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 with soft X-ray scanning microscope (STXM) using an unique imaging method 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. To apply 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 in the soft X-ray region. 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. We are now interested in the time dependence of distribution pattern of DNA and proteins in nuclei that undergo apoptosis.

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

Atomistic Dynamics in Metal-Semiconductor-Oxide (MOS) Transistor

This year, we have investigated on the static behavior of MOS transistors. MOS transistors are widely used in semiconductor industry. One of the bottlenecks in achieving the lower power consumption is random telegraph noise. In order to avoid the malfunctioning arising from the noise, the supply voltages should be higher than the optimal condition, resulting higher power consumption. The noise behavior in this study was investigated by manufacturing a transistor-element group of a fully-depleted silicon-on-insulator (FD-SOI) MOS transistors at a technology node equivalent to 350 nm node. The FD-SOI CMOS transistors haves a substrate terminal where we can externally control the vertical field in MOS channel. The low frequency drain-source noise around 100 Hz was measured at different substrate voltages. For a transistor (L = 0.4 μm/W = 1.0 μm) with high RTS noise was selected. At the substrate voltage of 0 V, the transistor shows prominent RTS noise; current shows two distinct levels with a difference of 1×10^{-8} A. At lower substrate voltage of –5 V, the RTS noise completely disappeared. Traditionally, this phenomenon was explained in terms of a defect in channel and channel depth within a classical band theory. In this study, this phenomenon was interpreted within an atomistic model based on quantum mechanics.