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Probing Attosecond Electron Dynamics in Helium with Attosecond Transient Absorption MICHAEL CHINI, XIAOWEI WANG, YAN CHENG, YI WU, University of Central Florida, DI ZHAO, DMITRY TELNOV, SHIH-I CHU, University of Kansas, ZENGHU CHANG, University of Central Florida — Recent advances in the generation, characterization, and application of isolated attosecond pulses and few-cycle femtosecond lasers have given experimentalists the necessary tools for dynamic measurements on fast-evolving quantum systems. In this work, attosecond transient absorption spectroscopy with ultrabroadband isolated attosecond pulses is used to elucidate the ultrafast dynamics – on timescales shorter than the laser cycle – in the laser-dressed singly-excited states of the helium atom, demonstrating for the first time that the attosecond transient absorption technique allows for state-resolved and simultaneous measurement of bound and continuum state dynamics. Subcycle phenomena are observed in prototypical quantum mechanical processes such as the AC Stark and ponderomotive energy level shifts, Rabi oscillations and electromagnetically-induced absorption and transparency, and two-color multi-photon absorption to dipole-forbidden states of the atom. Furthermore, dynamic interference oscillations, corresponding to quantum path interferences involving bound and free electronic states of the atom, are observed for the first time in an optical measurement. The ultrabroadband isolated pulses with durations as short as 67 attoseconds were characterized using the PROOF technique.

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