals in physics. 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 particular, since 2006, IMS has been contributing to the Ministry of Education's national project on Development & Application of Advanced High-Performance Supercomputer as the core center in nano-science to elucidate the microscopic mechanisms of self-organization and functionalities in bio-molecules and nano-scale assemblies.



Water molecules confined in cavities in a protein, visualized by the 3D-RISM method, a novel computational methodology based on statistical mechanics

Using light to capture lively figures of molecules

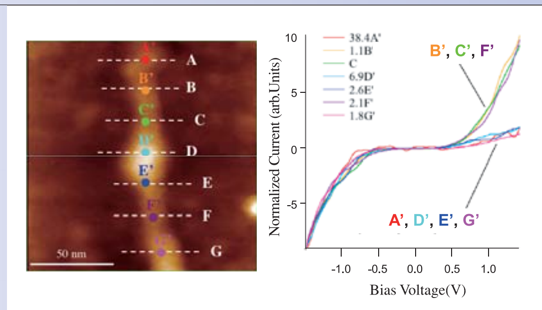
Light is one of the most valuable tools for detailed experimental examination of the characters of molecules and molecular assemblies. No field – from material science to bioscience – can proceed without utilizing light. In the area of photo-molecular science, highly active investigations are performed 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.



Laser facilities to generate intense ultra-short light pulses (with time duration < 10^{-14} second) and the fragment pattern observed when a molecule is dissociated explosively by the irradiation of the light

Designing molecules at nanometer scale

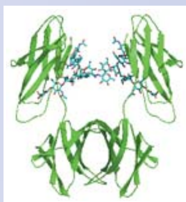
For synthesizing valuable compounds without undesirable byproducts and creating new materials with novel functionalities, it is necessary to take precise control of molecules and molecular assemblies. In the area of material molecular science, active researches are in progress to develop synthetic technologies 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. In addition, the Nanotechnology Support Project is underway to support various collaborative researches in the fields of nano-scale measurement and analyses, ultra-precision material processing, and advanced syntheses of molecules and materials.



Electric characteristics of a single-walled carbon nano-tube adsorbed with several organic molecules, investigated at nanometer-scale spatial resolution

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, synthetic systems for activating small molecules like N_2 and CO to produce useful chemical products, innovative organic synthesis free from unwanted byproducts, and novel biosensors based on nanoscale semiconductor processing.



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

Efforts for Forming Bases for Interdisciplinary and International Research through Cooperation Across Fields of Study

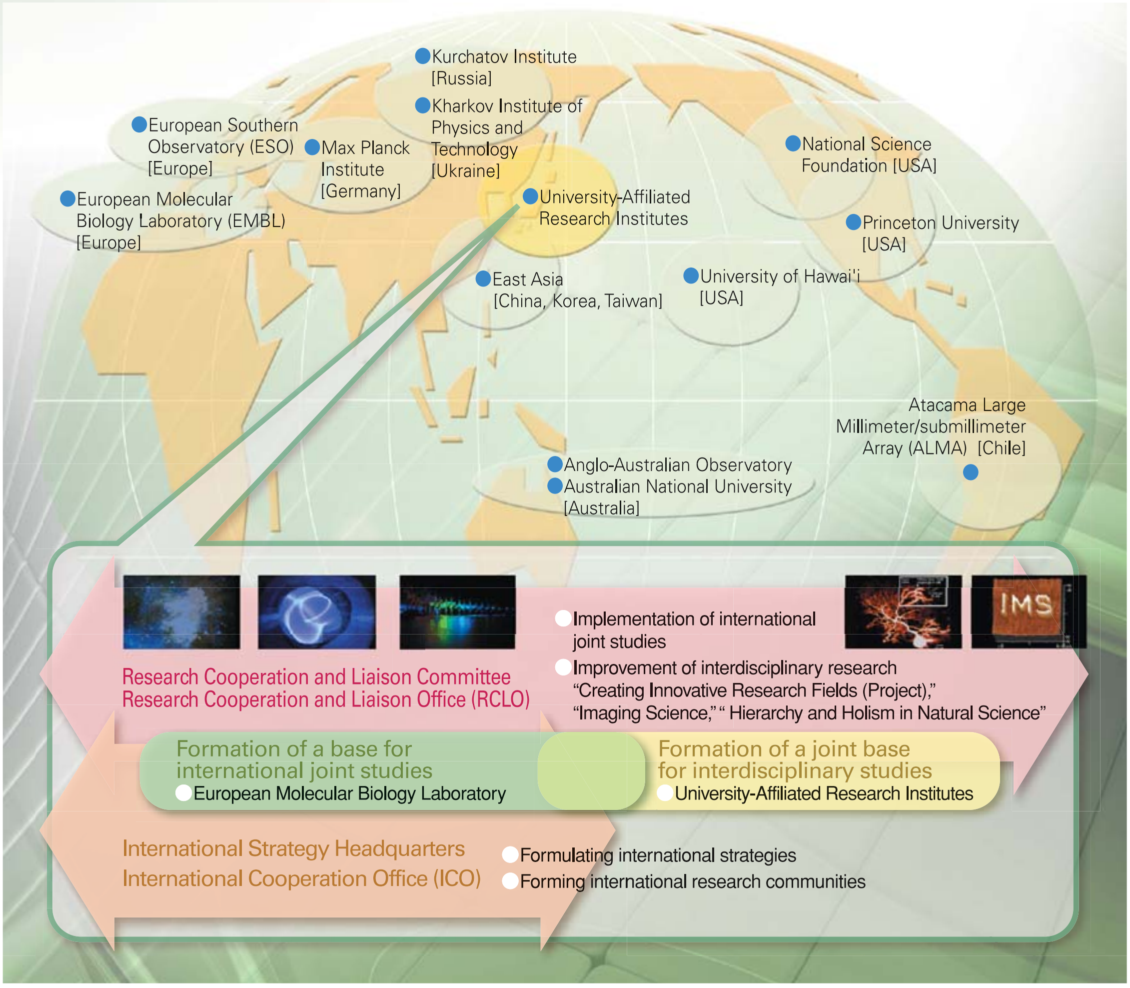
The five institutes established under the National Institutes of Natural Sciences (NINS) – NAOJ, NIFS, NIBB, NIPS and IMS – are Japan's Centers of Excellence of academic research in their respective fields. These institutes, coordinating activities with each other beyond the borders of academic fields, actively cooperate as bases for interdisciplinary research with universities, university-affiliated research institutes, and inter-university research institutes in the field of natural science. Together, these institutes promote the formation of new research communities. NINS also actively collaborates with institutes in the U.S., Europe, and Eastern Asia for the purpose of forming a base for international research involving the coordination of reputable researchers on a global basis.

In order to promote the formation of such interdisciplinary and international bases across fields of study, NINS established the Research Cooperation and Liaison Committee, under the authority of the President, to discuss and plan matters relating to research cooperation. It has also established the Research Cooperation and Liaison Office (RCLO), which is in charge of undertaking specific plans made by the Research Cooperation and Liaison Committee, and implementing liaison activities including symposia.

Since FY2005, in cooperation with the five member institutes, the RCLO has been aiming at the development of new fields with the themes "Imaging Science" and "Hierarchy and Holism in Natural Science." Up to this time, we have demonstrated achievements in organizing international symposia and shown successful results in developing new technologies. From now, we will continue to broaden our community of researchers and delve more deeply into our designated research fields.

Research Cooperation

Formation of an Interdisciplinary and International Research Base



Formation of an International Hub for Communities of Natural Sciences

The creation of new research fields in natural science will become possible as competent researchers in various fields cooperate with each other beyond the borders of their academic fields and form new research communities. In order to achieve this, it is necessary to strengthen cooperation with international research communities and overseas research institutes as well as deepen mutual understanding and implement active joint research.

Working toward formation of an international research base among the five institutes, NINS has established the International Strategy Headquarters to unify decision-making for its international activities. It also has set up the International Cooperation Office (ICO) for inter-organizational management of international activities and support for those activities in each institute.

The International Strategy Headquarters establishes international strategies aiming at the "Formation of an International Hub for Communities of Natural Sciences." With support and cooperation from the research community, it also promotes new approaches for the development of natural science. Furthermore, the ICO is implementing activities designed to enhance the international perspective of NINS' administrative staff. During this past year, the ICO conducted an intensive staff training seminar at NAOJ's facilities in Hawai'i.

International Cooperation

NINS' International Strategies

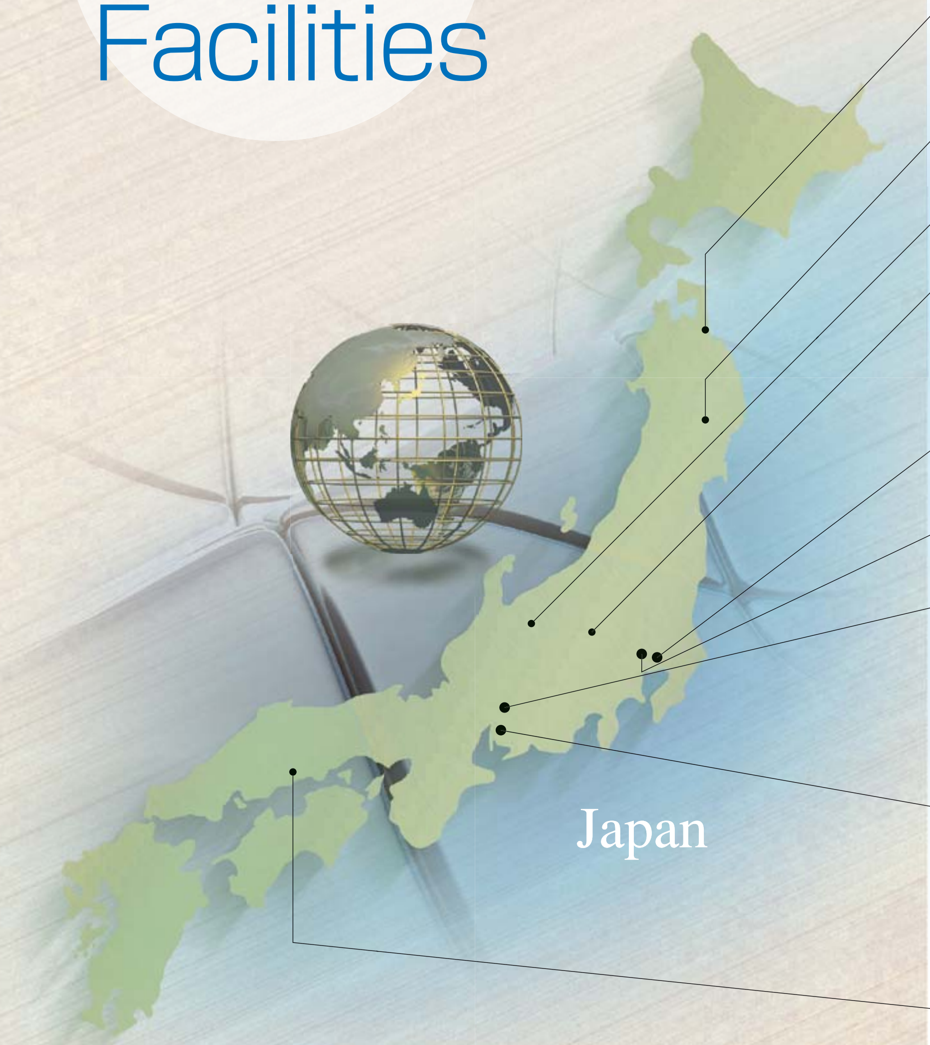
Okazaki Biology Conference

International Symposium on Hierarchy and Holism in Natural Science

NINS

inter-university research institutes
National Institutes of Natural Sciences

Facilities



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