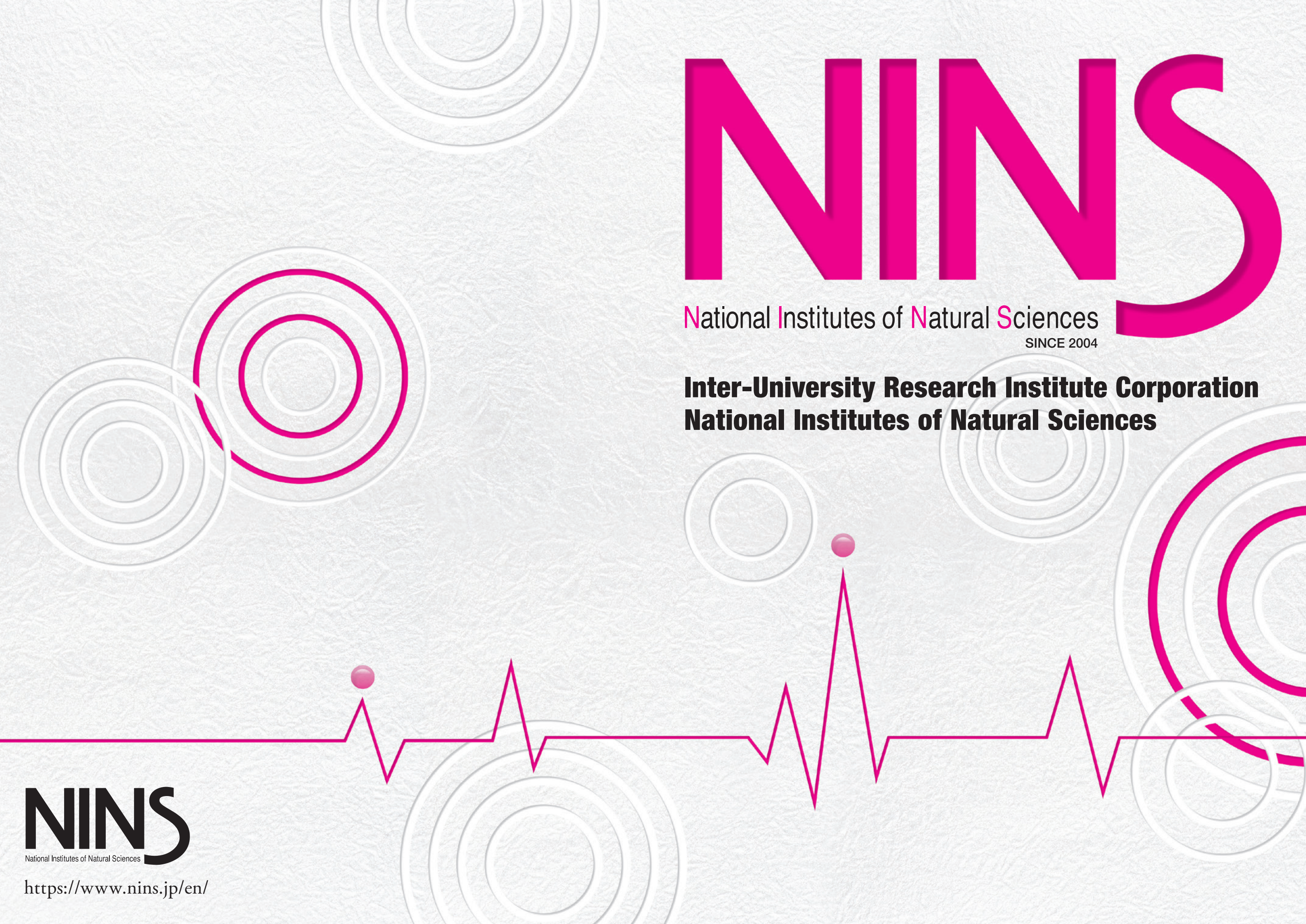


The background features a light gray textured surface. Scattered across it are several sets of concentric circles. Some circles are thin gray lines, while others are thicker pink lines. A pink line graph with several peaks and valleys runs horizontally across the lower half of the image. Some of the peaks are marked with small pink circles.

NINS

National Institutes of Natural Sciences
SINCE 2004

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

NINS
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<https://www.nins.jp/en/>

Message

from the President

Akio KOMORI

As an international Center of Excellence (COE), the National Institutes of Natural Sciences (NINS) promotes cutting edge academic fundamental research in diverse fields such as astronomy and astrophysics, plasma physics and fusion energy, basic biology, physiology and molecular science, by carrying out joint use and joint research with universities and research institutes around the world. NINS consists of five 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, NINS has four research centers: the International Research Collaboration Center (IRCC), the Center for Novel Science Initiatives (CNSI), the Astrobiology Center (ABC), and the Exploratory Research Center on Life and Living Systems (ExCeLLS), as interdisciplinary organizations directly operated by NINS. A point to note is that NINS possesses some of the world's largest experimental equipment such as the Subaru Telescope of NAOJ, the Large Helical Device (LHD) of NIFS, and the Ultra Violet Synchrotron Orbital Radiation (UVSOR) of IMS. NINS makes these facilities available for joint use and joint research performed by researchers and graduate students from Japan and abroad to promote the most advanced research in the world.

In FY 2019, NINS welcomed 12,000 researchers and graduate students as joint users and collaborative researchers. Approximately 1,000 of them consist of researchers and graduate students from abroad. As an international COE, NINS implements several big international research projects and various international collaborative research programs. This enhances the exchange of human resources, and thus NINS functions as a hub to connect researchers and graduate students both in Japan and overseas. Moreover, NINS conducts postgraduate education, and accepts internship graduate students from abroad to guide their research.

Through these efforts, NINS promotes cutting edge research, and would like to create new fields which are suitable for the 21st century, and thus contribute to the international society.

小森章夫
Akio Komori

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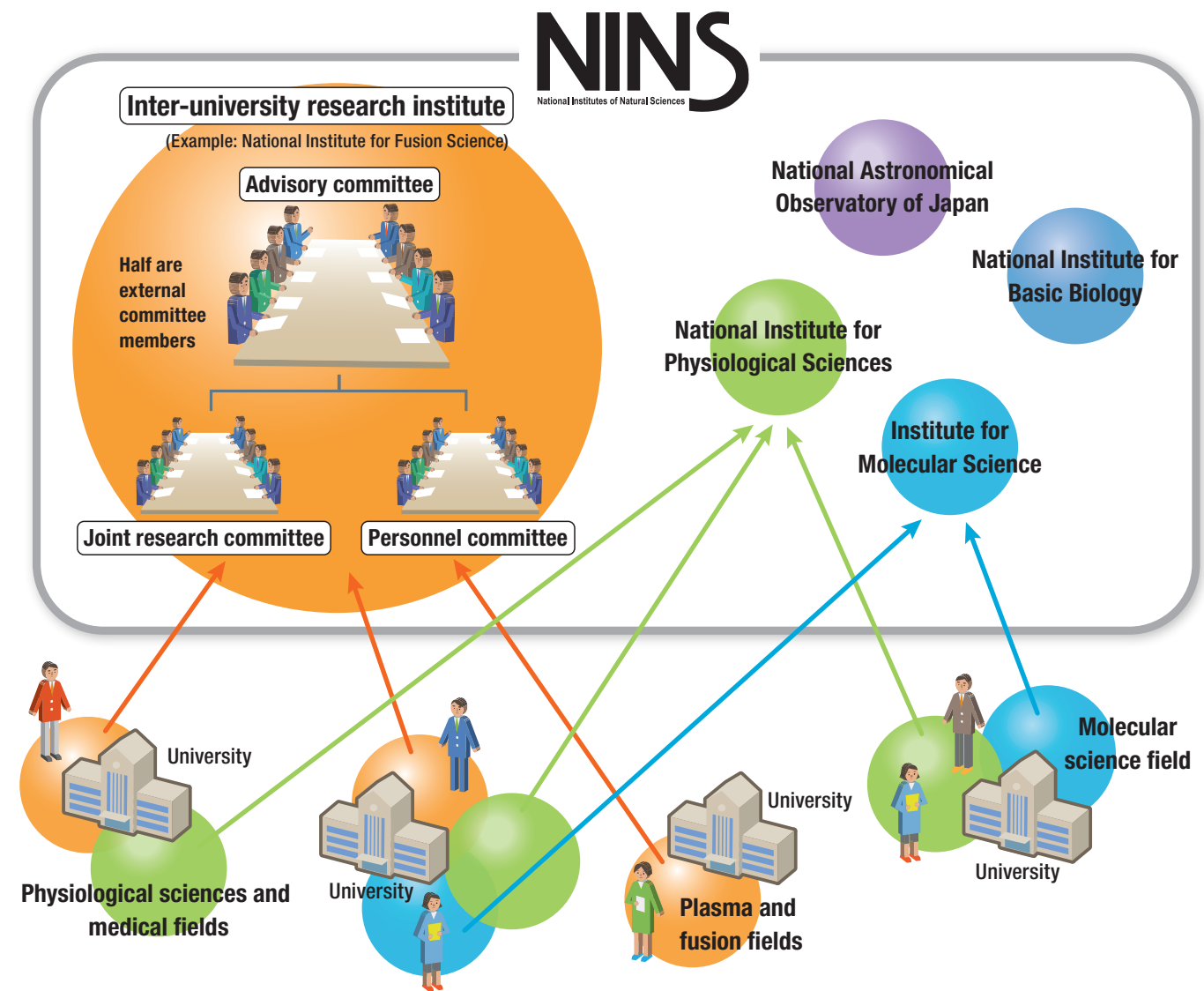
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National Institutes of Natural Sciences (NINS)



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 Sciences (NIFS), the National Institute for Basic Biology (NIBB), the National Institute for Physiological Sciences (NIPS), and the Institute for Molecular Science (IMS). As a global research center in the field of natural science promoting international and advanced research, we provide joint research and collaborative research for universities and other researchers all over the country. The result of our collaborative research contributes to strengthening Japanese research capabilities.

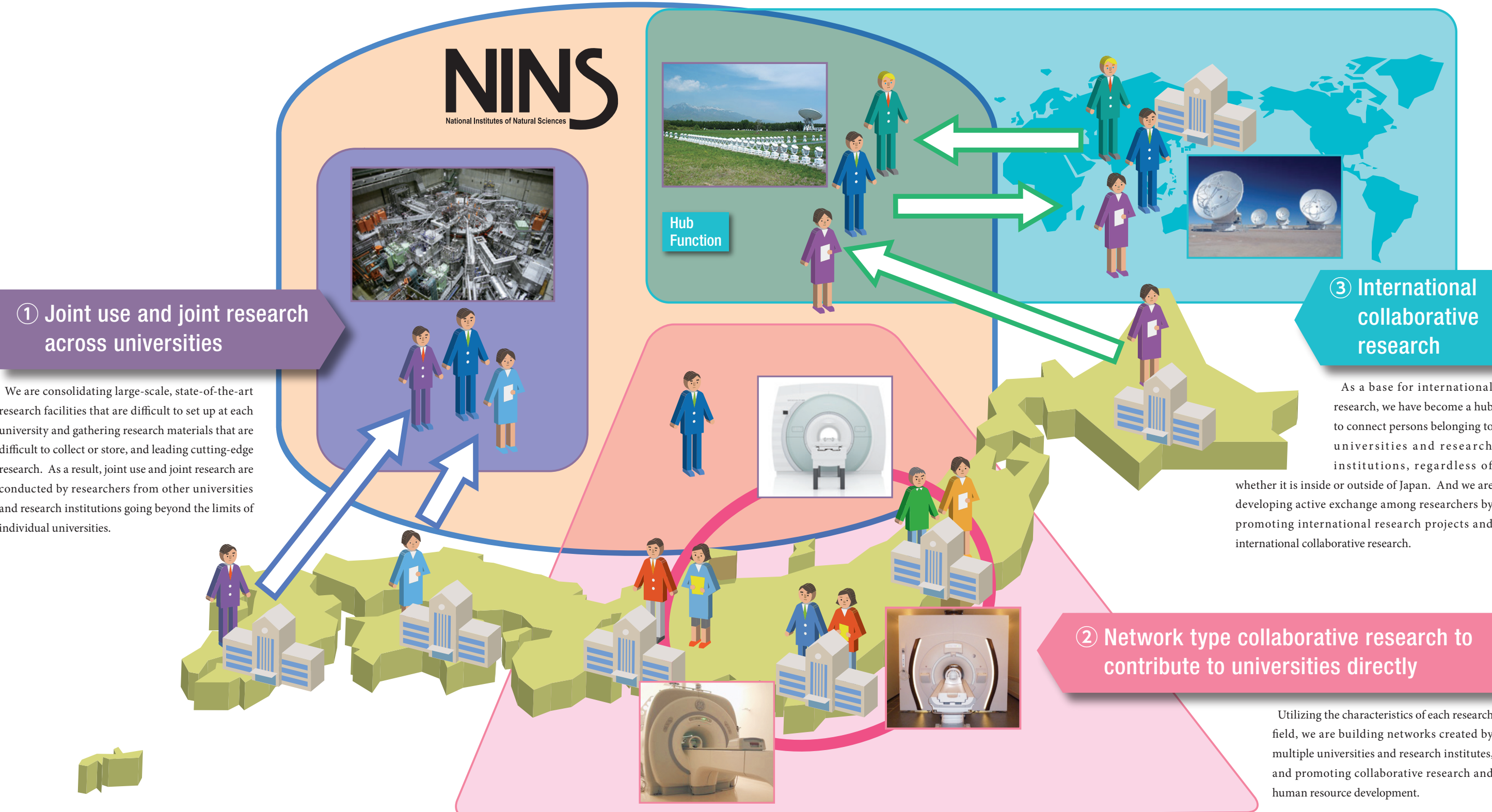


Management of Institutes by a Community of Researchers

Each Institute constituting NINS conducts the management supported by the community by being a member representing each researcher community in universities, etc. to the advisory committee, joint research committee, faculty personnel committee, and other committees. In addition, all members of the conference for selecting the President of NINS consist of external committee members. Approximately half of the Management Council and Education Research Council consists of external committee members.

Collaborative Research

NINS contributes to strengthening the research capabilities of Japanese universities as one of the inter-university research institutes. In order to contribute to strengthening the research capacity of Japanese universities, as an inter-university research institute, NINS is developing three types of collaborative researches while taking advantage of the characteristics of their academic field, as below.



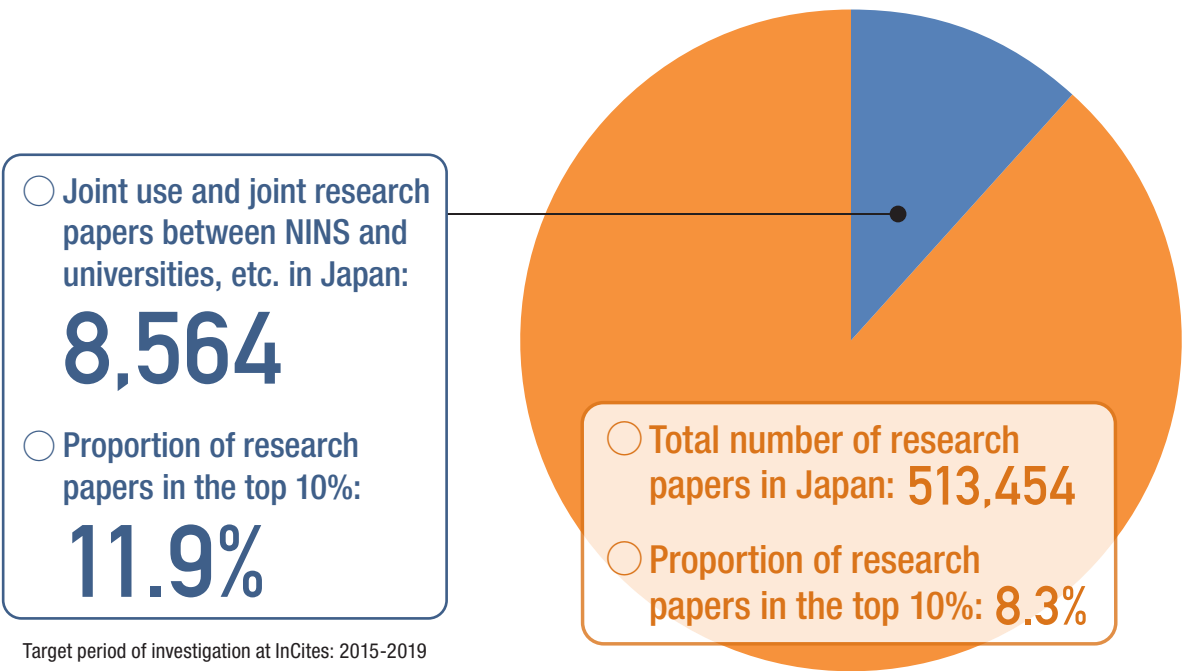
What NINS aims for

“On the Relationship with other Universities through Joint Use and Joint Research”

NINS actively accepts researchers from universities nationwide, and is promoting joint research. Moreover, we provide graduate school education as SOKENDAI (The Graduate University for Advanced Studies), and regardless of national, private and public universities, we accept graduate students from other universities as "special inter-university researchers" to instruct research. Supporting research activities of researchers belonging to other universities through these systems will result in strengthening the research capacity of universities in Japan.

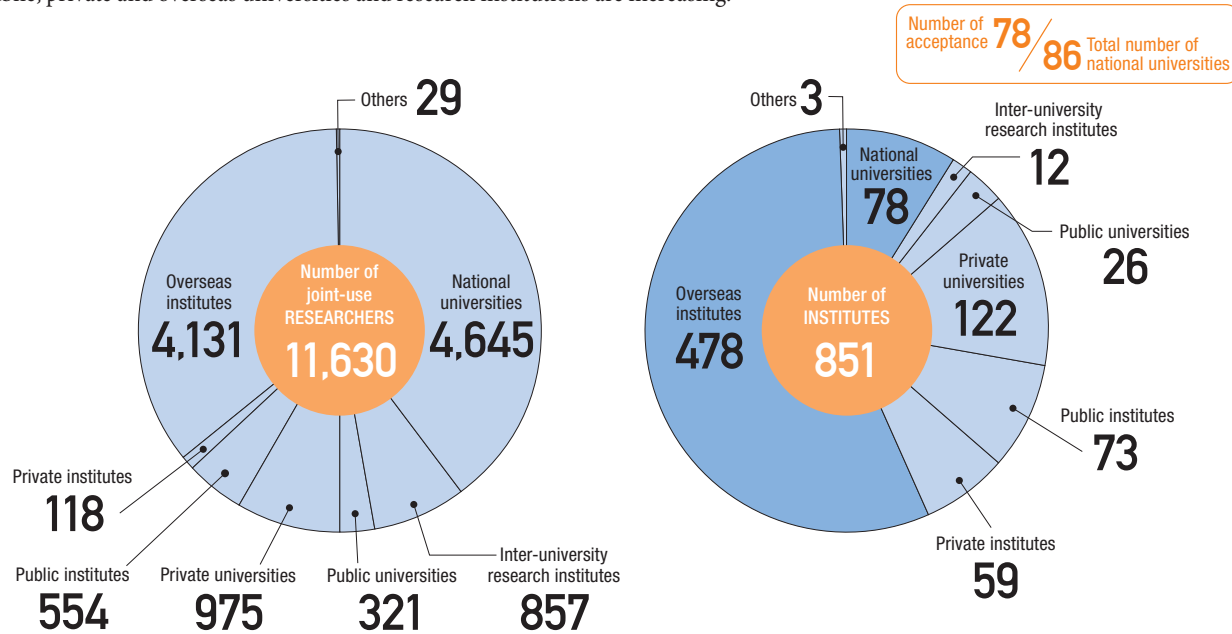
Visualize the contribution to universities

In order to visualize the contribution to other universities and research institutions, we are analyzing the number of citations of research papers resulting from joint use and joint research. From the results of the collaborative research of NINS and other universities over the past five years, the proportion of articles, which were cited in articles with high impact falling within the top 10% of all research papers was 11.9%. This ratio is higher than that of all the articles published from Japan (8.3%) adopted in the papers located in the top 10% of the world's papers. It means that we are contributing to a certain extent to the strengthening of the research capacity of universities in Japan.



Achievements of Collaborative Research (2019)

NINS accepts collaborative researchers from national, public, and private universities and research institutions regardless of national, private, and public universities. In particular, researchers from national universities accounted for 90%, and recently, researchers from public, private and overseas universities and research institutions are increasing.



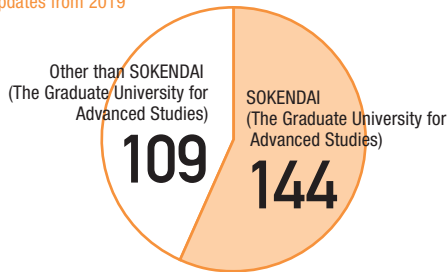
Number of researchers accepted by each research institute (2019)

Name of research institute	Total researchers	Number of international researchers	Number of institutes
National Astronomical Observatory of Japan	5,384	※ 400 (2018)	460
National Institute for Fusion Science	1,592	217	245
National Institute for Basic Biology	608	31	109
National Institute for Physiological Sciences	869	72	180
Institute for Molecular Science	2,839	290	208
Center, Etc.	338	17	113

※ No new data updates from 2019

Graduate Education

NINS conducts postgraduate education as the foundation of SOKENDAI (The Graduate University for Advanced Studies). In addition, as a special inter-university researcher, we accept graduate students from national, public, and private universities nationwide.



What NINS aims for

• The number of research papers covers the total from 2015 to 2019 and it is counted based on the research papers reported by joint users and joint researchers and research papers from NINS researchers which were searched by InCites, a research analysis tool of Clarivate Analytics.

• *For institutes with no registration on InCites, research papers are searched and counted with Scopus, a database of peer-reviewed literature by Elsevier.

Relationship with universities through joint use and joint research

NINS accepts a wide range of researchers from public and private universities as well as national universities nationwide and promotes joint use and joint research. As a result of joint use and joint research, a great deal of findings has been published from each university.

Number of Researchers and Articles (National Universities: 78 Universities in Total)

University	Researchers (2019)	Papers
Hokkaido University	180	431
Hokkaido University of Education	1	6*
Muroran Institute of Technology	11	12
Obihiro University of Agriculture and Veterinary Medicine	2	1
Kitami Institute of Technology	6	28
Asahikawa Medical University	1	5
Hirosaki University	33	61
Iwate University	5	20
Tohoku University	340	617
Miyagi University of Education	2	21
Akita University	17	11
Yamagata University	95	55
Fukushima University	2	4
Ibaraki University	48	105
University of Tsukuba	145	312
Tsukuba University of Technology	1	5
Utsunomiya University	12	34
Gunma University	35	44
Saitama University	26	97
Chiba University	107	173
The University of Tokyo	640	2,178
Tohoku Medical and Dental University	5	28
Tokyo Gakugei University	4	49
Tokyo University of Agriculture and Technology	18	54
Tokyo Institute of Technology	140	491
Ochanomizu University	19	35
The University of Electro-Communications	19	94
Hitotsubashi University	1	15
Tokyo University of Marine Science and Technology	2	9
Yokohama National University	34	44
SOKENDAI (The Graduate University for Advanced Studies)	49	1,758
Niigata University	48	76
Nagaoka University of Technology	19	20
Joetsu University of Education	5	18
University of Toyama	45	340
Kanazawa University	22	90
Japan Advanced Institute of Science and Technology	6	18
University of Fukui	59	44
University of Yamanashi	7	33

University	Researchers (2019)	Papers
Shinshu University	43	72
Gifu University	37	51
Shizuoka University	84	82
Nagoya University	540	1,066
Aichi University of Education	11	15
Nagoya Institute of Technology	59	45
Toyohashi University of Technology	18	18
Mie University	17	42
Shiga University	2	4
Shiga University of Medical Science	5	8
Kyoto University	421	1,147
Kyoto University of Education	1	1
Kyoto Institute of Technology	40	15
Osaka University	395	730
Kobe University	104	182
Nara University of Education	1	2
Nara Women's University	25	43
Nara Institute of Science and Technology	27	65
Wakayama University	6	4
Tottori University	18	32
Shimane University	12	47
Okayama University	52	107
Hiroshima University	92	313
Yamaguchi University	29	65
Tokushima University	13	38
Naruto University of Education	1	–
Kagawa University	5	30
Ehime University	40	217
Kochi University	7	38
University of Teacher Education Fukuoka	1	1
Kyushu University	187	388
Kyushu Institute of Technology	9	13
Saga University	12	18
Nagasaki University	6	19
Kumamoto University	16	60
Oita University	10	7
University of Miyazaki	3	20
Kagoshima University	67	190
University of the Ryukyus	18	51
Total	4,645	

Number of Researchers and Articles (Public Universities: 26 Universities in Total)

University	Researchers (2019)	Papers
Sapporo Medical University	1	9
Future University Hakodate	1	–
Miyagi University	1	–
Fukushima Medical University	3	30
Ibaraki Prefectural University of Health Sciences	1	–
Maebashi Institute of Technology	1	–
Tokyo Metropolitan University	29	76
Yokohama City University	24	74
Kanagawa University of Human Services	1	–

University	Researchers (2019)	Papers
Niigata College of Nursing	1	–
Toyama Prefectural University	2	4
Ishikawa Prefectural University	1	1
Gifu Pharmaceutical University	1	2
University of Shizuoka	9	19
Nagoya City University	33	143
Kyoto Prefectural University	15	9
Kyoto Prefectural University of Medicine	4	24
Osaka City University	29	63

University	Researchers (2019)	Papers
Osaka Prefecture University	101	165
University of Hyogo	39	102
Nara Medical University	9	4
Wakayama Medical University	3	9
Hiroshima City University	3	–
Sanyo-Onoda City University	3	3*
Kochi University of Technology	1	6
The University of Kitakyushu	2	–
Total	318	

Number of Researchers and Articles (Private Universities: 122 Universities in Total)

University	Researchers (2019)	Papers
Hokkaido University of Science	2	1
Rakuno Gakuen University	2	1
Hokkaido Information University	1	1*
Seisa University	1	–
Hachinohe Institute of Technology	1	2
Iwate Medical University	1	15
Tohoku Gakuin University	4	–
Tohoku Medical and Pharmaceutical University	2	3
Sendai Shirayuri Women's College	1	–
Ashikaga University	1	–
Jichi Medical University	21	36
Dokkyo Medical University	1	7
International University of Health and Welfare	6	1
Kiryu University	1	1*
Josai University	1	4
Nippon Institute of Technology	2	–
Bunkyo University	1	4*
Saitama Medical University	1	7
Saitama Institute of Technology	10	1
Bunkyo Gakuin University	1	–
University of Human Arts and Sciences	1	–
Nihon Pharmaceutical University	1	2*
Chiba Institute of Technology	7	38
The Open University of Japan	5	38*
Aoyama Gakuin University	7	49
Otsuma Women's University	2	4*
Gakushuin University	14	11
Kitasato University	32	53
Kyorin University	6	12
Keio University	92	129
Kogakuin University	11	74
International Christian University	3	19
Komazawa University	1	1*
Shibaura Institute of Technology	4	7
Juntendo University	2	22
Sophia University	11	34
Showa University	2	4
Seikei University	1	3
Takachiho University	1	–
Tamagawa University	12	12*
Chuo University	11	36

University	Researchers (2019)	Papers
Teikyo University	2	19
Tokai University	17	46
Tokyo Keizai University	1	–
The Jikei University School of Medicine	10	5
Tokyo Women's Medical University	2	6
Tokyo Denki University	20	8
Tokyo University of Agriculture	3	11
Tokyo University of Pharmacy and Life Sciences	1	13
Tokyo University of Science	76	82
Toho University	15	68
Toyo University	4	13
Nihon University	42	92
Japan Women's University	12	24
Hosei University	12	49
Hoshi University	5	6
Tokyo City University	1	2
Musashino University	1	–
Meiji University	9	18
Meiji Gakuin University	2	–
Meisei University	4	31
Rikkyo University	27	39
Waseda University	74	147
Tokyo University of Technology	1	9
Azabu University	3	1
Kanagawa University	13	18
St. Marianna University School of Medicine	1	4
Kanagawa Institute of Technology	1	1
Yokohama University of Pharmacy	1	1
Niigata Institute of Technology	1	–
Niigata University of Health and Welfare	3	–
Kanazawa Medical University	1	8
Fukui University of Technology	1	19*
Health Science University	1	–
Tokai Gakuin University	1	–
Gifu University of Medical Science	1	1*
Shizuoka Institute of Science and Technology	1	1*
University of Occupational and Environmental Health, Japan	7	–
Sojo University	2	1
Aichi Institute of Technology	5	4*
Daido University	3	3*
Chukyo University	1	2

University	Researchers (2019)	Papers
Chubu University	35	61
Fujita Health University	13	49
Meijo University	24	32
Aichi Medical University	5	15
Toyota Technological Institute	2	12
Nagoya Bunri University	1	–
Japanese Red Cross Toyota College of Nursing	1	–
Nagahama Institute of Bio-Science and Technology	7	20
Kyoto Sangyo University	4	160
Kyoto Women's University	2	3
Doshisha University	26	44
Ritsumeikan University	42	50
Meiji University of Integrative Medicine	3	–
Osaka Medical and Pharmaceutical University	2	5
Osaka Institute of Technology	8	14
Osaka Sangyo University	14	38*
Otemon Gakuin University	1	–
Kansai University	7	7
Kansai Medical University	3	16
Kindai University	10	68
Setsunan University	2	6
Osaka Yukioka College of Health Science	1	–
Kwansei Gakuin University	17	61
Konan University	12	105
Kobe Pharmaceutical University	1	4
Hyogo College of Medicine	8	13
Hyogo University of Health Sciences	2	–
Okayama University of Science	7	36
Kawasaki Medical School	2	9
Hiroshima Institute of Technology	2	7
Fukuyama University	1	1
Tokushima Bunri University	1	15
Kurume University	4	21
Fukuoka University	14	58
Fukuoka Institute of Technology	3	7
Fukuoka Dental College	3	9
University of Occupational and Environmental Health, Japan	2	8
Sojo University	1	1
Okinawa Institute of Science and Technology Graduate University	6	25
Nagasaki Women's Junior College	1	–
Total	975	

What NINS aims for

Promotion of International Collaborative Research

NINS is carrying out the following four large international projects in the Promoting Large Scientific Frontier Projects of the Ministry of Education, Culture, Sports, Science and Technology. Maintaining and managing these state-of-the-art devices not only provides a base for research activities but also leads academic research around the world and functions as an international base.

Large-scale international projects



Subaru Telescope

Large Optical Infrared Telescope. It can observe the universe with super high vision and super high resolution.



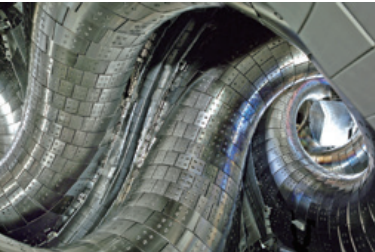
ALMA Telescope

Large Interferometer. It is operated by the National Astronomical Observatory of Japan (NAOJ) as an international project.



TMT Project

Thirty-meter class Optical Infrared Telescope.



Large Helical Device

The National Institute for Fusion Science (NIFS) leads the field of study of ultra-high temperature plasma in the world.

Project related numerical data (FY 2019)

Project	Total Users	Foreign Users	Institutes	Countries
Subaru Telescope	711	386	40	10
ALMA Telescope	4,194	3,580 **	348	43
Large Helical Device	824	44	132	15

** Including Japanese researchers who are affiliated with overseas institutes

Management of the Research University Consortium (Program for Promoting the Enhancement of Research Universities)

NINS is conducting various activities to contribute to the improvement of research capability of universities, with the support of the Program for Promoting the Enhancement of Research Universities of the Ministry of Education, Culture, Sports, Science and Technology (MEXT). As a part of these activities, NINS became an organizing institute of the "Research University Consortium" which is a group of universities that are taking a proactive stance for the enhancement of their research capability.

For the "Research University Consortium", executive directors for research from 36 universities are serving as constituent members, at present and discussing common issues (such as the utilization of highly professional human resources like URAs, analysis of research capability, and delivering information to the world) along with sharing best practices, through the website, symposium, and task forces of experts.

Institutes

- Hokkaido University
- Tohoku University
- University of Tsukuba
- Chiba University
- The University of Tokyo
- Tokyo Medical and Dental University
- Tokyo University of Agriculture and Technology
- Tokyo Institute of Technology
- The University of Electro-Communications
- Niigata University
- Kanazawa University
- University of Fukui
- Shinshu University
- Nagoya University
- Nagoya Institute of Technology
- Toyohashi University of Technology
- Kyoto University
- Osaka University
- Kobe University
- Okayama University
- Hiroshima University
- Yamaguchi University
- Kyushu University
- Kyushu Institute of Technology
- Kumamoto University
- Nara Institute of Science and Technology
- Tokyo Metropolitan University
- Waseda University
- Keio University
- National Institutes of Natural Sciences
- High Energy Accelerator Research Organization
- Research Organization of Information and Systems
- Yokohama National University
- Tokushima University
- Nagasaki University
- Japan Advanced Institute of Science and Technology

Four Task Forces

Task Force 1: Utilization of highly professional human resources and research administrators

NINS is gathering best practices and evidences, communicating and discussing necessary measures, in order to establish the utilization of highly professional human resources and research administrators such as URAs in actual research sites in Japan.

Task Force 2: Research Analysis

In order to keep track of the features of research capability at each university from multiple perspectives, NINS is gathering and sharing best practices and evidences with regard to research capability analysis, research IR (Institutional Research) and strategies, by utilizing a research capability analysis index.

Task Force 3: Delivering Information to the World

In order to improve the ability to deliver information to the world of each university, along with sorting out tasks, NINS is enhancing its ability to deliver information by utilizing international information transmission platforms such as EurekaAlert! of AAAS.

Task Force 4: Interdisciplinary Task Force

For the "promotion of interdisciplinary research," NINS shares best practices for interdisciplinary initiatives through discussions with URAs (University Research Administrators) and IRers (Institutional Researchers) and implements interdisciplinary IR (Institutional Research), visualization, review of evaluation technique, preparation of interdisciplinary research theme list, and other initiatives.

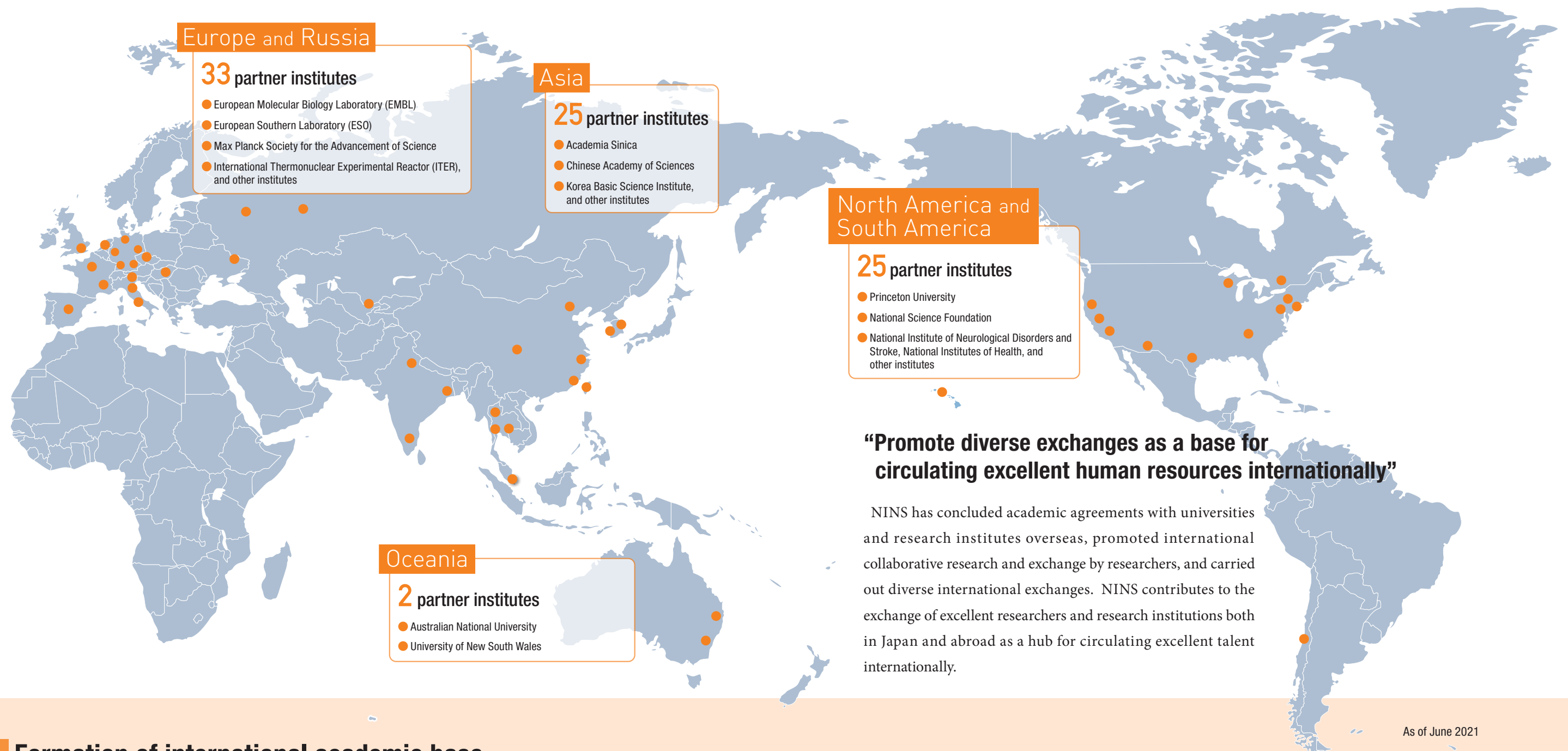
Symposium

All universities participating in the Research University Consortium converge and hold the symposium once a year. They discuss common issues about measures and systems on research capability enhancement which confront all RUC members, including sharing leading initiatives and best practices in a cross sectoral manner.



What NINS aims for

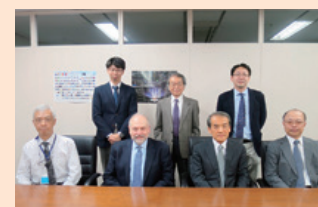
Promotion of International Collaborative Research



Formation of international academic base

International collaboration with Princeton University.

NINS and Princeton University signed an academic exchange agreement in March 2010. Based on this agreement, various exchanges are carried out by participating in mutual support for joint research, educational activities support, conference, and symposium. In order to strengthen the framework for promoting international joint projects, NINS North America base was installed in the university and staffed with an overseas URA in 2015.



Princeton University
NINS President receiving a courtesy call from P. Debenedetti

International Collaboration with the European Molecular Biology Laboratory (EMBL)

EMBL is a European-led international research institution funded and operated by 19 countries with headquarters in Heidelberg, Germany. Based on the academic agreement concluded in 2005 (re-extended in 2019) between NINS and EMBL, NINS has adopted exchanges on 3 fronts such as academic exchanges, personnel exchanges, and technical exchanges. For NINS, joint research is being promoted mainly by the National Institute for Basic Biology (NIBB) that is in charge of the area of research nearest to EMBL.

National Astronomical Observatory of Japan

Astronomy is one of the oldest and yet most active sciences. This means that human beings possess the fundamental desire to seek our origin and the reason for our existence through an understanding of the Universe. NAOJ utilizes our full strength to play a key role in establishing a new paradigm for understanding the Universe, the Earth, and life as a whole. For this purpose, we observe various objects, from the Earth to the most distant objects in the Universe, and we consider the fundamental theoretical laws behind the observed phenomena. We also develop new technology to support these activities.



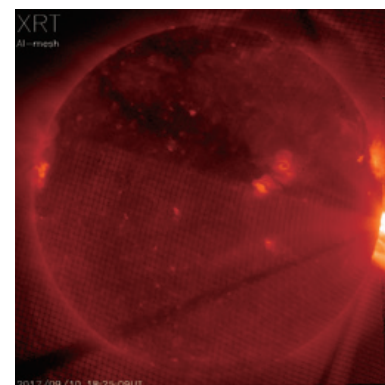
A black hole shadow at the center of Messier 87
NAOJ also joined this observation through ALMA
(Atacama Large Millimeter/submillimeter Array).

ALMA Telescope
(Clem & Adri Bacri-Normier (wingsforscience.com/ESO))

Topics of Research

01 X-ray image of the Sun taken with “Hinode”

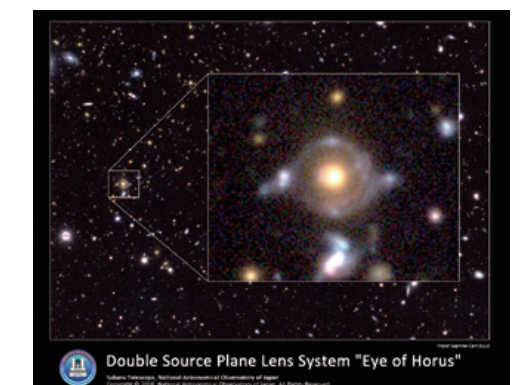
The Solar Observing Satellite Hinode has observed solar activity for more than ten years since its launch in 2006. The Sun is a typical star, but as our parent star it dominates the Solar System and facilitates life on the Earth. The Sun influences all of our surroundings and activities. The images and data obtained with Hinode are released as soon as they are acquired and are used by solar and space weather researchers all over the world.



A huge solar flare (right edge) imaged
by Hinode on September 11, 2017 (JST).
(NAOJ/JAXA/MSU)

02 Gravitational lens phenomena the “Eye of Horus”

The Subaru Telescope is undertaking a massive survey with Hyper Suprime-Cam to image a large area of the sky at an unprecedented depth. The Eye of Horus was discovered in images taken as part of this survey. A close inspection reveals two distinct arcs/rings of light with different colors. This strongly suggests that two distinct background galaxies are being lensed by the foreground galaxy. This extremely rare lens system offers a unique opportunity to probe the fundamental physics of galaxies and add to our understanding of cosmology.



Eye of Horus (false color image) discovered
by Subaru Telescope.
(NAOJ)

National Institute for Fusion Science

One of the world's top priorities is undoubtedly to obtain an energy source that is eco-friendly and inexhaustible. If we can achieve on Earth the nuclear fusion that has powered the sun and the stars, human beings will gain that never-ending energy. Deuterium and tritium are currently expected to be the most favorable fuels for fusion. Deuterium and the lithium that is necessary for tritium production are found in seawater.

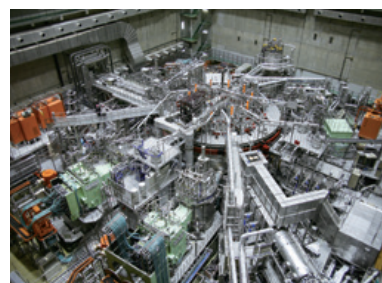
Aiming at the early achievement of fusion energy, the National Institute for Fusion Science (NIFS) is advancing its research activities in fusion plasma and other targets in fields of experimental research using the Large Helical Device (LHD), theory and simulation, and fusion engineering. NIFS is also playing an active role in mutual cooperation with universities and research organizations in Japan and abroad, and is producing excellent researchers.

The inside of the LHD plasma vacuum vessel.

Topics of Research

01 Research for high-temperature steady-state plasma in the LHD

The Large Helical Device (LHD) is the world's largest class of superconducting experiment devices for confining plasma. Using deuterium gas, the LHD achieves the ion temperature of more than 120 million degrees that is necessary for the fusion reaction. Helical devices have the advantages of controllability and steady state operation. The LHD project is advancing research in the physics of high-temperature steady-state plasma for achieving the future fusion reactor and in related fields of science and engineering. In addition to fusion research, the plasma generated by the LHD provides a platform for research in many fields from astrophysics to industrial applications.



The LHD as seen from above. The LHD is 13.5m in diameter and 9.1m high. Many plasma heating systems and plasma measurement devices are attached to the LHD.

02 Computer simulation of plasma

A fusion plasma is a typical complex system controlled by multi-physics and multi-time/space nonlinear processes, from macroscopic phenomena, such as plasma transport, to microscopic electron dynamics. In order to understand and systematize physical mechanisms in fusion plasmas, large-scale numerical simulation research has been carried out by utilizing the full capabilities of supercomputers. Based on this research and development, we promote large-scale simulation science, aiming at the ultimate realization of a helical numerical test reactor, which will be based on an integrated predictive model for plasma behavior over the whole machine range.



Simulation of the hydrogen diffusion behavior inside the divertor material receiving heat flux and particles from plasma.

National Institute for Basic Biology

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. The National Institute for Basic Biology promotes research to find the basic principles common to all creatures, and the mechanisms that enable diversity and allow life to adapt to changing environments.

Various organisms to be studied at NIBB

Topics of Research

01 Exploring the environmental adaptation strategies of living things

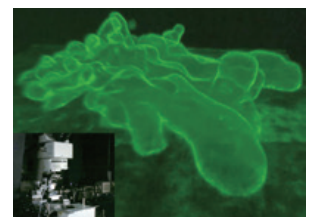
Living organisms have flexibly adapted to various environments on Earth and have acquired various forms and abilities. Therefore, NIBB conducts research to ascertain the environmental adaptation strategies used by animals and plants, such as the mechanism of photosynthesis regulation that corresponds to constantly changing light intensity dependent on the weather, adaptation mechanisms for seasonal changes in living organisms and evolutionary mechanisms utilized by carnivorous plants in order to adapt to environments lacking nutritional sustenance. In addition to this, we also work on the development of new model organisms to decipher unknown phenomena such as the establishment of symbiotic relations among living organisms.



Environmental control system for plants

02 Promotion of integrated bioimaging

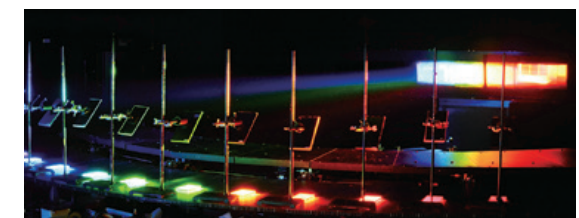
At NIBB, we advance observation technology via the use of cutting edge microscopes such as light sheet fluorescence microscopes, multiphoton excitation fluorescence microscopes and IR-LEGO, as well as develop new technologies for image processing and statistical processing to analyze acquired images. We also conduct activities to support experimental design, image acquisition and data analysis in an integrated manner for researchers through collaborative research.



Amoeba's movement captured
by light sheet fluorescence microscopy

03 Exploring the relationship between light and living organism using the Okazaki Large Spectrograph

The Okazaki Large Spectrograph projects a wavelength spectrum ranging from 250 nm (ultraviolet) to 1,000 nm (infrared) onto its 10 m focal curve with an intensity of monochromatic light at each wavelength which is more than twice as much as that of the corresponding monochromatic component of tropical sunlight at noon. The spectrograph is designed for action spectra analyses of various light-controlled biological processes.



Okazaki
Large Spectrograph

National Institute for Physiological Sciences

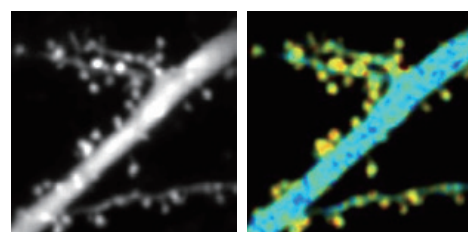
Bundles of nerve fibers in the human brain.

Topics of Research

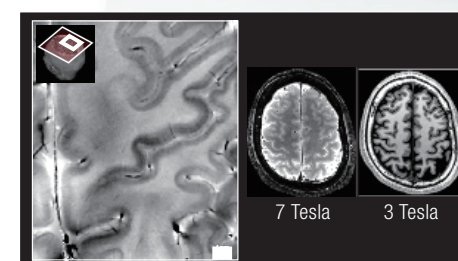
01 2-photon fluorescence lifetime imaging microscopy

Two-photon fluorescence lifetime imaging microscopy (2pFLIM) can be used to measure and image the fluorophore-fluorophore interaction. This method enables us to monitor protein-protein interactions in tiny subcellular compartments of living cells in deep tissues, such as in brain slices.

The right image is a fluorescence lifetime image of GFP-actin in a neuron of cultured hippocampal slices. GFP-actin and YFP mutant (YFPm) fused to actin were expressed and imaged by 2pFLIM. In the image, warmer color indicates actin polymerization. This data clearly shows that actin is highly polymerized in the dendritic spines, but not in the dendritic shaft.



(Left) 2-photon fluorescence image.
(Right) 2-photon fluorescence lifetime image.



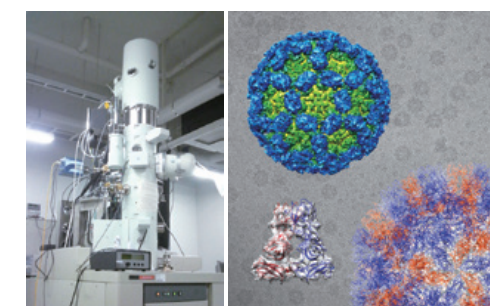
Cross-sectional view of human brain imaged with 7T MRI.
Vessels and nerves are depicted in units of 100 micrometers.

The mission of NIPS is to conduct research at the forefront of physiological science by examining the living body at various levels of organization, leading to a holistic understanding of the functional mechanisms of the human body. Recent progress in life sciences has been truly remarkable, and there have been notably marked developments 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 focusing on higher brain functions as one of the most important research targets, 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, information science, and medical engineering. NIPS offers its facilities and expert staff to domestic and foreign scientists for collaborative studies.

Ultra-high-field 7-Tesla
Magnetic Resonance Imaging (MRI) system.

02 Phase Contrast Electron Cryomicroscope

Phase contrast electron cryomicroscopy is an electron microscope developed for observing close-to-life-state biological samples with a combination of rapid freezing and ice embedding sample preparation methods. Biological specimens up to 200 nm thicknesses can be observed with high-resolution and high-contrast. Ultrastructure analyses of protein molecules, viruses, bacteria, cultured cells and frozen tissue sections are performed with this microscopic system.



Phase Contrast Electron Cryomicroscope and image of
Sappovirus capsid.

Institute for Molecular Science

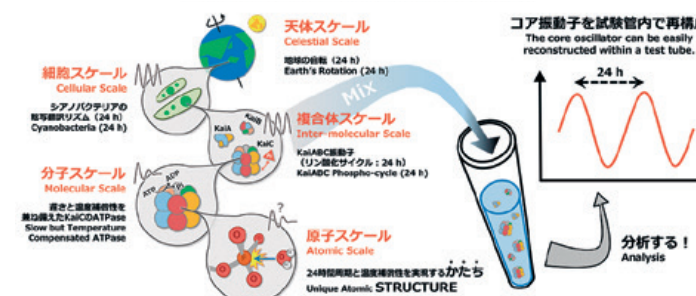
Molecular science is a field of science that aims at elucidating the essentials of intermolecular interactions and chemical reactions in which molecules change their shapes from both theoretical and experimental standpoints. The Institute for Molecular Science continues to provide opportunities of joint researches, in which the most advanced technology and instruments are accessible, for the researchers all over the world. To update our system continuously, we have established the Research Center of Integrative Molecular Systems and the Center for Mesoscopic Sciences, in addition to the four core departments of Theoretical and Computational, Photo, Materials, Life and Coordination-Complex Molecular Sciences. Collaborating with the 72 national university corporations all over Japan, we organize the Inter-University Network for Common Utilization of Research Equipments. In the network, researchers in universities, public research institutes and private enterprises can share the research equipment in participating institutions at reasonable cost.

The UVSOR synchrotron facility.

Topics of Research

01 Creating novel molecular systems with analyzing logic which connects “molecules” and “molecular systems”

The Research Center of Integrative Molecular Systems (CIMoS) is dedicated to the important and interdisciplinary subject of “how the characteristics of each molecule are integrated into excellent functions of the molecular systems with higher-order structures.” We learn the interlayer logic that links “individuals” and “assemblies” from life systems. We then aim at elucidating the principle of how the molecular systems develop their functions such as energy conversion, material conversion and life activities by exchanging energy or information in a concerted manner. CIMoS has a mission to be a base of common utilization of facilities and joint researches to create “molecular systems having flexible, robust and excellent functions.” With the mission, CIMoS contributes to the society and advancement of science.



Cyanobacterial Circadian Clock System

02 Capturing the behavior of molecules with light

The unique functions of molecules are realized in such a condition as a variety of molecules, not as single molecules, exist with the manner that molecular characteristics and macroscopic features of assemblies interact with each other. The Center for Mesoscopic Sciences has been founded on April 2017. In the center, novel mesoscopic measurement methods have been developed and applied to various systems. This is indispensable in understanding, controlling and developing the functions in the mesoscopic space-time domain in which microscopic and macroscopic natures interact with each other. We work to aim at providing foundations of basic researches on theoretical analysis, development of light sources and novel measurement methods and their applications.

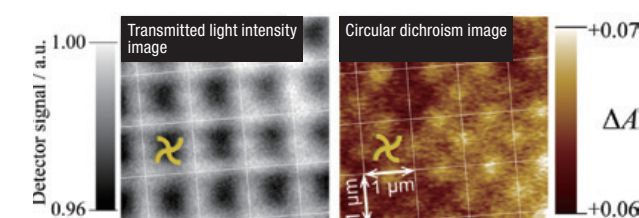
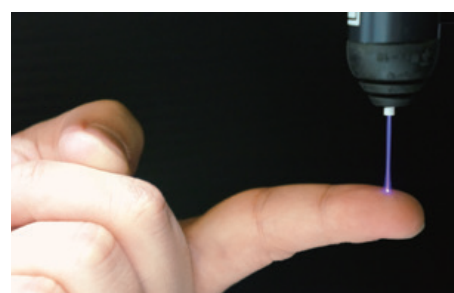


Image of chiral gold nano-structured samples by a newly developed high-precision circular dichroism microscope. (Achieving the apparent resolution over the diffraction limit.)

Center for Novel Science Initiatives (CNSI)

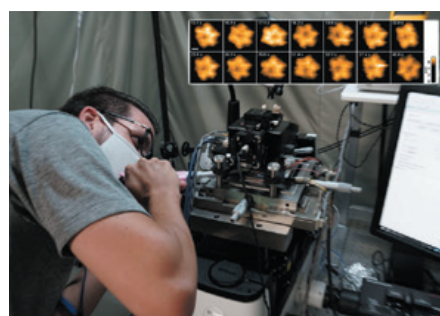
In the fields of natural science, the development of new techniques and productive interaction among different genres of research fields not only leads to further development of the own research fields, but also promotes to create novel research fields. The Center for Novel Science Initiatives (CNSI) has promoted the three research fields of "Brain Science", "Imaging Science", and "Astrobiology". In FY2018, we have launched the two new fields of "Advanced Optical Science" and "Plasma Bio Science". The former searches for wider use and application of the cutting-edge optical science, and the latter, which is a fused field of plasma science and life science, aims to elucidate the molecular and cellular mechanisms of interesting effects of plasma on living organisms. In addition, the "Office of Novel Science Exploration" of CNSI watches and studies current world-wide trends of natural sciences to discover seeds that may evolve to a new research field of the next generation.



Low-temperature atmospheric pressure helium plasma jet that can be directly irradiated to the living body.

Exploratory Research Center on Life and Living Systems (ExCELLS)

What is life? The Exploratory Research Center on Life and Living Systems (ExCELLS) was established in April 2018 to address this fundamental question. ExCELLS aims to achieve an integrative understanding of living systems by observing biological entities ("Observe"), deciphering the hidden information ("Read"), and creating living systems ("Create") utilizing state-of-the-art equipment and novel constructive approaches. Moreover, ExCELLS promotes collaborative, interdisciplinary research involving investigators who explore organisms living in extreme environments based on "Observe, Read, and Create" approach to explore the design principles of living systems.



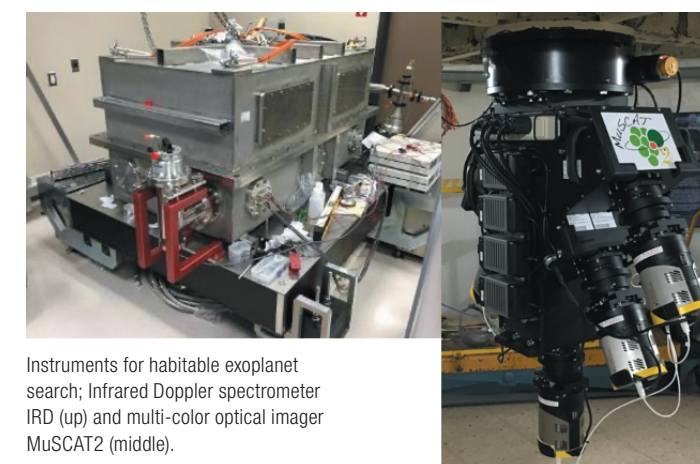
By using high-speed AFM (atomic force microscopy) combined with optical microscopy, we can visualize the dynamics of various biomolecules from proteins to cells. Combination with optical microscopy is also possible.



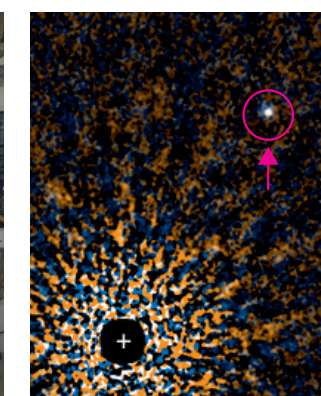
Tardigrade image with electron microscope

Astrobiology Center (ABC)

As a result of developments in extrasolar planet observations, astrobiology research to explore "life in the Universe" and uncover its mysteries has become a pressing subject. Astrobiology Center (ABC), established in 2015, advances this field by combining disciplines, promotes research into extrasolar planets and life both outside and within the Solar System, and develops observational instruments for these purposes.



Instruments for habitable exoplanet search; Infrared Doppler spectrometer IRD (up) and multi-color optical imager MuSCAT2 (middle).

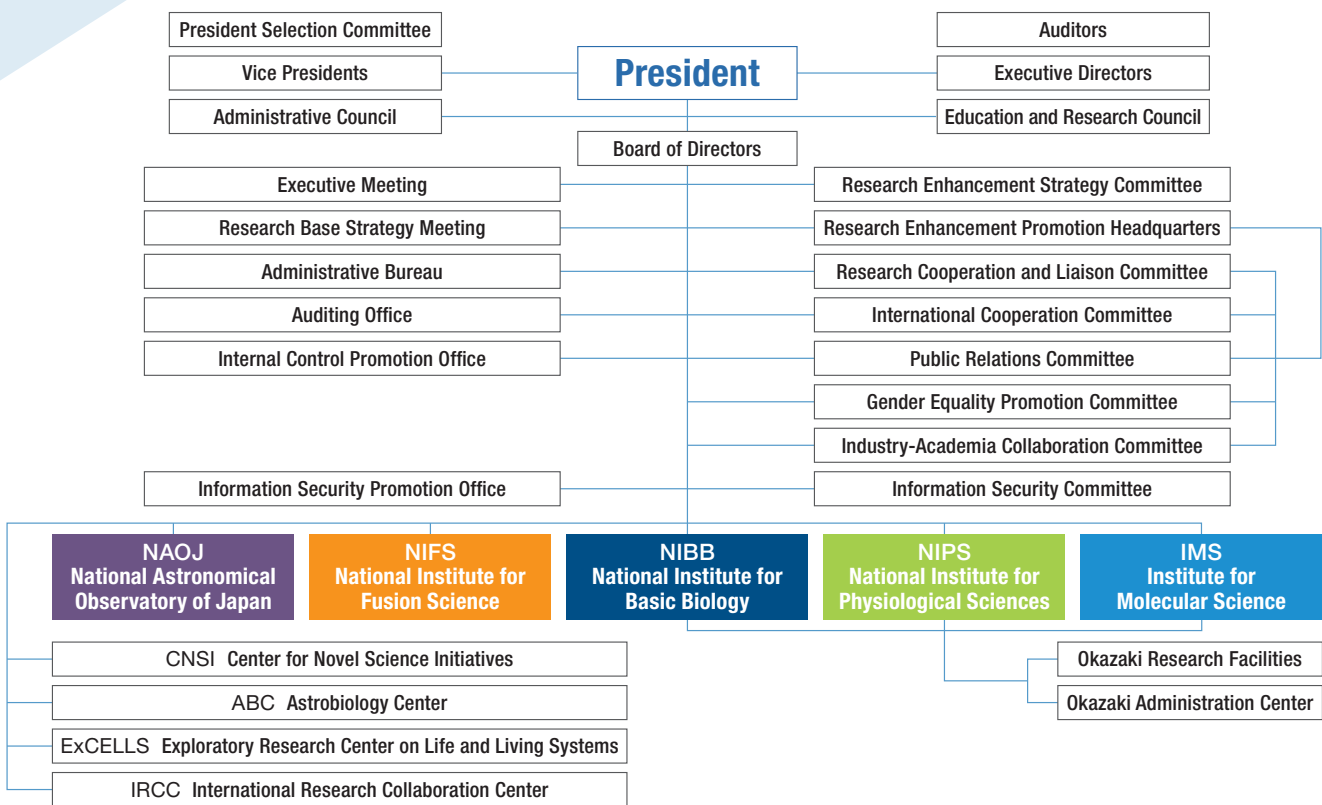


Direct image of a super-Jupiter exoplanet GJ504b (right).

International Research Collaboration Center (IRCC)

The five NINS Institutes are actively conducting international exchange activities in their respective research fields. Based on these activities, the IRCC was established in August 2018 to strengthen international exchange activities, particularly across the boundaries of research fields and institutions, and through organizational collaboration with overseas research institutes. In October 2018, the "Research Unit for Astro-fusion Plasma Physics" (AFP), which is the integrated research field of astrophysics and fusion science, was established in IRCC. The division conducts the research project of the three-party collaborations among NINS, Max-Planck Institutes in Germany, and Princeton University in the USA, and further progress of the international collaborations is anticipated.

Organization Chart



List

President

Name	Job Title
Akio KOMORI	President

Auditors

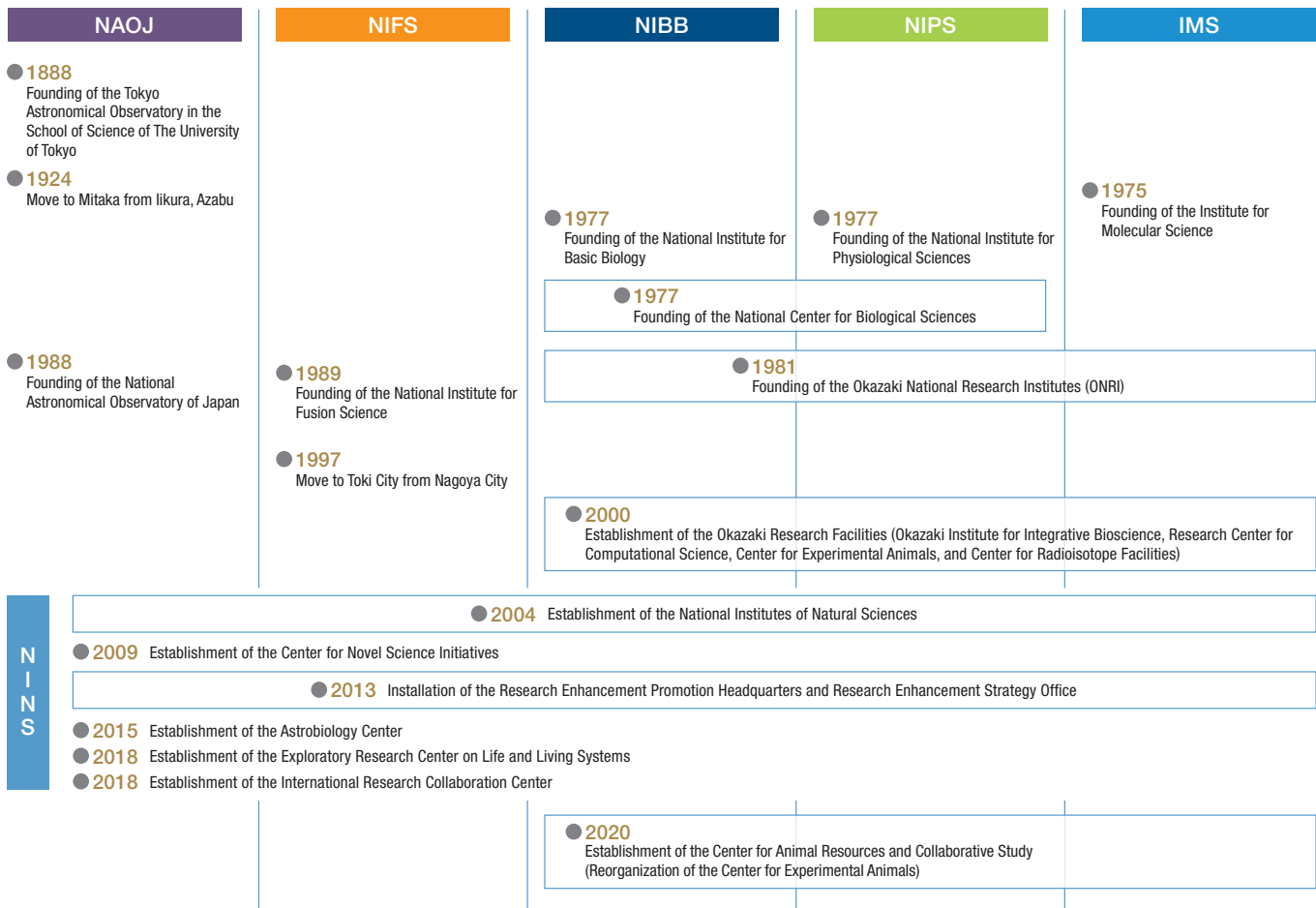
Name	Job Title
Yuichi OGAWA	Auditor
Hiomasa NINOMIYA	Auditor

Executive Directors / Vice Presidents

Name	Job Title
Tsugio TOKUTA	Executive Director and Secretary General
Osamu KANEKO	Executive Director
Maki KAWAI	Executive Director, Vice President, and Director General of IMS
Keiji IMOTO	Executive Director and Director of CNSI and IRCC
Takashi SAITO	Executive Director
Saku TSUNETTA	Vice President and Director General of NAOJ
Zensyo YOSHIDA	Vice President and Director General of NIFS
Kiyokazu AGATA	Vice President and Director General of NIBB
Junichi NABEKURA	Vice President and Director General of NIPS

As of July 2021

History



Nobel Prize and Monument of Professor Emeritus Yoshinori OHSUMI

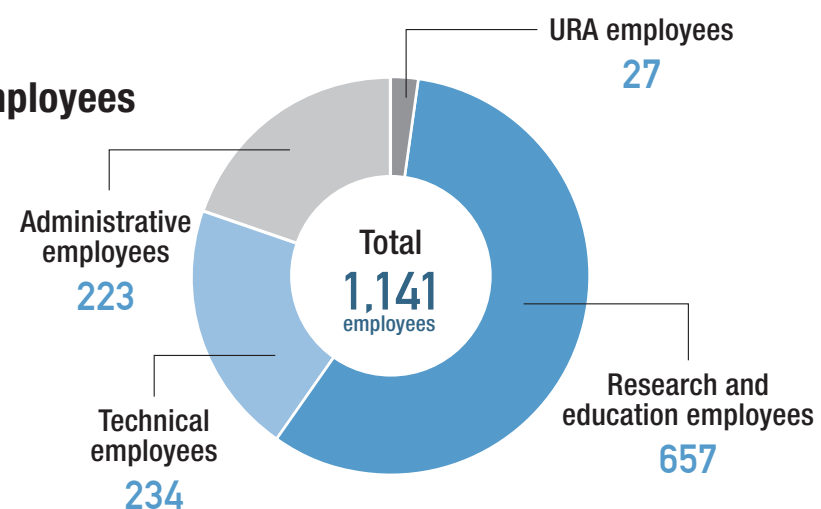
NINS Professor Emeritus Yoshinori Ohsumi, the Honorary Professor of NINS, won a Nobel Prize in Physiology or Medicine in 2016 for his findings on “autophagy” including research lasting 13 years in the National Institute for Basic Biology (NIBB). As a memorial of his achievement, the monument is installed in NIBB in the motif of “autophagy in yeast cells”.



Data

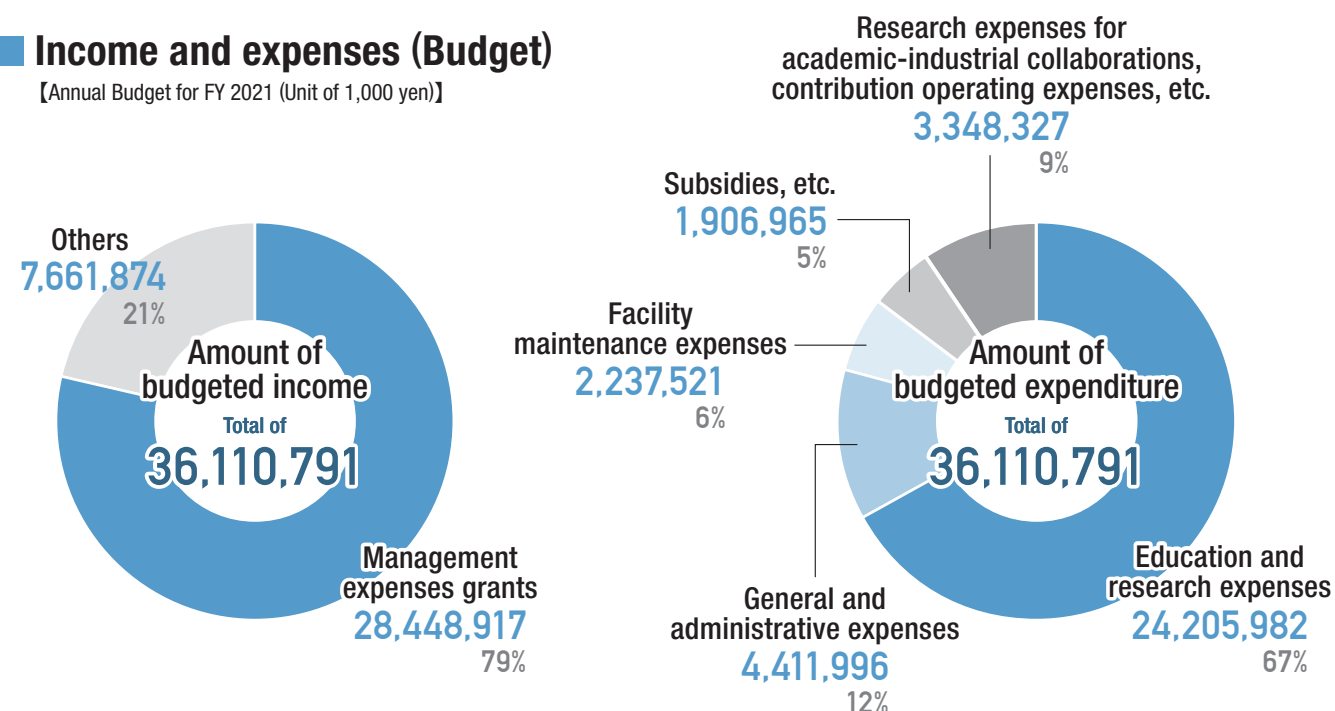
Number of employees

As of March 1, 2021



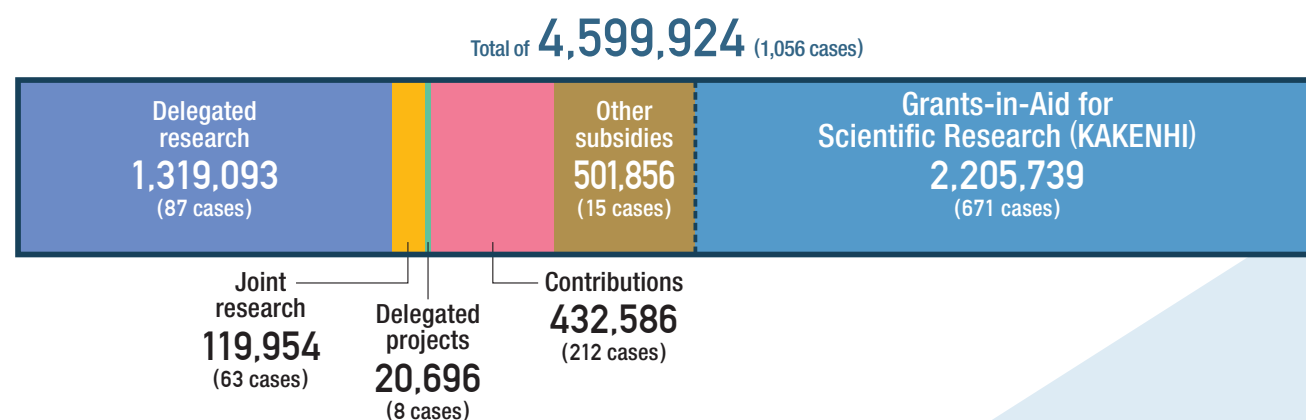
Income and expenses (Budget)

【Annual Budget for FY 2021 (Unit of 1,000 yen)】

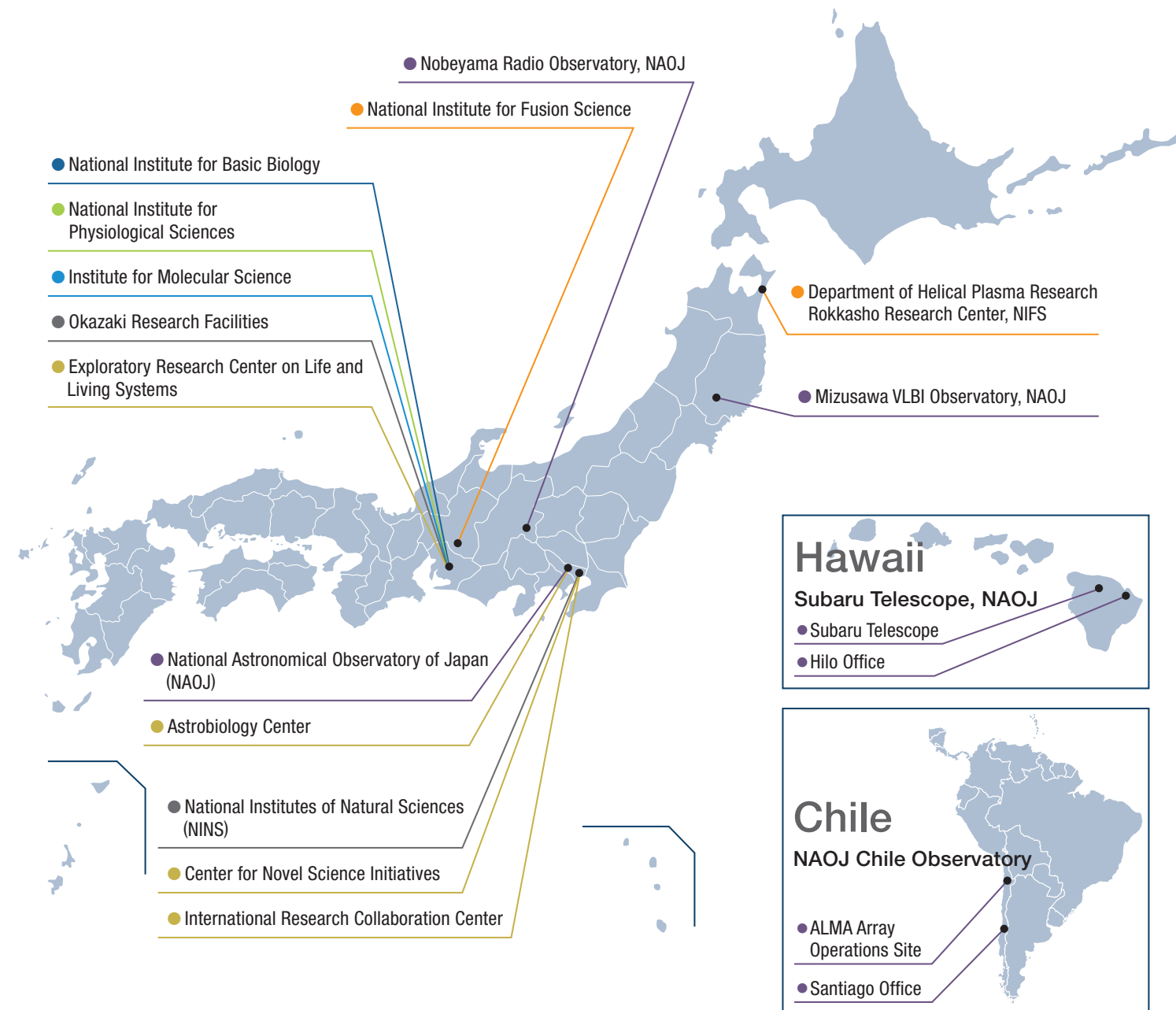


Breakdown of external funds

【Annual closing of accounts for FY 2020 (Unit of 1,000 yen)】



Facilities



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