

Séminaire SOLEIL

Multiple Ionization of Atoms, Molecules and Clusters Irradiated by Extreme Vacuum-Ultraviolet FEL at SPring-8

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Séminaires

In May 2008, a new facility, the SPring-8 Compact SASE Source (SCSS) test accelerator in Japan [1], has started operation for users. It is the second extremeultraviolet (EUV) free-electron laser (FEL) light source in operation after the one at Hamburg (FLASH) [2]. The SCSS test accelerator provides linearly polarized EUVFEL ($\sim 30 \mu\text{J}$ per pulse, 100 fs pulse width, 10-20 Hz repetition rate) in the wavelength region 51-61 nm under laser power saturation conditions. This energy regime is of particular interest because all atoms, except helium, in any forms of matter, can be ionized by just a single photon with huge photoionization cross sections. We have developed dead time-free ion momentum spectroscopy apparatus [3] that allows us to detect more than one hundred ions produced by a single FEL pulse [4], and started to use it to study multiple ionization of atoms, molecules and clusters [5,6] irradiated by this EUV-FEL. We report here the latest results out of this project, which include multiple ionization of the rare-gas atoms, which yields the highly charged ions with the charge states up to $8+$, ion-ion coincidence multiple ionization of N_2 and O_2 , which yields ion-ion coincidence signals with the charge states up to $3+/2+$, and multiple ionization of rare-gas clusters, with the averaged cluster size up to 10000, which yields energetic dicationic atomic ions up to 100eV in energy.

This work has been carried out with a number of collaborators (H. Fukuzawa, X.-J. Liu, G. Prümper, M. Okunishi, K. Shimada, K. Motomura, N. Saito, H. Iwayama, K. Nagaya, H. Murakami, A. Sugishima, M. Yao, A. Rudenko, M. Kurka, K.-U. Kühnel, J. Ullrich, L. Foucar, A. Czasch, O. Jagutzki, H. Schmidt-Böcking, R. Dörner, R. Feilfel, A. Belkacem, T. Harada, M. Toyoda, M. Yanagihara, M. Yamamoto, M. Nagasono, A. Higashiya, T. Togashi, M. Yabashi, T. Ishikawa, H. Ohashi, H. Kimura) and we are grateful to SCSS Test Accelerator Operation Group at RIKEN for continuous support, staff of the technical service section of IMRAM for their help in the construction of the apparatus, and LBL optics group for the fabrication of the focusing mirror. This study was supported by the X-ray Free Electron Laser Utilization Research Project of the Ministry of Education, Culture, Sports, Science and Technology of Japan (MEXT), by Japan Society of Promoting Science (JSPS), by the MPG Advanced Study Group at CFEL and by BMBF.

- [1] T. Shintake *et al.*, Nature Photon. **2**, 555 (2008).
- [2] V. Ayvazyan *et al.*, Eur. Phys. J. D **37**, 297 (2006).
- [3] X.-J. Liu *et al.*, submitted to Rev. Sci. Instrum.
- [4] K. Motomura *et al.*, submitted to Nucl. Instrum. Methods A.
- [5] H. Fukuzawa *et al.*, Phys. Rev. A **79**, 031201(R) (2009).
- [6] H. Iwayama *et al.*, J. Phys. B: At. Mol. Opt. Phys. (in press).

Formalités d'entrée : accès libre dans l'amphi du Pavillon d'Accueil. Si la manifestation a lieu dans le Grand Amphi Soleil du Bâtiment Central, merci de vous munir d'une pièce d'identité (à échanger à l'accueil contre un badge d'accès).

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