Strong-field physics in the molecular frame

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The interaction of strong laser fields with matter intrinsically enables the imaging of transient dynamics with extremely high spatiotemporal resolution. This paradigm of photophysics has grown into new emerging research areas, ranging from attosecond science to laser-induced electron di diffraction, providing new insight into atoms, molecules and, more recently, condensed matter. Also, the earliest moments of strong-field interactions have attracted attention for capturing the intrinsic nature of strong-field physics. While pioneering attosecond science experiments and molecular-frame measurements revealed non-trivial spatiotemporal features in electron tunneling, these initial conditions are generally considered a weak perturbation. We investigated strong-field ionization in the molecular frame. Carbonyl sulfide (OCS) molecules were quantum- state selected, strongly laser aligned, and ionized using short near-infrared laser pulses. We analyzed the dynamics of the electrons and discuss the obtained molecular-frame photoelectron-angular distributions. Our findings have strong impact in the interpretation of laser induced electron diffraction, where the photoelectron momentum distribution is used to retrieve molecular structures. Furthermore, the encoding of the time-energy relation in the photoelectron momenta provides new ways of probing electron tunneling and the molecular potential with sub-femtosecond resolution.

References

[1] A. Trabattoni, S. Trippel, U. De Giovannini, J.-F. Olivieri, J. Wiese, T. Mullins, J. Onvlee, S.-K. Son, B. Frusteri, Angel Rubio, and J. Küpper, Arxiv:1802.06622 (2018)