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Correlation Effects in Intense Laser-Atom Processes[1]

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Results for three processes involving interaction of the He atom with an intense, short laser pulse are presented, each of which demonstrates dramatic effects of electron correlations: high-order harmonic generation [1], few-cycle attosecond pulse ionization [2], and few-cycle attosecond pulse ionization plus excitation [3]. Results are obtained by solving the two-active-electron, time-dependent Schrödinger equation (TDSE) in its full dimensionality over the laser pulse duration. In cases of ionization, projections of the two-electron wave packet solutions of the TDSE onto correlated eigenstates of the field-free Hamiltonian are carried out. All numerical results are thus essentially exact. For high-order harmonic generation [1], as the laser pulse frequency varies from 4.6 eV to 6.6 eV, the 13th, 11th, and 9th harmonics sequentially become resonant with the isolated 2s2p(^{1}P) autoionizing state of He, which dramatically enhances these harmonics. For ionization of He to the He^+(n=1) state by an intense few-cycle attosecond pulse [2], asymmetries are found in the differential probability for ionization of electrons parallel and antiparallel to the linear polarization axis of the laser pulse. These asymmetries are greatly enhanced in the vicinity of two-electron doubly-excited (autoionizing) states. For ionization plus excitation of He to He^+(n=2) states by a few-cycle attosecond pulse [3], for most carrier-envelope phases (CEPs) asymmetries in the photoelectron angular distributions have opposite signs for He^+(2s) and He^+(2p) and are orders of magnitude larger than for ionization without excitation. All these results demonstrate a crucial role for many-body effects in intense laser-atom interactions.

[1] J.M. Ngoko Djiokap and A.F. Starace, *Phys. Rev. A* **84**, 013404 (2011).
[2] J.M. Ngoko Djiokap, S.X. Hu, W.-C. Jiang, L.-Y. Peng, and A.F. Starace, *New J. Phys.* **14**, 095010 (2012).
[3] J.M. Ngoko Djiokap, S.X. Hu, W.-C. Jiang, L.-Y. Peng, and A.F. Starace (submitted).

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