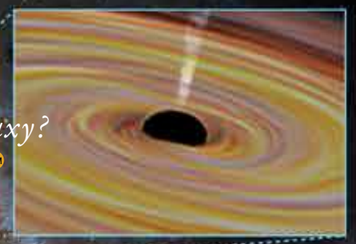
東京大学
大学院
理学系研究科

Department of Astronomy, Graduate School of Science,
The University of Tokyo

天文学専攻
理学部天文学科

東京大学
THE UNIVERSITY OF TOKYO

Credit:ESA/Hubble & NASA,
Acknowledgement:Judy Schmidt (Geckzilla)



What is the true nature of the Milky Way galaxy? MF NM

What is the nature of dark matter and dark energy? TT NK

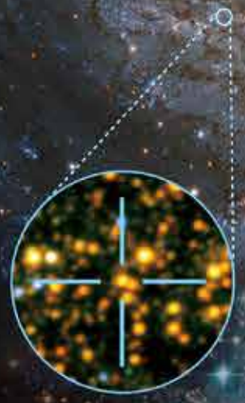
How did the first stars in the universe form? TT NK HU

What is the relationship between galaxies and black holes? TT NK KS MF

How and where are the elements made? TT HU NM

Why do galaxies have various appearances? TT NK KS MF

How and when did galaxies come into being? TT NK KS MF



Understanding the life of interstellar dust YA HU IS

How and when did the reionization of the universe happen and what caused it? TT NK KS

How does the interstellar medium change and circulate in the galaxy? YA MF IS NM

How have galaxies grown up? TT NK KS MF NM

Uncovering the identity of mysterious transient astronomical objects TT HU

Exploring the physics of extreme states by supernovae TT HU

TT Totani Lab. MT Tamura Lab. YA Aikawa Lab. NK Kashikawa Lab. KS Shimasaku Lab.
HU Umeda Lab. MF Fujii Lab. MT Takata Lab. IS Sakon Lab. NM Matsunaga Lab.

Credit:NASA, ESA and the Hubble
Heritage (STScI/AURA)-ESA/
Hubble Collaboration

What is the lighthouse of the universe? NM

How do stars form? MT YA

How do diverse planetary systems emerge? MT YA MF

Where is the source of gravitational waves? TT HU MF

Exploring the origin of organic matter in space YA IS

Is there life beyond earth? MT YA IS

What is the inner structure of a star? HU MT

Why do some stars change their brightness and shape? HU MT NM

Revolutionizing our view of the universe

Revolutionizing our view of the universe

- The real joy of astronomy

Astronomy is one of the oldest disciplines in the world. Many people may think of astronomers as an out-of-this-world person looking at the night sky through a telescopic mirror. Modern astronomy, however, is one of the hottest disciplines in the world, and is opening up the frontiers of humanity's understanding of the universe, encompassing the exploration of fundamental laws of physics and the origin of life in its subjects.

How and when did the stars, galaxies, and the universe come into being? What is the nature of dark matter and dark energy that makes up most of the universe? How were the various elements that make up our bodies created? Is there no other place in the universe that can support life like Earth? To answer these fundamental questions, humanity has been exploring the universe and expanding its horizons since the dawn of time and before. For example, geocentric theory, relativity, big bang theory of the universe, exoplanet theory, and so on and so forth, just to name a few. The mission and purpose of astronomy is to revolutionize humanity's worldview on a grand scale in the universe.

At the forefront of modern astronomy, giant ground-based telescopes and satellites are used to detect extremely faint and distant objects. These are equipped with advanced detectors that are full of the latest engineering technology. One of the attractions of astronomy is the close interaction between theory and observation, and large-scale numerical simulations are often performed to understand the observational data. Of course, the most important thing in both theory and observation is an original and novel idea.

Education is conducted at the Department of Astronomy at the Hongo campus and the Institute of Astronomy at the Mitaka campus, both of which cover a wide range of astronomical fields. A Schmidt telescope with a 1-meter aperture is installed at the Kiso Observatory, which is also used for undergraduate education. The 6.5-meter TAO telescope is under construction at the Atacama Highlands in Chile.

The foundation of modern astronomy is physics. For this reason, students in the Department of Astronomy are required to take courses in basic physics as well as specialized courses in astronomy. In the third year, students will have the opportunity to conduct astronomical observations using some telescopes. In the fourth year, students are divided into research groups with their supervisors and work on research projects. This is a great opportunity for students to learn about the latest observational data and theoretical research.

Astronomy is a discipline that is expected to continue to make great progress in the future. The Department of Astronomy is looking for prospective students who will be active not only domestically but also internationally, and who will conduct pioneering astronomical redearch. We look forward to your challenge to explore the romance of the great universe.

Undergraduate and graduate education

The University of Tokyo's Department of Astronomy (established in 1878) is located on the 10th and 11th floors of the first building of the Faculty of Science, which is located behind the Yasuda Auditorium, as seen from the main gate of the University of Tokyo. It is one of the smallest departments in the Graduate School of Science, with only 10 faculty members, but there are numerous other related groups in the Institute of Astronomy, the Research Center for the Early Universe, the Graduate School of Arts and Sciences, the Institute for Cosmic Ray Research, the Kavli Institute for the Physics and Mathematics of the Universe, the National Astronomical Observatory of Japan, and the Japan Aerospace Exploration Agency, with which people in astronomy are collaborating, so the scope of education and research opportunities is broad. In total, more than 30 faculty members play a central role in astronomy education and research at the University of Tokyo. The number of undergraduate students per academic year is limited to 10, and many students seem to enjoy the home-like atmosphere. The graduate school admits about 23 master course students every year, and more than 10 students earn a doctorate degree each year. There are only a limited number of universities in Japan that have astronomy departments and provide specialized education in astronomy from the undergraduate level. As mentioned above, the number of faculty members and the richness of the research topics covered by our multi-institutional cooperation are among the highest in Japan and abroad. In addition, students benefit from training in astronomy-specific instrumentation, observation, and data analysis through collaboration with the National Astronomical Observatory of Japan and its Astrobiology Center.

Research

Astronomy, along with medicine, has the longest history of any discipline in the world. Just as the mysteries of the universe are many, various fields of astronomy have been formed during its long history. As in other fields of science, each field has its own "season". However, there is no "art" in merely following the current state of affairs. At the moment, we are at the forefront of research in a wide range of fields including cosmology, distant galaxies, high-energy phenomena, supernovae, interstellar matter and chemistry, stellar structure and evolution, and exoplanets (in no particular order). In addition, the distribution of our classrooms is almost halfway between the so-called theoretical and observational categories. This allows us to respond to the broad interests of our students.

Members in department of astronomy

Tomonori Totani
Professor

Astrophysics

Motohide Tamura
Professor

Exoplanet Astronomy

Yuri Aikawa
Professor

Astrophysics

Nobunari Kashikawa
Professor

Early Universe, Galactic Astronomy

Kazuhiro Shimasaku
Associate Professor

Galactic Astronomy

Hideyuki Umeda
Associate Professor

Theoretical Astrophysics

Michiko Fujii
Associate Professor

Theoretical Astrophysics

Masao Takata
Assistant Professor

Astrophysics

Itsuki Sakon
Assistant Professor

Infrared Astronomy

Noriyuki Matsunaga
Assistant Professor

Optical / infrared Astronomy

Cosmology Galaxy Star Inter stellar matter Exoplanet Theory Observation Instrumentation




From the voices of students enrolled in the Department of Astronomy

Student A D1

One of the fascinating aspects of astronomy is its wide range of research. Astronomy covers a wide range of research targets, from planets, stars and galaxies to the entire universe and space-time itself. Therefore, we make use of knowledge from many different fields, including chemistry and biology, in addition to a wide range of physics. Moreover, a variety of techniques are used to detect faint signals coming from the sky, including highly technical observations and instruments, and cutting-edge data analysis techniques. I think one of the fascinating aspects of astronomical research is that you can not only closely look at humanity's collective abilities to tackle the mysteries of the universe, but you can also experience a part of it yourself. To give you an extreme example, at a conference I once attended, one day there were talks by philosophers and talks on dark matter and black holes, the next day there was a presentation on future plans to explore a neighboring star, and on the last day there was a presentation on biology. Research activities offer many different experiences in addition to the many things you can learn on a daily basis. For example, even as a graduate student, you have the opportunity to participate in conferences abroad, stay for long periods for collaborative research, and have many other exciting international experiences. I also spent most of my first year of the doctoral program in the United States, and it was a valuable experience for me. I think this variety of experiences is one of the best things about studying astronomy.

Student B D2

In 2015, I entered the Master's program in Astronomy at the Graduate School of Science, where I studied the brightest explosive astronomical phenomena in the universe in the radio band, known as fast radio bursts, under the guidance of Professor Tomonori Totani. In addition to the sensitivity of the human eye to visible light, astronomy uses telescopes, which observe at various wavelengths, as "eyes" to explore the universe. Looking through a telescope, we often encounter new astronomical phenomena at different wavelengths and on different time scales. High-speed radio bursts are one such example, and new discoveries are reported every day all over the world, and we are struggling to interpret them. I think the unique appeal of astronomy lies in explaining these unknown phenomena and solving their mysteries. The Department of Astronomy at the University of Tokyo covers a wide range of research areas related to the universe and is one of the most diverse educational and research institutions in Japan. Students will not only learn about astronomy, but they will also engage in real research. In discussions about research, even students are treated as equals, and I think they will learn the most important habit as researchers: to think for themselves. Take advantage of your free time in graduate school, the excellent research facilities, and the excellent researchers around you, and discover the joy of exploring the unknown.

Student C D3

The appeal of the Department of Astronomy is that the small class size of 10 to 20 students in each grade makes it possible for students to study astronomy in a homey atmosphere and conduct world-leading research. The Department of Astronomy is one of the few departments in Japan that specializes in astronomy, and our department is home to many researchers in a wide range of theoretical, observational and instrumental fields, from exoplanets to galaxy evolution and cosmology. Laboratory assignments offer a rich choice of fields and allow students to conduct research and instrument development using the latest data from their senior year graduation research. We are very fortunate to have many researchers from different laboratories to discuss our research, and we are able to have discussions with them easily. In order to pursue your own cutting-edge topic of interest, students can take the initiative in submitting observation proposals to telescopes around the world, collaborating with researchers in Japan and abroad, and taking an active role in other activities that will lead to a very fulfilling life. Even if you go on to a doctoral program, the seven years you spend in the department will go by in a blink of an eye. I recommend the Department of Astronomy not only to those who aim to become an astronomer in the future, but also to those who aim to get a job in a company after fully engaging in astronomical research that they cannot do elsewhere during their school years.

Student D D3

For thousands of years, human beings have gazed up at the sky, appreciating the beauty of the heavens and wondering about our place in the Universe. Perhaps even before early humans developed the language with which to talk about the stars, they had already developed a connection with the night sky, as they first began to understand the connections with seasonal weather patterns. Humanity's connection with astronomy is both ancient and deep, an important part of our survival and a constant source of inspiration.

We now live in the so-called “golden age” of astronomy, in which the advent of modern technology has enabled an explosion in our understanding of the Universe. With the increasing sophistication of computers and charge-coupled devices (CCDs) beginning in the late 20th century, the volume of astronomical data and the computational power with which to analyze it have grown exponentially. Now it has become almost a routine exercise to launch telescopes equipped with hundred-million-pixel cameras into space. In this way, NASA's *Kepler* space telescope has discovered thousands of planets orbiting other stars in the Galaxy, and its successor mission, *TESS*, has just begun its own search for planets around many more stars even closer to the Earth. In the early 2020's, the *Hubble* space telescope's successor, *JWST*, will enable astronomers to study the atmospheres of some of these planets, and in doing so possibly even discover the signatures of biological activity on other worlds. This will be a momentous occasion in human history, as we will be able to address empirically the age-old question: Are we alone?

As the exponential growth of astronomical resources continues, even powerful modern computers will struggle to cope with the deluge of data generated by near future projects, such as LSST. What discoveries lie ahead? The Universe is a big and mysterious place, and as with all scientific endeavors, the more that we understand, the more we realize we don't know, and the more questions there are to ask. Asking the right questions is the necessary first step to pushing the boundaries of human knowledge, and working hard to pursue the answers is a rewarding journey. At the end of the day, there are many reasons why I hope to see more people study astronomy in the future, but perhaps the simplest reason is the best one: it's fun.

※ Grades are current at the time of writing.





Remote sensing of the internal structure of stars based on helio- and asteroseismology

Observational, theoretical, and experimental studies of interstellar dust in space
The evolution of matter in space based on those studies

Cosmology and High Energy Astrophysics

Exoplanet detections and observations from ground and space
Star and planet formation, ISM, and IR instrumentations

Observational studies of galaxy formation and evolution

Supernovae, gamma-ray bursts, nucleosynthesis, and the early universe

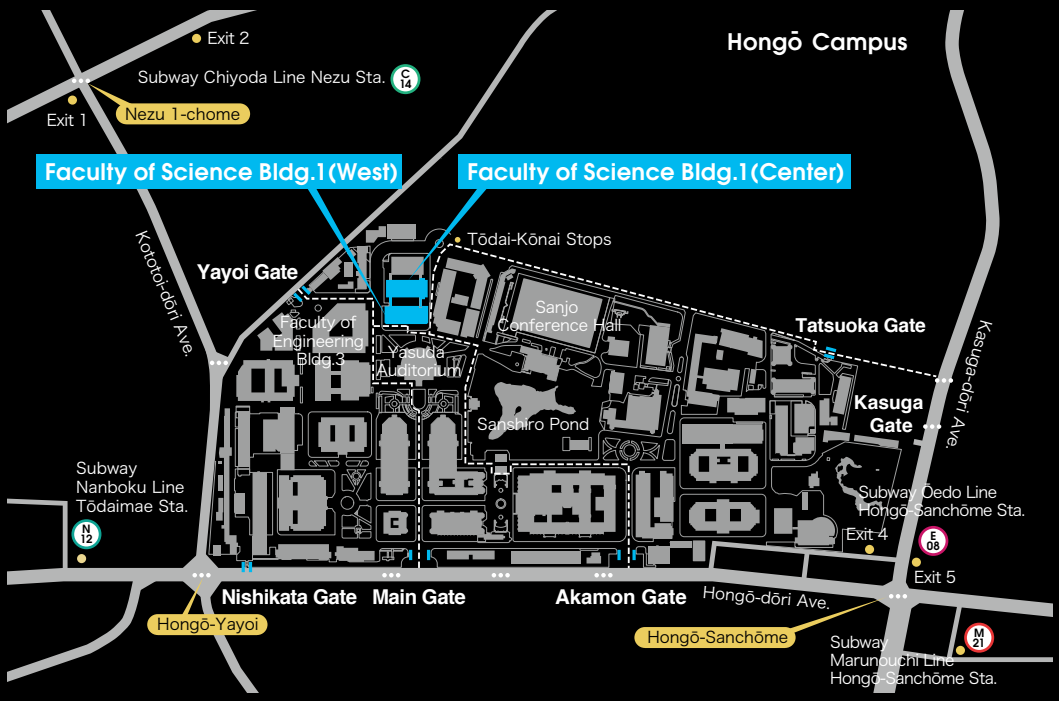
Formation of stars and planetary systems
Astrochemistry

Early universe, galaxy formation, black hole, structure formation, cosmic reionization, and inter galactic medium

Study of the formation and evolution of galaxies, star clusters, and planets using numerical simulations

Pulsating variable stars and the application to study the structure and evolution of the Milky Way

ACCESS



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