Attosecond-resolved photoionization of chiral molecules

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Abstract

When chiral molecules are photoionized by circularly polarized radiation, a strong asymmetry appears in the angular distribution of the photoelectrons: more electrons are emitted forward or backward the light propagation direction, depending on the handedness of the light or the enantiomer [1]. This asymmetry, called photoelectron circular dichroism (PECD), is one of the most sensitive probes of static [2] and dynamical [3] [4] molecular chirality. It originates from subtle modifications of the outgoing electron scattering in the chiral molecular potential. PECD emerges in all ionization regimes: in single photon, multiphoton, above threshold and tunneling ionization [5].

In this talk, I will focus on the use of attosecond (as) photoelectron interferometry [6] [7] to capture the ultrafast dynamics of chiral photoionization. Using this technique, we have measured the angularly-resolved photoionization dynamics with a precision on the order of few-attoseconds. For non-resonant photoionization, we measured delays of sub-20 as between electrons emitted forward and backward. These delays change sign upon switching the enantiomer or helicity of the electric field. Moreover, we have measured the photoelectron wavepacket spectral amplitude and phase around a near-threshold autoionizing resonance. This allows reconstructing the angularly-resolved temporal profile of the resonant photoelectron wavepacket. It shows complex temporal structures, reflecting the interference between direct and indirect ionization pathways. This temporal structure presents strong forward/backward asymmetry, revealing the chiral character of the autoionizing process [8].

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