Extreme Photonics Seminar

No. 2

Language: Japanese

Date: June 14th(Mon), 2010, 9:30 ～ 12:00

Location: Cooperation Center, 5F Meeting Room, W524

Title: Time-resolved X-ray SR experiments using synchronized femtosecond pulsed laser

Speaker: **Dr. Yoshihito Tanaka** (RIKEN SPring-8 Center)

Significant progress in recent development of synchrotron radiation (SR) sources has offered the opportunity for time-resolved X-ray diffraction studies with pico- and femtosecond time resolution. In SPring-8, we developed a synchronization system of femtosecond pulsed laser and the storage ring SR X-ray pulses, and evaluated the synchronization precision using an X-ray streak camera. Fast lattice response of a semiconductor single crystal which is induced by femtosecond pulsed laser irradiation has been observed by time-resolved X-ray diffraction with laser-pump SR-probe method. At the seminar, the time-resolved diffraction methods and the laser-SR synchronization scheme are reviewed. The future prospective on the investigation of lattice dynamics using an X-ray free electron laser will also be discussed.

Title: Adiabatic theory of ionization of atoms by intense laser pulses and related topics

Speaker: Dr. Toru Morishita (Univ. Electro-Communications)

I will present the recent progress of our research work on the electron dynamics of atoms and molecules under intense laser fields. First, I will discuss the adiabatic theory of atoms by intense few laser pulses. In this approach, we construct the asymptotics of the solution to the time-dependent Schrodinger equation and photoelectron spectrum, introducing a single parameter giving a ratio of the atomic and laser time scales. Second, I will present a new theory of tunnel ionization of atoms and molecules by high static electric fields, which is important for the first step of the so-called three step model to various intense field phenomena such as above threshold ionization and high-order harmonic generation. Third, I will present some demonstrations of the imaging procedure to extract charge densities of the target atoms and molecules by use of existing experimental ATI spectra.

Title: Nonlinear optical processes of atoms and molecules induced by intense XUV-FEL light

Speaker: Dr. Takahiro Sato (Univ. Tokyo)

By using the SCSS (SPring-8 Compact SASE Source), a high-power and tunable free electron laser (FEL) in the extreme ultraviolet (XUV) wavelength region developed at RIKEN SPring-8 Center, we investigated multiphoton ionization processes of atoms and simple molecules and molecular decomposition associated with the ionization. Sample gases such as He, Ar, N_2, methanol, and ethanol were irradiated with XUV-FEL light, and generated ion species were detected by time-of-flight mass spectrometer. In the case of He, on the basis of the dependences of the yield of He^+ on the FEL intensity at 53.4, 58.4, 56.0 and 61.4 nm, the absolute values of the two-photon ionization cross sections of He at the four different wavelengths were determined [1]. For N_2, the wavelength dependence of the dissociative multiple ionization processes were investigated. By the analysis of the momentum distribution of N^+ ejected through the Coulomb explosion of N_2 and by the single-shot correlation between the yields of N_2^+ and N^+, it was shown that double ionization of N_2 proceeded by the two-photon absorption of the XUV light [2]. When methanol molecules were irradiated, a variety of fragment ions were generated. It was confirmed that (i) the stable dications, CH_2OH^{2+} and CH_2OD^{2+}, were produced respectively from CH_3OH and CD_3OH, and $C_2H_2OH^{2+}$ from C_2H_5OH via the direct and/or stepwise two-photon absorption, and (ii) C^+ and CH^+ were produced from C_2H_5OH via the stepwise two-photon absorption of the XUV light. It was also confirmed by the formation of H_3O^+ from CH_3OH and C_2H_5OH, and HOD_2^+ from CD_3OH that hydrogen migration processes were induced by the irradiation of the intense XUV light [3].

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