UTSIP Kashiwa 2022

Program A

Host Laboratory List

Division of Transdisciplinary Sciences

1. Advanced Materials Science (AdvMS)
2. Complexity Science and Engineering (CSE)

Division of Biosciences

3. Integrated Biosciences (IB)
4. Computational Biology and Medical Sciences (CBMS)

Division of Environmental Studies

5. Environment Systems (EnvSys)
6. Socio-Cultural Environmental Studies (SCES)
7. International Studies (Int'lStud)

Division of Transdisciplinary Sciences

Department of Advanced Materials Science

Laboratory	Faculty	Introduction of research activities and laboratory	Key words	Projects or activities summer program students can participate
KIMURA (Tsuyoshi) Laboratory	Prof. KIMURA Tsuyoshi	The research subject of our laboratory belongs to the field of "Materials Physics" which deals with the understanding of materials' properties based on 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 ferroaxial, magnetic toroidal, magnetic quadrupole, and chiral orders, which lead to unconventional control of electronic properties in materials.	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.

Division of Transdisciplinary Sciences

Department of Complexity Science and Engineering

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

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
Laboratory of Evolutionary Anthropology	Assoc. Prof. NAKAYAMA Kazuhiro	We all suffer from diseases. In particular, noncommunicable diseases related to modern lifestyles, such as metabolic syndrome, affect many people. The susceptibility to lifestyle-related diseases is related to the genetic variants inherited from our ancestors. What was the significance of the disease-prone/resistant variants before the modern lifestyle prevailed? Our primary interest is in the relationship between obesity and adaptation to starvation and cold. We are seeking evidence that environmental adaptations in our ancestors were involved in shaping the susceptibility of modern humans to disease. To achieve this goal, we are developing research that combines a variety of methods, including phenotyping experiments on human subjects, statistical analysis using genome-wide DNA variation data, and population genetic analysis to detect traces of natural selection.	Evolution of modern humans, genome variation, adaptation, lifestyle related diseases	We plan to conduct molecular anthropological experiments on the simple measurement of brown adipose tissue function in humans. Students will learn the basic methodology of a human association study, including DNA extraction from human specimens, small-scale genotyping methods for single nucleotide polymorphisms (Taq-Man real-time PCR, for instance), genotype-phenotype statistical analyses, and measurements of cold-adaptive thermogenesis using a thermal camera. If time permits, students may be able to learn evolutionary genetic studies using genome-wide SNP genotype data. Additionally, students will join the journal club co-hosted with Prof. Shoji Kawamura, Laboratory of Evolutionary Anthropology, GSFS.

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 probability 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, 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 advantage 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 effect. For example, though the groundwater becomes a 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 areas, and 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, groundwater becomes a more important water resource under changing climate. In addition, 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 problems. 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 the clayey layer. The model usually contains large uncertainty. In this program, we try to numerically simulate the evolution of the preconsolidation stress under the historical groundwater abstraction and find a critical groundwater level in the future groundwater usage with uncertainty analysis.
Akizuki Laboratory	Lecturer AKIZUKI Makoto	“Supercritical fluid” refers to a fluid in which the material’s critical points of temperature and pressure are being exceeded. Dramatic physical changes are possible depending on the operating conditions of the material. In particular, the ionic content and dielectric constant of supercritical water changes extensively based on temperature and/or pressure. As a result of this, it becomes possible to select a reaction based on one’s objective: from an ionic atmosphere suitable for acid/base 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. In regards to all of these fields, by designing, analyzing, and controlling reactions based on a study of chemical reaction rate and reaction engineering, we are advancing extensive research, from fundamental research related to the chemical reaction of supercritical fluids, to the cultivation of new engineering application technologies.	Supercritical Water; Reaction Engineering; Organic Synthesis; Tunable Solvent; Catalysis	Supercritical water is a promising reaction medium for organic reactions because its solvent properties can be varied with the temperature and the pressure, and these properties affect reaction kinetics and mechanisms. The aim of this study is to propose a methodology which enables to control the reaction rate and the selectivity of organic synthesis reactions only with the change of temperature and pressure of supercritical water.

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 mangrove, (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, at short distance from our campus, is one of our main study fields. 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; water quality and ecosystems; blue carbon; storm surges	Students will firstly learn physical and biogeochemical processes in estuarine and coastal waters, which may include some of 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), ROMS (Regional Ocean Modeling System), and TEEM (Tokyo Bay Estuarine Ecosystem Model deeloped in the lab). 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 as well as numerical computation are welcome. Students are expected to have basic IT skills such as programming in Python and Linux.

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.