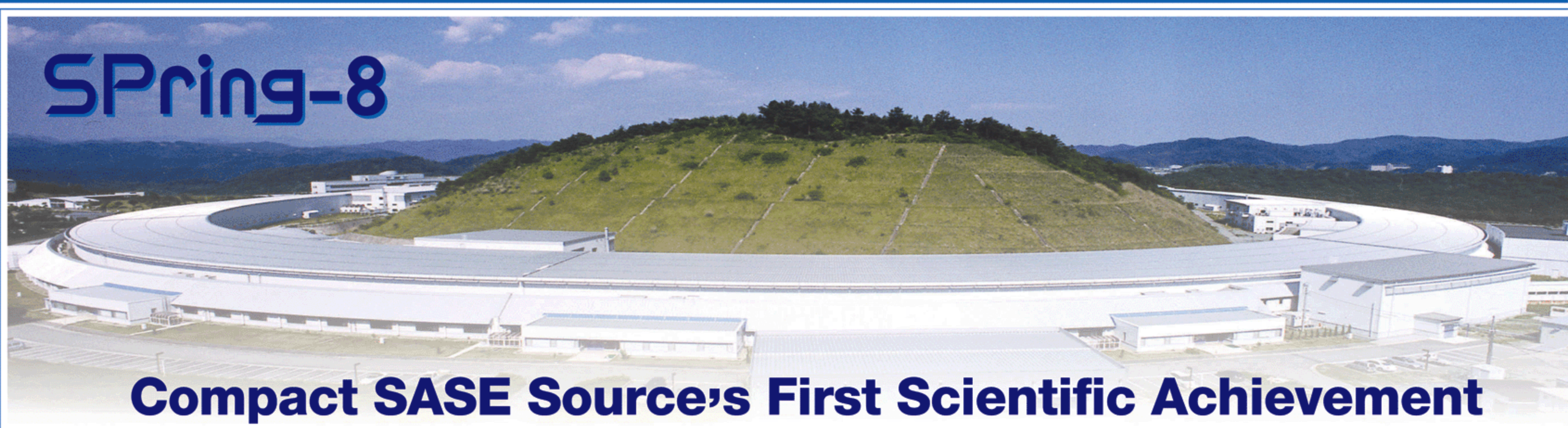

Compact SASE Source's First Scientific Achievement

Two-photon and three-photon ionization processes of N_2 by intense XUV light

The joint research group composed of six research institutes (The University of Tokyo, KEK, Keio University, JAEA, RIKEN and NTT) led by Professor K. Yamanouchi at The University of Tokyo succeeded, with the collaboration with the RIKEN SPring-8 XFEL project team, in investigating the non-linear optical responses of nitrogen molecules to intense XUV light by using the SCSS (SPring-8 Compact SASE Source) test accelerator of RIKEN/SPring-8, and published the results in the April 14, 2008 issue of Applied Physics Letters. This is the first scientific report on the results obtained using the SCSS light source. The report demonstrated that the XFEL light pulses are very intense, and are best suited for investigating non-linear optical phenomena in the VUV and XUV wavelength regions. The quadratic increase of the N^+ signal in the time-of-flight mass spectrum as a function of the field intensity of the XUV light at 50.3 nm (Fig. 1), and the split peaks of N^+ and N^{2+} (Fig. 2) representing the Coulomb explosion of multiply charged nitrogen molecular ions, N_2^{2+} and N_2^{3+}, which are generated by two and three photon absorption of the XUV light (Fig. 2), are the clear evidences of the non-linear optical processes occurring in the XUV wavelength region, having paved the way for the new research frontiers in intense light field science in the short wavelength region.

Reference:

T. Sato, T. Okino, K. Yamanouchi, A. Yagishita, F. Kannari, K. Yamakawa, K. Midorikawa, H. Nakano, M. Yabashi, M. Nagasono, T. Ishikawa, "Dissociative two-photon ionization of N_2 in extreme ultraviolet by intense self-amplified spontaneous emission free electron laser light," *Appl. Phys. Lett.* **92**, 154103 (2008).

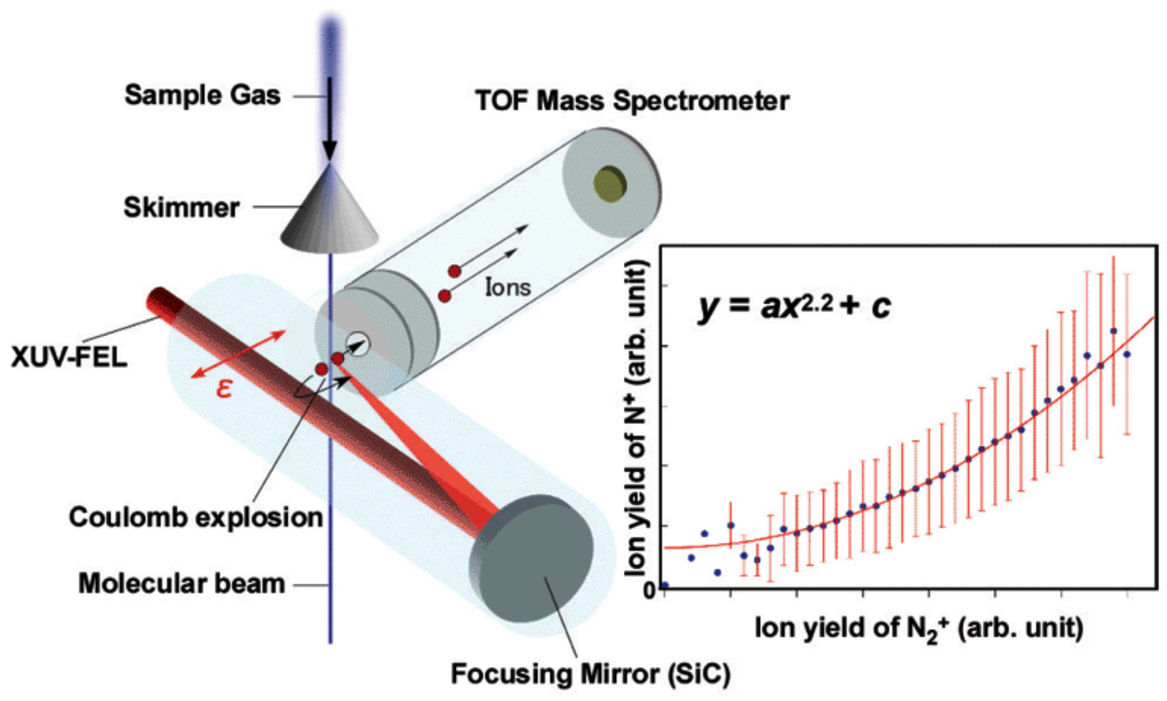

Fig. 1

Experimental set-up and the dependence of the N^+ signal intensity as a function of the N_2^+ signal intensity, representing that two photons are necessary for preparing N_2^{2+}, decomposing into $N^+ + N^+$ through Coulomb explosion.

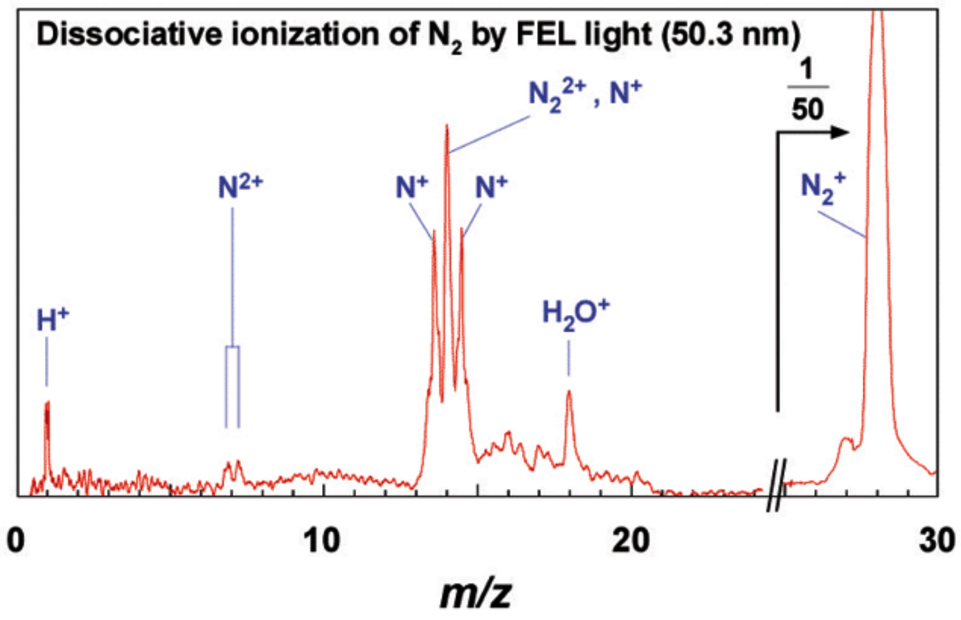

Fig. 2

Time-of-flight mass spectrum of ion species generated when nitrogen molecules are irradiated with intense XFEL light at 50.3 nm. A pair of peaks is identified for N^+ as well as for N^{2+}, representing the Coulomb explosion of multiply charged parent molecular ions prepared by the two-photon and three-photon absorption processes.

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