Control of electron wave packets by near-single-cycle terahertz fields

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In a joint experimental-theoretical study [1], xenon is ionized by combined infrared (IR) and terahertz (THz) pulses. By multiphoton absorption, a femtosecond pulse creates a temporally-localized electron wave packet at a well defined phase of a time-synchronized near-single-cycle terahertz pulse. The photoelectron momentum distributions are recorded as a function of the time delay. For the analysis of the measurements, we use both numerical solutions of the three-dimensional time-dependent Schrödinger equation and classical trajectory models. Among the multiphoton absorption peaks, the low-energy electrons close to the continuum threshold are particularly sensitive to the electron-core interaction. Here, we observe signatures of various processes that are partially familiar from the electron dynamics in common strong-field ionization, but with the additional possibility of control via the IR-THz delay. These processes include recollision-free acceleration, electron-ion scattering induced by the terahertz field, and photoelectron holography.

References

[1] S. Brennecke, M. Ranke, et al., Phys. Rev. Lett. **129**, 213202 (2022).