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Imaging population transfer in atoms with ultrafast electron pulses[1] HUA-CHIEH SHAO, Purdue University, ANTHONY F. STARACE, University of Nebraska - Lincoln — Ultrafast electron diffraction and microscopy have made significant progress recently in investigating atomic-scale structural dynamics in gas-phase and condensed materials. With these advances, direct imaging of electronic motions in atoms and molecules by ultrafast electron diffraction is anticipated. We propose imaging a laser-driven coherent population transfer in lithium atoms by femtosecond ultrafast electron pulses. Valuable information and insight can be obtained from studying such a system in order to refine ultrafast electron techniques and to interpret experimental results. Adiabatic passage by level crossing is used to transfer the electron population from the $2s$ to the $2p$ state. Our simulations demonstrate the ability of ultrafast electron diffraction to image this population transfer, as the time-dependent diffraction images reflect the electronic motion in the scattering intensity and angular distribution. Furthermore, asymmetric diffraction patterns indicate that even the relative phases of the electronic wave function can be resolved, provided there is sufficient temporal resolution.

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