Graduate School of Science and Faculty of Science
Tohoku University

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TOHOKU UNIVERSITY

Graduate School of Science and Faculty of Science
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- Mathematics
- Physics
- Astronomy
- Geophysics
- Chemistry
- Earth Science
- Biology

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As the water planet came into being along with immeasurable time,
a very sophisticated balance over billions of years created the biodiversity.
Research on elucidating a theory of natureis prodressing continuously:
Human genome sewuencing is complete and a unified theory to integrate macroscopic and microscopic systems is underway.
Though, may be an even deeper mystery.
It might be you that will solve the mystery.
Science gives you the pleasure of understanding and comprehending nature - the generation, mechanism and relationship between matter in the universe - through observation, investigation, experimentation, analysis and thinking.

Contents

The Dean's message

Professor
Kimio Hanawa

A university is a center for inheriting knowledge and creating new knowledge. To inherit knowledge, it is critical to learn both basic knowledge from a wide range of fields and deep knowledge from specialized fields. However, acquiring the systematic body of knowledge that human beings have built up through the ages cannot possibly be completed in the few years of university.

At a university, it is important to change from a stance of passive learning to one of actively seeking knowledge on your own, so that you acquire learning techniques while learning knowledge.

Creating knowledge requires ascertaining the current state of knowledge, and from there, taking one more step. In other words, creating knowledge is research. To carry out good research, it is vital to have the ability to set your own challenges and to learn to pursue the question all the way to the bottom.

As a result of inheriting and creating knowledge, men and women are fostered to actively work as researchers, or to leave the university and to lead the next generation of society. Let us truly make the university a place to inherit knowledge and create knowledge by uniting, students and teachers together, as one.

Kimio Hanawa

Tohoku University

Tohoku University has been committed to the "Research First" principle and "Open-Door" policy since its foundation, and is internationally recognized for its outstanding standards in research that are useful as solutions to societal problems and for educating students with the capabilities of leadership.

Tohoku University was founded in Sendai in 1907 as the Tohoku Imperial University. It was the third Imperial University in Japan, following Tokyo University (1877) and Kyoto University (1897), and was comprised of the College of Agriculture and College of Science. Since its foundation, the university has been very progressive and provided a stimulus to society. To give a few examples, it was the first Imperial University to admit applicants who had not finished regular preparatory courses, i.e., it accepted graduates from Medicine and Technical Colleges and those who held certificates as secondary-school teachers. It was also the first Japanese university to introduce coeducational classes. It presented university extension lectures to the public well ahead of its time. Tohoku University also opened its doors to foreign students and conferred degrees on foreign graduates as far back as 1911. Today, the university is one of the largest and oldest national institutions in Japan with five campuses in Sendai.

Fundamental Principles and Objectives

The following objectives are being pursued to uphold these principles.

A Research-intensive University

Tohoku University's prime objective is to contribute to the well-being and advancement of humanity through its research. To achieve this, the university is undertaking the followings.

- Integrated Body of Knowledge. Research is coordinated between all departments and research institutes devoted to the study of natural and social sciences and other humanities deemed necessary for the betterment of society.
- Accumulation of Knowledge. World-class research is continually being conducted in new fields of knowledge, technology, and values.
- Transmission and Spread of Knowledge. Researchers are educated to attain a broad vision, outstanding professional qualifications, and a keen sense of social responsibility.

A University Open to the World and the Community

Tohoku University strives to contribute globally as well as to the local community as an open university. This objective is being carried out through the followings.

- We welcome capable and highly motivated students, regardless of nationality, race, gender, or religion, as well as offer an outstanding research faculty.
- We vigorously promote collaboration between the university and industry in the interests of forging closer relationships with communities and regions.
- We actively provide educational opportunities to the general public through programs such as open courses, online learning, extension programs, and free legal counseling.
- We continue in our efforts to develop an environmentally friendly campus, which will be enjoyable and stimulating to local people.

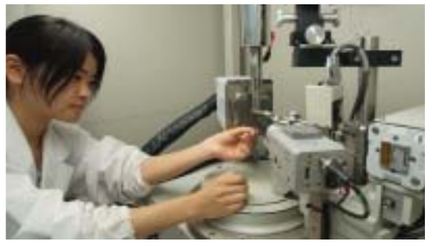
Development of Future Leaders

At Tohoku University, those in charge of education in the various departments and graduate schools are faculty members who are leaders in their own fields of research. By exposing their students to cutting-edge knowledge, these outstanding teachers are committed to nurturing students capable of assuming leadership in advancing both society and knowledge. The undergraduate programs stress the acquisition of a solid foundation in the various specializations and languages, and the ability to effectively utilize information so that students are capable of working internationally.

While educating researchers who will be familiar with world-class research and capable of making substantial contributions, the graduate programs also produce professionals with a high level of theoretical and practical knowledge in their respective fields.







School of Science

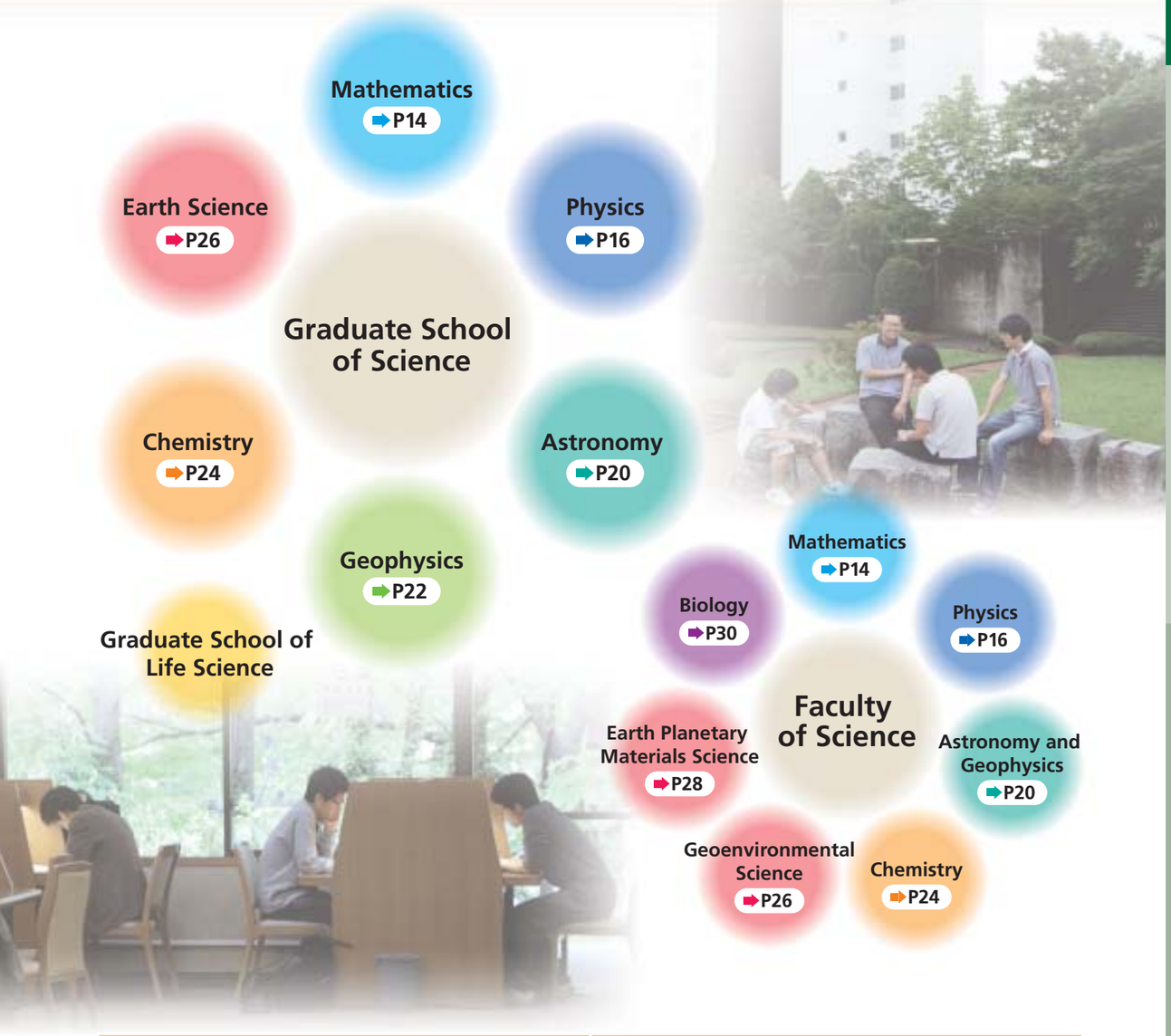
The Faculty of Science was established as the College of Science of Tohoku Imperial University in 1907. The Departments of Mathematics, Physics, and Chemistry began offering courses in 1911, followed by the Department of Geology the very next year. The College of Science was renamed the Faculty of Science in 1919. Numerous departments and research laboratories have been added since then.

Tohoku University is committed, first and foremost, to excellence based on the principles of its foundation, i.e., "Research First" and "Open-door" policies. The School of Science has been playing important roles in the university to achieve these goals. The principle of "primary emphasis on research" is based on the belief that leading researchers can provide the best education. This ideology has remained for more than a century within our faculty in education and research with an emphasis on creativity.

Examples of our "open-door" policies can be seen in the break with tradition in the era of modernization in Japan. Our faculty was the first in Japan to accept three female students in 1913. Of these three, Ume Tange went on to earn her Ph.D. at Johns Hopkins University in 1927. She was the first Japanese woman to earn her doctorate. Professors Chen Jiangon and Su Buqing, who were the most eminent mathematicians in China, were awarded the Doctor of Science degree, the former in 1929 and the latter in 1931. They were the first two foreign students to receive their doctor's degrees in Japan.

These two principles have been upheld since the foundation of the College of Science and have been the driving force behind our research. However, recent global changes have required universities in Japan to establish new objectives based on globalization and their contribution to society. The new objectives of the Faculty of Science, which can be achieved by promoting creative research and training new researchers, should be for it to gain recognition throughout the world for higher levels of research and for it to play a major global role in the advancement and propagation of new scientific technology. To achieve these objectives, steps were taken in 1995 toward expanding the graduate schools of the university and giving them greater significance. This shift toward emphasis on graduate school study started with the reorganization of the Faculty of Science into the Graduate School of Science, which was aimed at achieving higher levels of research and education. The Graduate School of Science is comprised of six departments, Mathematics, Physics, Astronomy, Geophysics, Chemistry, and Geoenvironmental Science, and eight research centers and facilities.

School of Science Organization



Undergraduate course	Graduate (Master's, Doctoral) course
Mathematics	Mathematics
Physics	Physics
Astronomy and Geophysics	Astronomy
	Geophysics
Chemistry	Chemistry
Geoenvironmental Science	Earth Science
Earth and Planetary Materials Science	
Biology	

Educational Programs

For more detailed information on eligibility and admission procedures, refer to the Website:
Graduate School of Science and Faculty of Science, Tohoku University

URL *http://www.sci.tohoku.ac.jp/english/2nd/admission.html*

Undergraduate Program

Bachelor of Science Japanese

The Faculty of Science offers a four-year undergraduate program leading to the Bachelor of Science. The program provides basic training for future scientists and graduates will be well prepared for graduate study in science and to become leaders in various fields throughout the world based on their skills and knowledge in science.

URL *http://www.sci.tohoku.ac.jp/english/2nd/academicprograms.html*

Graduate Program

Master & Doctor of Science Japanese

The Graduate School of Science aims to enrich knowledge about nature, contribute to society, and educate top-class leaders in advanced science in an international research environment. The two-year master's and three-year doctoral programs are research-oriented. Students can explore their areas of interest in depth under guidance of a supervisor.

URL *http://www.sci.tohoku.ac.jp/english/2nd/academicprograms.html*

International Graduate Program for Advanced Science (IGPAS) English

IGPAS is a consecutive interdisciplinary course in English from master's to doctoral programs designed for international students who seek to do advanced research and be educated in Japan. IGPAS students are offered scholarship opportunities by the Japanese Government (MEXT, Monbukagakusho) and Tohoku University International Advanced Research and Education Organization(IIARE).

URL *http://www.sci.tohoku.ac.jp/english/2nd/igpas.html*

Exchange Program

Tohoku University and the Graduate School of Science have academic agreements with more than 150 universities and research institutions. Students of the partner institutions may participate in the following exchange programs with tuition waivers. Contact the international office of your home institution for further information and details on the application procedure.

Double Degree/Joint Education Program English

Tohoku University is one of the pioneering universities in Japan that offer a Joint Education (Double Degree) Program with academic institutions in Asia and Europe, aiming to nurture the new generation of leaders in global society. Participants who attend both Tohoku University and the partner institution will be awarded degrees from both institutions on completing the joint program.

Junior Year Program in English (JYPE) English

JYPE, in principle, is a one-year undergraduate program for third and fourth year students in partner institutions. The program offers courses in English. JYPE students attend lectures, conduct research, and learn Japanese while enjoying life and culture in Japan.

URL *http://www.insc.tohoku.ac.jp/jype/index.html*

Direct Enrollment Education Program (DEEP) Japanese English

DEEP is a non-degree exchange program for students of partner universities offered in two categories (similar to the short-term program below): special auditing students (Japanese language skill equivalent to Japanese Proficiency Test Level 1 is required) and special research students.

URL *http://insc.tohoku.ac.jp/infor-IES.htm*

Short-term Program

International students may take advantage of enrolling in world-class education at Tohoku University in a non-degree program for up to one year. Extension of stay may be allowed if approved. Japanese language skills are strongly recommended for the program.

Research Japanese English

Research students conduct research under an academic supervisor at Tohoku University.

Auditing Japanese English

An auditing student registers in classes and earn credits. Most courses are presented in Japanese.

International Affairs

The two policies at Tohoku University since its establishment have been "primary emphasis on research" and an "open door," which have continuously motivated the Graduate School of Science and the Faculty of Science to enhance international collaboration in research and education. More than 200 international scholars, including visiting researchers, professors, and lecturers, have been affiliated with the School of Science at Tohoku University within the past five years. Eighty-one international students have been studying science in the Graduate School of Science and the Faculty of Science since April 1, 2008.

To support these international researchers and students in science as well as our faculty members who actively conduct research all over the world, the Graduate School of Science established the Division of International Research and Educational Cooperation (DIRECT) in 2002 to provide specific support in science in addition to the Center of International Exchange at the university level. DIRECT (1) serves as an international liaison for research and educational activities based on academic agreements, (2) coordinates international educational programs for students, and (3) provides support to international researchers and students to facilitate their activities in the Graduate School of Science and the Faculty of Science.

The Academic Affairs Section of the Graduate School of Science and the Faculty of Science administer admissions and registrations for international students as well as students from Japan.

Division of International Research and Educational Cooperation (DIRECT)

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Honored Alumni

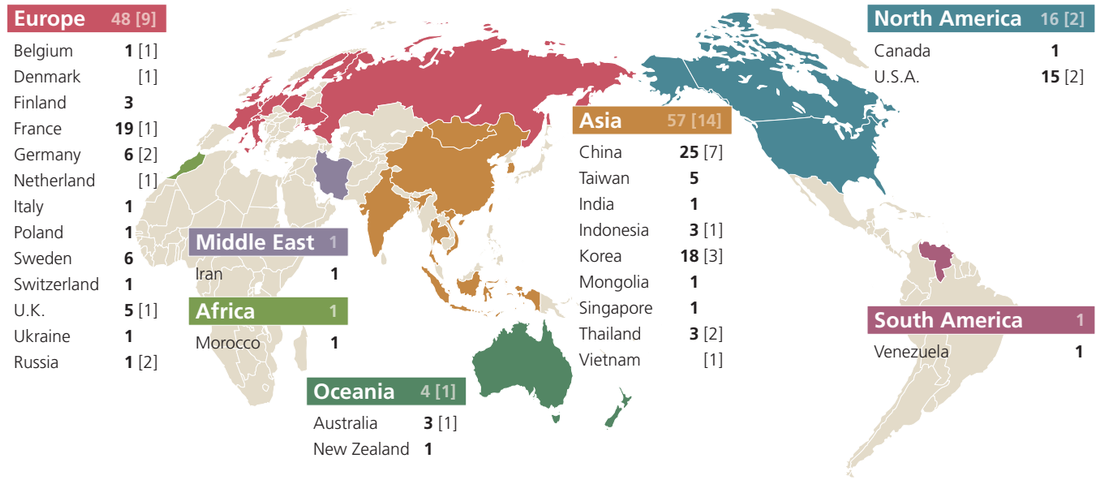
The Faculty of Science of Tohoku Imperial University was established in 1911 and its Graduate School of Science has produced many internationally noted alumni including the eminent mathematicians Professors Chen Jiangong and Su Buqing. Professor Chen graduated from the Department of Mathematics in 1923 from the Faculty of Science at Tohoku Imperial University as an exchange student and became the first international student in Japan who obtained his Doctor of Science in 1929. Professor Su taught as a lecturer at the Teacher Training School of Tohoku Imperial University after he graduated from its Department of Mathematics in the Faculty of Science in 1927. He then continued to study mathematics and obtained the second Doctor of Science awarded to an international student in Japan in 1931. Both returned to their home country after graduation to promote mathematics at Zhejiang University, China. Professor Chen served as the Vice President of Zhejiang University, a Professor at Fudan University, and the President of the Zhejiang Science and Technology Association. Professor Su became President of Fudan University. At the same time he played a remarkable role as the Vice President of the Chinese People's Political Consultative Conference.

Chen Jiangong

SU Buqing

Academic Agreements *(As of June 2008)*

**[ ]: department level agreements of the Graduate School of Science*

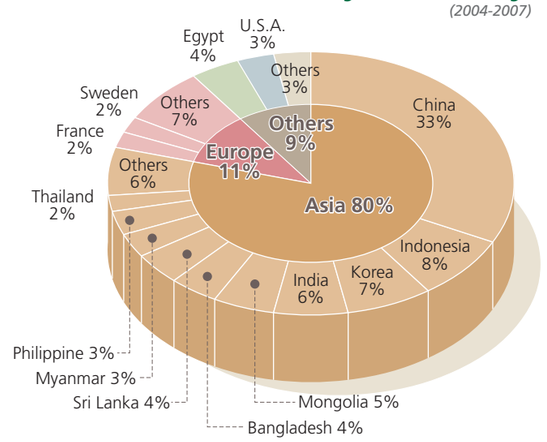


Facts

Faculty/Students Ratio	1/3.9 (Undergraduate) 1/2.1 (Graduate)
Degree Awarded	327(Undergraduate) 218 (Master's) 99 (Doctoral)
Advancement Rate	81.1%
Female Students	15%
International Students	1.5% (Undergraduate) 7.3% (Graduate)

International Students by Nationality

(2004-2007)



Class of 2007

Employers

Jusco International, Japan
Asahi Kasei Corporation, Japan
Dow Corning Toray, Japan
Cheil Industry, Korea
Tohoku University, Japan
Osaka University, Japan
Harvard University, USA
Xian Technological University, China
Nanyang Technological University, Singapore
Haluoleo University, Indonesia

		Undergrad.	Master's	Doctoral	Total
Continuing Education	at Tohoku Univ.	1	6	0	7
	Other	0	0	0	0
Employed	in Japan	0	1	5	7
	in home country	0	1	3	3
	in other location	0	0	2	2
undecided		0	2	8	10
Postponed Graduation		0	2	0	2
Total		1	12	18	31

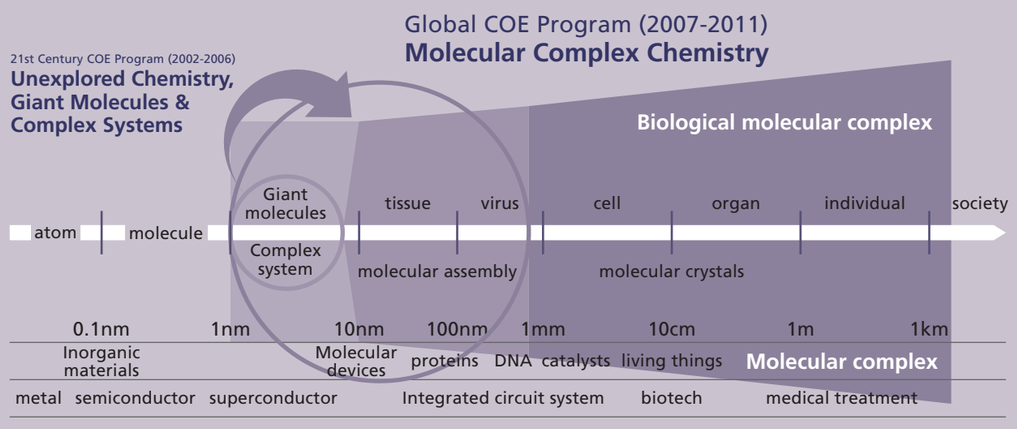
01

The Global COE Programs

International Center of Research & Education for Molecular Complex Systems

Chemists in this century need to undertake various tasks themselves to contribute more productively to society. A characteristic feature of chemistry in the field of natural sciences and technologies is its capability to adopt a bottom-up methodology regarding the size of substances. Chemical methods allow the buildup of small molecules to larger molecular systems, which exhibit various functions.

Giant molecules are 1–10 nm in diameter as exemplified by the polyether natural product ciguatoxin, and complex systems are assemblies of small molecules on surfaces or at interfaces containing 1- to 10-nm-diameter substances. The present Global COE Program's aim is proposing various research studies on larger molecular systems ranging from 10 nm to 0.1 mm by building up giant molecules and complex systems. The focus of this program will be the study of three-dimensional and time-dependent functions of various molecular systems, and such a research field is called "Molecular Complex Chemistry". Along with this research field, chemists participating in this program will be involved in the Ph.D. education of chemists of the next generation, who can nationally and internationally take leadership in various fields on advanced chemistry and related sciences.



Leader *Masahiko Yamaguchi*

Under the new COE program, we have introduced various procedures to provide research-activity, international-exchange, career-path, and financial-aid support to nurture true elites enrolled in chemistry education for Ph.D. students. Participation in international collaboration and experience with high levels of research are emphasized in this program. It should be emphasized that we are determined to ensure that the program to nurture human resources through the Ph.D. will continue even after students complete their five-year Global COE Program and that Tohoku University will remain a center for fostering the talents of those who can serve as a forerunners in chemistry research.

URL http://iremc.pharm.tohoku.ac.jp/index_en.html

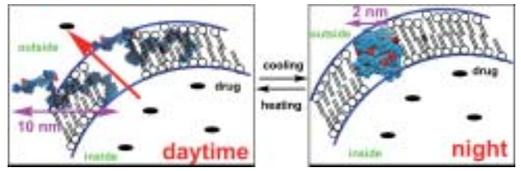
TOPICS

01 Structure and function of three-dimensional molecular complex system

Masahiko Yamaguchi

The development of a time-responding three-dimensional molecular complex system containing giant molecules is the most important issue in this project. We take advantage of synthetic giant molecules to obtain various ordered structures by intra- and intermolecular noncovalent bond interactions, which small molecules cannot obtain. Ordered three-dimensional structures with sizes up to 1 μm will be constructed, and attempts to change their structure time-dependently will be made.

One example is a liposome, which contains a thermally sensitive double helix forming molecules with a molecular weight of several thousands. The giant molecules change their structure between 2 and 10 nm length on heating and cooling. Being highly sensitive to temperature, the system may recognize daytime and night by drastically changing its structure. As a result, material can be delivered from inside the liposome to outside it, which may find a use in drug delivery.

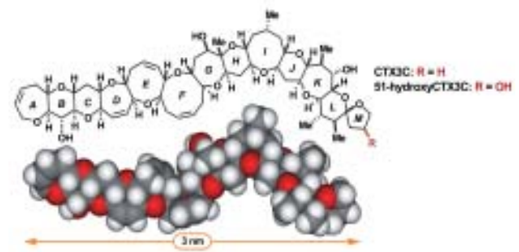


Time-responding delivery system

02 Total Synthesis and Biological Application of Ciguatoxins

Masahiro Hirama

Ciguatera is a major source of food poisoning in tropical and subtropical regions, and causes long-lasting neurological problems together with diverse symptoms. Detailed biological studies at the atomic level as well as the preparation of anti-ciguatoxin (CTX) antibodies for detecting CTXs prior to consumption have been hampered by the extremely low availability of the causative agents. The development of efficient methodologies and strategies is particularly important for total synthesis of CTXs because of their long (3 nm) and complex polyether structures. In 2001, we achieved the first total synthesis of CTX3C by assembling four structural fragments and we have also developed highly sensitive methods of immunochemical detection.

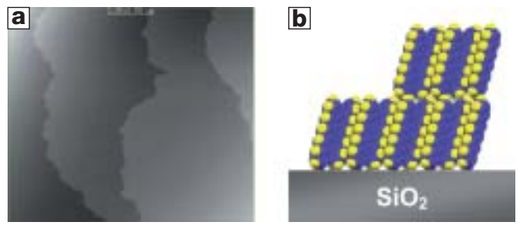


03 Growth and Properties of Perfect Single Molecular Crystals for Electric Devices

Kingo Itaya

Electric devices such as FETs, electro-luminescence (EL), and solar cells are important application fields of application for semiconductors based on organic and inorganic molecules. The chemical and physical properties of molecular crystals must be evaluated for these applications. The growth of nearly perfect single crystals is one of the most crucial important issues in these areas. The evaluation of electron and hole transport properties in single crystals is are also extremely important.

Our research group has recently found that molecular crystals such as pentacene and rubrene prepared from these solutions have unique chemical and physical properties. These crystals weare found to be nearly perfect single crystals and demonstated show very high mobility of hole mobility. This finding provided strongly encouragements for us to elucidate of the nature of numerous many molecular crystals for use as semiconductors.



AC-AFM image (a) and model structure (b) of a single crystal of pentacene on SiO_2

02

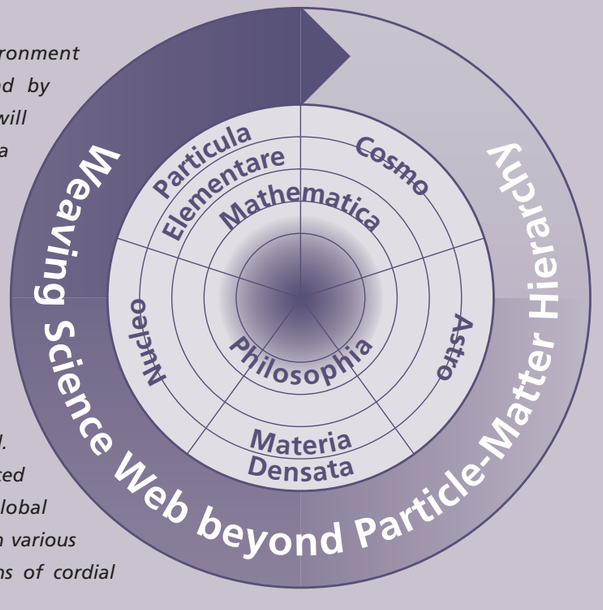
The Global COE Programs

Weaving Science Web beyond Particle-matter Hierarchy

Natural science has mainly developed with research on the phenomena within each "Particle-Matter Hierarchy" formed along with the creation and evolution of the universe, such as elementary-particle, nuclear, and condensed-matter physics, including astronomy and cosmic physics. It is needless to mention the importance of more intensive research within the hierarchy, and the exploration of inter-hierarchical research frontiers have thus far been overlooked even by advanced intelligent majorities, which are indispensable for further developments in physical science. Young scientists undertaking such developments have to direct research in international environments and have to have a extensive view of natural science and science ethics for practical applications. However, the separation between basic science and social interests due to the public's unfamiliarity with science and the deterioration of mathematical skills are currently being debated in Japan. Thus, what is important is the development of research on social relations and the nurturing of young talent who will continue to develop this research and who will act as opinion leaders to raise the importance and outcomes of science research to the public.

Based on experiences with propelling international cutting-edge research on a wide range of hierarchies under the previous COE program of "exploring new science by bridging the particle-matter hierarchy," this program attaches great importance to international collaboration and challenging new fields. Collaborations with international researchers and foreign institutes with agreements on cooperative education programs are synchronously organized as a Global Education Hub. We strongly promote characteristic studies in every hierarchy and also explore new science frontiers through extensively increasing interconnections between hierarchies just like weaving a web. This Science Web provides an environment for pursuing intensive studies and exploring new science frontiers and thus challenging new fields. Students nurtured through this education will create a new academic culture and contribute to social innovations.

The research and educational environment achieved by weaving a science web and by establishing a global education hub will continue after this program to act as a premier world-class science research/education center. This program will widely disseminate cutting-edge research and will provide many young talented researchers with scientific literacy and adaptability to society. These young talents will connect basic science and social interests, and will contribute to raising the intellectual levels of humankind. At the same time, those who have experienced international cooperation within this global education hub will actively collaborate with various countries and will become the foundations of cordial relations between these countries.



URL http://www.scienceweb.tohoku.ac.jp/english/

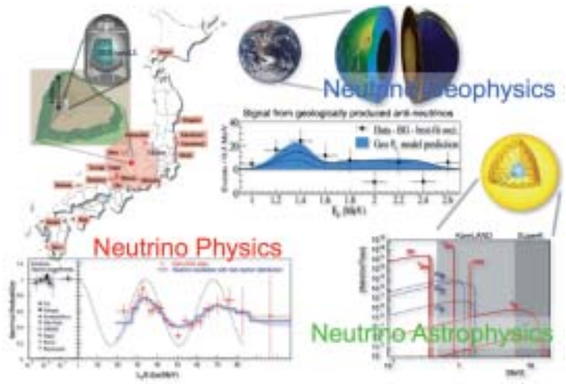
TOPICS

01 Frontiers of Neutrino Science

KamLAND propels interdisciplinary science and further explores new fields on the science web woven by this GCOE program. It has a 1000-ton ultra-pure liquid scintillator and is located 1000 meters underground. It offers an ultra-low background environment and allows us to observe very rare signals such as neutrino interactions.

KamLAND has helped us to find that anti-neutrinos from nuclear-power reactors repeat to vanish and reappear. This is clear evidence of neutrino oscillation resulting in the most precise measurements of the neutrino mass structure. Consequently, KamLAND has made neutrinos new tools to see through astronomical objects that are opaque. Success in the first observation of geologically produced neutrinos is a breakthrough for observational geophysics and is the start of "Neutrino Geophysics". It also aims at propelling neutrino astrophysics by enabling the interior of the Sun to be observed with abundant low-energy solar neutrinos. We also plan to utilize the ultra-low background environment of KamLAND to explore neutrino-less double beta decay. One possibility is loading highly soluble ^{136}Xe gas into the liquid scintillator. We expect to reach the world's highest sensitivity on the absolute Majorana neutrino mass.

Neutrino Science with KamLand



02 Mathematics is the common language in weaving the science web.

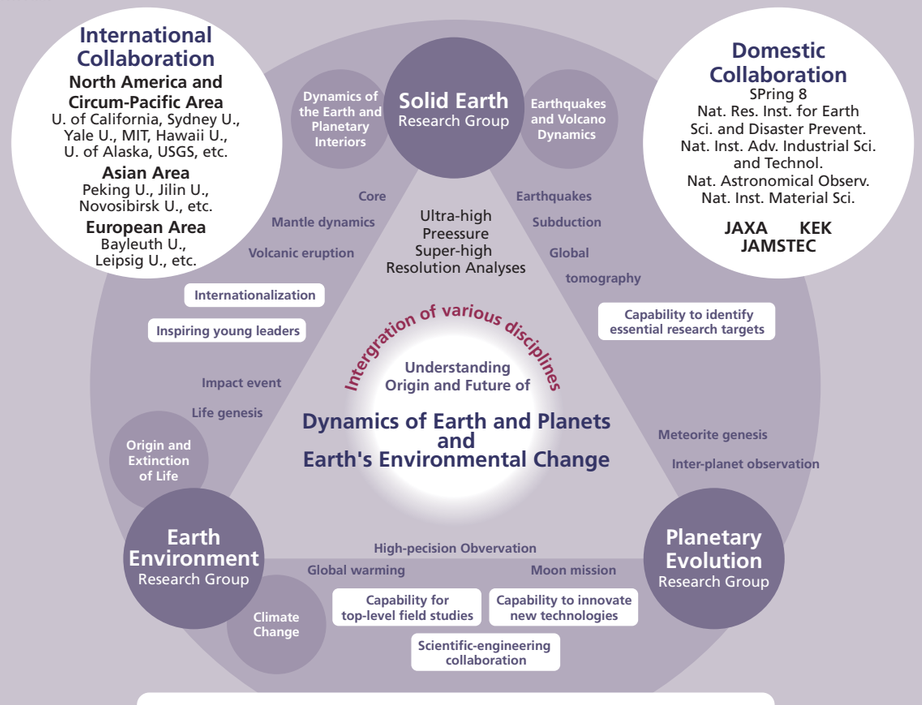
Our GCOE program covers large areas of the particle-matter hierarchy such as particle, nuclear, and solid-state physics, including astronomy and cosmic physics. In terms of mathematics, which plays a fundamental role as a common language in natural science, we intend to generate a number of complex interactions among all hierarchies, and develop new research fields that have been overlooked even by advanced intelligent majorities. As a result, we expect to expand this new frontier to various fields of science. In other words, our purpose is to weave a "science web site" providing research exchanges among cosmic particle-matter hierarchies on the worldwide level. Furthermore, we intend to propagate our science web itself in other hierarchies such as chemistry, biology, and geophysics so fully that it can greatly influence all fields of natural science in the near future. Our final goal is to establish a unified understanding of time, space, matter, and mathematics that goes beyond that of the particle-matter hierarchy. Throughout this extensive and constructive research center of advanced studies, we allow graduate students to actively devote themselves to research and engage in various experiences by participating in international collaborations and entering challenging new fields.

Leader *Kunio Inoue*

This program has attracted researchers who engage in international cutting-edge research in the fields of physics, mathematics, and astronomy. It zealously makes the best use of the given environment to nurture students. In cooperation with the philosophy course, it challenges students to undertake new activities that eliminate the barriers between Science and the Liberal Arts. We remain convinced that numerous unexplored scientific frontiers can be explored by promoting cooperation between diverse fields and top-class personnel who have a strong sense of internationalism and a broad outlook.

The Global COE Programs
Global Education and Research Center for Earth and Planetary Dynamics

Tohoku University has conducted globally recognized research on Earth and Planetary Sciences. It has many faculty members whose research interests cover a great variety of topics within these fields. In our Global COE program, we will focus on research targets in Earth and planetary dynamics and Earth's environmental changes through a combination of multi-disciplinary approaches such as: solid geophysics and Earth materials science; space and planetary science; ocean, atmosphere, and climate sciences; biogeoscience; and engineering to mitigate against natural hazards. We have already undertaken world-class research during the 21st Century COE program (2003–2007). The Global COE program aims to build on the achievements of this previous program, and to further advance our knowledge in critical areas of Earth and planetary dynamics and in Earth's environmental changes. The most significant characteristic of Tohoku University is that we have pioneered key laboratories that can produce their own unique datasets by developing advanced cutting-edge methodologies to make observations and analyze data. The objective of this Global COE program is to achieve the highest level of research and education by further strengthening these key laboratories and by networking them to undertake pioneering work that traverses scientific disciplines.



Core Organization at Tohoku University

Dept. of Earth Sciences
Dept. of Geophysics
Dept. of Envionmental Studies
Center for
- Predict. Earthquake and Volcanic Erupt.
- Disaster Control Res.
- Planetary Plasma and Atmospheric Res.
- Atmospheric and Oceanic Studies
- Northeastern Asian Studies

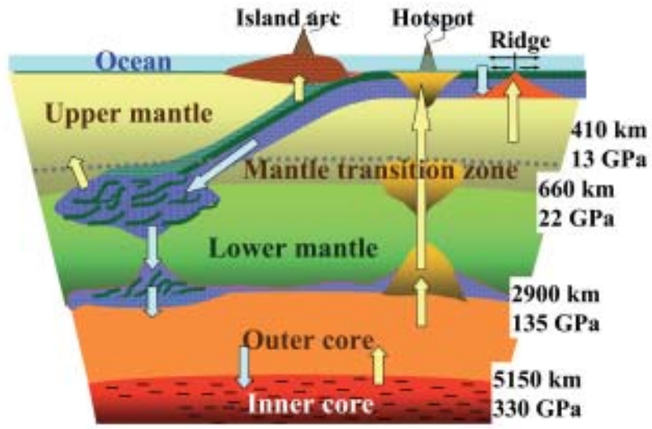
URL http://www.gcoe.geophys.tohoku.ac.jp/index-e.htm

TOPICS

01 Dynamics of the Earth and planets:

1) Mantle plumes and stagnant slabs: Using our global tomography technique, we took higher-resolution images of subducting slabs and mantle plumes. We found that there are deep mantle plumes under some hotspots based on a systematic investigation into whole-mantle structures, and clearly imaged the stagnant Pacific slab in the mantle transition zone under East Asia.

2) Global circulation of materials from surface to core: We clarified global water circulation in the whole mantle from the crust to the core. We discovered a hydrous phase that is stable under core-mantle boundary conditions of 120 GPa and 2000 K. We generated the conditions of the Earth's core, i.e., 270 GPa and 3600K, and clarified the stable existence of an hcp phase in FeSi alloys, which is a potential candidate for the inner core.



02 Earth's environmental changes:

1) We made significant contributions to the study of environmental changes based on a collection of reliable high-precision data in (a) the re-emergence phenomenon of subtropical mode water and (b) satellite-derived sea surface temperature (SST). Our advanced satellite technology dramatically improved the capability of observing warm pools, which enabled us to detect new phenomena. We also obtained data on (c) the precise determination of concentrations and isotopic ratios of greenhouse gases. Our program for (d) analyses of polar ice cores revealed temporal and spatial variations in greenhouse gases in the troposphere and the stratosphere on a global scale.

2) Origin of life and search for early forms and their extinction: We focus on the geological events of "late heavy bombardment" for the production of amino acids and "plate tectonics" for protein formation. We found additional evidence of the oldest life in Isua, Greenland. In addition, the ecosystems of early life and their surrounding environments are now better understood. Evidence was found of a gigantic release of sulfur at the end of the Permian, which is a probable cause of the largest mass extinction.

Leader *Eiji Ohtani*

Our Global COE program is aimed at creating a global center in Earth and Planetary Sciences. It focuses on research targets in Earth and planetary dynamics and Earth's environmental changes through a combination of multi-disciplinary approaches. The objective of this program is to achieve the highest level of research and education by further strengthening these key laboratories and by networking them to undertake pioneering work that crosses scientific disciplines. I strongly believe this program can be successful and will contribute greatly to creating innovative views of the Earth and planets and new scopes for Earth and Planetary Sciences.

数学

Department of

Mathematics

Mathematics is known to provide the language for describing the natural world. Its progress has been directly linked to that of other scientific fields, as notably seen in the case of Einstein's formulation of general relativity, made possible by the timely development of Riemannian geometry.

The Mathematical Institute of Tohoku University was established in 1911. Many important contributions to various fields of modern mathematics have since originated at the Institute. Among these are Tannaka's Duality Theorem, by Tadao Tannaka, as well as the concept of Sasakian Manifolds, by Shigeo Sasaki, which has recently drawn renewed interest in its connection to Superstring Theory.

The Institute is currently a base of many researchers and students, both undergraduate and graduate, who are actively engaged in a wide range of research fields, which cover algebra, analysis, geometry, and logic.

The Institute houses a library, one of the best in the country, which holds more than 60,000 books and journals. The members of the Institute have full access to the resources, and it offers a welcome environment for active learning and research. In addition, the Institute has continued to publish the "Tohoku Journal of Mathematics" since its founding in 1911, the very first of its kind in Japan, now internationally recognized for its academic authority.

Contact

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- E-mail web-admin@math.tohoku.ac.jp
- URL http://www.math.tohoku.ac.jp/english/

Undergraduate Studies

The undergraduate program in mathematics consists of four years of studies, in general and mathematical subjects. The courses in the first two years are mostly offered at the Kawauchi campus, where along with general subjects such as foreign languages, the students take courses on calculus, linear algebra, and point-set topology. Students will begin their third year at the Aobayama campus to learn more advanced subjects, including manifold theory, group/ring/field theory, differential equations, real/complex analysis, and functional analysis. In these courses, lectures are supplemented by problem-solving sessions. In their fourth year, students can pursue specialized mathematical interests by taking classes in more advanced topics, as well as participating in one of the senior seminars, each made up of a small group of seniors supervised by a faculty member.

Graduate Studies

The master's program is two years. The "Master of Science" degree is awarded after students fulfill requirements to earn 30 credits by taking graduate courses, by participating in seminars, and by completing a master's thesis, which is written under the supervision of a faculty member. There is an oral examination on the content of the thesis, where each candidate is to demonstrate mastery of the subject acquired during the course of independent study.

The doctoral program is three years, during which the student is to earn 20 credits, and to write a doctoral dissertation consisting of original research. The "Doctor of Science" degree is then conferred. All doctoral students are strongly encouraged to develop habits of independent thinking through immersing themselves in the frontier of mathematical research, while belonging to the active community of fellow students and faculty members at the Mathematical Institute.

Algebra

Masaki Hanamura
algebraic geometry, theory of motif

Nobuo Hara
algebraic geometry, commutative ring theory

Koji Hasegawa
representation theory, quantum groups

Masanori Ishida
algebraic geometry, toric variety

Gen Kuroki
representation theory, integrable system

Yasuo Morita
number theory

Shoetsu Ogata
algebraic geometry, singularity theory

Atsushi Sato
number theory

Nobuo Tsuzuki
number theory, p-adic analysis

Takao Yamazaki
arithmetic geometry

Akihiko Yukie
number theory, prehomogeneous vector space

Analysis

Hiroyuki Chihara
partial differential equations, harmonic analysis

Yuu Hariya
probability, Feynman path integral

Tetsuya Hattori
probability, theory of renormalization

Kazuhiro Horihata
partial differential equations, harmonic heat flow

Kazuhiro Ishige
parabolic partial differential equations

Hideo Kozono
partial differential equations, Navier-Stokes equation

Makoto Nakamura
partial differential equations, nonlinear wave equations

Takayoshi Ogawa
nonlinear partial differential equations

Tokushi Sato
partial differential equations, nonlinear elliptic theory

Satoru Shimizu
several variable complex analysis

Izumi Takagi
partial differential equations, biological modeling

Masayoshi Takeda
probability, Dirichlet form

Eiji Yanagida
partial differential equations, reaction-diffusion equations

Geometry

Shigetoshi Bando
differential geometry, Kahler-Einstein metrics

Masaharu Ishikawa
differential topology, singularity theory

Hiroyasu Izeki
differential geometry, geometric group theory

Yoshikata Kida
geometric group theory, ergodic theory

Motoko Kotani
differential geometry, probability

Reiko Miyaoka
differential geometry, surface theory

Seiki Nishikawa
differential geometry, geometric variational problems

Takeo Nishinou
differential geometry, tropical geometry

Takashi Shioya
geometry of metric space

Sumio Yamada
geometric analysis

Logic and Computation

Yohji Akama
learning theory, information security

Kazuyuki Tanaka
mathematical logic, theory of computation

Takeshi Yamazaki
theory of foundation, reverse mathematics

Department of Physics

The Department of Physics at Tohoku University is one of the oldest and largest in Japan, having almost a century-old history since its foundation in 1911. It currently has a faculty of more than 160 professors and approximately 250 students in the graduate school. Not only faculty members but also eminent scholars from research institutes and laboratories are actively involved in the school's programs. Research in our department covers all physics fields from particle and nuclear physics to condensed-matter physics, and extends even further to biophysics and industrial physics. Our graduate students are undertaking world-class research at the highest levels at the frontiers of physics under the guidance of experienced supervisors. The advanced research facilities provided by our Department assist them in all their activities. Our Department was ranked second in Japan and eleventh in the world in physics in 2008 according to a report published by the ISI Web of Science.

Our Department has begun to conduct a global center of excellence (GCOE) program, "Weaving the Science Web beyond the Particle-Matter Hierarchy", in collaboration with the Department of Astronomy and Mathematical Institute of Tohoku University. This GCOE program is supported by the Ministry of Education, Culture, Sports, Science and Technology of Japan. The aim of the program is to train and educate young researchers who will be world leaders in basic scientific fields in the next several decades. The program actively promotes international collaboration and education, particularly for young researchers. Many young researchers and students from all over the world are participating in a variety of international programs/projects supported by the GCOE program and are presently engaged in world-class research at the highest levels.

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Undergraduate Studies

The undergraduate course is a four-year program. In the first one and half years, students are collectively assigned to the Division of Physical Sciences (physics, astronomy, and geophysics) and taught basic mathematics, physics (classical mechanics, electromagnetism, and thermodynamics) and general education requirements. After being assigned to the Department of Physics, the program begins with quantum mechanics and statistical physics as fundamentals of modern physics, as well as laboratory studies. Specific subjects such as particle, nuclear, and condensed matter physics are then taught. Students join one of the research groups of the department in the final year to earn their bachelor's degree. The course aims at both preparing students in the basics necessary for graduate studies and providing sound fundamental scientific knowledge for employment in industry.

Graduate Studies

The graduate course consists of a two-year master's program followed by a three-year doctoral program. Graduate students can choose from a broad range of advanced subjects on modern physics and related areas of science offered by our graduate school to acquire advanced skills and knowledge under the guidance of a thesis or dissertation supervisor. We also offer the "International Graduate Program for Advanced Science (IGPAS)" to foreign graduate students. All the classes for the IGPAS course are presented in English and all graduate students can take them.

Particle and Nuclear Theory

Theoretical Nuclear and Particle Physics

Particle Theory and Cosmology
Zyun F. Ezawa, Ken-ichi Hikasa, Masahiro Yamaguchi, Takeo Moroi, and Satoshi Watamura
http://www.tuhep.phys.tohoku.ac.jp/

Nuclear Theory
Kouichi Hagino
http://www.nucl.phys.tohoku.ac.jp/index-e.html

Condensed Matter Theory

Theoretical Condensed Matter Physics

Theoretical Condensed Matter and Statistical Physics
Toshihiro Kawakatsu, Yoshio Kuramoto, Riichiro Saito, Sumio Ishihara, Naokazu Shibata, and Yoshinori Hayakawa
http://www.cmpt.phys.tohoku.ac.jp/eng

Metal Physics *(Institute for Materials Research)*

Quantum Condensed Matter Theory
Sadamichi Maekawa, and Michiyasu Mori
http://www.maekawa-lab.imr.tohoku.ac.jp/index_e.html

Experimental Nuclear and Particle Physics

Experimental Nuclear and Particle Physics, High Energy Physics *(Department of Physics and Research Center for Neutrino Science)*

Experimental Particle Physics
Kunio Inoue, Hitoshi Yamamoto, Masayuki Koga, Tomoki Hayashino, Tadao Mutsui, Tomoyuki Sanuki, Junpei Shirai, Fumihiko Suekane, and Kengo Nakamura
http://www.awa.tohoku.ac.jp

Experimental Nuclear Physics
Osamu Hashimoto, Toshio Kobayashi, Hirokazu Tamura, Naohito Iwasa, and Satoshi N. Nakamura
http://lambda.phys.tohoku.ac.jp/

Intermediate Energy Nuclear Physics
Kazushige Maeda
http://nuclear.phys.tohoku.ac.jp

Nuclear Science *(Laboratory of Nuclear Science)*

Nuclear Science
Jirohta Kasagi, Hajime Shimizu, Hiroyuki Hama, Tadaaki Tamae, Tsutomu Otsuki, and Masayuki Kawai
http://www.lns.tohoku.ac.jp

Nuclear Radiation Physics *(Cyclotron and Radioisotope Center)*

Nuclear Radiation Physics
Yasuhiro Sakemi and Tsutomu Shinozuka
http://www.cyric.tohoku.ac.jp/

Accelerator Science *(Japan Atomic Energy Agency)*

Accelerator Science
Michikazu Kinsho, Junichi Haba, and Kazuhiro Tanaka

Ultrahigh-resolution photoemission spectrometer to achieve the world-best-level energy resolution. Professor and students are working together to prepare the measurements. They investigate the electronic structure and the mechanism of novel materials such as high-temperature superconductors, nano-carbons, and low-dimensional metals on surface. ▶

Condensed Matter Experiment I

Condensed Matter Physics ---Electronic Properties---; Strongly Interacting with Many Particle Quantum Systems

Microscopic Research on Magnetism
Hideya Onodera and Shigeru Takagi
http://www.nhpm.phys.tohoku.ac.jp/index_j.htm

Materials Structure Physics
Youichi Murakami, and Kazuaki Iwasa
http://calaf.phys.tohoku.ac.jp/english

Low-dimensional Quantum Physics
Naoki Toyota and Hiroshi Matsui
http://ldp.phys.tohoku.ac.jp/

Photoemission Solid-state Physics
Takashi Takahashi
http://arpes.phys.tohoku.ac.jp/

Solid-state Physics on Nano-network Solids
Katsumi Tanigaki
http://sspns.phys.tohoku.ac.jp

Very Low-temperature Physics (Center for Low-temperature Science)
Haruyoshi Aoki and Akira Ochiai
http://www.clts.tohoku.ac.jp/vlt/index.html

Metal Physics (Institute for Materials Research)

Superconductivity Physics
Norio Kobayashi and Takahiko Sasaki
http://ltp.imr.tohoku.ac.jp/

Condensed Spin Matter
Kazuyoshi Yamada and Kenji Ohyama
http://www.yamada-lab.imr.tohoku.ac.jp/index.html

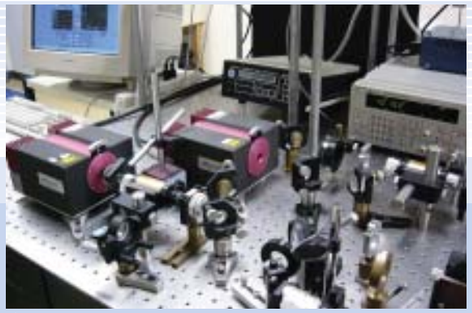
Nanostructured Materials Physics
Yoshihiro Iwasa and Taishi Takenobu
http://iwasa.imr.tohoku.ac.jp/

High Magnetic Field Condensed Matter Physics
Hiroyuki Nojiri and Yasuhiro Matsuda
http://www.hfpm.imr.tohoku.ac.jp/

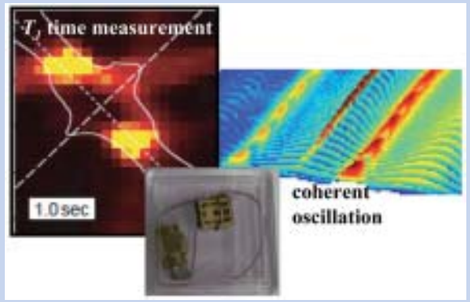
Low-temperature Materials Science (Center for Low-temperature Science)
Tsutomu Nojima
http://ltsd.imr.tohoku.ac.jp/index-e.html

Physics of Strongly Correlated Electrons

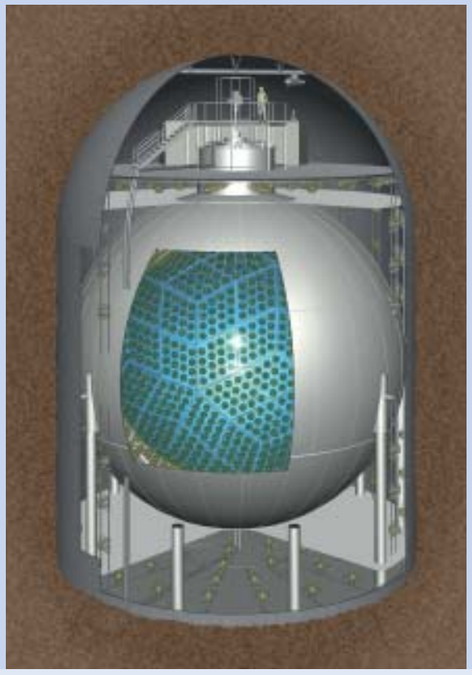
Strongly Correlated-electron Physics
Masatoshi Arai, Yoshinori Haga, and Ashish Chainani



▲ *High-precision stimulated Brillouin spectrometer. Frequency difference between two lasers generates coherent hypersonic waves (accoustic phonons) inside samples. Linewidth resolution of the system reaches as high as 10kHz (4×10^-11 eV), which is essential for studying quantum-mechanical properties of crystals and amorphous solids.*

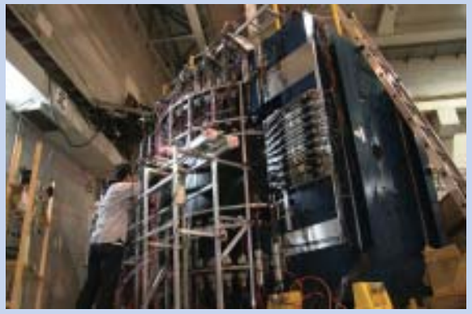


▲ *The resistively-detected NMR (nuclear magnetic resonance) has been developed based on electron spin and nuclear spin interactions in semiconductor quantum systems. This highly-sensitive NMR has been successfully applied to novel NMR measurements of electron spin characteristics. Coherent control of nuclear spins was also demonstrated in nanometer scale regime toward future semiconductor qubits.*



The underground detector, KamLAND, monitors elusive neutrino interactions on the liquid-scintillator with photo-sensors arrayed inside the spherical container. Studies on neutrino properties and applied neutrino observations to geophysical and astrophysical studies are executed. Its ultra-low-background environment serves for a rare phenomenon search. ▶

▲ *Tohoku University leads the international collaboration E01-011 of Thomas Jefferson National Accelerator Facility (JLab). Just before the experiment, the collaborators gathered in front of the HKS (High-resolution Kaon Spectrometer) installed in Hall C, JLab. The HKS was designed and fabricated in Japan by Tohoku University and shipped to USA.*



▲ *A large spectrometer (named NKS2) for investigating neutral kaon photo-production viewed from downstream of gamma beam direction. The spectrometer is located at the experimental hall of Laboratory of Nuclear Science, Tohoku University. A doctor course student is checking detector status.*

▲ *Master course students are setting read-out cards of a drift chamber (DC) of NKS2 on the top. DC is a detector to measure charged particle trajectories with an order of 200 μm position resolution, and we used it to measure particles produced in gamma-nucleon reaction.*

Condensed Matter Experiment II

Quantum Condensed Matter Physics, Biophysics

Synchrotron Radiation and Photoelectron
Shoji Suzuki
http://srpe.phys.tohoku.ac.jp/

Surface Physics
Shozo Suto
http://surface.phys.tohoku.ac.jp

Laser Spectroscopy
Masayuki Yoshizawa
http://www.laser.phys.tohoku.ac.jp/index-e.html

Biophysics
Kazuo Ohki and Hidetake Miyata
http://www.bio.phys.tohoku.ac.jp/

Solid-state Photophysics
Teruya Ishihara and Shinichiro Iwai
http://sspp.phys.tohoku.ac.jp/

Solid-state Quantum Transport
Yoshiro Hiyrayama and Go Yusa
http://www.quant-trans.org/Etop_new.html

Crystal Physics (Institute for Materials Research)

Lattice-defect Physics
Ichiro Yonenaga and Yutaka Ohno
http://lab-defects.imr.tohoku.ac.jp/index-e.html

Crystal-growth Physics
Kazuo Nakajima and Noritaka Usami
http://www.xtalphys.imr.tohoku.ac.jp/

Surface/Interface Science
Yasunori Fujikawa
http://apfim.imr.tohoku.ac.jp/

Solid-state Spectroscopy (Institute of Multidisciplinary Research for Advanced Materials)

Solid-state Ion Physics
Junichi Kawamura
http://www.tagen.tohoku.ac.jp/labo/kawamura/index_e.html

Correlated-electron Solid-state Physics
Takahisa Arima
http://www.tagen.tohoku.ac.jp/labo/arima/index-j.html

Electron-crystallography and -spectroscopy
Masami Terauchi and Kenji Tsuda
http://www.tagen.tohoku.ac.jp/labo/terauchi

Structural Physics and Crystal Physics
Yukio Noda and Hiroyuki Kimura
http://www.tagen.tohoku.ac.jp/labo/noda/index.html

Laser Quantum Optics (NTT Basic Research Laboratories)

Quantum Sensing and Measurement
Hiroshi Yamaguchi, Satoshi Sasaki, and Chiko Otani
http://www.brl.ntt.co.jp/E/organization/psrl/psrl.html

Department of

Astronomy

A total of 70 members of the institute, including faculty members, postdoctoral researchers, and students, are working on wide varieties of problems related to astronomical objects. The research activities cover 1) searching for planets around nearby stars, 2) understanding the physical properties of stars in our galaxy, 3) revealing formation and evolutionary processes for galaxies in the distant universe, and 4) understanding the cosmological framework of the universe. These subjects are studied in two ways. The first is through theoretical research, where models are created and analyzed to enable a variety of fundamental astronomical phenomena to be understood on the basis of physics and mathematics, occasionally using computational resources such as supercomputers. The second is through observational research. Astronomical phenomena are observed with electromagnetic waves at all wavelengths, i.e., radio, infrared, optical, ultraviolet, X-rays, and gamma-rays using various modern telescopes, such as the 8.2-meter Subaru Telescope at the summit of 4,200-meter-high Mauna Kea on the island of Hawaii. The data obtained through such observations are analyzed and compared with physical models of the astronomical phenomena. Opening up new windows to the unexplored universe by developing new telescopes and cutting-edge instruments is also a unique and important activity at the institute.

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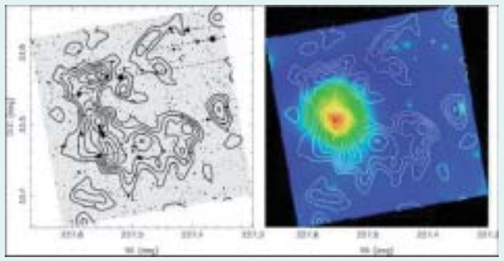
Undergraduate Studies

Undergraduate education has primarily been organized to enable fundamental physics and basic mathematics to be understood, which are the basis for understanding astronomical phenomena. The course includes mechanics, thermodynamics, statistical mechanics, electromagnetics, quantum mechanics, the theory of radiation, and general relativity. As an introduction to astronomy, courses on general, galactic and extragalactic, and observational astronomy are provided. Field work using real telescopes is also conducted by the department to enable students to experience observations of astronomical objects. Astronomy-specific classes start in the second semester of the second year. Seminars conducted using astronomy texts with small groups of students start in the third year.

Graduate Studies

Graduate students select their own research topics and thesis supervisor and begin their investigations. These can be selected from a wide range of astronomical themes studied by institute staff, i.e., stellar physics, stellar dynamics, galactic astronomy, observational and theoretical cosmology, and the development of cutting-edge instruments. A variety of advanced courses are provided, e.g., stellar physics, galactic astronomy, observational astronomy, and mathematical cosmology. Some of the courses are provided in English. Professional astronomy lectures by institute members and visiting astronomers from all over the world are given every week.



Distribution of dark matter in the cluster of galaxies revealed by the weak gravitational lensing method.

Professors

Hideyuki Saio
Stellar physics. Theoretical studies on evolution and stability of stars. Studying inside structure of stars through pulsation. Non-radial oscillations in magnetic and rotating stars.

Masashi Chiba
Observational cosmology. Theoretical and observational studies on dynamical structures and formation and evolution of galaxies. Observational cosmology using gravitational lensing.

Toshifumi Futamase
General relativity. Theoretical studies on structure and evolution of universe. Theoretical and observational studies on gravitational lensing.
http://www.astr.tohoku.ac.jp/~tof/index_tof.html (Japanese)

Takashi Ichikawa
Extragalactic astronomy. Observational studies on galaxy formation and evolution and large scale structure of galaxies. Development of telescope for Antarctic site and infrared instruments.
http://www.astr.tohoku.ac.jp/~ichikawa/index.html (Japanese)

Toru Yamada
Extragalactic astronomy. Observational studies on galaxy formation and evolution. Observational searches for extra-solar planets. Scientific advisory for next-generation large-scale astronomical projects.
http://www.astr.tohoku.ac.jp/~yamada/index_ok.htm

Associate Professors

Masafumi Noguchi
Extragalactic astronomy. Theoretical studies on dynamical aspects of structure of galaxies and formation and evolution of galaxies using numerical simulations.
http://www.astr.tohoku.ac.jp/~noguchi/galaxy/ (Japanese)

Umin Lee
Stellar physics. Theoretical studies on pulsating variable stars and on accretion disks around neutron stars.

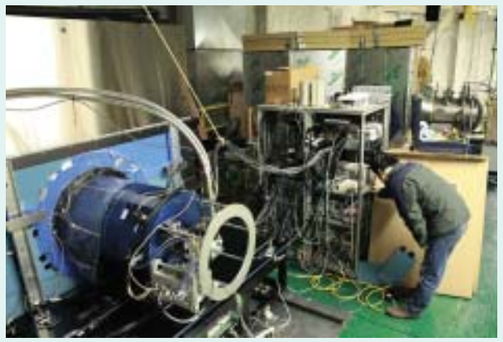
Makoto Hattori
Observational cosmology. Theoretical and observational studies on cosmic microwave background radiation. Studies on hot plasma of clusters of galaxies.
http://ryukyu.astr.tohoku.ac.jp/pukiwiki/index.php (Japanese)

Masayuki Akiyama
Extragalactic astronomy. Observational studies on galaxy formation and evolution and large-scale structure of galaxies. Development of infrared instruments.
http://www.astr.tohoku.ac.jp/~akiyama/(Japanese)

Assistant Professors

Takashi Murayama
Extragalactic astronomy. Observational studies on active galactic nuclei and galaxies in distant universe.

Shijun Yoshida
Stellar physics. Theoretical studies on compact objects, such as black holes, neutron stars, and boson stars. Studies on gravitational waves from compact objects.
http://www.astr.tohoku.ac.jp/~yoshida/ (Japanese)



Subaru telescope and its two instruments, which are developped by staff members in the institute.

Department of

Geophysics

Geophysics is a broad research field that involves studies on the solid Earth, oceans, atmosphere, upper atmosphere, ionosphere, and planets. Geophysicists take physical approaches to investigating various phenomena in these areas and studying their structures as well as their long-term and short-term variations to clarify the formation and evolutionary processes of mother Earth and the solar system. Geophysics, as a natural science, has been developing with a close relationship to human society in recent years.

During the last six decades, the Department of Geophysics has made great efforts and important contributions to establishing the framework of geophysics. We value the proud history and tradition established by many of our predecessors in the Department, and at the same time we are working to open up new frontiers of geophysics. For this purpose, we have made efforts to revise the examination rules for graduate-school entrance, improve graduate-school programs, and establish the Global Center of Excellence (GCOE) program to intensely and conscientiously support our graduate students in their research and education as well as their living conditions. Thus, current students will be able to become outstanding researchers and scientific leaders in the near future.

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- URL http://www.geophys.tohoku.ac.jp/en/

Undergraduate Studies

The undergraduate geophysics course is a four-year program. Its objective is to provide students with a broad scientific background to understand the structure and evolution of the Earth and the solar-planetary system, environmental sciences, natural disasters, and Earth resources. After studying basic physics and mathematics for three semesters, the students will undertake a course in geophysical experiments and attend various geophysical lectures. In the final year, students join one of the research groups of the department to learn how to conduct geophysical investigations. A student can select a faculty member as their academic advisor for this graduate research. The geophysical course aims at both teaching students in the basics necessary for graduate studies and providing them with sound basic scientific knowledge for employment in industry.

Graduate Studies

The objective of graduate education in geophysics is to provide advanced knowledge and research skills on geophysics to students who will work as scientists or engineers on the research front or as specialists in industrialized society. All graduate students can choose their thesis advisor from our faculty members at the time they enroll. To complete their master's in two years, they are required to attend advanced lectures and seminars, and must submit their thesis on their research topic. Students who complete the coursework and pass the final oral examination are awarded the Master of Science degree. The doctoral course is offered to graduate students who wish to acquire greater expertise and a broader range of knowledge. Doctoral students are required to attend special lectures and seminars, and must submit their dissertations on their special research project to complete the course in three years. They are strongly encouraged to have their research papers published by international academic journals. Students who complete the doctoral coursework and pass the final viva voce examination are awarded the Doctor of Science degree.

Faculty Members of the Department

Solid Earth Physics Laboratory

Professor Haruo Sato
Associate Professor Takeshi Nishimura
Assistant Professors Hisashi Nakahara, Mare Yamamoto
Their research interests include: seismology, seismic wave propagation, earthquake source processes, and volcanic eruptions.

Atmospheric Science Laboratory

Professor Toshiki Iwasaki
Associate Professors Takeshi Yamazaki, Weiming Sha
Their research interests include: meteorology, hydrology, and planetary boundary layers.

Physical Oceanography Laboratory

Professor Kimio Hanawa
Associate Professors Toshio Suga, Shoichi Kizu
Their research interests include: large-scale ocean-atmosphere interactions, water mass formation processes, and El Nino.

Planetary Plasma Physics Laboratory

Professor Takayuki Ono
Associate Professor Masahide Iizima
Assistant Professor Atsushi Kumamoto
Their research interests include: plasma waves, wave particle interactions, and surface and subsurface sounding of the moon and planets.

Planetary Atmosphere Physics Laboratory

Professor Yasumasa Kasaba
Associate Professor Isao Murata
Lecturer Yukihiro Takahashi
Assistant Professor Hitoshi Fujiwara
Their research interests include: planetary atmospheres, Venus, Earth, Mars, Jupiter, and aurora.

Installation of temporal seismic station.

Students play an important role in the development of Tohoku University's Satellite "Sprite-sat". The A mechanical model of the satellite has been used in the vibration test tohat simulated a rocket launch.

An Auroral spectroscopic observation is performed at Arctic Svalvard in an international collaboration project.

A Graduate student who takes participating in the developingment of Japanese lunar-orbiter spacecraft, Kaguya.

Checking performance of the litate planetary radio telescope.

Inspecting the performance of optical camera lens that installed on the Tohoku University's Satellite 'Sprite-sat' in a laser experiment.

Department of
Chemistry

The department of chemistry was established in June 1907 with the establishment of Tohoku Imperial University, predecessor to the present Tohoku University. In the 100 years since its founding, the department of chemistry has grown to become the most prestigious institution of chemistry in Japan. The department of chemistry, with its 52 faculty members in 19 research groups, is now the largest in the nation. Thirteen groups in the research institutes of Tohoku University also cooperate in education and supervise research by graduate students in the department. The student/faculty member ratio is almost 1:1, and this creates a highly conducive environment for specialized research and study.

The members of the department of chemistry are all instilled with a strong motivation to seek out and investigate the unknown, and many of our most outstanding scientists have left a legacy of important work in their respective fields. Majima Riko, Akabori Shiro, Nozoe Tetsuo, and Koji Nakanishi, all recipients of the National Culture Award of Japan, are four of the most distinguished members of our faculty. The department of chemistry is one of the main providers of the Global COE program: the "International Center of Research and Education on Molecular Complex Chemistry", which is an important promotional project by the Ministry of Education, Science, Sports, and Culture (MEXT), Japan.

The chemistry buildings, which are approximately 10,000 square meters, were constructed in 1972 at the Aobayama Campus. The main building was renovated in 2008 to equip it with modern research facilities to ensure high degrees of safety for frontier studies.

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- URL http://www.chem.tohoku.ac.jp/index-e.html

Undergraduate Studies

Undergraduate education in our department has been organized to provide students with a broad background in the fields of inorganic, analytical, organic, physical, and polymer chemistries, including radiochemistry and biochemistry. A one-year laboratory-training course to learn the basic experimental techniques in chemistry is also provided in the fourth and fifth semesters. From the sixth semester, students join one of the 19 research groups, and start their research on frontier chemistry to earn the bachelor's degree.

Graduate Studies

The department is devoted to the study of basic and advanced inorganic, analytical, organic, and physical chemistries, and biochemistry, within the divisions of inorganic and analytical, organic, physical, and interdisciplinary chemistries. Graduate students can choose from a wide range of course subjects offered by departmental and research-institute staff. Students can select their thesis supervisor from either departmental or research-institute staff.

Division of Inorganic and Analytical Chemistry

Laboratory of Inorganic Chemistry
***Professor** Hiromi Tobita*
Organo-transition metal chemistry, metal-element multiple bonds, and dynamic behavior of complexes.

Laboratory of Analytical Chemistry
***Professor** Norio Teramae*
Molecule recognition and mesoporous silica-surfactant nano-composites.

Laboratory of Coordination Chemistry
***Professor** Masahiro Yamashita*
Nano-sciences on advanced metal complexes, single-molecule and single-chain quantum magnets, and gigantic optical nonlinearity in nano-wire metal complexes.

Division of Organic Chemistry

Laboratory of Bioorganic Chemistry
***Professor** Minoru Ueda*
Bioactive natural products, chemical biology, and protein chemistry.

Laboratory of Synthetic and Structural Organic Chemistry
***Professor** Noboru Morita*
Novel aromatic chemistry, extended π-electronic systems, and multi-functional materials science.

Laboratory of Natural Product Chemistry
***Professor** Masahiro Hirama*
Natural product synthesis and design of bioactive molecules.

Laboratory of Fundamental Organic Chemistry
***Associate Professor** Hiroyuki Sakaba*
Chiral NMR shift reagents and transition metal complexes.

Division of Physical Chemistry

Laboratory of Quantum Physical Chemistry
***Professor** Koichi Ohno*
Quantum physical chemistry and chemical reaction dynamics.

Laboratory of Quantum Chemistry
***Associate Professor** Asuka Fujii*
Laser molecular spectroscopy and molecular clusters.

Laboratory of Organic Physical Chemistry
***Professor** Hiroshi Fukumura*
Laser chemistry, ultrafast and nanoscopic spectroscopy.

Laboratory of Theoretical Chemistry
***Professor** Hirohiko Kono*
Ultrafast laser chemistry and excited state dynamics.

Laboratory of Computational Molecular Science
***Professor** Akihiro Morita*
Molecular simulation in condensed phase

Division of Interdisciplinary Chemistry

Laboratory of Organic Reaction Processes
***Professor** Masahiro Terada*
Asymmetric catalysis, transition metal catalysis, and organocatalysis.

Laboratory of Organic Chemistry II
***Professor** Hiroyuki Isobe*
Physical and synthetic organic chemistry

Laboratory of Organometallic Chemistry
***Associate Professor** Naoki Asao*
Organometallic chemistry and organic synthesis.

Laboratory of Functional Molecular Chemistry
***Professor** Nagao Kobayashi*
Functional molecules, phthalocyanines, porphyrins, and giant aromatic molecules.

Research and Analytical Center for Giant Molecules
Giant molecules, analysis, and synthesis.

Division of Advanced Atomic and Molecular Science

Laboratory of Radio Chemistry
***Associate Professor** Yasushi Kino*
Exotic atoms and molecules

Laboratory of Environmental Radio Chemistry
***Professor** Tsutomu Sekine*
Positrons and positronium chemistry

Laboratory of Biochemistry
***Professor** Kazuhiro Sogawa*
Genes, transcription factors, and live cell imaging.

Laboratory of Molecular Transformation
***Professor** Yoshinori Yamamoto*
New organic transformations, catalytic reactions, and new concepts in organic chemistry.

Cooperative Research Groups

Institute of Multidisciplinary Research for Advanced Materials

Laboratory of Surface Chemistry
***Professor** Tadahiro Komeda*
Surface chemistry, single molecule spectroscopy, and nanochemistry.

Laboratory for Analysis of Quantum Processes
***Professor** Kiyoshi Ueda*
Atomic and molecular dynamics, synchrotron radiation, and femtosecond pulse lasers.

Laboratory of Functional Photochemistry and Chemicalbiology
***Professor** Takehiko Wada*
Chemical biology based on nucleic acids chemistry, cancer cell specific gene therapy, and supramolecular asymmetric photochemistry.

Laboratory of Bioinspired Synthetic Chemistry
***Professor** Kazushi Kinbara*
Biomimetic and nanomaterials chemistry.

Laboratory of Reaction Intermediates
***Professor Seigo** Yamauchi*
Advanced EPR, excited multiplets, and protein structures.

Laboratory of Organic Materials Chemistry
***Professor** Hidetoshi Oikawa*
Organic and polymeric materials, nanocrystals, and photonics materials.

Laboratory of Bioreaction Design
***Professor** Toru Shimizu*
Heme, sensor, and metal proteins.

Laboratory of Bioreaction Analysis
***Professor** Tanetoshi Koyama*
Isoprenoid biosynthesis, enzyme mechanisms, and physiological functions.

Laboratory for Synthesis of Organic Functional Molecules
***Professor** Fumi Nagatsugi*
Oligonucleotides, DNA binding molecules, in cell chemistry, and artificial functional nucleotides.

Laboratory of Structural Biology and Bioinorganic Chemistry
***Professor** Masao Ikeda-Saito*
Oxygen activation mechanism and macromolecular crystallography.

Institute for Materials Research

Laboratory of Superstructured Thin Film Chemistry
***Professor** Masashi Kawasaki*
Oxide electronics, combinatorial chemistry, and semiconductors.

Laboratory of Crystal Chemistry
***Professor** Satoshi Uda*
Phase equilibria, solute redistribution, and crystal growth under external fields.

Advanced Industrial Science and Technology Tohoku

Laboratory of Reaction and Separation Processes
***Professors** Toshishige Suzuki and Hideyuki Matsunaga*
Separation of metal ions, detection of metal ions, and supercrytical fluids.

Japan Atomic Energy Agency

Laboratory of Heavy Elements Chemistry
***Professors** Yuichiro Nagame and Takaumi Kimura*
Superheavy elements, single atom chemistry, and actinide chemistry.

Department of

Earth Science
Geoenvironmental Science

The land we stand on, the air we breathe, and the food we eat are all products of the past 4.6 billion years of Earth's history. We humans are also products of this evolution. How were we created? What is our destiny?

The Earth's integrated system of atmosphere, hydrosphere, and biosphere is driven by the energy of solar radiation just as we are, and even the system of the solid Earth (lithosphere) is driven by the decay energy of radioactive elements in the Earth. The boundary region between these four spheres is called the Geosphere, and these four spheres interact through the circulation of energy and materials. A huge variety of episodes has occurred and evolved in the Geosphere during the long history of the Earth, and we human beings are the newest product of this sphere.

Our Department of Geoenvironmental Science is pursuing changes in the past, present, and future of the Geosphere's environment from ancient rocks and sediments through current knowledge of physics, chemistry and biology, which are not yet fully understood only by using today's observational research, from the viewpoint that they are snapshots of the evolving Geosphere. Our Department is coming to a better understanding of the Earth's environmental system because current human activities are having serious consequences on the Earth's environment.

Undergraduate Studies

The Division of Geoenvironmental Science offers outstanding opportunities for students who wish to pursue studies on Earth and Planetary Environmental Sciences including Human Geography, which are of unprecedented importance to contemporary society. Because the Earth's integrated system is interconnected, the training broadly spans the Geosphere. During the first four semesters, students are collectively assigned to the Department of Earth Science (Geoenvironmental Science and Earth and Planetary Materials Science) and are trained in the basic sciences (broad disciplines of physics, mathematics, chemistry, biology, language, economics, and social sciences). After being assigned to the Division of Geoenvironmental Science in the fourth semester, our program is separated into two upper-level courses that focus on 1) Geological and Paleontological Science, and 2) Geographical Science. Students complete their undergraduate thesis in two years, which affords them the opportunity to do original research under the guidance of department faculty, involving fieldwork or laboratory work on original data and samples. The career opportunities made possible by our division are diverse, spanning private oil-related and electronics companies, governments, high-school teaching, and graduate studies.

Graduate Studies

As never before, we could not live on the Earth without understanding what consequences human activities are having on global warming. Moreover, we must mitigate against the ill efforts of earthquakes, landslides, and volcanic eruptions. These practical aspects of society are increasingly impacted by our relationships with the Earth. Therefore, we must understand the whole nature of the Earth from deep underground to space through time. Our Earth Science Department is pursuing studies to understand the entire picture of the evolution of the Earth and life, and to envision its future. We are actively facilitating research and educational alliances to advance collaboration between science and engineering related Earth and Planetary Sciences at Tohoku University. With further developments in cutting-edge technology in Earth and Planetary Science, we can also clarify the total picture of the evolution of the Earth and life.

Our graduate studies in the Department of Earth Science involve a two-year Master's program followed by a three-year Doctoral program. The Doctoral program is supported by the JSPS "Global COE (Centers-of-Excellence)" program with the collaboration of the Department of Geophysics, the Graduate School of Environmental Studies, and the Department of Engineering (2008-2012). Once enrolled, doctoral students are provided with financial support.

Professors

Masayuki Ehiro
(The Tohoku University Museum)
Adjunct professor in the geology and paleontology course.
Keywords: Stratigraphy, tectonics, and ammonoid paleobiogeography.

Masateru Hino
Professor in the geography course.
Keywords: Human geography, particularly studies on the development of urban systems, the regional formation of economic activities, and regional policies.

Toshifumi Imaizumi
Professor in the geography course.
Keywords: Tectonic geomorphology, active faults, and seismic reflection surveys.

Kunio Kaiho
Professor in the geology and paleontology course.
Keywords: Micropaleontology, mass extinctions studies, and paleo-environmental changes in the ancient Earth.

Koji Minoura
Professor in the geology and paleontology course.
Keywords: Environmental geology, tsunami science, and cosmic-ray related climate science.

Hiroyuki Nagahama
Professor in the geology and paleontology course.
Keywords: Structural geology, mathematical geophysics, and earthquake forecasting studies.

Motoyoshi Oda.
Professor in the geology and paleontology course.
Keywords: Micropaleontology, biostratigraphy, and paleoceanography.

Kenshiro Otsuki
Professor in the geology and paleontology course.
Keywords: Plate tectonics, material seismology, and structural geology.

Kiyotaka Sakaida
(Graduate School of Environmental Studies)
Adjunct professor in the geography course.
Keywords: Climatology, particularly climatic change in instrumental and historical ages, focused on regional differences and their correlation with human activities.

Associate Professors

Shinichi Hirano
Associate professor in the geography course.
Keywords: Geomorphology, particularly tectonic landforms in Japan and Southeast Asia.

Toru Nakamori
Associate professor in the geology and paleontology course.
Keywords: Coral reef geology, paleoclimatology, and fossil morphological studies

Osamu Sasaki
(The Tohoku University Museum)
Adjunct associate professor in the geology and paleontology course.
Keywords: Paleobiology and statistical methods for obtaining fossil records.

Masanori Shimamoto
(The Tohoku University Museum)
Adjunct associate professor in the geology and paleontology course.
Keywords: Paleontology and molluscan phylogeny (DNA and or isozymes)

Gen Ueda
Associate professor in the geography course.
Keywords: Human-environmental geography and social geography. His particular research interests are in Kenya, Tanzania, and other developing countries.

Lecturer

Soichi Osozawa
Lecturer in the geology and paleontology course.
Keywords: Exhumation of metamorphic rocks, melange genesis, ophiolite geochemistry, and active tectonics.

Assistant Professors

Tatsuya Ishiyama
Assistant professor in the geography course.
Keywords: Tectonic geomorphology, active tectonics, and applied geophysics.

Norihiro Nakamura
Assistant professor in the geology and paleontology course.
Keywords: Earth and planetary paleomagnetism, structural geology, and material magnetism

Yoshinori Otsuki
Assistant professor in the geography course.
Keywords: Geomorphology and geomorphic change associated wiath environmental conditions, especially landslides and slope processes in semi-arid areas.

Shin'Ichi Sato
(The Tohoku University Museum)
Adjunct assistant professor in the geology and paleontology course.
Keywords: Paleobiologay and paleoecology. His particular interests include the shell microgrowth patterns of fossil records and those of recent bivalves and gastropods in Isahaya Bay, western Kushu, Japan.

Ryohei Sekine
(Graduate School of Environmental Studies)
Assistant professor in the geography course.
Keywords: Human geography, particularly, agricultural geography in Japan and Chinese Mongolia.

Noritoshi Suzuki
Assistant professor in the geology and paleontology course.
Keywords: Micropaleontology, radiolarian biostratigraphy, and aleoceanography.

Tsutomu Yamada
Assistant professor in the geology and paleontology course.
Keywords: Stable isotope geology, coral reef geology, and carbonate geochemistry.

Contact

- TEL +81-22-795-6674
- E-mail tigaku-jm@bureau.tohoku.ac.jp
- URL http://www.dges.tohoku.ac.jp/

Department of

Earth Science
Earth and Planetary Materials Science

Research on highly advanced Earth and Planetary Sciences is required to address new topics and find new tools to not only understand the phenomena of Earth but also those of space environments. These include studies on the ultra-high pressure of planetary minerals, the evolution of materials and life on Earth and in space environments, the formation of low-gravity materials in space, and various molecular-scale materials-formation mechanisms. The Department of Earth Science has not hesitated to adopt novel methods and to develop advanced techniques for synchrotrons, microgravity, and novel in-situ observation systems for crystal growth and phase transition.

Contact

- TEL +81-22-795-6674
- E-mail tigaku-jm@bureau.tohoku.ac.jp
- URL http://www.ganko.tohoku.ac.jp/

Undergraduate Studies

The Division of Earth and Planetary Materials Science offers outstanding opportunities for students who wish to pursue studies in Earth and Planetary Materials Science. During the first four semesters, students are collectively assigned to the Department of Earth Science (Geoenvironmental Science and Earth and Planetary Materials Science) and are trained in the basic sciences (a broad discipline of physics, mathematics, chemistry, language, economics, and social sciences). After being assigned to the Division of Earth and Planetary Materials Science in the fourth semester, students are trained in the specialized disciplines of mineralogy, petrology, isotope geochemistry, crystal growth, physics of the Earth and planetary interior, high pressure physics, and volcanology. Moreover, students complete their undergraduate thesis by their final year, which affords them the opportunity to do original research under the guidance of department faculty, involving fieldwork or laboratory work using original data and samples. Career opportunities resulting from our division are diverse, spanning private ceramics companies, governments, high-school teaching, and graduate studies.

Graduate Studies

As never before, we could not live on the Earth without understanding what consequences human activities are having on global warming. Moreover, we must mitigate against the ill efforts of earthquakes, landslides, and volcanic eruptions. These practical aspects of society are increasingly impacted by our relationships with the Earth. Therefore, we must understand the whole nature of the Earth from deep underground to space through time. Our Earth Science Department is pursuing to understand the entire picture of the evolution of the Earth and life, and to envision its future. We are actively facilitating research and educational alliances to advance collaboration between science and engineering related Earth and Planetary Science at Tohoku University. With further developments in cutting-edge technology in Earth and Planetary Science, we will also be able to clarify the total picture of the evolution of the Earth and life.

Our graduate studies in the Department of Earth Science involve a two-year Master's program followed by a three-year Doctoral program. The Doctoral program is supported by the JSPS "Global COE (Centers-of-Excellence)" program in collaboration with the Department of Geophysics, Graduate School of Environmental Studies, and the Department of Engineering (2008-2012). Once enrolled, doctoral students are provided with financial support.

RESEARCH GROUPS

Mineralogy

This group conducts research on mineralogy, crystallography, and crystal chemistry by utilizing single crystal X-ray diffraction methods using not only laboratory but also synchrotron radiation (Photon Factory, Tsukuba). This group is especially making progress in studies on the crystal structures of mantle minerals under high-pressure conditions. Fine texture observations relating to the crystal growth stage of natural minerals are also carried out by Transmission Electron Microscopy (TEM).

http://www.ganko.tohoku.ac.jp/Mineral/mineralE.html

Professor *Yasuhiro Kudoh*
Associate Professor *Toshiro Nagase*
Assistant Professor *Takahiro Kuribayashi*

Petrology and Solid Geochemistry

This group conducts research on petrology, geochemistry, and radiogenic isotope geology, volcanology, cosmochemistry. Its current research is on magma genesis in island arcs and continents, elemental cycles between the crust and mantle, the origin and evolution of volcanoes, the origin, evolution, and destruction of meteorite parent bodies, and the evolution of oceans recorded in fossils.

http://www.ganko.tohoku.ac.jp/gansekilindexE.html

Professor *Hirokazu Fujimaki*

Natural Resources and Environmental Geochemistry

Experiments under microgravity are conducted to simulate the formation of cosmic materials to illustrate materials evolution at the initial stage of the early solar system and the subsequent evolution of life materials on the Earth. Crystallization under extreme conditions is studied by highly advanced optical in-situ observation on the molecular scale. The "origin" of life and "environments" of the early Earth are also focused on by this group. Experiments to synthesize amino acids and proteins are carried out under a simulated environment with meteorite impact. The early environments and evolution of life are investigated by field surveys of ancient rocks in Greenland, Australia, and South Africa.

http://www.ganko.tohoku.ac.jp/shigen/

Professor *Katsuo Tsukamoto*
Associate Professor *Takeshi Kakegawa*
Assistant Professor *Hitoshi Miura*

Earth and Planetary Material Physics

This group conducts research on the highpressure physics of Earth and planetary materials , and the origin and evolution of Earth and the planets. Its current research is on the partitioning of elements between metal and silicate at high pressure and its application to the core formation process of Earth, melting and phase relations of mantle materials, physical properties and equation of state of minerals and magmas at high pressure, and diffusion and kinetics of phase transition of mantle minerals. We are also conducting studies on material transport from the surface to the core and the large-scale circulation of the Earth's materials including its volatiles.

http://www.ganko.tohoku.ac.jp/busseiJ/english/index.html

Professor *Eiji Ohtani*
Associate Professor *Akio Suzuki and Motohiko Murakami*
Assistant Professors *Hidenori Terasaki and Takeshi Sakai*

Arc Magmatism

This group conducts research on geochemistry, petrology, and volcanology. Its on-going research involves correlative studies on granitic rocks in continental and island-arc crusts, spatial and temporal variations in the composition of island-arc igneous rocks, and petrological and geochemical studies on quarternary islandarc volcanic rocks.

http://www.ganko.tohoku.ac.jp/touko/english/index.html

Professor *Takeyoshi Yoshida*
Associate Professor *Michihiko Nakamura*
Assistant Professor *Takeshi Kuritani and Ken-ichi Ishikawa*

Geology and Petrology

(Division of Geochemistry, Department of Basic Studies, Center for Northeast Asian Studies)

Our research group studies earth materials science from a viewpoint of regional geology focused in Northeast Asia. Main objects of our study are ophiolites and volcanoes. Ophiolites are fragments of the ancient oceanic lithosphere that were accreted to the continental margin through subduction processes, and provide a key to elucidate structure and composition of the oceanic lithosphere as well as tectonic evolution of orogenic belts and genesis of our mineral resources. Our studies on volcanoes include geological mapping and geochemical analyses of lavas and pyroclastic deposits as well as geophysical measurements and analogue experiments of volcanic eruptions. These studies will clarify the intensity and mechanism of large-scale volcanic eruptions in the past, and contribute for mitigation of volcanic hazards in future.

Professor *Akira Ishiwatari*
Assistant Professor *Akio Goto, Tsuyoshi Miyamoto, and another AP to be assigned*

Reaction and Kinetics in Earth's Interior

(Cooperative programs with Agency of Industrial Science and Technology)

This group conducts geochemical studies on seafloor hydrothermal activities, the origin of islandarc magmas and crystal evolution, the nature of lunar and planetary volcanism, and the flow and fracture of rocks in the Earth's interior.

Department of Biology

The land that we stand on, the air that we breathe, the food that we eat, all are products of the past 4.6 billion years of Earth's history. We human beings are too. How were we created? What is our destiny?

The Department of Biology was established in 1922 and has been producing a number of graduates and postgraduates active in both the academic and non-academic world. Since the Department was founded, the priority-in-research and open-door spirit of Tohoku University has prevailed over the Department as well. While the Department has kept the spirit and tradition founded by the pioneers on the one hand, it has been promoting updated research activities in response to ever-developing biological sciences on the other. Present research activities cover a wide range of basic biology, from molecular and cellular biology through ecology and evolutionary biology. Three facilities, the Asamushi Laboratory of Marine Biology, the Mount Hakkoda Botanical Laboratory, and the Botanical Gardens, also contribute to education and research in the Department. In 2001, the whole department was reorganized to establish the Graduate School of Life Sciences. The Graduate School consists of 38 laboratories that were established by reorganizing three faculties and four institutes of Tohoku University. Our Department has enrolled approximately 40 undergraduates and our Graduate School has enrolled approximately 40 doctoral and more than 100 master's students every year. We more than welcome talented biologists and students who can promote and enjoy the study of biological sciences at Sendai.

Contact

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- URL http://www.biology.tohoku.ac.jp/english/index2.html

Professors

Mitsunori Fukuda
Membrane Trafficking Mechanisms
Keywords: Organelle transport, melanin transport, neurotransmitter release, secretion, autophagy

Tatsushi Muta
Cell Recognition and Response
Keywords: Innate immunity, host defense, gene expression, NF-κB, IκB-ξ

Kazuhiko Nishitani
Plant Cell Wall Biology
Keywords: Development, phytohormones, carbohydrates, enzymes, gene families

Koji Tamura
Organogenesis
Keywords: Development, regeneration, morphogenesis, limbs, asymmetry

Daisuke Yamamoto
Neurogenetics
Keywords: Brain, insects, instinct, learning and memory, behavioral genes

Toshio Iijima
Systems Neuroscience
Keywords: Neuroscience, brain science, learning and memory, optical imaging, brain machine interface

Hideki Katow
Developmental and Cell Biology
Keywords: Neurogenesis, axon guidance, basal deuterostomes, sea urchins, morphogenesis

Kazuo Yamamoto
Molecular Genetics
Keywords: Genome instability, cell cycle, carcinogenesis, DNA repair, mutagenesis

Kensaku Mizuno
Molecular Cell Biology
Keywords: Actin cytoskeleton, signal transduction, cell migration, cancer cell invasion, neurite outgrowth

Toru Nakashizuka
Functional Ecology
Keywords: Biodiversity, canopy biology, disturbance, forest dynamics, sustainable management

Practice scene

Masakado Kawata
Evolutionary Biology
Keywords: Evolution, biodiversity, ecology, molecular ecology, ecological genomics

Jotaro Urabe
Community and Ecosystem Ecology
Keywords: Community ecology, aquatic ecosystems, food web, trophic interaction, material cycling

Mitsuo Suzuki
Functional and Evolutional Plant Anatomy
Keywords: Plants, morphology, functions, evolution, structures

Eisuke Kikuchi
Regional Ecosystem Studies
Keywords: Ecosystems, wetlands, estuaries, benthic animals, material cycling

Associate Professors

Hiroaki Yamamoto
Molecular Diversity
Keywords: Developmental genetics, pigment cells, functional diversification of pigment cells, visual and auditory senses, hair cycle

Makoto Mizunami
Neurogenetics
Keywords: Neurobiology, learning, memory, insects, microbrain

Ken-ichiro Tsutsui
Systems Neuroscience
Keywords: Electrophysiology, fMRI, prefrontal, parietal, dopamine

Keiichiro Kyozuka
Developmental and Cell Biology
Keywords: Oocyte maturation, maturation inducing hormones, calcium measurement, fertilization, sperm penetration

Takuya Minokawa
Developmental and Cell Biology
Keywords: Embryology, evolution, gene expression, transcription regulation, echinoderm

Sea urchins in Asamushi

Tatsuo Nunoshiba
Molecular Genetics
Keywords: Genome instability, cell cycles, carcinogenesis, DNA repair, mutagenesis

Kazumasa Ohashi
Molecular Cell Biology
Keywords: Actin dynamics, LIM-kinase, cofilin, imaging, signaling

Satoki Sakai
Functional Ecology
Keywords: Adaptation, evolutionary ecology, mathematical biology, plant ecology, reproduction

Kouki Hikosaka
Functional Ecology
Keywords: Plant ecophysiology, global change, photosynthesis, acclimation, adaptation

Masayuki Maki
Evolutionary Biology
Keywords: Biodiversity, conservation biology, evolutionary genetics, phylogenetics, plant speciation

Satoshi Chiba
Community and Ecosystem Ecology
Keywords: Ecology, ecological genetics, evolution, island biology, biodiversity

Syuichi Shikano
Regional Ecosystem Studies
Keywords: Ecosystems, wetlands, lakes, food webs, microbes

Lecturers

Ryusuke Yokoyama
Plant Cell Wall Biology
Keywords: Plants, development, cell walls, genomes, morphology

Reaserch Centers

Laboratory of Nuclear Science (LNS)

LNS operates a 300-MeV(mega-electron volts) electron LINAC and a 1.2-GeV (giga-electron volts) electron synchrotron to provide electron and photon beams in a wide energy range from MeV to GeV for the study of quark hadron physics, nuclear physics, and radio-chemistry. A recent study on quark nuclear physics at LNS has revealed a new narrow baryon resonance, indicating the signal of a penta-quark baryon with hidden strangeness. Some remarkable nuclear phenomena influenced by environmental changes have been found in material science. These are, for example, a change in the lifetime of radioisotopes encapsulated in a C60 cage and a change in the nuclear reaction rates in metal. In accelerator science, intensive work has been done at LNS to achieve original ideas for a ring-type THz light source.

TEL +81-22-743-3400 *FAX* +81-22-743-3401 *URL* http://www.lns.tohoku.ac.jp/

Research and Analytical Center for Giant Molecules

The Research and Analytical Center for Giant Molecules consists of two sections for analytical and experimental research. The analytical section has the latest high-performance instruments for elemental, mass spectrometric (MS), nuclear magnetic resonance (NMR), X-ray crystal structure, and plasma atomic emission (ICP) analyses. These instruments play an important role in determining the structures of small and giant molecules in research on fundamental and applied sciences. The experimental research section investigates the development of new chemical reactions using organometallics and catalysts, and their application to the synthesis of new materials and biologically active natural products.

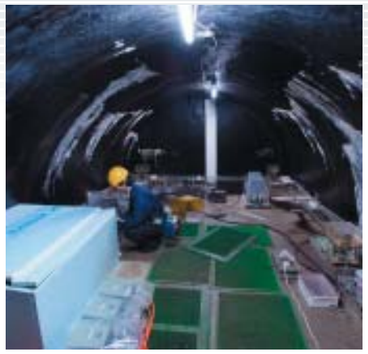
TEL +81-22-795-6752 *FAX* +81-22-795-6752 *URL* http://www.kiki.chem.tohoku.ac.jp/

Center for Atmospheric and Oceanic Studies (CAOS)

The Center is composed of the Atmospheric Trace Gas Laboratory, the Radiation and Climate Physics Laboratory, the Satellite Oceanography Laboratory, and the Atmosphere-Ocean Exchange Laboratory. The vision and mandate of the Center are to advance the scientific understanding of climate change and variations in the global atmosphere and oceans caused by anthropogenic and natural processes. To achieve the research objectives of the Center, we conduct extensive measurements of greenhouse gases, analyses of polar ice cores, numerical simulations of global cycles of greenhouse gases, and observations of radiative properties of aerosols, clouds, and water vapor, using passive and active sensors and satellites to assess their effects on climate. We also conduct analyses of air-sea interactions, regional oceanic circulation, and bio-geophysical interactions using a variety of satellite data and numerical simulations.

TEL +81-22-795-5793 *FAX* +81-22-795-5797 *URL* http://caos.a.geophys.tohoku.ac.jp/

Research Center for Prediction of Earthquakes and Volcanic Eruptions



This center was newly established in 1997 and it originated from the historic Mukaiyama Observatory founded in 1912. It is divided into three laboratories involving crust physics related to earthquake prediction, physical volcanology related to the prediction of volcanic eruptions, and marine geophysics related to the study of plate dynamics in subduction zones. More than 60 observation stations operated by the center are widely distributed in the Tohoku district to provide invaluable data not only for prediction studies but also for fundamental studies in geophysics. We are conducting internationally collaborative research with experts from all over the world and aiming to become one of the most comprehensive centers of study on the plate subduction zone.

TEL +81-22-225-1950 *FAX* +81-22-264-3292 *URL* http://www.aob.geophys.tohoku.ac.jp/aob-e/

Research Center for Neutrino Science (RCNS)

Ordinary matter including our bodies ultimately consists of electrons and up and down quarks. A neutrino is an elementary particle categorized with these matter particles. Neutrinos are 9 to 10 orders of magnitude more abundant than the other matter particles in the universe. Their characteristics are closely related to the structure of the universe and the grand-unified theory of elementary particles. Neutrino properties are also expected to explain why our universe is made of matter. However, neutrinos penetrate matter almost freely and they are rather difficult to detect. The RCNS reveals the properties of such elusive neutrinos using an underground-, huge-, ultra-low-background detector, i.e., the Kamioka Liquid-scintillator Anti-Neutrino Detector (KamLAND). KamLAND detects anti-neutrinos from distant nuclear power plants and enables us to determine how electron-type neutrinos travel. Neutrinos currently serve as tools to enable the interiors of opaque objects to be observed. KamLAND has pioneered "Neutrino Geophysics" enabling neutrinos emanating from the earth to be observed and this is going to propel "Neutrino Astrophysics" through detecting abundant low-energy neutrinos created at the center of the sun.

TEL +81-22-795-6727 *FAX* +81-22-795-6728 *URL* http://www.awd.tohoku.ac.jp/

Planetary Plasma and Atmospheric Research Center (PPARC)

Our principal aim at the Planetary Plasma and Atmospheric Research Center (PPARC) is to investigate the little known world of planets by sensing the atmospheres and plasma surrounding planets from the Earth using radio and optical techniques. Research on the physical processes governing various phenomena related to the planets will be a major part of basic sciences well into the 21st century. Such studies will also shed light on an understanding of our own planet, Earth. The formation and environment of planets is studied by investigating the physics of phenomena on planetary atmospheres and plasma. This research is based on our own observations of planets employing radio and optical methods, analysis of planetary mission data, as well as modeling and simulation using these data.

TEL +81-22-795-6367 *FAX* +81-22-795-6406 *URL* http://pparc.geophys.tohoku.ac.jp

Campus map

Graduate School of Science and Faculty of Science

1 Physics and Natural Science
2 Museum of Natural History
3 Earth Science
4 Administration
5 Biology
6 Chemistry
7 Physics A
8 Physics B
9 Physics C
10 Lecture Hall
11 Mathematics
12 Cafeteria and Shops
13 Library (Kita-Aobayama branch)
14 Co-op for School of Science

Pine tree garden

15 Research Center for Neutrino Science (RCNS)
16 Planetary Plasma and Atmospheric Research Center (PPARC)
Center for Atmospheric and Oceanic Studies (CAOS)
Research and Analytical Center for Giant Molecules
17 Research and Analytical Center for Giant Molecules

2 Museum of Natural History

Over 600,000 specimens of fossils, minerals, and rocks, including old topographic maps are stored in museum. There materials have mainly been collected by successive scholars for their own research, or partly purchased for education purposes. About 1,200 examples are exhibited.

Opening hours *10:00 - 16:00 Close in every Monday*

TEL,FAX *+81-22-795-6767* ***URL*** *http://www.dges.tohoku.ac.jp/museum/museum.html*

13 Kita-Aobayama Library

Opening hours

During the semester	*9:00 - 20:00 Mon - Fri*
During the summer, winter, and spring vacations	*9:00 - 17:00 Mon - Fri*

*Kita-Aobayama Library is closed on weekends and holidays.

TEL *+81-22-795-6372* ***FAX*** *+81-22-795-3753* ***E-mail*** *klib-s@library.tohoku.ac.jp*

14 Co-op for School of Science

The cafeteria, restaurant, and bookstore are located in Co-op.

Cafeteria, Restaurant ***TEL*** *+81-22-263-2990*
Bookstore ***TEL*** *+81-22-263-0126*

Directions

Tohoku University Sendai, Japan

Location

North-East of Japan
Distances from Tokyo: 350 km

Sendai Airport (SDJ) mainly functions as a domestic airport with regular flights to other large cities in Japan. There are also a few international frights to neighboring countries, such as South Korea, Taiwan and China.

The airport is linked to the city with the Sendai Airport Access railway, which takes 17-25 minutes to JR Sendai Station.

Sendai is a major station on the Tohoku Shinkansen (bullet train) line, some two hours from Tokyo.

Buses

From the bus terminal (Bus stop No.9) at the JR Sendai Station West Exit, about a 25 minute ride on the "Aoba-dori Ichibancho Keiyu Dobutsukoen Junkan". Get off at the "Rigakubu Shizenshihyohonkan-mae" bus stop. About a 25 minute ride on the "Aoba-dori Ichibancho Keiyu Kogakubu / Miyakyodai-yuki". Get off at the "Johokagaku kenkyuka-mae" bus stop and it is about 5 minutes on foot from the bus stop. The fare is 220 yen for both routes.

Taxis

From the taxi stand at the JR Sendai Station West Exit, it takes about 15 minutes and costs about 1,600 yen.

Sendai City Information

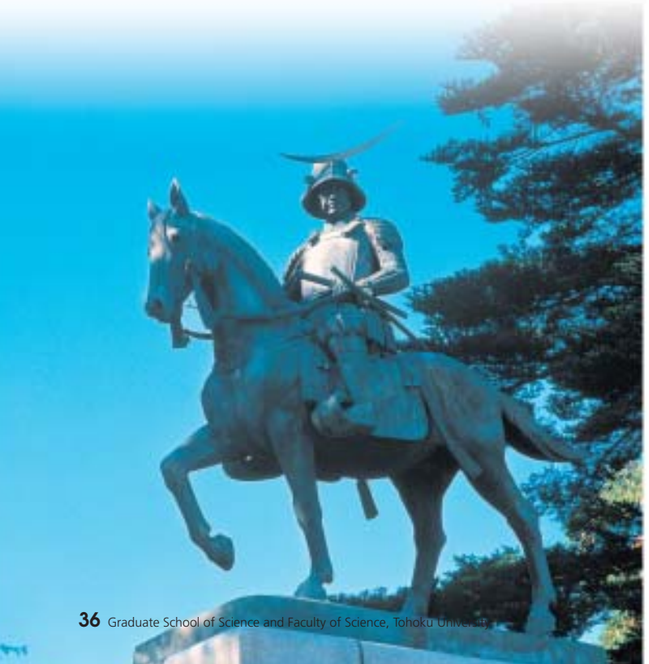
The Graduate School of Science and the Faculty of Science of Tohoku University have a campus in Aobayama on the western side of the central urban area of Sendai City.

The modern history of Sendai City saw its start as the largest castle town in northern Japan when Date Masamune constructed a castle in Aobayama in 1600. With a population of one million, Sendai is the largest city in the Tohoku Region, whose land area is equal to one-fifth the national total, and grew as an academic and cultural city centered on Tohoku University and as an international city.

The city is surrounded by scenic sites, including Matsushima, an international sightseeing spot and one of the "Three Great Views of Japan", Mt. Zao, famous for spas and skiing, and Minami-Sanriku with a beautiful ria coast. In 1922, Albert Einstein visited Tohoku University and took a trip to Matsushima.

It is known that he said to an accompanying reporter about Matsushima, "Such beauty of nature can be seen neither in picture by famous artists nor in sophisticated photos. This is the scenery that moves me the most in my visit to Japan ("Einstein Shock", Iwanami Shoten)".

You will enjoy various aspects of research life in Sendai where "Urban environment", "Natural environment" and "Cultural environment" are well harmonized.



Tanabata Festival

Pageant of Starlight

Street Jazz Festival

Matsushima

Ski Resort

*Provided by the Miyagi Prefecture Industry Department, Tourism Division

Contact Information

Graduate Sachool of Science and Faculty of Science

6-3 Aramaki Aoba, Aoba-ku, Sendai, Miyagi 980-8578, Japan
URL *http://www.sci.tohoku.ac.jp/english/*

DiRECT *(Division for International Research and Educational Cooperation Graduate School of Science)*

6-3 Aramaki Aoba, Aoba-ku, Sendai, Miyagi 980-8578, Japan
Phone *+81-22-795-5829* ***Facsimile*** *+81-22-795-5831*
E-mail *direct@sci.tohoku.ac.jp*
URL *http://sciserv.sci.tohoku.ac.jp/direct/*

Application for Undergraduate Admission

6-3 Aramaki Aoba, Aoba-ku, Sendai, Miyagi 980-8578, Japan
Phone *+81-22-795-6350* ***Facsimile*** *+81-22-795-6345*
E-mail *sci-kyom@bureau.tohoku.ac.jp*

Application for Graduate Admission

6-3 Aramaki Aoba, Aoba-ku, Sendai, Miyagi 980-8578, Japan
Phone *+81-22-795-6351* ***Facsimile*** *+81-22-795-6345*
E-mail *sci-in@bureau.tohoku.ac.jp*

Helpful Web Sites

Graduate School of Science and Faculty of Science

http://www.sci.tohoku.ac.jp/english/

Tohoku University

http://www.tohoku.ac.jp/

Center for International Exchange, Tohoku, University

http://insc.tohoku.ac.jp/index-j.html

Ministry of Education, Culture, Sports, Science and Technology

http://www.mext.go.jp/english/

Japan Society for Promotion of Science (JSPS)

http://www.jsps.go.jp/english/

Japan International Science and Technology (JISTEC)

http://www.jistec.or.jp/index_e.html

Japan Information Network

http://jin.jcic.or.jp

Miyagi Prefecture

http://www.pref.miyagi.jp/english/

City of Sendai

http://www.city.sendai.jp/index-e.html