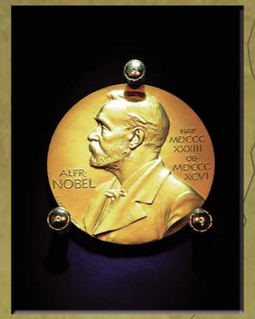
The photomultiplier used in the Nobel Prize winning KAMIOKANDE neutrino observatory.




The Nobel Prize for Prof. Koshiba.

Physics Department main building.

## List of useful websites

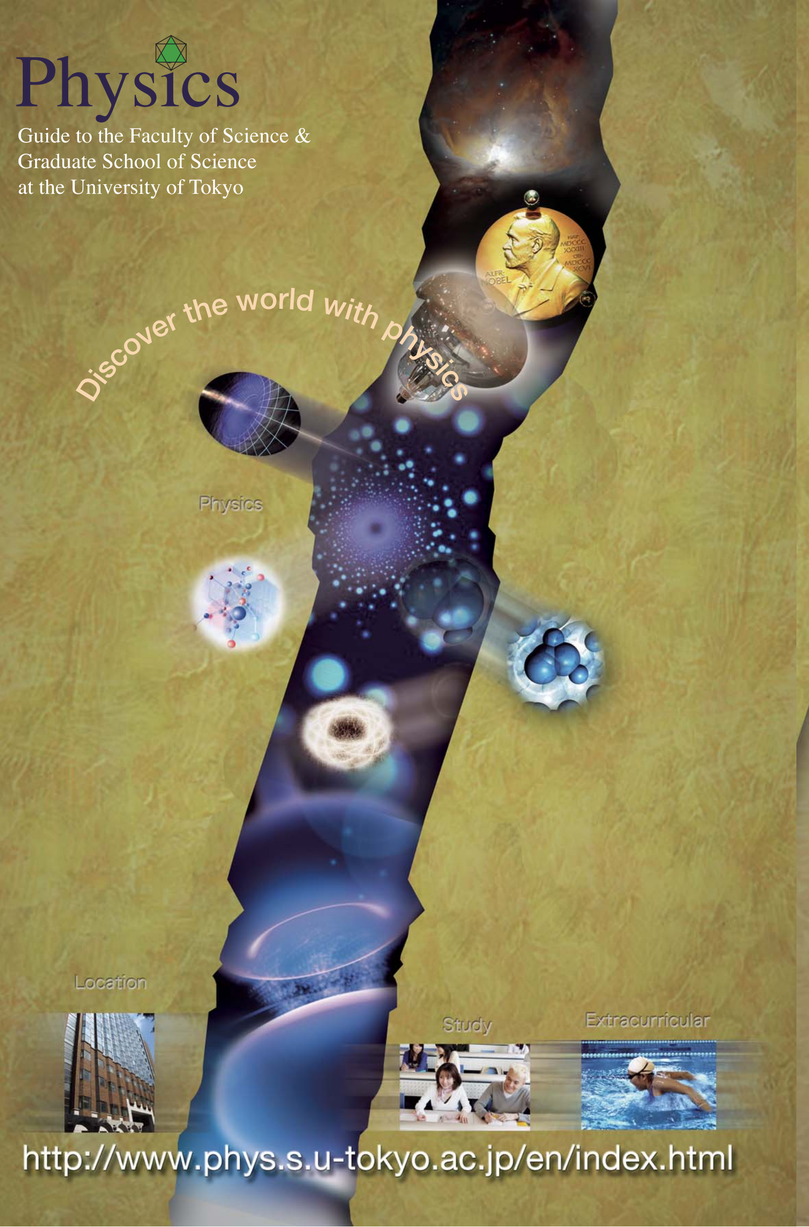
School of Science, International Liaison Office
An administrative office for the support of international students.
**http://www.s.u-tokyo.ac.jp/ilo/en**

Scholarships Information.
**http://www.phys.s.u-tokyo.ac.jp/en/scholarships.html**
**http://www.s.u-tokyo.ac.jp/ilo/en/scholarship.html**
and
**http://www.u-tokyo.ac.jp/res03/i14_e.html**

Department of Physics, Graduate School of Science, The University of Tokyo
7-3-1 Hongo, Bunkyo-ku, Tokyo 113-0033
TEL : +81-3-5841-4242 FAX : +81-3-5841-4153

# Physics

Guide to the Faculty of Science &
Graduate School of Science
at the University of Tokyo




## GENERAL INFOMATION

### About us

The Department of Physics has more than 130 faculty members. They are all internationally recognized researchers who's work covers almost all of the frontiers of Physics such as Condensed Matter Physics, Astrophysics and Cosmology, Particle Physics, Nuclear Physics and General Physics. We have the longest history among Japanese universities for education and research in physics, turning out many outstanding physicists including Leo Esaki, a 1973 Nobel laureate, Ryogo Kubo, Yoichiro Nambu and Masatoshi Koshiba, a Professor Emeritus and 2002 Nobel laureate, over the past century. Our Department is considered one of the world's largest and top-ranked graduate schools for physics.

### Structure

The frontiers of modern physics span a considerably wide range. Thus, our faculty members are working not only for the Department of Physics at Hongo Campus but also for related graduate schools, research institutes and centers, and outside research organizations, which enables us to conduct diverse and advanced research. For example, in the field of experimental physics using large facilities like particle accelerators, experiments are carried out at the research institutes and centers in collaboration with international research organizations.

### Admission

There are two graduate courses in our Department; one is the two-year master's program for students who have completed undergraduate courses and the other the three-year doctor's program for students who have completed master courses. The enrollment dates are October 1st and April 1st of every year, and the corresponding application periods depend on your visa status. If you are interested in admission to our Department, it is crucial to understand research subjects and affiliations of your potential supervisors through their web pages and to contact them by e-mail well before the application. The faculty members welcome any questions from you. Please visit our website for general information: http://www.phys.s.u-tokyo.ac.jp/en/index.html.

### Scholarships and supports

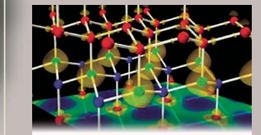
To promote the strongest graduate students and researchers coming to our university, several scholarships provided by the Japanese Government and the University of Tokyo are available for international students. Please check our websites listed in the last page for further details. The International Liaison Office of the School of Science supports international students on their admission, arrival orientation, scholarships and student lives.

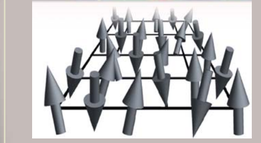
# Research activities

In the Graduate School of Physics, there are more than 130 senior faculty members who can supervise graduate students, and they cover most of the frontiers in physics at the highest level. In the following, we give a brief introduction of these research activities, focusing on the Department of Physics in Hongo Campus. Topics available on other campuses and laboratories are introduced on the Organization page. For more information, please visit our web page:

*http://www.phys.s.u-tokyo.ac.jp/en/index.html*

## Condensed Matter





The experimental condensed-matter physics group, which comprises six professors, covers a wide range of materials and phenomena that include strongly-correlated electron systems exemplified by the high-Tc superconductor, superfluid helium, quantum Hall systems, Tera-Hertz photons, and physics of surfaces. We explore new, and sometimes unexpected, physical principles by combining high-quality, exotic materials with advanced techniques, some of which are rather globally unique. We recognize such a line of approach as a true charm of experimental physics.

The theoretical condensed-matter physics group, comprising four professors, covers a wide spectrum as well, which ranges from fundamental aspects to realistic analysis of diverse materials. Many-body effects (superconductivity, magnetism, fractional quantum Hall effect) in correlated electron systems and spin systems, both in and out of equilibrium, are among the main interests. Another pillar is the first-principles electronic structure, including the "beyond LDA", in ordinary and extreme conditions. By combining many-body theories and first-principles electronic structures (as symbolized by the picture here) we also envisage a materials design for correlated electron systems. Active collaborations between experimental and theoretical groups are under way.

## Astrophysics and Cosmology

The theoretical astrophysics group is actively working on a variety of broad topics in astrophysics and cosmology. In particular, our current interests include the following three major research topics: "Physics of the Early Universe", which aims at describing the birth of the Universe in the framework of string theory and brane-world models; "Observational Cosmology", which attempts to understand the evolution of the Universe based on the rapidly accumulating observational data in multiple wavebands; and "Particle and Nuclear Astrophysics", which confronts unexplored aspects of particle and nuclear physics with astrophysical phenomena in regimes of extremely high energy, density, and temperature.

In addition, there are five experimental groups, covering a wide variety of topics in astrophysics. Two X-ray groups are jointly studying the physics of cosmic nucleosynthesis, particle acceleration, and compact objects including black holes, using SUZAKU and other X-ray satellites. The gravitational-wave group is operating a 300-m baseline laser interferometric detector (TAMA300), and is conducting various developmental studies for future projects. An extensive search for neutralinos and solar axions without accelerators is being carried out by the dark-matter group. The radio group is investigating star formation and the chemistry of the interstellar matter through millimeter- and submillimeter-wave observations.

SDSS1004+4112: This is the Hubble telescope image of the first cluster-lensed multiple quasar discovered by our group as part of the Sloan Digital Sky Survey (credit: ESA, NASA, K. Sharon and E. Ofek).

## Particle Physics

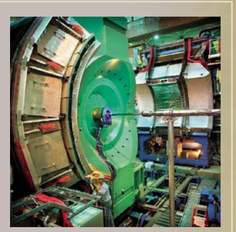
Particle Physics is fundamental research to quest for the origin of the materials, forces, and our universe. The present experimental data are well described by the Standard Model: quarks and leptons are the fundamental constituents of matter, and they interact with each other by four forces (electromagnetic, weak, strong and the gravitational interactions ). Although the Standard Model has been remarkably successful mathematical physics, so far, we believe it is not the ultimate theory of particle physics, and we are aiming at a more fundamental theory underlying Nature, where all matter and interactions are described in a unified way.

There are puzzles in the cosmological observations: ordinary matter accounts for only 4% of the total energy density of the Universe, and all the rest consists of dark matter (23%) and dark energy (73%). The origin of matter anti-matter asymmetry, and the origin and nature of the dark matter and dark energy are not yet identified. They should also be explained in terms of particle physics in the future. There are both the experimental and theoretical activities in our university.

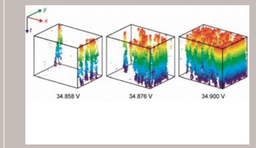
Scientific activities in the theory group of particle physics covers model building, phenomenology, string theory, mathematical physics, and particle cosmology. The LHC (photo) is the energy frontier collider, in which the origin of the mass and the physics beyond the Standard Model will be discovered in the near future. The other experimental activities to discover dark energy, dark matter, and the origin of the CP violation are also ongoing in our particle physics groups.

## Nuclear Physics

A wide variety of subjects are studied both theoretically and experimentally in the nuclear physics group toward a comprehensive understanding of strong interaction and the origin of matter. The structure of nuclei and properties of nuclear force have been investigated in terms of quantum many-body problems with nucleon degrees of freedom. Nowadays, nuclear physics extends its scope to the structure of exotic/unstable nuclei, antimatter, nuclear/hadronic matter under extreme conditions and quark gluon plasma which are intimately linked to atomic physics, elementary particle physics and astrophysics. We also explore fundamental problems such as the dynamical origin of proton mass, precise measurement of antiproton mass, and the EPR paradox.



## General Physics




Physics is the pursuit of finding fundamental laws that govern all natural phenomena. Thus the area of interest is not only directed toward space, time, and matter, but also to new research areas such as quantum information processing and biological systems where development of physical concepts are in high demand. General physics covers the study of nonlinear non-equilibrium physics, quantum information processing, quantum optics, atomic/molecular physics, plasma physics, biophysics, and neuroscience. To give a typical example, self-organization is a widely observed phenomenon in non-equilibrium systems, however its theoretical foundation is in the developing stages. Theory of dynamical systems provides general approaches to wide ranging phenomena from vortex dynamics in cold atoms to organization in fluid/plasma turbulence and is still developing to account for complex phenomena including living systems. The division of general physics is attempting to expand our conceptual scope, which promotes the Department of Physics at the University of Tokyo to be truly original and unique..

# Curriculum

There are more than 30 lectures on a variety of fundamental and advanced subjects in physics every academic year. We recommend some of them as semi-compulsory subjects depending on your research field. Usually all of the lectures are given in English unless all students in the class are Japanese. Some of the lectures are shared with other Graduate Schools such as those of Engineering or Frontier Sciences. Besides regular lectures, there are intensive lectures given by guest professors from other universities on various topics in physics.

## Summer Semester

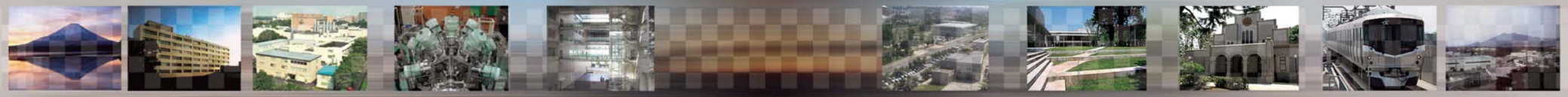
Quantum Field Theory IA & IB
General Relativity
Nuclear Physics
High Energy Physics
Astro Particle Physics
Astrophysics
Particle Accelerator
Experimental Particle and Nuclear Physics
Statistical Physics
Solid State Physics IA
Plasma Physics
General structure of extreme quantum systems

## Winter Semester

Quantum Field Theory IIA & IIB
Elementary Particle Physics
Cosmic Ray Physics
Magnetism
Solid State Physics IB
Physics of Fluid
Optical Physics
Statistical Physics

physics

from 2008-2009 lecture program



## Organization Map

The Graduate School of Physics is composed of not only the Department of Physics located at the Hongo campus, but also many collaborating independent laboratories. In total, there are about 130 senior faculty members who supervise graduate students. Links to individual laboratories are summarized on the web-site, http://www.phys.s.u-tokyo.ac.jp/en/organization/index.html

Hida, Gifu
Kamioka Observatory
- Institute for Cosmic Ray Research

Tsukuba, Ibaraki
High Energy Accelerator Research Organization
- High Energy Accelerator Research Organization

Kashiwa, Chiba
University of Tokyo, Kashiwa Campus
- Institute for Solid State Physics
- Department of Complexity Science and Engineering
- Institute for Cosmic Ray Research
- Institute for the Physics and Mathematics of the Universe

Wako, Saitama
Riken
- Riken

Bunkyo, Tokyo
University of Tokyo, Hongo Campus
- Department of Physics
- Research Center for the Early Universe
- Center for Nuclear Study
- Institute Center for Elementary Particle Physics
- Institute of Molecular and Cellular Biosciences
- Department of Physiology

Sagamihara, Kanagawa
Japan Aerospace Exploration Agency
- Institute of Space and Astronautical Science

Meguro, Tokyo
University of Tokyo, Komaba Campus
- Institute of Physics, Department of Arts and Sciences
- Institute of Industrial Science

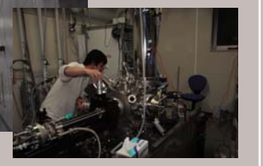
0 20 40 60 80 100 km

## Major Collaborating independent laboratories

Collaborating independent laboratories accept a significant portion of graduate students. Here, five major laboratories are listed. Visit their web-site for a list of research activities. All faculties in our course are listed in the following web-site, as well.
http://www.phys.s.u-tokyo.ac.jp/en/members.html

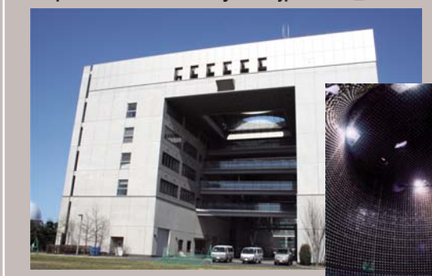
Institute of Physics,
Department of Arts and Science
**http://phys.c.u-tokyo.ac.jp/index.html.en**

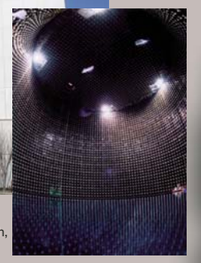
Institute for Solid State Physics
**http://www.issp.u-tokyo.ac.jp/index_e.html**



Photograph in typical facilities for research

Institute for Cosmic Ray Research
**http://www.icrr.u-tokyo.ac.jp/index_e.html**

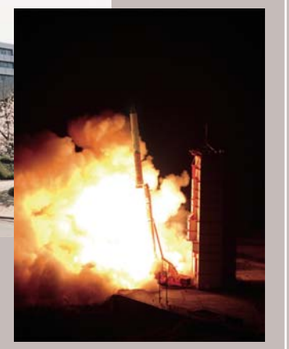




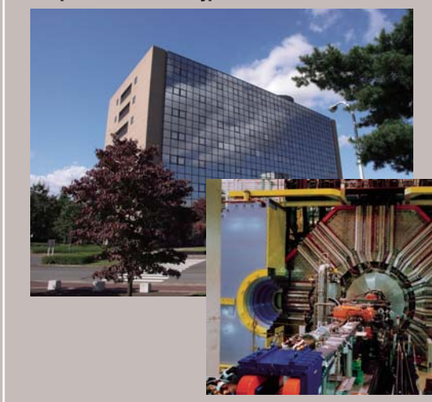
(c) Kamioka Observatory,
ICRR (Institute for Cosmic Ray Research,
The University of Tokyo)

Institute of Space and Astronauical Science (ISAS),
Japan Aerospace Exploration Agency (JAXA)
**http://www.isas.jaxa.jp/e/index.shtml**

JAXA, Sagamihara Campus



High Energy Accelerator
Research Organization (KEK)
**http://www.kek.jp/intra-e/index.html**



# Location of The University of Tokyo

Hongo campus of the University of Tokyo is located near downtown areas such as Ginza, Shinjuku, Asakusa, and Akihabara, which makes life very convenient. It is also easy to access Tokyo station from which one can travel to the provinces by Shinkansen (high speed train).There are many choices of the rental apartment in the vicinity.

## Location of the Departm ent of Physics

The Department of Physics is located in Faculty of Science Bldg. 1 which is just behind Yasuda auditorium. Basic facilities such as cafeterias, Co-op shops, gym, are are located within 3 minutes on foot.


Cafe "Subway"

Restaurent "Matsumotorou"

Co-op shop (Computer, Stationery)

Co-op Refectory "Icho-Metro Shokudo"

First Co-op Refectory

Co-op shop (Foods)

Convenience Store "Lawson"

Cafe "DOUTOR"

Faculty of Science Bldg. 1

Second Co-op refectory and Co-op book store

ex. Faculty of Science Bldg. 1

Faculty of Science Bldg. 4

Yasuda Auditorium (Student Counselling Center)

Koshiba Hall, which commemorates Prof. Koshiba's NobelPrize, is located in Bldg. 1

## After School

After the class, it is possible to refresh oneself in the sports facilities, movie theaters, shopping streets, restaurants which are located in the vicinity.