COAST Symposium on

Laser Based Ultrashort VUV and X-ray Sources and Their Applications

March 29th, 2005

Auditorium 5th Floor, Chemistry Bldg.(Main), Hongo Campus

The University of Tokyo

Co-chairs

Kazutaka Nakamura (Tokyo Institute of Technology)

Kaoru Yamanouchi (University of Tokyo)

Sponsors

JSPS Core-to-Core Program: "Ultrafast Intense Laser Science"

MEXT Priority Area Program: "Control of Molecules in Intense Laser Fields"

Program

10:30-10:40 Opening

10:40-11:20 Dr. Luca Labate (Intense Laser Irradiation Laboratory - IPCF (CNR) , Italy)
"LPP X-ray generation at ILIL-CNR: sources characterization and advanced imaging applications"

11:20-12:00 Dr. Kazutaka G. Nakamura (Tokyo Institute of Technology, Japan)
"Quantum emission and its application to dynamical measurement of matter"

12:00-13:10 Lunch

13:10-13:50 Dr. Jonathan Marangos (Imperial College London, UK)
"Development of an XUV attosecond source and molecular HHG with few-cycle pulses"

13:50-14:30 Dr. Kenichi L. Ishikawa (Univ. Tokyo, Japan)
" Above-threshold double ionization of helium with attosecond intense soft X-ray pulses"

14:30-15:10 Dr. Kennosuke Hoshina (Univ. Tokyo, Japan)
"Dissociative ATI of H_2 and D_2 in intense soft X-ray fields"

15:10-15:40 Coffee Break

15:40-16:20 Dr. Jeff Squier (Colorado School of Mines, USA)
"PULSE: Photonics and Ultrafast laser Science at CSM"

16:20-17:00 Dr. Hidetoshi Nakano (NTT Basic Research Laboratories, Japan)
"Picosecond time-resolved XAFS measurements using femtosecond laser-produced plasma soft x-rays"

17:00-17:10 Concluding Remarks

17:30-19:30 Reception

ABSTRACTS

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LPP X-ray generation at ILIL-CNR: sources characterization and advanced imaging applications

Luca Labate (Intense Laser Irradiation Laboratory - IPCF (CNR) – Pisa, Italy)

A brief survey of the activity on short pulse X-ray generation from laser-produced plasmas at the Intense Laser Irradiation Laboratory of the CNR (Pisa) will be given. In particular, a detailed characterization of the soft X-ray emission properties of a ns laser based source will be presented, followed by a description of an application for differential imaging of tracing elements in thin samples. Finally, the setting up of a Kalpha based fs X-ray source will be reported.

Quantum emission and its application to dynamical measurement of matter

Kazutaka G. Nakamura (Tokyo Institute of Technology, Japan)

Quantum emissions (high-energy and short-pulsed beams of electrons, ions and photons) from metal targets in femtosecond intense laser fields have been studied. The generated pulsed electron beams have been applied for time-resolved electron shadowgraphy of laser ablation process. The results showed time evolution of charge-separated field in the laser plasma. We also performed picosecond time-resolved X-ray diffraction in order to monitor transient lattice deformation of semiconductors under laser shock compression.

Development of an XUV attosecond source and molecular HHG with few-cycle pulses

Jonathan Marangos (Imperial College London, UK)

We will explore time resolved measurements, especially of molecular structure, using few cycle laser pulses. Progress in a project at Imperial College to develop an XUV attosecond source based upon HHG from a few-cycle laser will be reviewed. We will also discuss recent studies we have conducted into HHG from molecules that provides insights into the role of the molecular structure in this strong field process. We further discuss how these studies, and studies of the effect of nuclear dynamics upon molecular HHG, lead to new classes of sub-femtosecond resolved measurement of molecular structure.

Above-threshold double ionization of helium with attosecond intense soft X-ray pulses

Kenichi L. Ishikawa (Univ. Tokyo, Japan)

We theoretically study a process in which helium is doubly ionized by absorbing two soft X-ray (91.5 eV) photons from attosecond, intense high-order harmonic sources, based on the numerical solution of the time-dependent Schrodinger equation. Whereas the two electrons are ejected sequentially, absorbing a single photon each, the ionization interval is so short that the second ionization takes place during core relaxation, which leads to energy spectrum significantly different from that upon usual sequential double ionization.

Dissociative ATI of H_2 and D_2 in intense soft X-ray fields

Kennosuke Hoshina (Univ. Tokyo, Japan)

The dissociative photoionization process of H_2 and D_2 in an intense, short-pulsed soft X-ray field (λ = 29.6 nm, $\sim 3\times10^{12}$ W/cm^2, $\sim$15 fs) generated as the 27th high-order harmonic of Ti:Sapphire laser are investigated for the first time by time-of-flight mass spectrometry of the energetic H^+ and D^+ fragment ions. The ejected H^+ (D^+) fragment ions having the kinetic energy range of 3-15 eV centered at 9.5 eV (11.3 eV) exhibit a non-linear dependence of the order of 1.7(1) (1.6(2)) on the light field intensity of the 27th harmonic. The non-linearity and kinetic energy distributions are interpreted well by the two coexisting processes; (i) the dissociative above-threshold-ionization process through the repulsive $2p\pi_u$ state of H_2^+ and (ii) the one-photon dissociative ionization process.

PULSE: Photonics and Ultrafast laser Science at CSM

Jeff Squier (Colorado School of Mines, USA)

The PULSE laboratory was established at the Colorado School of Mines in 2003. Our progress in developing new high-intensity (>10^20 W/cm^2), ultrafast laser sources will be described. We are developing new technologies for improving spatio-temporal phase control, and contrast for high intensity lasers. An overview of the laser facilities and development efforts will be presented, as well as new applications of ultrafast lasers (at low-intensities) that have resulted from these efforts.

Picosecond time-resolved XAFS measurements using femtosecond laser-produced plasma soft x-rays

Hidetoshi Nakano, Katsuya Oguri, and Tadashi Nishikawa
(NTT Basic Research Laboratories, NTT Corporation, Japan)

We describe our experimental results of absorption spectroscopy using ultrafast broadband soft x-ray emitted from femtosecond laser-produced plasma as a probe. We carried out time-resolved absorption measurements near LII,III absorption edge (~100 eV) of optically excited silicon. We observed a rapid absorption change in the sample near the absorption edge due to the rapid melting induced by 5-TW/cm2 laser pulse irradiation. The absorption change suggests that the electronic structure of the sample changed to ametallic state due to the rapid melting.