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Imaging Electronic Motion with Attosecond Electron Pulses[1]
HUA-CHIEH SHAO, ANTHONY F. STARACE, The University of Nebraska-Lincoln — Ultrashort electron pulses have been proposed to observe time-dependent phenomena in atoms and molecules [1]. Owing to the temporal and spatial resolutions of short keV electron pulses, studying electronic motion in attosecond and sub-Angstrom regimes is feasible. We report benchmark calculations for oscillating electronic charge distributions in the H atom and in the H_2^+ molecule to determine the effect of such charge oscillations on the elastic scattering cross section for a sub-fs electron pulse. In the pump/probe calculations, a femtosecond laser pulse is used to excite a coherent superposition of states, whose charge distribution oscillates with the beat frequency. The electron pulse scattering cross sections are calculated in the Born approximation. For the H atom, the cross section exhibits an oscillating effective radius. For the H_2^+ molecules, the superposed state is chosen such that the electronic charge distribution oscillates from one nucleus to the other; hence, the differential cross section shows the localization of the electron.

[1] P. Baum and A.H. Zewail, PNAS **104**, 18409 (2007).

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