UTSIP Kashiwa 2020

Host Laboratory List

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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 Asst. Prof. KIMURA Kenta	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 Asst.Prof. TANABE Hiroshi	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-β confinement using economic high-power heating, where the beta is the plasma thermal pressure P confined by the unit magnetic field: β=P/(B2/2μ0). We have developed a number of new ideas for (1) high-power heating: merging/ reconnection heating and (2) high-β confinements: second-stable Spherical Tokamak (ST) , using the TS-3, TS-4, 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 2keV, respectively. We found the new scaling law of reconnection heating energy proportional to Brec2, 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 Brec > 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 propose 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
Takase-Ejiri-Tsuji Laboratory	Prof. TAKASE Yuichi	Our group is performing experimental research on high-temperature plasmas with the aim of realizing fusion energy. Plasmas are collections of charged particles which exhibit collective behavior under the influence of electromagnetic fields. The greatest challenge of fusion research is to confine a plasma with sufficiently high density and temperature for long enough time. In our laboratory, research is performed using the TST-2 spherical tokamak. Research topics include: development of a new method to form and maintain the plasma, development of heating and current drive techniques using radiofrequency (RF) waves, studies of plasma instabilities and energy transport processes, and development of methods to control them. Using a new confinement concept, the spherical tokamak (ST) is capable of producing high-performance plasmas in a compact device, and may provide a way to realize an economically competitive fusion reactor. Research at our laboratory focuses primarily on plasma heating and current drive by RF waves, plasma performance improvement, and development of plasma start-up scenarios without the use of the central solenoid, which is indispensable for realizing a fusion reactor based on the ST concept. In addition, various plasma diagnostics based on a variety of physical processes are being developed.	plasma; fusion; tokamak	Students can participate in experimental or computational research in any of the research topics described above, under the guidance of our research staff. Examples in experimental research include plasma start-up experiments using RF waves, and measurement and characterization of plasma turbulence. These will involve data acquisition using existing diagnostics and analysis of the acquired data. Diagnostic development using various techniques, including low frequency electromagnetics, RF waves, microwaves, light (infrared, visible, ultraviolet), X-rays, or particles (electrons or ions) are also possible. Examples in computational research include modelling of RF wave excitation, propagation and absorption, and subsequent development of the particle velocity distribution function, leading to heating and current drive. Another possibility is to work on time-dependent plasma modelling in order to realize the achievement of highly autonomous advanced tokamak plasma with high confinement, high stability, and high fraction of self-driven plasma current, which is the leading candidate for realizing the fusion reactor.

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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.OYA 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 (1) system biology based on cell imaging, (2) haploinsufficiency, and (3) autophagy. (1) To understand biological system as the network of logical and informational process, one of the invaluable tools is genetics. 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 can be applied to identifying intracellular drug target, monitoring fermentation process during culture and studying biological diversity. Our ultimate goal is to place all yeast genes and their corresponding products on a functional signaling network based on phenotyping. (2) Haploinsufficiency, a dominant phenotype caused by a heterozygous loss-of-function mutation, has been rarely observed. However, our recent study with high-dimensional morphological phenotyping revealed haploinsufficiency phenotypes for more than half of 1,112 yeast essential genes under optimal growth conditions. Additionally, 40% of the essential genes with no obvious phenotype under optimal growth conditions displayed haploinsufficiency under severe growth conditions. Two models have been developed to explain the occurrence of haploinsufficiency: insufficient amount hypothesis and the balance hypothesis. We are now analyzing molecular mechanism of morphological haploinsufficiency in yeast. (3) Autophagy 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) Multivariate analysis of high-dimensional morphometric data to our understanding of the pharmacology of antifungal drugs. (2) High-Content, image-based profiling to identify drug target. (3) Chemical genetic analysis of yeast cell cycle (4) High-dimensional morphological phenotyping of yeast haploinsufficient genes (5) Molecular mechanism of haploinsufficiency (6) Live imaging and biochemical analysis of autophagosome formation and its degradation (7) Chemical genetic analysis of yeast autophagy (8) Cell biological analysis of membrane sources of autophagosomes
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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Moleculer Recognition Laboratory	Assoc.Prof. NAGATA Shinji	Our research interest is to know the function of various neutral lipids including sterol compounds in the natural sources. We are investigating the various sterol compounds and their metabolisms in insects; the allocation of the sterols in the insect body. Some plants include non-ingestible and non-digestible sterol compounds by insects are present. The variety of sterol compounds and the ability of metabolisms of sterol compounds might determine herbivore characteristics of phytophagous insect species.	Sterol; Insects; Crickets; Enzyme; Metabolisms	The program students may experience the following activities of our recent progress and recent investigating projects using insects focusing on the sterol metabolisms in the plant-feeding insect species. -Insect sterol metabolisms using crickets. Enzymatic analyses of sterol metabolisms. GC-MS and chemical modification by simple organic chemistry. -Chemical structural analyses of sterol compounds in several plant-feeding insects including silkworm and crickets by GC-MS. -Transcriptional level analyses of the sterol metabolism-related enzymes. Quantitative RT-PCR. -Chemical biology approaches to understand sterol metabolisms in insects. Conversion of the ingested sterols and tracing of sterol compounds in insects.
Laboratory of Evolutionary Anthropology	Assoc. Prof NAKAYAMA Kazuhiro	Our project focused on role of genetic adaptation for local environments in shaping the ethnic variety of diseases susceptibilities in East Asians. We recently reported evidence for positive natural selection events in Mongolians, one of the representative nomadic group in East Asia, using high density genome wide single nucleotide polymorphism (SNP) data (Nakayama K et al. Mol Biol Evol 2017 34:1936-46.). SNP that showed signature of selection in Mongolians would contribute to evolution of metabolic traits in Mongolians. We also identified the TRIB2 as a gene influencing visceral fat accumulation in modern East Asians and moreover, discovered signatures of positive natural selection related with adaptation to cold environments in ancestors of East Asians during the last glacial maximum (Nakayama K et al. Hum Genet 2013 132:201-17; Nakayama K and Iwamoto S J Physiol Anthropol 2017 36:16.).	Human genome; genetic variation; evolution	We are planning to assess phenotypic consequences of the variants under selection using medical genetic approaches, including in silico functional prediction and the association analysis with various cohorts. The student can learn about DNA extraction and genotyping of focal SNPs in human DNA samples. Additionally, the student may learn about the principal of evolutionary genetic analyses using focal and genome-wide SNP genotype data.

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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).
Biomedical Sciences Laboratory	Prof. MASAI Hisao	Our goal is to understand the molecular mechanisms underlying the faithful inheritance and stable maintenance of the genome. We try to elucidate how chromosomes replication is regulated during cell cycle and by genome/ epigenome and other chromatin signature We have come to realize the crucial roles of non-B-type DNA, more specifically, G-quadruple structures (G4) in regulation of DNA replication. It can serve as a universal genome signal for initiation of replication as well as a genome platform for generating chromatin architecture defining replication timing domain. Through analyzing the roles of G4 structures in replication initiation and chromatin regulation, we would like to disclose more general biological functions of G4 structures. We are also interested in how the block to ongoing DNA replication, a threat to the genomic integrity, is dealt with in cells to enable the replication of the entire genome with minimum errors. Replication stress is an ultimate trigger of impairment of genome integrity. We would like to understand how biological stresses could potentially generate replication stress, ultimately leading to carcinogenesis. Our laboratory currently has 8 students (three undergraduate, two master, three PhD course students); one of the students is from Taiwan, and one postdoc is from Taiwan. We will have students from Vietnam and also from Hong Kong next year. We are quite open to cultures from other countries; We believe that we can communicate with anybody in the world by the language of science.	DNA replication; genome stability; chromatin architecture; DNA replication stress checkpoint; G-quadruplex	We use various model organisms (E.coli, yeasts, mice, cultured cells) to solve the problems from many different viewpoints. Summer program students can join the projects listed below and others. 1. Elucidate the mechanisms of second mode of E.coli DNA replication (in vitro DNA replication; genetic characterization of mutants) 2. Elucidate the Rif1 dynamics and its role in replication, repair and recombination (ChIP-seq, Hi-C, Replication timing analyses, CRISPR-Cas9 mediated mutagenesis). 3. Development of new methods for cellular detection of G4 structure (new antibody, novel idea targeting the loop segment). 4. Roles of Claspin and Cdc7 in induction of replication checkpoint (How is Cdc7 kinase recruited to the site of fork stall, and how is Claspin activated? 5. Roles of Claspin in response to various other cellular stresses (temperature, oxidative stress, osmotic stress, hypoxia, PLS, nutrient etc.). 6. Developmental roles of replication factors (Cdc7, ASK, Claspin, Rif1 etc.)

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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 CO2 storage in subsea underground, biological CO2 fixation, formation and dissociation modelling of methane hydrate, CO2 geological storage by hydrate, development of multi-scale ocean model, modelling of flashing light effect of photosynthesis and the effects of CO2 on marine biota.	Offshore CO2 storage; CO2 hydrate; Methane hydrate; Numerical modelling; Computer simulation	Carbon dioxide capture and storage is an efficient technology to reduce CO2 emission. One of the reservoirs of CO2 is an aquifer in the sub-seabed geological formation under a caprock. However, there is a risk of CO2 leakage even though such probability is extremely low. When the water depth of a storage site is large: say, about 400 m or more, leaked CO2 changes its form to gas hydrate, which may block CO2 rise in the sediment. To estimate the sealing potential of CO2 hydrate, it is necessary to evaluate effective permeability of the sediment after CO2 hydrate forms. In this study, a series of numerical models will be used to investigate microscopic hydrate distribution that essentially controls the effective permeability. The method consists of packing sand grains within microscopic computational domains, arranging water and CO2 phases in the pore space of the packed sand grains, placing multiple hydrate nuclei, and growing hydrate in the pores of the sand grains. Then, efficient permeability was estimated using the results of the simulation of water flow through the pore space, regarding the formed hydrate as a solid.
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 engineerin; 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.
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	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.

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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 are developing a wave model to forecast Arctic waves for the Northern Sea Route. We will also 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 geometry. 3D reconstruction of wave field as well as image processing of ice distribution will be conducted. 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; modeling; emergency situation; uncertainty analysis	**Numerical analysis of land subsidence caused by groundwater abstraction in an emergency situation** Land subsidence caused by groundwater abstraction has been one of the severe environmental problems in Asian coastal megacities. 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. 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. The schedule is roughly planned as follows: 1st-2nd week: Introduction to land subsidence simulation and uncertainty analysis. 3rd-4th week: Simulation of the past land subsidence and proposal for the future.
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	**Organic synthesis using supercritical water as an environmental technology** 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	coastal flooding; seawater intrusion; groundwater resources; modeling; field investigation	Fresh groundwater in shallow unconfined aquifers is an important water resource for many coastal zones worldwide which, however, are threatened by seawater intrusion. Coastal flooding events such as tsunamis and storm surges can cause fast infiltration of seawater into aquifers, which would result in long-term deterioration of groundwater quality. The problem of seawater intrusion induced by coastal flooding involves multiple physical processes including fluid/air flows and mass transport in unsaturated-saturated porous media. 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 groundwater systems 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.
Industrial Information Systems Laboratory	Assoc. Prof. HIEKATA Kazuo	In modern days, distributed human agents and artifacts cooperate in highly networked information society. Our target is to study about reforming and creating structures of industries by utilizing advanced information technologies. Our research topics include deployment of wearable computers in shipbuilding and aircraft manufacturing, developing information management platforms for product maintenance and life-cycle, designing new transportation systems based on simulations, leveling up reliability of man-machine systems based on the analysis of situation awareness of operators. The research topics include applied researches to the industry and diversions of basic research. One of the applied research topics is the development of accuracy measurement system for large size assemblies using laser scanners. Development of information system for on-demand transportation and the experimental operation is the representative research topic of diversions for the society. For carrying out these researches, perspectives from several academic disciplines, such as engineering, information technology, economics, business administration and domain specific knowledge, are necessary to be integrated.	Complex Systems Design; Simulation; IoT; Cloud Computing	Students will study several methods for systems approach. The methods include stakeholder analysis, requirement definition, mission and architecture analysis and performance forecast for large complex system of systems. For example, identification and framing of a problem in complex production lines in manufacturing firms, current transportation systems or society are the potential topics. Model based systems design for solving these problems is in the scope, so students may work on development of industrial/business process simulators as a part of their project. One example is on-demand transportation system, which is a demand responsive transit service where the vehicles will transport users after they reserve their seats, and the vehicle will not move when there is no reservation. One of candidate research topics is to detect unusual behaviors of each elderly person by using the log data of On Demand Bus system in some fields. Social welfare council needs to call each elderly person at a specific interval for watching their health condition. By detecting unusual behavior of each elderly person, social welfare council can call each elderly person efficiently. (https://is.edu.k.u-tokyo.ac.jp/)
Morita Laboratory	Prof. MORITA Takeshi	By applying pressure to piezoelectric material, electrical energy can be generated; it means you can utilize this phenomenon for sensors or energy harvesters. On the contrary, by applying electrical field to the piezoelectric material, mechanical strain can be obtained with piezoelectric effect, which contributes to be actuators. Without complicated structure such as an electromagnetic coil shape, a conversion between electrical and mechanical energy is possible by using the piezoelectric effect. Based on the high conversion efficiency and the large energy density, piezoelectric effect is utilized for medical acoustic devices, ultrasonic transducer, micro energy harvester and so on.Our group is interested in developing innovative piezoelectric devices; for example, we propose new driving principle of piezoelectric actuator and sensor control system. At the same time, we believe that breakthrough comes from the fundamental understanding of the piezoelectric effect itself. Therefore, the research field is not limited to the design of the transducer but is expanded to the nonlinear piezoelectric vibration, the dynamic resonant frequency control and the shape-memory piezoelectric actuator, which are related to the domain structure inside the piezoelectric ceramics.	Piezoelectric effect; Functional material; Energy harvesting device; Modeling	A practical experience is quite effective for starting something new. In this project, a piezoelectric plate sandwiched with thin metal electrodes is provided to the students. Flipping this plate, the electrical energy between two electrodes will be confirmed by monitoring the oscilloscope. You can say that this is one of the energy harvesting devices. Then, please modify the mechanical structure and the electrical circuit for the practical device application. Of course we'll support you. You can use 3D printer and machining equipment.What do you want to utilize this piezoelectric plate for? Wind force power generation? Or, do you want to get energy from walking behaver by putting this material under yours shoes? Any idea is welcome, but maybe you don't like to study for boring topics. It's up to your proposal. After making your device, a modeling for the device is conducted to understand the piezoelectric effect.

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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 livelihoods 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 enhancing environmental restoration, rehabilitation and mitigation in the bay supported by scientific evidence. Disaster mitigation for 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 coastal sustainability in developing countries, especially in mangrove coastal areas influenced by climate change and associated sea level rise, are also our targets.	Coastal engineering; numerical simulation; coastal circulation; waves and currents; water quality and ecosystems	Students will firstly learn physical and biogeochemical processes in estuarine and coastal waters, which may include some of coastal circulation, water quality, ecosystems, and sediment quality. Secondly students will choose one of the related problems, learn its mechanism and consider measures for resolving the problem by applying a numerical model. Students will also learn some of the basics of computer literacy, e.g., pre-processes and post-processes for numerical computation using, e.g., Python based tools. One of the open source models coded in Fortran, including FVCOM (unstructured-grid Finite Volume Community Ocean Model), GOTM (1-D water column model), and TEEM (coastal circulation, water quality and sediment quality model) will be selected. Students will create figures for showing results and interpret and discuss them. Students will be requested to present their outcomes in our laboratory's progress report seminar. We welcome students who are interested in estuarine and coastal environmental studies and coastal engineering 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 and stock management 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 in Graduate Program in Sustainability Science – Global Leadership Initiative (GPSS-GLI)	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.

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