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Clocking molecular fragmentation of N₂ with XUV pump-probe experiments

Y. Zh. Zhang^{*}, A. Senftleben[†], K. Schnorr[†], G. Schmid[†], M. Kurka[†], A. Rudenko[‡], L. Foucar^{††},
M. Kübel[§], M.F. Kling^{§,‡}, K. Ueda^{||}, R. Treusch[§], J. Ullrich^{**}, C.D. Schröter[†], Y.H. Jiang^{*,1}
and R. Moshhammer^{†,2}

^{*}Shanghai Advanced Research Institute, Chinese Academy of Sciences, Shanghai, 201210, China

[†]Max-Planck-Institut für Kernphysik, Heidelberg, 69117, Germany

^{††}Max-Planck-Institut für medizinische Forschung, Heidelberg, Germany

[‡]J.R. Macdonald Laboratory, Kansas-State University, Manhattan, USA

[§]Max-Planck-Institut für Quantenoptik, Garching, 85748, Germany

^{||}Institute of Multidisciplinary Research for Advanced Materials, Tohoku University, Sendai, 980-8577, Japan

^{**}Physikalisch technische Bundesanstalt, 38116 Braunschweig, Germany

[§]DESY, Notkestrasse 85, Hamburg, 22607, Germany

Synopsis The dynamics of multi-photon induced fragmentation of N₂ has been investigated in XUV-pump/XUV-probe experiments at the Free-Electron Laser in Hamburg (FLASH) by recording the ion kinetic energy release (KER) and angular distributions for various dissociation- and Coulomb-explosion channels as a function of the pump-probe delay-time.

The interaction of very intense XUV-radiation with molecules is governed by multiple ionization and dissociation initiated by few-photon absorption. Previous single-pulse measurements [1] revealed unexpected transition pathways and a clear dominance of sequential, or step-wise absorption of several photons. Here, using an XUV-pump/XUV-probe approach, we present time-resolved measurements for multi-photon induced multiple-ionization and dissociation of N₂.

In the experiment we used very intense ($\sim 10^{12}$ W/cm²), ultra-short (~ 30 fs) light-pulses (28 eV) delivered by FLASH in combination with a reaction microscope equipped with a XUV split-and-delay mirror. The delay-dependent fragmentation for various target charge-states has been recorded. In figure 1(a) the KER-spectrum for N₂²⁺ → N⁺ + N⁺ is shown, integrated over all delay times (up to 300 fs). The peaks located at ~ 6.7 , 8.2 and 10.4 eV can be associated with dissociation along the A¹Π_u, d³Π_g and D¹Σ_u states of the dication, in agreement with our previous assignment [1]. Remarkably, also very high-lying doubly-ionized states are populated, leading to large KERs around ~ 21 eV and ~ 34 eV.

The delay-dependent ionization yields for selected KERs (red and blue areas in figure 1(a)) are displayed in figure 1(b) and (c), respectively. Surprisingly, for low KER a wide minimum is observed whereas the yield for high KER shows a sharp maximum at zero delay. Additional re-

sults will be presented and discussed in the poster.

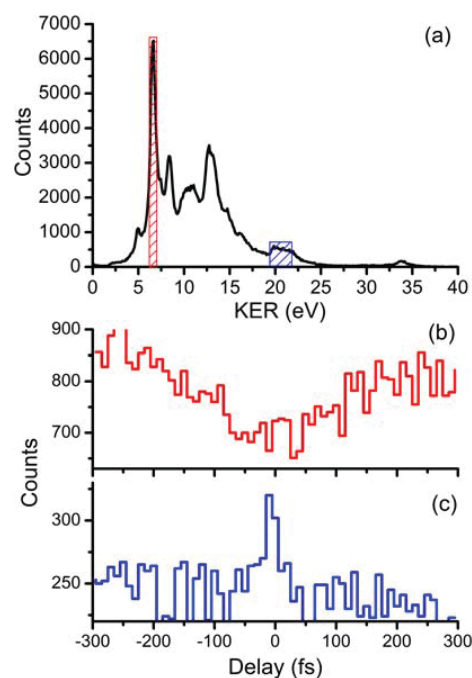


Figure 1: KER spectrum of N⁺+N⁺ pairs (a) and delay-dependent yields for selected KERs (b and c) (see text).

References

- [1] Y. Jiang *et al*, 2009, *Phys. Rev. Lett.* **102** 123002

¹E-mail: jiangyh@sari.ac.cn

²E-mail: Robert.Moshhammer@mpi-hd.mpg.de