UTSIP Kashiwa 2023   Program A

For UTokyo Undergraduate Students, Komaba - College of Arts and Sciences

Host Laboratory List

Division of Transdisciplinary Sciences

- Advanced Energy (AdvEng)

Division of Environmental Studies

- Ocean Technology, Policy, and Environment (OTPE)
- Environment Systems (EnvSys)
- Human and Engineered Environmental Studies (HEES)
- Socio-Cultural Environmental Studies (SCES)
- Graduate Program in Sustainability Science - Global Leadership Initiative (GPSS)

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
Ono-Inomoto-Tanabe Laboratory	Prof. ONO Yasushi Dr. INOMOTO Michiaki Dr. 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 cost-effective /high-beta confinement using some economic high-power heating method, where the beta is the plasma thermal pressure P confined by the unit magnetic field: beta=P/(B^2/2μ_0) ~ fusion output power / coil cost. We have developed a number of new ideas for (1) high-power heating: merging/ reconnection heating and (2) ultra-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 (mergng of two ST plasmas) converts about half of poloidal (reconnnecting) magnetic energy into plasma ion kinetic/ thermal energy, our TS-3 and ST-40 experiments documented significant ion heating over 2.3keV. 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 like neutral beam injection (NBI). 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 Inc). ■ Web：http://tanuki.t.u-tokyo.ac.jp/	Plasma Experiment; Fusion Energy; Laboratory Astrophysics; Magnetic Reconnection; 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 in 2023 using 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 both in 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, 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 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
Applied Physical Oceanography	Lecturer KODAIRA Tsubasa	We have studied topics in the field of physical oceanography because environmental conditions are critical factors for the ocean engineering projects and shipping. We have conducted field observations, laboratory experiments, and numerical simulations of such as ocean waves and ocean currents. Recent research target regions include high latitudes such as the Arctic and Antarctica. Arctic sea ice extent is rapidly decreasing during the recent period of global warming, and the change in the region is critical even for the global climate. Because one of the significant factors of the Arctic sea ice loss is oceanic heat transport from lower latitudes, we have studied on the heat input from the Pacific to the Arctic Ocean. Another possible potential factor of the reduction is ocean surface waves. For better understanding of the roll of ocean surface waves in the polar region, we have developed marine IoT wave buoy. Facilities available to us includes the Hiratsuka ocean observation tower, large experimental wave tanks, wave-ice tank, and supercomputers. Applications of our research results include ship navigation, feasibility studies of marine renewable energy and disaster prevention.	marine IoT; ocean waves; ocean currents; Arctic Ocean; Antarctica	Driven by technical advances in low-cost electronics, massive deployment of ocean sensing devices has become increasingly feasible. We have developed an inexpensive MEMS-IMU based small wave buoy with which intensive deployments become possible. The intensive deployments of the wave buoys are effective for several conditions, such as waves under the storms or waves under the sea ice in the high latitudes. The observational results could provide insight to improve the predictions. During the summer program students can participate the development and test of the wave buoy near the Hiratsuka Offshore Experimental Tower
Marine Environmental Modeling and Synthesizing 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 CO_2 storage in the deep ocean and in subsea underground, biological CO_2 fixation, formation and dissociation of methane hydrate, CO_2 geological storage by hydrate, development of photobioreactors for microalgae, development of multi-scale ocean model, modeling of flashing light effect of photosynthesis and the effects of CO_2 on marine biota.	Floating large plastic debris; Hotspot in Tsushima Strait; Offshore recovery of floating debris; Numerical simulation; Adjoint method	Strong ocean currents from the East China Sea then carry large quantity of plastic waste into the Sea of Japan. Tsushima Island has been seriously polluted by marine plastic. The Tsushima government spends around 300 million JPY annually on beach cleanups. If the concentrated areas of marine plastic are located, then offshore recovery of marine plastic debris could be conducted before it reaches the beaches not only in Tsushima Island but also on the coast of the Sea of Japan. The cost for offshore recovery may be lower than the whole costs the local governments spend for beach cleanup. To recover floating debris efficiently, a proper numerical method may help identify marine plastic pollution hotspots, the positions with concentrated marine plastic. In this research, the adjoint sensitivity method will be used to locate the major pathways or concentrated sea area for floating marine plastic in Tsushima Strait using the measurement data on the Sea of Japan.

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
Oshima Laboratory	Prof. OSHIMA Yoshito Dr. NEZU Yukiko	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 conditions of the experimental research field, and to analyze this system by acquiring data through scientific methods from actual experimental research sites. Some of the most significant data gathered include tracking the flow line of an experimenter's movement, the usage of chemical reagent bottles, and the distribution of chemicals induced by indoor airflow. The collected data is then integrated and analyzed by a deep learning method as means of investigating the system configuration of laboratory which enables us to objectively and quantitatively understand the conditions of experimental sites and the characteristics of their research. ""Laboratology"" is a new concept area that is being proposed for future research. Laboratory safety must be discussed more scientifically and quantitatively. Undoubtedly, this concept will contribute to comprehending the characteristics of various research activities more precisely and help facilitate discussing risk assessment of laboratory experiments.	Laboratory safety; Visualization; Airflow analysis; VR; Eye tracking	You can choose one of the following projects. (1) Laboratories are workplaces in which complex airflows are formed, primarily due to the simultaneous and arbitrary work of many experimenters acting according to different experimental purposes and plans. Such complex airflows may inadvertently expose experimenters to hazardous and potentially toxic chemicals and fumes in laboratories. To prevent such exposure, the dynamics of the airflow in the laboratory need to be precisely analyzed. In this project, 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, while 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 the laboratory in view of an outlet/inlet ventilation layout and experimenter movement. (2) To consider the sites of experimental research at universities, it is an important proposition to design rationally while ensuring work efficiency and safety. Also, because of the complex operating conditions of experiments, understanding how experimenters perceive the laboratory environment and objects is important to ensure that experiments are conducted safely. In this project, virtual reality (VR) and eye tracking technology are combined to explore the characteristics of the experimenters' flow line and their visual information distribution in the laboratory, with the aim of improving laboratory design, reducing laboratory hazards, and accumulating basic knowledge of the laboratory.

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
Laboratory for Intelligent Systems Design	Prof. HIEKATA Kazuo	Societies and industries can be thought as a system of people, technology, and institutions. Although these social and industrial systems have evolved and met the high expectations of humans, the mechanisms of the systems have become more complex, giving rise to difficult problems to solve, such as global warming and aging populations. This laboratory is engaged in research that contributes to solving such problems by supporting human intellectual activities such as decision-making related to systems with simulation, sensing, and data analysis technologies.	Multi-agent simulation; Model-based design; Maritime Transportation; Decarbonization	We evaluate multiple policy options for decarbonization of International Maritime Shipping. Since the optimal behavior of one shipping company changes depending on the behavior of another, top-down simulations cannot accurately predict the future CO2 emissions. The internship student will customize and develop a multi-agent simulation program for the quantitative evaluation of multiple policy options. In the internship, we will explore better policy options for accelerating decarbonization based on the simulation results.

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 focus on estuarine and coastal environmental studies in the field of civil, coastal, and hydro-environmental engineering: (1) Numerical modeling and application of physical and biogeochemical processes in urban bays and mangroves. (2) Environmental restoration in urban bays. (3) Mitigation of and adaptation to climate change, including blue carbon. (4) Coastal disaster mitigation. (5) Sustainability of community and livelihood in coastal areas in developing countries. Tokyo Bay is one of our main study fields at a short distance from our campus. The bay has suffered from a decline in fishery and water quality, including hypoxia and anoxia, for a long time. We have been considering strategies for environmental restoration, rehabilitation, and mitigation in the bay supported by scientific rationale. Disaster mitigation against storm surges and tsunamis is also our research target, including developing and applying prediction systems for coastal hazards using open-source numerical models. Our focus is also on coastal zone management for sustainability in developing countries, especially in mangrove areas influenced by climate change and associated (relative) sea level rise.	Coastal engineering; numerical simulation; water quality and ecosystems; blue carbon; storm surges	Students will first study physical and biogeochemical processes in estuarine and coastal waters, including coastal circulation, 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 skills in pre-processing and post-processing for numerical computation using Python tools and/or Matlab. Students may select one of the open source models coded in Fortran, including FVCOM (unstructured-grid Finite Volume Community Ocean Model) and ROMS (Regional Ocean Modeling System). Students will plot results, interpret them, and present their works and outcomes at the lab's progress report seminar. Students interested in estuarine and coastal engineering and numerical computation are welcome. Students are expected to have basic IT skills, such as programming in Python and working on Linux.

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 Dept. of International Studies and is working together with Graduate Program in Sustainability Science -Global Leadership Initiative (GPSS-GLI): an interdepartmental master/Ph.D. program in sustainability science. 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.	disaster; resilience; adaptation; SLR; sustainability	UTSIP students can participate in “disaster recovery and resilience” project. Tokyo downtown Area has experienced the land subsidence in 1960s-70s due to the excess grand water consumption, leading to the creation of ""under zero-meter grounds"". This area is under the sea surface level and is now protected by dikes and seawalls. In this sense, Tokyo has adapted to such a “relative” sea level rise (SLR) in the past, although Tokyo is now facing with the big discussion on whether this protection is enough safe against the future climate change impacts. In this project, students will discuss what kind of lessons can be withdrawn for adaptation to the climate induced sea level rise (SLR) in other countries. In addition to the above-mentioned topic, other topic is possible based on the applicant’s interest.