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Probing shake-up states in He by laser controlled rescattering of XUV photoelectrons — •Renate Pazourek[1], Johannes Feist[1], Stefan Nagele[1], Emil Persson[1], Lee A Collins[2], Barry I Schneider[3], and Joachim Burgdörfer[1] — [1]Inst. for Theor. Physics, Vienna University of Technology, Austria — [2]Theor. Division, Los Alamos National Laboratory, USA — [3]Physics Division, NSF, USA

Recent progress in the generation of ultrashort XUV pulses and few-cycle infrared pulses opens the possibility for various novel pump-probe setups for the study of ultrafast electronic dynamics. We present numerical ab initio simulations where we employ an XUV pulse to singly ionize a helium atom in the presence of an IR field which can induce rescattering of the ionized electron at the parent ion.

For XUV pulses with photon energies slightly above the first ionization potential ($I_1 \approx 24.6\,\mathrm{eV}$) one electron is ionized and the remaining ion relaxes to the He^+ ground state. For photon energies $\hbar\omega > 65.4\,\mathrm{eV}$ a second channel, where the bound electron is excited into a shake-up state, opens. In this contribution we present velocity maps, i. e. angularly resolved momentum distributions of the singly ionized electrons, experimentally accessible by a velocity map imaging spectrometer. Insights into two-electron effects, a sine qua non for the shake-up process to occur, can be obtained. We compare our ab initio simulations (without approximations for inter-electron interactions) with single-active electron calculations in order to show to what extent electron-electron interactions account for the observed effects.

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