Attosecond Imaging and Control of Electronic Processes in Elliptically Polarized Few-Cycle Laser Pulses

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Angular streaking has become a powerful tool for investigation of electronic and nuclear dynamics in molecules upon interaction with laser radiation. When performed with elliptically polarized few-cycle pulses, the CEP-induced modulation of transition probabilities enables angular resolution of electronic wavefunctions [1]. In this talk I will present the capabilities of angular streaking in attosecond tracing of nuclear and electronic wavepackets, as it was recently demonstrated for a dissociation of hydrogen molecule [2].

Next, the chirality of molecules and electronic orbitals is another powerful to tool probe a state of a molecule. The interaction of an elliptically polarized light with a chiral object results in an asymmetric photoelectron distribution referred to as photoelectron circular dichroism (PECD). Based on the recent observations of CEP dependent photoelectron circular dichroism, I will discuss the possibilities of probing the chiral state using the bond-selective role of CEP in molecules [3].

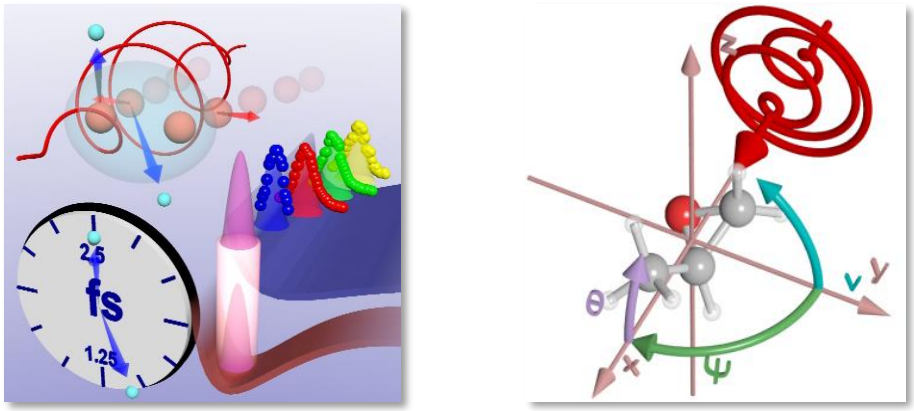

Figure 1: (left) A visualization how can an evolution of a vibrational wavepacked be imaged and timed using angular streaking applied in double ionization of a hydrogen molecule. The angle between the electrons represents a minute hand, while the energy of fragments is like an hour hand of a virtual wristwatch. (right) An illustration of an interaction of a small chiral molecule – methyloxirane – with an elliptically polarized few-cycle laser pulse. Respective orientation of molecule and field evolution dictated by CEP, hence the attosecond timing, has a decisive role on what orbitals will be ionized and consequently the amount of asymmetry observed due to the photoelectron circular dichroism effect.

References

[1] S. Kangaparambil et al., Phys. Rev. Lett. 125, 1–6 (2020).
[2] V. Hanus et al., Phys. Rev. Lett. 123, 263201 (2019).
[3] V. Hanus et al., Phys. Chem. Chem. Phys. 25, 4656–4666 (2023).