Visiting Professors

Visiting Professor
KODAMA, Ryosuke *(from Osaka University)*

High Energy Density Sciences

Now it is relatively easy to realize high energy density states with high power lasers. The states would have a variety of attractive fields of sciences and technologies such as particle acceleration, laboratory astrophysics, and material science, nuclear science including medical applications and laser fusion, which is "High Energy Density Science: HEDS." One of the advantages of the HED states is its energy density, which is much higher than that of the solid state matter. He is now exploring high energy density sciences in methods of introducing a Plasma Photonics concept to control intense light and high energy charged particles with high energy density plasmas. Applying the novel geometry with plasma photonic devices, theoretical approach is being made on nonlinear optics in vacuum with super ultra-intense laser light as an extreme condition of the high energy density sciences. As his other important topics, he is interested in creation of high pressure condensed matter such as metallic solid hydrogen with high power lasers. Freezing of a higher energy density state or metallic Si have been already realized, extending the new scheme to more number of materials to have novel materials in hand, which have never seen on the earth.

Visiting Associate Professor
KERA, Satoshi *(from Chiba University)*

Electronic Structure of π-Conjugated Organic Thin Film by Photoelectron Spectroscopy

To clarify the charge transport and injection mechanism in weakly-interacting organic molecular solids, ultraviolet photoelectron spectroscopy (UPS) is considered a conventional and novel powerful technique. Hole-vibronic coupling as well as intermolecular energy-band dispersion is important fundamental properties to reveal mysterious electric properties of organic molecular solids. Moreover, a quantitative analysis of the photoelectron angular distribution in angle-resolved UPS using photoelectron scattering theory gives us information on the molecular orbital character as well as bonding nature, leading important aspects on intermolecular and molecule-substrate interaction to electronic/spin configuration. Photoemission process related phenomena, *e.g.* scattering, interference and lifetime effect of photogenerated hole on a discrete and delocalized state of molecular orbital, are hot issue.

Visiting Associate Professor
UENO, Kosei *(from Hokkaido University)*

Nano-Imaging of Photocurrent Generation Locally Enhanced Optical Near-Fields

The development of a high-efficiency solar cell is critical in order to create a future realizing low-carbon society. To produce a solar cell with high photoelectric conversion efficiency, we need to develop a system that responds to wide spectrum of solar light, from visible to near-infrared wavelength. Nano-particles of noble metals exhibit localized surface plasmons (LSPs) associated with enhancement of an electromagnetic field due to its localization in nanometric domains at the surface of nanoparticles. Recently, we demonstrated the plasmonic photoelectric conversion from visible to near-infrared wavelength without deteriorating photoelectric conversion by using electrodes in which gold nanorods are elaborately arrayed on the surface of TiO_2 single crystal. IQE measurements allowed us to elucidate the photo induced electron transfer from gold nanorods to TiO_2 resulting from the excitation of the LSPs is nonlinearly induced not only by optical antenna effects but also by electromagnetic field enhancement effects. To study the effect in detail, it is important to pursue where the photocurrent generation is locally enhanced at the gold nanoblocks. We are trying to measure a high-resolution image of the photocurrent generation using near field light as a local excitation source, which is obtained from an optical probe working on a near-field optical microscope.

Visiting Associate Professor
TAKAHASHI, Toshiharu *(from Kyoto University)*

Development of New Spectroscopic Methods Using THz Coherent Synchrotron Radiation

We are developing new spectroscopic techniques using a brilliant light source in the THz-wave region, *i.e.*, coherent synchrotron radiation (CSR) from short bunches of relativistic electrons. One is the technique of the scanning near-field transmission and reflection microscopy in the THz-wave region, where the high special resolution below the diffraction limit is available. On the other hand, the method of the THz pump–photoemission probe spectroscopy (PES) is also developing. Since the VUV radiation by the coherent harmonic generation (CHG) can be emitted using the laser pulse in UVSOR, the jitter-free pump-probe spectroscopy is possible with the THz-CSR. In order to perform these spectroscopic techniques, we are constructing a new CSR beamline in UVSOR.