Visiting Professors

Visiting Professor
NODA, Susumu *(from Kyoto University)*

Strong Coupling of Single Atoms to Photonic Crystal Cavity Field

We have investigated photonic crystal structures which enable modification of propagation properties of an electromagnetic field and also tight confinement of the field to a tiny resonator. Accordingly the field strength inside the resonator is much enhanced and therefore the field can be strongly coupled to a quantum emitter such as a quantum dot even at a single photon level. Such a nanostructure device would be suitable for applications in optical communication and future quantum information processing in terms of its scalability. We have studied the strong coupling of the cavity field with a quantum dot and also the Purcell effect. Recently we have been interested in adopting a single cold atom as a quantum emitter, which shows much longer coherence time and therefore would be desirable for future application. Cold atoms are first loaded into a magneto-optical trap and then one of them is captured in tightly-focused optical tweezers. A movable lens-positioner can translate the position of the focal point, thereby transferring the trapped atom to the vicinity of the photonic crystal cavity. With this technique, the strong coupling of the single atom with the cavity field will be studied.

Visiting Professor
ITO, Atsushi *(from Tokai University)*

X-Ray Spectromicroscopy of Biomedical Specimens

Soft X-ray microscopy has a great advantage over other microscopies in the mapping of light elements or molecules containing such elements at high resolution. The mapping is realized by X-ray spectromicroscopy which utilizes distinctive spectral features of elements and molecules, that is, absorption edges and XANES profiles observed in the vicinity of the absorption edge. For applying this method to biomedical specimens, XANES profiles have been surveyed for a variety of biomolecules such as DNA, proteins (histone and albumin), sulfur-containing amino acids, calcium-containing biomolecules and iron-containing proteins at the C-K, N-K, O-K, S-L, Ca-L and Fe-L absorption edges. One of the most interesting and useful results obtained in this survey is that DNA and histone, a nuclear protein, exhibited significantly different spectra at the N-K edge, suggesting the possibility to image DNA and proteins in cellular nuclei separately. Spectromicroscopy at the N-K edge for a whole cell or an isolated nucleus would provide a unique method to image DNA distribution in a nucleus.

Visiting Associate Professor
TSUBOUCHI, Masaaki *(from Japan Atomic Energy Agency)*

THz Pulse Shaping by Interaction between THz Light and Photo-Induced Carrier

We are developing pulse shaping techniques in the THz frequency region to realize precise control of molecular rotation. First, we have developed the THz tomography of photo-induced carriers in a semiconductor. Since the photo-induced carrier strongly interacts with THz light, the measurement and control of the carrier distribution and dynamics are significantly important to design THz optics. For the aim of pulse shaping, we have demonstrated an etalon with an optical shutter that can generate a THz pulse train with high efficiency. Our THz etalon consists of a Si plate as an input coupler and an ITO coated glass plate as an output coupler. After the THz pulse is transmitted from the Si plate, the Si is irradiated by a UV light to generate the plasma layer which strongly reflects the THz light. The UV light operates as an optical shutter which traps the THz pulse in the etalon cavity.

Visiting Associate Professor
HATSUI, Takaki *(from RIKEN SPring-8 Center)*

Theoretical Study on the Interaction between Matter and X-Ray Free Electron Laser

This year, we have investigated on the valence excitations of multiply ionized states for envelope measurement of X-ray free electron laser. Multiply ionized ground/excited anilines created by X-ray free electron lasers (XFELs) were analyzed by first-principles calculations. The analyses revealed that red shift of the optical absorption appear dominantly during XFEL illumination owing to the ultra-short lifetime of the core-hole states. The XFEL pulse envelope information is thus transferred from X-ray to optical frequency domain, where precise measurement is feasible. The predictions give foundation of novel pulse envelope monitor indispensable for future envelope-controlled XFEL experiments, such as seeded XFEL.