Unraveling the mysteries of molecules and extending their possibilities

The aim of the Institute for Molecular Science is to investigate fundamental properties of molecules and molecular assemblies through both experimental and theoretical methods. Since its inception, based on a policy directed to fostering numerous joint programs involving IMS scientists, IMS has made its facilities available to the international scientific community.

Our studies are directed to the design and development of novel materials with new applications and to the advance in innovative methodologies. Molecular reactivities, dynamics, and diverse interactions between different molecules and substances are elucidated.

We have entered the fifth year of incorporation (privatization), and the evaluation of the first mid-term plan has started on a full-scale. As exemplified by this kind of a bit too much evaluation work and the fatigue of faculty members due to this, Japanese academic policy is still quite serious. It would be necessary to seriously reconsider the present system from the viewpoint of a permanent national policy. The development of science and culture is fundamental and very crucial for Japan to be an advanced cultural country.

The nationwide network system for efficient use of research equipments in chemistry, which has been constructed in order to prevent the collapse of the basis of scientific research in Japan with the participation of 72 national universities, is still financially poorly supported. However, we further work hard to make this system a solid one. In future it would be necessary to build up a much more stable budgetary framework than just a request from one institution. We believe that this kind of network system should be effective in other fields of science and is very economical and useful even in the case that the government budget becomes much healthier.

The special programs for the operation of which IMS is taking a major responsibility have been carried out nicely. (i) The nanotechnology network project has started satisfactorily to provide various facilities and supports to researchers. (ii) In the Asian Core Program, not only a variety of collaborative researches are going well, but also various activities to stimulate young scientists are regularly performed. (iii) The grand challenge to next-generation integrated nano-science in the next-generation supercomputer project has entered into a full-scale activity stage.

In the 2007 fiscal year, we carried out evaluation of all research groups and research facilities, and the results will be published in IMS Report 2007. Concerning the operation and management of IMS, we had discussions also inside the institute and some improvements are under investigation.

Considering the present national policy that tends to incline to the technological innovation and the short-sighted research projects, we, scientists, should keep appealing the significance of promotion of science and culture as a permanent national policy, and at the same time we should strive to pursue basic scientific researches of high quality and originality. As I always say, we should devote to that by pursuing the consciousness of truth, good and beauty, and furthermore the consciousness of myoh (B) higher than the former.

April, 2008

NAKAMURA, Hiroki

Message from IMS Director-General
In theoretical and computational chemistry, it is an important goal to develop functional molecules prior to or in cooperation with experiment. Thus, new bonds, structures and reactions provided by heavier atoms are investigated. In addition, chemical modification and doping of cage-like large molecules and clusters such as fullerenes and carbon nanotubes are investigated to develop functional nanomolecular systems. Efficient computational methods are also developed to perform reliable quantum chemistry calculations for large molecular systems.

The research conducted by the Institute for Molecular Science (IMS) is broadly divided into four fields: theoretical and computational molecular science, photo-molecular science, materials molecular science, and life and coordination-complex molecular science. In each field, independent research groups led by professors are conducting most advanced researches based on the creative thinking of researchers. In addition, IMS is making efforts at promoting molecular science on a global basis by providing many researchers in Japan and abroad with collaborative research opportunities using its state-of-the-art facilities and forming a close-knit research partnership network with research centers in East Asia.

Theoretical and Computational Molecular Science

Describing invisible and intricate molecules

It is our ultimate goal to develop theoretical and computational methodologies that include quantum mechanics, statistical mechanics, and molecular simulations in order to understand the structures and functions of molecules in gasses and condensed phases, as well as in bio and nano systems.

Theoretical Molecular Science I

Theoretical Study and Design of Functional Molecules

NAGASE, Shigeru (Professor)

In theoretical and computational chemistry, it is an important goal to develop functional molecules prior to or in cooperation with experiment. Thus, new bonds, structures and reactions provided by heavier atoms are investigated. In addition, chemical modification and doping of cage-like large molecules and clusters such as fullerenes and carbon nanotubes are investigated to develop functional nanomolecular systems. Efficient computational methods are also developed to perform reliable quantum chemistry calculations for large molecular systems.

Theoretical Molecular Science I

Theory of Photoinduced Quantum Dynamics in Nanostructures

NOBUSADA, Katsuyuki (Associate Professor)

All of the compounds in nature consist of a huge number of atoms and/or molecules. Nanometer-sized molecules, which are constructed from several tens to several hundreds of atoms, have characteristic geometrical and electronic structures, and unprecedented functions. Despite scientific interest in and technological importance of the nanometer-sized molecules, the fundamental properties of the molecules have not been well elucidated. We are currently investigating the photoinduced quantum (electron, spin, exciton) dynamics in various types of nanometer-sized molecules.
Modern electronic structure theory that is practiced with high-performance computers is now capable of supplying analytic interpretation of chemical phenomena, and is being advanced so as to provide accurate information of experiments a priori. The research is aimed at development of a new generation of *ab initio* quantum chemistry methodology that allows one to describe a wide range of complicated electronic structures, which can be found in conjugated systems or metal complexes, in a predictive chemical accuracy by exploiting cutting-edge theory and sophisticated computing techniques. The resultant method is eventually applied to realistic problems in molecular science.

By theoretically clarifying how photoirradiation alters the properties of materials, we are able to control or rapidly switch the dielectric and/or transport properties of a material. Molecular Materials have characteristic directions with respect to the motion of their electrons and molecular arrangements can easily be modified. With the help of cooperativity between interacting electrons, a photoinduced phase transition in which the physical properties are macroscopically modified by very weak laser light can be achieved.

Most of proteins have internal cavities in which water molecules and other chemical compounds are trapped. Those molecules play essential roles as proteins perform their functions. For example, the reaction to produce sugar from cellulose is a hydrolysis in which water is directly involved in a chemical species. In that case, water and cellulose should be accommodated inside a protein cavity for the reaction to be taken place. Some of those water molecules have been detected by the X-ray crystallography. Recently, we have succeeded to detect such water molecules for the first time by mean of the statistical mechanics theory. The method can be readily extended to the problems such as the recognition of a ligand by a protein.
Molecules in gas phase undergo translational, rotational and vibrational motions in a random manner, and the total molecular system is a statistical ensemble that contains a number of molecules in many different states of motions. This research group aims to establish methods to manipulate the quantum-state distribution pertinent to molecular motions, by utilizing the coherent interaction with laser lights. Here lasers with ultimate resolution in time and energy domains are employed complementally and cooperatively for manipulation of molecular motions. At the present stage, the following subjects have been extensively explored: 1) an exploit of impulsive interaction with ultrafast intense laser fields to achieve a nonadiabatic excitation of molecular rotation, 2) realization of complete population transfer via an adiabatic interaction with coherent light fields from high-resolution ns pulsed laser systems, which have been newly constructed in this laboratory.

It is impossible to resolve extremely small structures with a conventional optical microscope because of the diffraction limit (ca. 0.5 m for visible light). However, using recently developed near-field optical microscopy, we can observe nanometer-sized materials. This method makes it possible to take color photographs (i.e., spectral information) of nanomaterials. In addition, we can observe dynamic behaviors point-by-point on nanomaterials at the femtosecond timescale. We also found that wave function, which is essential in determining the material characteristics, is observable in some of nanomaterials. Based on such a methodology, we are currently conducting basic research into the novel optical properties and optical control of nanomaterials.

The wave nature of matter is at the heart of the quantum world. Quantum mechanics was founded more than 70 years ago, and our modern civilized societies are deeply indebted to inventions made possible by quantum mechanics such as computers and CD players. The quantum world is, however, not yet fully understood, and considerable potential for its application still exists. We are trying to control completely the wave nature of atoms and molecules with light to better understand the quantum world. Improved understanding of the quantum world will result in the development of novel quantum technologies such as single-molecule information processing and subnanoscale bond-selective chemistry.
UVSOR- Shapiro Institute for Molecular Science is an electron accelerator, which was constructed about 25 years ago. As the result of continuous efforts on improving the machine, its performance is in the world top level. Our research group is developing light source technologies by using the high quality electron beam from UVSOR-, such as synchrotron radiation which is intense white light emitted by high energy electrons traveling in a strong magnetic field, free electron laser which is a laser technology based on synchrotron radiation and new technologies using laser-electron interactions. These lights are widely used in research works on molecular sciences and other research fields.

MITSUKE, Koichiro (Associate Professor)

The main interests of our group focused on elementary reactions of solitary molecules induced by photoexcitation and/or photoionization in the extreme ultraviolet region ranging from 6nm to 200nm. Principal research subjects are (1) photoionization and photodissociation dynamics studied by electron and fluorescence spectroscopy, (2) development of high-resolution vacuum ultraviolet and soft-X ray monochromators for synchrotron radiation studies, (3) pump-probe or double resonance experiments combining synchrotron radiation and laser, and (4) photoionization and photodissociation mechanisms of fullerenes studied by quantitative photoabsorption spectroscopy, mass spectrometry together with theoretical analyses using the transient-state model, velocity-map imaging spectroscopy, and various coincidence techniques.

HISHIKAWA, Akiyoshi (Associate Professor)

Intense laser fields, comparable in magnitude with the Coulomb field within atoms and molecules, can be generated by focussing high-energy and ultrashort laser pulses. When exposed to such an intense laser field, molecules exhibit various exotic features that cannot be observed in weak laser fields. We are seeking a deeper understanding of the behavior of molecules in intense laser fields to elucidate how molecules interact with light and to apply the new features they exhibit to the real-time visualization and the control of chemical reactions.

KIMURA, Shin-ichi (Associate Professor)

Synchrotron radiation is a high brilliant light source with broad band from the terahertz to x-ray. The investigation of the functionality of materials under extreme conditions that has been regarded to be impossible up to now becomes available using the light sources. In particular, to clarify the origin of a metal-insulator transition under a high pressure, a high magnetic field and a low temperature provides important information for the design of functional materials based on electron correlations.
“Micro Solid-State Photonics.” based on the micro domain structure and boundary controlled materials, opens new horizon in the laser science. The engineered materials of micro and/or microchip solid-state, ceramic and single-crystal, lasers can provide excellent spatial mode quality and narrow linewidths with enough power. High-brightness nature of these lasers has allowed efficient wavelength extension by nonlinear frequency conversion, UV to THz wave generation. Moreover, the quasi phase matching (QPM) is an attractive technique for compensating phase velocity dispersion in frequency conversion. The future may herald new photonics.

When a molecule is irradiated by high-energy radiation like X-rays, the inner-shell electron with no or very small contribution to any chemical bond in the molecule is excited. The molecule with an inner-shell vacancy thus created is quite unstable due to its fairly high internal energy, and subsequent electronic relaxation processes and/or ionic fragmentations take place. Such high-energy photochemical reactions strongly depend on which inner-shell electron in a molecule is involved, as well as the type of molecule. We inspect a wide variety of the reaction processes observed in each individual molecule by utilizing monochromatized synchrotron radiation, which is emitted by electrons orbiting in a storage ring.

Metal acetylides composed of a carbon molecule (C2) and metal atom(s) generate nano-structures by the photo- or thermal-segregation reactions with various functions characteristic of metal species such as Schotky Barrier devices, antirust transition metal nanomagnets, quasi-one-dimensional metal particle arrays, conductive nanosheets, oxygen sensors, hydrometers, and carbon nanodendrite electrodes. Mesoporous Carbon Nano-Dendrites simply produced from Ag2C2 exhibit BET surface areas as wide as 1500m²/g and the surface is composed of graphene-type double wall or triple walls. They can be used as electrodes of super capacitors, Lithium Ion Batteries, and fuel cells.

We investigate magnetic properties of surfaces and thin films using photons. The engineered materials of micro and/or microchip solid-state, ceramic and single-crystal, lasers can provide excellent spatial mode quality and narrow linewidths with enough power. High-brightness nature of these lasers has allowed efficient wavelength extension by nonlinear frequency conversion, UV to THz wave generation. Moreover, the quasi phase matching (QPM) is an attractive technique for compensating phase velocity dispersion in frequency conversion. The future may herald new photonics.
Atomic nuclei of molecules have nuclear spin, which placed in magnetic field behave as small magnet, and it is possible to control those behaviors by applying electromagnetic waves at suitable frequency. This technique is referred to as nuclear magnetic resonance (NMR), and it enables to determine interatomic distances and interbond angles accurately without damage of molecules. Many of important biomolecules such as membrane proteins, and advanced materials are insoluble and functional at amorphous state. Thus solid state NMR is essential for the characterization of those molecules. We are mainly working on the methodology and hardware developments for solid state NMR and its applications.

How to control the composition, the alignment, and the cooperativeness of molecules is a key issue in function design of supramolecules and macromolecules. This laboratory focuses on novel extended -electronic systems, with a challenge to function design of intelligent photo, electronic, and spin functional supramolecules and macromolecules that are responsive to external stimuli, through chemical construction based on a protocol that seamlessly fuses molecular design, precise integration, and function exploration. We develop spin functional supramolecules with photo-controllable spin state and magnetism, by taking advantage of spatially confined alignment of metallo-complexes. We explore conjugated gigantic macromolecules with 2-D extended sheet structure and create unprecedented functional macromolecules with tunable nanopores.

We investigate anomalous electronic phases observed in molecular-based conductors by magnetic resonance measurements such as NMR and ESR. Although pristine organic materials are well-known as insulators, we can get electric conductors after electro chemical carrier doping. The fundamental properties of molecular-based conductors have been clarified. However it is also true that a lot of unsolved problems remain. Moreover, molecular-based conductors attract much attentions because of various electronic phases. Magnetic resonance is advanced technique which enables us to clarify character of materials by nuclear and/or electron magnets as probes without contact and destruction.

Temperature and pressure often change the electronic properties of materials drastically. If we investigate the properties under various temperature and pressure, we can make a map of the properties (electronic phase diagram). The electronic phase diagram plays an important role in understanding the material’s properties and developing new materials. Utilizing the Raman spectroscopy, we are investigating the electronic phase diagram of organic conductors, especially focusing on the electronic phase neighboring on a superconducting phase.

Pressure dependence of the Raman spectrum of an organic conductor at 20 K. 1 GPa corresponds to 104 bar. This compound changes into metallic state above 1.5 GPa. Right figure shows a tool to generate high-pressure.

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Bowl-shaped conjugated compounds including partial structures of the fullerenes or the cap structure of nanotubes, which are called buckybowls, are of importance not only as model compounds of fullerenes but also as their own chemical and physical properties. However, very few buckybowls have been achieved for preparation mainly due to their strained structure. In addition, most of the thus-reported procedures are performed under severe reaction conditions, limiting the sort of the introducible atoms/functional groups. In the present works, we develop the rational route to the various kinds of buckybowls using the organic synthesis approach. We are also interested in the development of metal nanocluster catalyst and its application to synthetic organic chemistry.

Photosynthesis supports all sorts of activities of lives on the earth, through conversion of solar energy to chemical energy. This is done by green plants by use of a set of complicated biological molecules, which constitute one of the finest pieces of molecular machinery ever created by Nature. Our research aims at mimicking this machinery with artificial molecules. The ultimate goal is, like plant photosynthesis, to make useful organic compounds out of carbon dioxide with solar energy. Although this is still far away, we are confident that, by combining our knowledge on the mechanism of natural photosynthesis and our experience on synthetic chemistry, we will be able to realize a new form of photosynthesis of purely artificial origin.

Organic semiconductor is of great interest because of the applications for plastic electronics such as organic light-emitting diodes, transistors, and photovoltaics. Unlike conventional inorganic semiconductors, organic devices are thin and flexible. We have been synthesizing new organic semiconductors for such devices. Our collaborators construct the devices to see the performance of our materials. Some of them are used in the laboratories of universities and companies worldwide for science and technology.

A single-molecular quinone pool. It stores the photochemical energy via chemical conversion within the molecule.
Metalloproteins play an important role for energy metabolism, molecular metabolism, and signal transduction in biological systems. The elucidation of the structure and function of these metalloproteins is central to understanding the regulatory mechanisms associated with biological functioning. We are currently elucidating the structure-function relationships of metalloproteins using experimental methods in the areas of biochemistry, molecular biology, organic chemistry, inorganic chemistry, and physical chemistry.
A wide variety of biomacromolecules have adopted their own three-dimensional structures during the long process of evolution and thereby enabled them to express sophisticated functions in the biological systems. Our biomolecular studies are based on detailed analyses of structures and dynamics of various biological macromolecules and their complexes at atomic level, primarily using nuclear magnetic resonance (NMR) spectroscopy. In particular, we conducted studies aimed at elucidating the dynamic structures of glycoconjugates and proteins for integrative understanding of the mechanisms underlying their biological functions. For this purpose, we use multidisciplinary approaches integrating the methodologies of molecular and cellular biology and nanoscience along with molecular spectroscopy.
Leading the sustainable future of Japan

Next Generation Integrated Nanoscience Simulation Software

A national project named “Next Generation Integrated Nanoscience Simulation Software” was initiated on April 1, 2006 at Institute for Molecular Science (IMS). The project is a part of the “Development & Application of Advanced High-Performance Supercomputer Project” of MEXT, which aims to develop a next generation supercomputer and application software to meet the nation’s computational science needs.

The primary mission of our project is to resolve following three fundamental problems in the field of nanoscience, all of which are crucial to support society’s future scientific and technological needs: (1) “Next Generation Energy” (e.g., effective utilization of the solar energy), (2) “Next Generation Nano Biomolecules” (e.g., scientific contributions toward overcoming obstinate diseases), and (3) “Next Generation Nano Information Function and Materials” (e.g., molecular devices). In these fields, new computational methodologies and programs are to be developed to clarify the properties of nanoscale substances such as catalysts (enzymes), bio-materials, molecular devices, and so forth, by making the best use of the next generation supercomputer.

State-of-the-art facilities supporting cutting-edge research

Research Facilities

UVSOR Facility
Vacuum ultraviolet (UV) light is not alive when the solar light reaches the earth, because the VUV light strong interaction with molecules in the air. The wavelength of the VUV light is between ultraviolet (UV) light and X-rays. Since the VUV light is indispensable in photo-science of molecules, it is artificially produced. Institute for Molecular Science constructed a circular accelerator based on the synchrotron radiation(SRF) mechanism in 1983. In 2003, we upgraded the accelerator to achieve the world’s highest brilliance of small SR facilities. The next generation soft X-ray emission spectrometer was recently successfully developed. Our SR facility is called UVSOR.

Inter-University Network for Efficient Utilization of Chemical Research Equipments
Academic and industrial activities in Chemistry in Japan have been highly influential over the past 30 years. Needless to say, it is highly important to improve the supporting environment for research and education in science and engineering. In particular, research equipment advances the time to more intelligent and expensive ones, making measurement time shorter with higher reliability. It would be economic and efficient for the researchers and students of all national universities to share such equipments for performing high level research and education.

On April 7th 2007, the selected representatives from 72 universities gathered in Okazaki and decided to start the Inter-University Network for Efficient Utilization of Chemical Research Equipments. This system is operated through internet machine-time reservation and charging system by the help of equipment managers and accounting sections in each university. All the universities are grouped into 12 regions and in each region the hub university organizes the regional committee for the operation of regional network system. There is no barrier for every user to access to any universities beyond his/her regional group. We will promote applications not only to each supporting element, but to combined usage of several supporting elements such as a nanobiotechnology field that is highly efficient in this joint project.
Research Center for Molecular Scale Nanoscience

The Center was established in 2002 with the mission of undertaking comprehensive studies of Molecular Scale Nanoscience. The Center consists of one divisions staffed by full-time researchers and two divisions staffed by adjunctive researchers. Their mandates are 1) fabrication of new nanostructures based on molecules, 2) systematic studies of unique chemical reactions and physical properties of these nanostructures. The Center also provides various kinds of nanotechnology programs.

Laser Research Center for Molecular Science

The center aims to develop new experimental apparatus and methods to open groundbreaking research fields in molecular science, in collaboration with the Department of Photo-Molecular Science. Those new apparatus and methods will be served as key resources in advanced collaborations with the researchers from the community of molecular science. The main targets are (1) advanced photon sources covering wide energy range from terahertz to soft X-ray regions; (2) novel quantum-control schemes based on intense and ultrafast lasers; and (3) high-resolution optical imaging and nanometric microscopy. The center also serves as the core of the joint research project “Extreme Photonics” between IMS and RIKEN.

Instrument Center

This center is established in 2007 combining the general-purpose instruments of the Research center for molecular-scale nanoscience and Laser research center for molecular science. The main instruments are NMR, mass spectrometer, powder X-ray diffractometer, diode refrigerator with superconducting magnet, fluorescence spectrophotometer, UV-VIS-NIR spectrophotometer, circular dichroic spectrometer in Myodaiji campus. We mainly support a general-use experiment, and we often support a special one such as the experiment combining lasers and general-purpose machines. We provide liquid nitrogen and liquid helium using helium liquefiers. We also support the network sharing system of the chemistry-oriented instruments, which starts in the April of 2007.

Research Center for Computational Science

High-quality hardware and software services are provided to the scientists in our country in the field of molecular science and bioscience. Pioneering large-scale quantum chemical and molecular dynamics calculations are conducted using our super computer systems “Grid Computing System” and “Super-High-Performance Molecular Simulator.” Totally, they have performance as high as near 20 TFLOPS. A new supercomputer system was introduced further in this year to realize much higher computational environment.

Equipment Development Center

We are developing various kinds of apparatus and devices required for conducting molecular science experiments, either by ourselves or through collaborations with in-house and outside scientists. Facilities for mechanical, electronics and glass works are well established, and the requirements of advanced research initiatives in molecular science are supported by these facilities based on the high level of technology that has been developed since the establishment of IMS. It is our mission to provide the technological environment necessary for supporting highly innovative research through facilitating the consultative process between the scientist and the engineer.

Research Center for Molecular Scale Nanoscience

The Center provides various kinds of nanotechnology programs. 920 MHz NMR Spectrometer (left) and measured example (right). Culture, Sports, Science and Technology (MEXT) as a core organization, and conducts the Nanotechnology Network Project of the Ministry of Education, administers offers public usage of the advanced ultrahigh magnetic field NMR instruments, which starts in the April of 2007.

Okazaki Research Facilities

As one of the important functions of an inter-university research institute, IMS facilitates joint study programs for which funds are available to cover the costs of research expenses as well as the travel and accommodation expenses of individuals. Proposals from domestic scientists are reviewed and selected by an inter-university committee. The programs are conducted under one of the following categories: (1) Joint Studies on Special Projects (a special project of significant relevance to the advancement of molecular science can be carried out by a team of several groups of scientists); (2) Research Symposia (a symposium on timely topics organized as a collaborative effort between outside and IMS scientists).

Joint Study Programs

(3) Cooperative Research (a research program conducted by outside scientists with collaboration from an IMS scientist).
(4) Use of Facilities (a research program conducted by outside scientists using the research facilities of IMS).
(5) Invited Research Project.
(6) Joint Studies Programs using beam lines of the UVSOR Facility.
(7) Use of Facilities in the Research Center for Computational Science (research programs conducted by outside scientists at research facilities in the Research Center for Computational Science).
International communication and cooperation

IMS has accepted many foreign scientists and hosted numerous international conferences since its establishment and is now universally recognized as an institute that is open to foreign counties. In 2004, IMS initiated a new program to further promote international cooperation. As a part of this new program, IMS faculty members can, (1) nominate senior foreign scientists for short-term visits, (2) invite young scientists for long-term stays and, (3) undertake visits overseas to conduct international collaborations. In 2006, IMS started a new program, JSPS Asian CORE Program on Frontiers of Material, photo- and theoretical molecular sciences* (2006-2010). This new program aims to develop a new frontier in the molecular sciences and to foster the next generation of leading researchers through the collaboration and exchange among IMS and core Asian institutions: ICCAS (China), KAIST (Korea) and IAMS (Taiwan).

Highly capable personnel nurtured by abundant research resources

Personnel Training : Education in Graduate School

What is SOKENDAI?
The Graduate University for Advanced Studies (hereafter referred to by the Japanese contraction, “Sokendei”) was founded in 1988 with the intention of cultivating new integrative research fields and to promote academic excellence through its doctoral course programs that are also open to foreign students. The university is based in the town of Hayama in Kanagawa Prefecture, Japan, and its unique education programs are currently available in Hayama, as well as at eighteen other national academic research institutes to which individual students are assigned according to their field of study.

Common Facilities in Okazaki

Okazaki Library and Information Center

http://www.lib.orion.ac.jp/

In the Okazaki Library and Information Center, books and journals from three affiliated institutes (IMS, NIBB, NIFS) are collected, arranged and stored for the convenient use of staff and visiting users.

Available services:
- Library is open 24 hours using ID cards
- Online reading of journals and searching using Web of Science, Scifinder Scholar, etc.

Okazaki Conference Center

http://www.orion.ac.jp/occ-e/

The Okazaki Conference Center was founded in February 1997 for the purposes of hosting international and domestic academic exchanges, developments in research and education in the three Okazaki institutes, as well as the promotion of social cooperation. An auditorium (Ookage-shitsu), a middle room (Chu-kaigi-shitsu) and two small rooms (Sho-kaigi-shitsu) with seating capacities of 250, 150, and 50, respectively, are available.

Dormitories for Visiting Researchers

http://www.orion.ac.jp/occ-e/lodge/

For visiting researchers from universities and institutes within Japan and all over the world, the dormitory called the Makim Lodge is available. It takes 10 minutes on foot from the Myodaiji area to the Makima Lodge.

Staff (as of April, 2008)

Budget (2007) (Thousand yen)

Personnel 1,239,485
Researchers 2,002,248
Total 3,230,713

Grants-in-Aid (2007)*

Personnel 334,258
Research 21,071
Total 355,329

* Included in the left table ** Including contract-based research and indirect expenses

JSPS : Japan Society for the Promotion of Science
JST : Japan Science and Technology Agency
CREST, PRESTO, others** : Special Coordination Funds for Promoting Science and Technology from MEXT**
Others** : 29,000
Total 1,005,075