UTSIP Kashiwa 2021 (UTSIP Online Intensive 2021)

Host Laboratory List

Division of Transdisciplinary Sciences

1. Advanced Energy (AdvEng)

Division of Biosciences

2. Computational Biology and Medical Sciences (CBMS)

Division of Environmental Studies

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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.

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).

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.

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.

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.

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.

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.

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.