We investigate multi-ionization processes using novel classical and semiclassical methods and find very good agreement with experiments on the triple photoionization of lithium by a single photon. Our method reveals surprising mechanisms for multi-electron escape:
The four-body Coulomb ionization proceeds through a sequence of electron-electron collisions involving three-body Coulomb subsystems. These attosecond time-scale collisions can explain the surprising configurations of three- and four-electron escape for small excess energies. The
break-up geometries are found to depend on the initial state of the atom, contrary to conventional wisdom based on two-electron atoms. Thus our studies
point the way for future experiments which will test our findings.
These novel classical and semiclassical techniques have been recently generalized to describe strongly driven atomic systems. We demonstrate the predictive power of these techniques by exploring the frequency dependence of double ionization of the strongly driven Helium. We show that up to near UV- frequencies recoil collisions underly the double ionization process.
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