UTSIP Kashiwa 2021

Host Laboratory List

Division of Transdisciplinary Sciences

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Division of Transdisciplinary Sciences

Department of Advanced Materials Science

Laboratory	Faculty	Introduction of research activities and laboratory	Key words	Projects or activities summer program students can participate
KIMURA (Tsuyoshi) Laboratory	Prof. KIMURA Tsuyoshi	The research subject of our laboratory belongs to the field of “Materials Physics” which deals with the understanding of materials’ properties based in quantum mechanics, the exploration for state-of-arts functional materials based on synthetic chemistry, and the development of cutting-edge measurement systems of materials properties. Especially, we explore multi-functional electronic materials in which various electric and magnetic properties are entangled and induce unexpected materials functionalities. For this purpose, we design and synthesize various transition-metal compounds, and carry out measurements of their electric and magnetic properties under various environmental conditions in terms of temperature, pressure, and electric and magnetic fields. “Multiferroics” are one of such functional materials and are defined as materials in which multiple order parameters such as ferromagnetic, ferroelectric, and ferroelasitic orders coexist and couple each other. We aim to explore new types of mutiferroic couplings and orders such as magnetic monopole, magnetic toroidal, magnetic quadrupole, and chiral orders, which lead to unconventional control of electronic properties in materials, and hopefully which will be used for future electronic devices.	Physics and chemistry; Multi-functional materials; Crystal growth; Electronic properties; Magnetic and electric fields	In this summer program, you will learn how to investigate multi-functional electronic materials such as multiferroics in which their electronic properties respond to both magnetic and electric fields. Electronic properties of materials are strongly dominated by their constituent elements and crystal structures. Thus, you will begin with the synthesis of the materials from chemicals, and have an experience of crystal growth. The obtained specimens will be characterized by structural analyses such as an x-ray diffraction measurement which reveals the crystal structures of the specimens. Subsequently, you will characterize their magnetic, mechanical, and electric properties under various environmental conditions such as low temperatures and high magnetic and electric fields. By comparing the results of several compounds, you will find the required conditions to achieve materials with (multi-)functional properties.

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Division of Transdisciplinary Sciences

Department of Advanced Energy

Laboratory	Faculty	Introduction of research activities and laboratory	Key words	Projects or activities summer program students can participate
Yasushi Ono Laboratory	Prof. ONO Yasushi	Our main research fields are Plasma Physics and Engineering, especially development of fusion energy, alternative energy sources, space and solar plasmas and plasma applications. The present fusion research already realized fusion power output larger than the input power as an exhaustless energy without any global warming gas. Its key question is whether we can develop economic ultra-high-beta confinement using economic high-power heating, where the beta is the plasma thermal pressure P confined by the unit magnetic field: bet=P/(B^2/2μ_0). We have developed a number of new ideas for (1) high-power heating: merging/ reconnection heating and (2) high-beta confinements: second-stable Spherical Tokamak (ST) , using the TS-3, TS-4, TS-6, UTST and MAST, ST-40 devices (based on UK-Japan collaboration). Since the magnetic field-line reconnections converts magnetic energy into plasma kinetic/ thermal energy, our TS-3 and ST-40 experiments documented significant ion heating over 2.3keV, respectively. We found the new scaling law of reconnection heating energy proportional to square of reconnecting magnetic fiels B_rec, indicating that the high-B_rec ST merging will heat ions to the burning plasma regime without using any additional heating facility. This fact leads us to new high-magnetic field ST merging/ reconnection experiments TS-6 with B_rec > 0.3-0.5T for ion heating >1keV. We are now organizing the international world-wide reconnection collaboration program CMSO for physics, application of merging and reconnection and also for international and interdisciplinary plasma education of young scientists among MRX (Princeton U.), MST (Wisconsin Univ.), MAST (Culham lab.) and ST-40 (Tokamak Energy). ■ Web：http://tanuki.t.u-tokyo.ac.jp/	Plasma Experiment; Fusion Energy; Laboratory Astrophysics; Spherical Tokamak (ST); Magnetic Self-Organization	We, international plasma research groups composed of Univ. Tokyo, Princeton Univ, NIFS, JAXA etc. are planning annual interdisciplinary schools and workshops of plasma astrophysics based on bidirectional exchanges of research staffs, graduate and undergraduate students. This new approach focuses on interrelationship of laboratory plasma experiments, space/ astrophysical plasma observations and numerical/ theoretical plasma studies and their applications based on the international and interdisciplinary collaborations. Our annual school and workshop will be held in Tokyo area for graduate and undergraduate students. Mutual visits of faculty members and graduate and undergraduate students will be encouraged and realized. Our initiative will provide a new interdisciplinary and balanced education of plasma astrophysics in both the undergraduate and the graduate schools. This program involves laboratory experiments, space observations and numerical / theoretical studies of plasma astrophysics. Our activities will generate a joint consortium of departments of advanced energy, complexity, space-astrophysical science, physics and electrical engineering. We believe that our annual school and workshop will provide new opportunities of international and interdisciplinary lectures, discussions and experiments to all plasma-course students.

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Division of Transdisciplinary Sciences

Department of Complexity Science and Engineering

Laboratory	Faculty	Introduction of research activities and laboratory	Key words	Projects or activities summer program students can participate
Ejiri-Tsuji Laboratory	Assoc. Prof. EJIRI Akira	In Ejiri-Tsujii laboratory, fusion-oriented high-temperature plasma research is performed. The main research topic is the start-up and sustainment of a spherical tokamak configuration using RF wave power. This is an important issue to realize an economical reactor producing energy from the nuclear fusion reaction of deuterium and tritium. Besides the issue, we also study various MHD instabilities and wave induced nonlinear phenomena in plasma. We have a spherical tokamak device (TST-2) in our laboratory located at the Kashiwa campus, and we are running it by ourself. The major radius of the plasma is 0.36 m, and the maximum electron temperature is about 400 eV, and the density is up to about 2x10^19 m^-3, and the discharge duration is less than about 0.1 sec. In order to study the above topics, someone is developing an RF devices including RF antennas, while others are developing measurement systems or simulation codes. Please visit our website http://fusion.k.u-tokyo.ac.jp/index-e.html for more information, and visit https://www.youtube.com/channel/UCKTRHAVdVptxZFo2AasGeJg/ to feel the atmosphere.	plasma physics; nuclear fusion; tokamak; visible light detection; plasma production	Since high temperature plasmas are far from thermal equilibrium and have spatial inhomogeneity and temporal evolutions, it is quite important to get information on the plasma as much as possible. However, plasmas are too hot to insert sensors into the plasma, and remote measurements are necessary. Optical measurements are one such method. During UTSIP, our laboratory provides an opportunity to construct a very wide dynamic range visible light detection system, which consists of several detectors (i.e., photomultipliers, photodiodes) with different sensitivities and several collection optics. By using it you can observe the growth of a plasma from a very low density state to a standard high density state. The target density range is 10^10 m^-3 to 10^18 m^-3. This measurement is quite useful to understand the physics of plasma production process by inductive electric field, which is a standard plasma production process in tokamak devices.

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Division of Biosciences

Department of Integrated Biosciences

Laboratory	Faculty	Introduction of research activities and laboratory	Key words	Projects or activities summer program students can participate
Signal Transduction Laboratory	Prof.OHYA Yoshikazu Assoc. Prof. SUZUKI Kuninori	The budding yeast Saccharomyces cerevisiae is a very attractive model organism for studying the fundamental theories and concepts of eukaryotic cells. We applied the power of yeast genetics to understand many aspects of yeast cells. Our current research is mainly focused on two topics. (1) Phenotypic analysis based on cell imaging: To understand biological system as the network of logical and informational process, one of the invaluable tools is genotyping/phenotyping. Global analysis of the mutant phenotypes can provide relationships between knockout of the gene and function in the network. We developed CalMorph image analysis system useful to examine high-dimensional quantitative phenotypes under the fluorescent microscope. This method combined with AI can be applied to identifying intracellular drug target, studying replicative life span, and monitoring fermentation process. Our ultimate goal is to place all yeast genes and their corresponding products on a functional signaling network based on phenotyping. (2) Autophagy: It is a major pathway of bulk degradation of cytoplasmic materials. In yeast, autophagy has been studied as a cellular response for survival during nutrient-limited conditions. During autophagy, cytoplasmic components are enclosed in a membrane compartment, called an autophagosome. We are now studying the mechanisms of autophagosome formation and its degradation. Moreover, we have a particular interest in physiological significance of autophagy.	Budding yeast Saccharomyces cerevisiae; systems biology; imaging; cell cycle; autophagy	(1) Identification of intracellular drug target with a high-throughput platform for yeast morphological profiling (2) Morphological changes critical for control of replicative life span
Bio-resource regulation Laboratory	Assoc. Prof. SUZUKI Masataka	Our research goal is to elucidate evolutionary dynamics of sex determination mechanisms in invertebrate species. For this purpose, we are now studying on sex determination and sexual development using several insect species such as spiders, sawfly, silkworm, and fruit fly as model organisms. Our major research topics as follows: 1. Evolution of sex determination mechanisms, 2. Identification of novel factors that regulate sex determination and sexual differentiation, 3. Identification of common gene regulatory pathways that govern sexual dimorphisms. As a result of our study, several novel genes that are unique to the sex determination cascade of the silkworm have been successfully identified. By applying our findings, we have succeeded to establish a female-specific sterile technique that will be applicable for genetically sterile insect technique (gSIT) and release of insects carrying dominant lethal gene or genetic systems (RIDLs). We have also identified several genes whose functions in sexual differentiation are conserved between mammals and insects. Recently, we started a unique project to develop a novel system to monitor the global warming by focusing on the sex ratio bias of insects whose sex determination is dependent on the temperature of the environment.	Sex determination; Sexual differentiation; insects; genome editing; temperature-dependent sex determination	1) Identification of doublesex target genes involved in sexual development of gonads and germ cells In this project, students identify genes involved in sexual development of gonads and germ cells under the control of doublesex (dsx) gene, which is a master regulatory gene for sexual differentiation in the silkworm, by comparing transcriptome data of gonads between wild-type and dsx mutant silkworms. Perform expression analysis to find out a gene that expresses in a sex-specific manner. Finally, investigate the function of the candidate genes by genome editing technique such as CRISPR/Cas9. 2) Investigation of the effect of growth temperature on the sex ratio of gypsy moth, Limandria dispar The old literature reported that temperature of the environment affects the sex ration of gypsy moth. To verify this finding, in this project, students investigate the effect of environmental temperature during development on the sex ration of gypsy moth. Identify genes orthologous to Masc and dsx genes, both of which are important for sexual development of the silkworm, from the gypsy moth genome and investigate whether environmental temperature alters expression patterns of these genes

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Molecular Recognition Laboratory	Assoc.Prof. NAGATA Shinji	My research interest is to investigate the instinctive behavior observed in insects. We are particularly interested in feeding strategies such as carnivorous, herbivorous, and omnivorous characteristics. To explore the mechanisms of host preference and feeding motivation observed in insects, we focus on the endocrine control in the nervous system and metabolic mechanisms. In the lights of biology, biochemistry, molecular biology, and chemical biology, we run our projects to address the insect's innate behavioral motivation.	Insect, feeding behavior; endocrine factors; knockdown; metabolism	【Experimental projects】Using crickets Gryllus bimaculatus, program students will experience the functional assay of feeding behavior. Program students will also experience transcriptional knockdown techniques of RNA interference targetting several genes, which are related to endocrine factors and signaling molecules, for example. Finally, program students must evaluate if those target molecules can influence innate feeding behavior and/or metabolisms in crickets. 【Experience during UTSIP activity】RT-PCR, quantitative RT-PCR, GC-MS, MALDI-TOF MS, and generally using techniques of molecular biology and chemical biology, and behavioral analyses using crickets.

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Division of Biosciences

Department of Computational Biology and Medical Sciences

Laboratory	Faculty	Introduction of research activities and laboratory	Key words	Projects or activities summer program students can participate
Frith Laboratory	Prof. FRITH Martin	Our ultimate aim is to decipher the functional and historical information in genome sequences. We do this using statistical models (such as hidden Markov models) and computational methods (such as enhanced suffix arrays and dynamic programming). A major approach is to compare and align related sequences to each other, to see how they have evolved. One recent focus is characterization of genome rearrangements in evolution and disease. Another long-term interest is promoter sequences and DNA motifs that regulate gene expression. Further interests are everything "weird": malaria genomes (80% A+T), frameshifts (especially in microbial metagenomes), unexplained evolutionary conservation, trans-splicing, etc.	Genome; evolution; orthology; probability-based	Students are encouraged to pursue their own ideas on analyzing genetic sequences. There are broadly two types of project: biological investigation, and method development. Examples of biological investigation: survey the evolution of gene structure by gain or loss of splice sites, frameshifting, gene fusion or fission, etc; compare the evolution of mitochondrial versus plastid genomes; compare genome evolution to major body-form evolution (e.g. snakes, whales). Examples of method development: make a sensitive probabilistic model for finding distantly-related DNA sequences; devise a beautiful way to visualize complex sequence rearrangements; develop a way to extract specific rearrangement events from pair-wise alignments of long sequences (e.g. long DNA reads or whole genomes).

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Division of Environmental Studies

Department of Ocean Technology, Policy and Environment

Laboratory	Faculty	Introduction of research activities and laboratory	Key words	Projects or activities summer program students can participate
Sato Laboratory	Prof. SATO Toru	Our researches are aimed to form concepts of environmentally harmonizing systems, which coexist with natural environments for the global sustainability. For this purpose, we are developing computational models of environments using physics, chemistry, and biology, etc. Then these models are synthesized into simulation systems in order to predict environmental impacts and construct public acceptance. Our research interests are environmental impact assessment of CO_2 storage in subsea underground, biological CO_2 fixation, formation and dissociation modelling of methane hydrate, CO_2 geological storage by hydrate, development of multi-scale ocean model, modelling of flashing light effect of photosynthesis and the effects of CO_2 on marine biota.	Offshore CO_2 storage; CO_2 hydrate, Methane hydrate; Numerical modelling; Computer simulation	CO_2 capture and storage is a promising strategy against global warming. Although there is concern about the risk of CO_2 leakage from deep saline aquifers, it is expected that leaking CO_2 forms gas hydrate and this hydrate formation suppresses the CO_2 leakage. When the water depth of a storage site is large: say, about 400 m or more, leaked CO_2 changes its form to gas hydrate, which may block CO_2 rise in the sandy seabed sediment. Therefore, hydrate formation in the sub-seabed sand sediments is one of key factors in lowering the risk of CO_2 leakage and it is important to know conditions under which CO_2 leakage is suppressed by hydrate formation. On the other hand, using this leakage trap mechanism, it is also possible to store CO_2 in the form of gas hydrate without a cap rock in the sub-seabed geological formation. To estimate the sealing effect of CO_2 hydrate against CO_2 leakage beneath the seafloor, it is necessary to evaluate the permeability of the stratum after CO_2 hydrate forms. In this project, numerical simulations of hydrate formation in sand sediment will be conducted for CO_2 injected in the sub-seabed geological formation.
Takagi Laboratory	Prof. TAKAGI Ken	Takagi Lab aims at enhancing ocean technologies which could overcome big issues of mankind such as depletion of natural resources, food crisis and global warming. For this purpose, we are conducting several marine projects and trying to identify key technologies in each project. Now, we focus on the ocean current turbine system, which convert ocean current energy to electricity. So far, we formed a consortium with several private companies, and developed a prototype floating current turbine which was tested last year. We are also interested in other offshore technologies and expanding the research field such as marine drones, floating systems and riser systems. These technologies are expected to be applied for offshore oil & gas development in developing countries and the construction of wind farm in Japan. It is noted that our final goal is not only to develop new technologies but also to make proposals for ocean technology policy in comprehensive and systematic fashion based on findings in these research projects.	Ocean renewable energy; Offshore technology; Oceanic engineering; Marine technology	We are developing a floating type ocean current turbine system as stated above. The full scale device is planned to have two big turbines whose diameter is about 40m for the 2MW system. We have done a demonstration of a 100kW prototype model in water of off Kuchinoshima Island. However, we still have many concerns. Major concerns to commercialize the proposed system is whether the system is safe, reliable and low cost or not in realistic ocean current which contains turbulence, wave effect. To give an answer, we have conducted an ocean current measurement at sea as well as a numerical simulation of ocean current. On the other hand, we developed a simulator of the current turbine system. Combining measurement data and the simulator, we are tackling above mentioned concerns. Summer program students can participate elementary researches which have wide spectrum from analysis of the real sea data to the simulation of the device controlling system. We are also interested in planning a small energy network system centered on the ocean current turbine in a small remote island. Details of the research theme will be decided after consulting with the supervisor according to the knowledge and ability of the candidate.

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Ocean Resource and Energy Laboratory	Assoc. Prof. HIRABAYASHI Shinichiro	Developing new types of resources and energies that reduce global warming and negative environmental impact is a key issue to establish a sustainable society. The ocean provides such opportunities. Development of ocean renewable energy such as offshore wind, ocean current, thermal, wave, and solar energies is one of the areas of our research. In addition, research on development of platform technologies such as riser, floating platform, station keeping and materials are investigated. Main areas of laboratory research are (1) ocean renewable energy, (2) development of ocean natural resources, (3) CO2 ocean sequestration, (4) ocean space utilization for transportation, and (5) storage of resources in the ocean.	Ocean renewable energy; floating offshore wind turbines; ocean space utilization, floating systems; ocean natural resources; flow-structure interaction; Experimental/Computational Fluid Dynamics	We have a variety of research topics related to ocean renewable energy and ocean natural resources. The applicant can choose what he/she wants to do after acceptance through discussions. Some examples we can offer are the design of novel energy-harvesting systems, measurement and analysis of the dynamic response of floating platform, development of effective wave absorbing systems, and measurement of wave/vortex field around a floating body. Experiments will be done in the water channel in our laboratory.
Applied Physical Oceanography Laboratory	Prof. WASEDA Takuji	The following research activities are on-going: i) waves in the ice-covered sea; ii) Stereo-imaging of ocean waves and ice. In the first project, we will conduct experiments in a small wave-ice tank. In the second project, a field observation is conducted using stereo photogrammetry from a ship to reconstruct 3D surface wave and ice geometry and distribution. The activities in our group encompasses theoretical, observational and numerical studies of ocean waves, currents and wind to understand the basic physics. And eventually, the knowledge will be applied to support ocean developments such as the Northern Sea Route, safe navigation and operation at sea, and marine renewable energy.	Ocean waves; sea ice; marine wind; marine renewable energy; stereo photogrammetry	The student will engage him/herself in a self-motivated research project that includes but is not restricted to the research topics listed above. The research may involve analyses of observation data and model outputs. Those motivated can challenge in programming the numerical model and analysis program as well. The research will be guided by postdoctoral researchers, graduate students, Assistant Prof. Kodaira and Prof. Waseda. Regular meetings will be held in English. The past UTSIP students undertook the following research topics: developing phase resolved nonlinear wave model based on High-Order Spectral Method; diagnosis of East China Sea density structure; Synthetic Aperture Radar image analysis for ocean waves; validation of model wave power considering the performance of Wave Energy Converter; optimization of sail assisted ship navigation; freak wave occurrence near Japan; wind and waves in the north Atlantic. The student with prior programming knowledge with Matlab, Python, C, Fortran 90, GrADS, etc. may have an advantage undertaking the project, but, the senior students will guide those who do not have any experience. The research topics can be determined upon discussion with Prof. Waseda prior to the visit to Japan via e-mail exchange. We are happy to host those who are interested not only in research but also in learning about Japanese culture.

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Division of Environmental Studies

Department of Environment Systems

Laboratory	Faculty	Introduction of research activities and laboratory	Key words	Projects or activities summer program students can participate
Energy and Environment Laboratory	Lecturer AICHI Masaatsu	Current approaches to energy supply and consumption face problems such as climate changes and dwindling resources. The development of key technologies for saving energy, switching to renewable energy resources, and appropriate waste disposal is required. Our goal is to perform research that will contribute to the development of these technologies, especially by taking advantages of the characteristics of subsurface formations. For example, we study ways of developing a sustainable energy system, especially through hydrogeological and thermo-poro-mechanical modeling of geothermal heat pumps, geothermal power plants, and the geological sequestration of carbon dioxide. On the other hand, we also start to study how to adapt to global warming. Combining mitigation and adaptation is an attractive choice but it is not simple because one countermeasure possibly causes another environmental effects. For example, though the groundwater becomes more important water resource under changing climate, the overexploitation of groundwater possibly causes another environmental problem such as land subsidence, sea water intrusion in coastal area, so on. We try to predict and prepare for this kind of domino-like propagation to other environmental problems in advance.	Groundwater resource; land subsidence; numerical modeling; uncertainty analysis	Land subsidence simulation with unertainty analysis Land subsidence caused by groundwater abstraction has been one of the severe environmental problems. By strictly regulating the groundwater abstraction, the land subsidence in several cities in Japan stopped today. On the other hand, the groundwater becomes more important water resource under changing climate. In addition, the groundwater is considered to be an important water resource after an earthquake or flood disaster. Furthermore, the high groundwater pressure is harmful for the subsurface infrastructures. Then, the possibility to restart groundwater abstraction is becoming a matter of debate. However, it is essential to avoid the restart of land subsidence problem. Theoretically, it can be achieved by controlling the groundwater level such that the effective stress does not exceed the preconsolidation stress of subsurface formations. However, it is very difficult to find practically because of the heterogeneity in subsurface formations and the complex history of hydraulic head change in clayey layer. The model usually contains large uncertainty. In this program, we try to numerically simulate the evolution of the preconsolidation stress under the historical groundwater abstraction and find a critical groundwater level in the future groundwater usage with uncertainty analysis.
Akizuki Laboratory	Lecturer AKIZUKI Makoto	“Supercritical fluid” refers to a fluid in which the material’s critical points of temperature and pressure are being exceeded. Dramatic physical changes are possible depending on the operating conditions of the material. In particular, the ionic content and dielectric constant of supercritical water changes extensively based on temperature and/or pressure. As a result of this, it becomes possible to select a reaction based on one’s objective: from an ionic atmosphere suitable for inorganic reactions, to one implementing the dissolving of organics, which is equivalent to a non-polar solvent. Taking advantage of these properties, it is expected that this new, inexpensive, environmentally-friendly reaction medium will replace conventional organic solvents. Our laboratory has many research goals, covering a broad range of topics: Degradation of harmful waste products using the oxidation reaction in supercritical water, organic synthesis using solid catalysts, and synthesis of inorganic materials such as nanoparticles and polymers. In regards to all of these fields, by designing, analyzing, and controlling reactions based on a study of chemical reaction rate and reaction engineering, we are advancing extensive research, from fundamental research related to the chemical reaction of supercritical fluids, to the cultivation of new engineering application technologies.	Supercritical Water; Reaction Engineering; Organic Synthesis; Tunable Solvent; Catalysis	Supercritical water is a promising reaction medium for organic reactions because its solvent properties can be varied with the temperature and the pressure, and these properties affect reaction kinetics and mechanisms. The aim of this study is to propose a methodology which enables to control the reaction rate and the selectivity of organic synthesis reactions only with the change of temperature and pressure of supercritical water.

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Oshima Laboratory	Prof. OSHIMA Yoshito	In university experimental research, carrying out research safely without losing research creativity and activities is a difficult proposition because research promotion and its risks are inextricably linked. When considering the safety of an academic laboratory, it is important to view the laboratory as a system that consists of human behavior, the transportation of things, and the condition of the experimental research field, and to analyze the system by acquiring data through scientific methods from actual experimental research sites. Examples of data include flow line of an experimenter's movement, tracking the usage of chemical reagent bottles, and distribution of chemicals induced by indoor airflow. Collected data are then integrated and analyzed by a deep learning method to investigate the system configuration of laboratory, which enables us to objectively and quantitatively understand the conditions of experimental research sites and the characteristics of experimental research. "Laboratology" is a new concept area that is being proposed for future research. Laboratory safety must be discussed more scientifically and quantitatively, and this concept will undoubtedly contribute to comprehending characteristics of the research activity more precisely and help facilitate discussion on risk assessment of laboratory experiments.	Laboratory safety; Visualization; airflow analysis; PIV; CFD	In university chemical laboratories, many different types of chemicals are used for various purposes. Laboratories are workplaces in which complex airflows are formed because many experimenters work simultaneously and arbitrarily and the laboratory layout also frequently varies according to one's experimental purposes and plans. Such complex airflows can inadvertently cause experimenters to become exposed to chemicals in laboratories. To prevent experimenters from being exposed to hazardous chemicals, the dynamics of the airflow in the laboratory need to be precisely analyzed. In this program, you will conduct airflow analyses in university laboratory by Particle Image Velocimetry (PIV) analysis and Computational Fluid Dynamics (CFD) simulation. PIV is an optical method of flow visualization used to obtain the velocity of fluids. The fluid is seeded with tracer particles which are assumed to faithfully follow the flow dynamics. CFD is a system that uses numerical analysis to analyze and work out complications concerning fluid flow with the aid of computer-based simulation. Using these techniques, you will investigate the air environment in laboratory in view of outlet/inlet ventilation layout and experimenter movement. You will also clarify the impact on airflow by laboratory layout and walking experimenters by using a scale model, PIV, and CFD.
Geosphere Environment Systems Laboratory	Prof. TOKUNAGA Tomochika	Underground geosphere environment has been extensively used to support highly developed human society; e.g., extraction of energy resources and groundwater, waste disposal, construction of tunnels and underground spaces. Because of these activities, environmental problems which affect the sustainability of our society have emerged. The target of our laboratory is to understand and predict the change of geosphere environment caused by human activities, and to develop necessary engineering measures to attain sustainable use of geosphere environment. Current research topics include, studying and evaluating geosphere environmental changes caused by energy resources development and proposing necessary technological measures for sustainable resources development, securing stable and safe freshwater resources and development of efficient management schemes, and modeling long-term fluid flow and material transport processes through geosphere and its application to waste disposal and energy resources exploration.	Groundwater; coastal zone; seawater intrusion; modeling; field survey	Fresh groundwater in shallow unconfined aquifers is an important water resource for many coastal zones worldwide which, however, is threatened by seawater intrusion induced by both natural and anthropogenic forcing. Natural disasters like tsunamis and storm surges can cause fast infiltration of seawater into aquifers, which would result in long-term deterioration of groundwater quality. Anthropogenic activities such as land reclamation, abstraction of freshwater and other natural resources, construction of underground structures, and alternation of land surface conditions, could disturb freshwater-seawater interactions from the natural conditions. In this study, the techniques of analytical and numerical modeling combined with geophysical exploration techniques will be applied to understand seawater intrusion phenomenon both from conceptual understandings and field survey. Students will learn fundamental knowledge of coastal hydrological processes and gain the ability to analyze environmental issues through hands-on practice of using advanced modeling tools as well as participating field investigation. Also, students will have chances to get involved in other research activities in this laboratory, such as GIS-based mapping, water sampling, chemical and isotopic analysis, and laboratory experiments.

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Division of Environmental Studies

Department of Human and Engineered Environmental Studies

Laboratory	Faculty	Introduction of research activities and laboratory	Key words	Projects or activities summer program students can participate
Simulation of Complex Systems Laboratory	Prof. CHEN Yu	In our lab, fields of research range from social-economic, complex fluid, to biological systems. There are three research directions: (1) Multi-agent cooperative evolutionary games for modeling and simulations of financial markets; (2) Discrete kinetic models for the simulation of complex fluids; (3) Cellular automata and heterogeneous stochastic agent models for the simulation of aging and cancers.	Complex Systems; Agent-based modeling; Financial Markets; Soft-condensed Matters; Cancer	In the program, a small project will be assigned to the visiting student, basically relating to model construction and computer simulations. The specific complex system for study depends on student's interest. It could be a financial market, a solution including colloid, or a growing tumorous tissue. Apart from the research activity, visits of related labs in other university, and/or scenic sites surrounding Tokyo, etc. are also being scheduled.

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Division of Environmental Studies

Department of Socio-Cultural Environmental Studies

Laboratory	Faculty	Introduction of research activities and laboratory	Key words	Projects or activities summer program students can participate
Jun SASAKI (Estuarine & Coastal Environment) Laboratory	Prof. SASAKI Jun	We are involved in estuarine and coastal environmental studies in the field of civil and coastal engineering, such as (1) numerical modeling of physical and biogeochemical processes, (2) environmental restoration in enclosed coastal waters, (3) disaster mitigation, (4) mitigation of and adaptation to climate change, and (5) sustainability of community and livelihood in coastal areas in developing countries. Tokyo Bay, at short distance from our campus, is one of our main fields for studying environmental restoration and disaster mitigation based on field observation and development and application of numerical models. The bay has suffered from decline in fishery and water quality, including hypoxia and anoxia, for long time. We have been considering strategies for environmental restoration, rehabilitation and mitigation in the bay supported by scientific evidence. Disaster mitigation against storm surges and tsunamis is also our research targets, including development and application of prediction systems for coastal hazards using open source numerical models. Studies on coastal zone management for sustainability in developing countries, especially in mangrove coastal areas influenced by climate change and associated sea level rise, are also our main focus.	Coastal engineering; numerical simulation; coastal circulation; water quality and ecosystems; storm surges	Students will firstly learn physical and biogeochemical processes in estuarine and coastal waters, which may include some of coastal circulation, storm surges, water quality and ecosystems, and sedimentary processes. Secondly students will choose one of the related problems and learn its mechanism by applying a numerical model. Students will also learn some of the basics of computer literacy, e.g., pre-processing and post-processing for numerical computation using, e.g., Python based tools and Matlab. Students may select one of the open source models coded in Fortran, including FVCOM (unstructured-grid Finite Volume Community Ocean Model), ROMS (Regional Ocean Modeling System), and TEEM (Tokyo Bay Estuarine Ecosystem Model deeloped in the lab). Students will plot results and interpret them. Students will be requested to present their works and outcomes at our laboratory's progress report seminar. We welcome students who are interested in estuarine and coastal engineering studies using numerical computation.

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Division of Environmental Studies

Department of International Studies

Laboratory	Faculty	Introduction of research activities and laboratory	Key words	Projects or activities summer program students can participate
Honda Laboratory	Prof. HONDA Riki	Our society is exposed to various types of risks including natural disasters. Preparation for such risks is essential, but no countermeasure can provide perfect protection against severe disasters. In the presence of various threats such as climate change, huge earthquakes and tsunamis, society needs to be endowed with capability of adaptation and resilience. In our group, mechanism of collective behavior observed in the society coping with the situation with severe uncertainty is discussed from the viewpoints of social networks, game theory, adaptive systems theory, etc. Innovative mathematical approach for uncertainty management, such as financial problems is also in our scope. Development and management of infrastructure systems, advanced design methods, asset management and international technology transfer are also of our interest.	Infrastructure; natural disaster; community resilience	Statistical Analysis of Community Behavior: It is essential for disaster management, to be accepted by concerned people with affirmative attitude. In order to discuss how such attitude is developed and what kind of factors affect, various cases are discussed from various viewpoints. The mission of the intern will be analysis and numerical simulation of statistical analysis over the collected survey data.

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Division of Environmental Studies

Graduate Program in Sustainability Science – Global Leadership Initiative

Laboratory	Faculty	Introduction of research activities and laboratory	Key words	Projects or activities summer program students can participate
Onuki Laboratory	Assoc. Prof. ONUKI Motoharu	Our laboratory belongs to an interdepartmental master/Ph.D. program on sustainability science: "GPSS-GLI". Students select their own research topic related with sustainability by themselves and conduct research by interacting many faculties and students with different academic background in our group. Currently, we are conducting following research: "disaster recovery and resilience", "environmental pollution and risk", "sustainability education evaluation", "negotiation and consensus building for sustainability", "sustainability of civil infrastructure under shrinking society", "Smart City Projects in Kashiwanoha", etc.	Sustainability; sustainability education; Sustainability science; SDGs	UTSIP students can participate in "sustainability education evaluation" project. The University of Tokyo is now coordinating research and education activities under a concept of Sustainable Development Goals (SDGs). In addition to participating core educational activities of GPSS-GLI including "GPSS-GLI seminars" and some of the core courses, they are expected to conduct interview surveys of GPSS-GLI faculties and students on their research topics and linkage between their topics and SDGs. By using several methods including network analysis, transdisciplinarity of GPSS-GLI will be assessed in the project. Further comparative study between GPSS-GLI and other sustainability programs in the world could be possible. In addition to the above-mentioned topic, other topic is possible based on the applicant's interest.

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