CFEL SCIENCE

SEMINAR

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CFEL – Building 99, seminar room I+II (ground floor)

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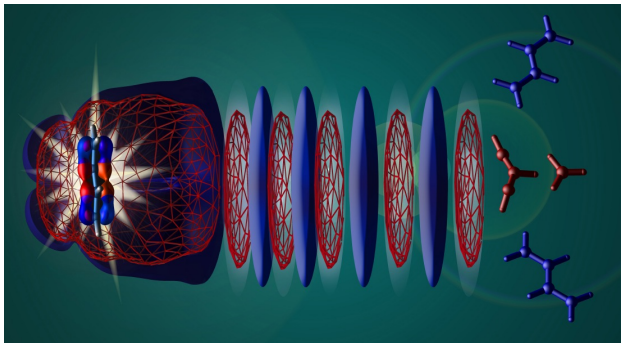
Channel-Resolved Above-Threshold Ionization in the Molecular Frame



Intense laser fields can exert electric forces on valence electrons exceeding those that bind them, leading to Strong Field Ionization (SFI) within a fraction of an optical cycle. This process lies at the heart of the burgeoning field of Attosecond Science. To date, attosecond dynamics can be observed by combining phase-controlled light fields with attosecond pulses or by utilizing SFI derived phenomena, which gain attosecond resolution from the highly non-linear interaction with the laser field.

In the first part of my talk, I will focus on the failure of the single contiuum approximation of SFI, which has important consequences for strong field spectroscopy and orbital tomography. At the National Research Council in Ottawa, we developed Channel-Resolved Above Threshold Ionization (CRATI), which dissects SFI into different continuum channels [1], based on the covariant detection of photoelectrons and –ions [2,3]. We discern different SFI channels for a series of similar four carbon atom molecules. Laser alignment of 1,3-butadiene moreover allows us to extend CRATI to the molecular frame [4,5].

In the second part, I will report on evidence for the influence of attosecond electronic coherence on femtosecond molecular dynamics. At the Max-Born-Institute in Berlin, we have investigated the two-color dissociative photoionization of N2, induced by an attosecond extreme-ultraviolet pulse train and probed by a phase-controlled infrared laser. We find that the N+ fragment kinetic energy distribution is modulated with delay on an attosecond timescale. Theoretical modeling suggests that this behaviour is the result of an interference between two pathways, which depends on the phases between two electronic states of N2+ established in photoionization [6].

Finally, I will briefly speak about a new experiment to study chemical reaction dynamics on the electronic ground state surface, combining techniques of molecular ion preparation and strong field spectroscopy.

[1] Boguslavskiy, et al., Science 335, 1336 (2012) [2,3] Mikosch & Patchkovskii J. Mod. Opt. 60, 1426 & 1439 (2013) [4] Mikosch et al., Phys. Rev. Lett. 110, 023004 (2013) [5] Mikosch et al., J. Chem. Phys. 139, 024304 (2013) [6] Medisauskas, et al. (submitted)

Host: Terry Mullins/ CFEL Molecular Physics Seminar