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Ultra-Strong Field Ionization From Ne to Xe[1] BARRY WALKER, ISAAC GHEBREGZIABHER, ANTHONY DICHIARA, SASI PALANIYAPPAN, University of Delaware — We report the ionization of Ne, Ar, Kr and Xe in ultrastrong laser fields from 10^{16} W/cm^2 to 10^{18} W/cm^2. At 10^{18} W/cm^2 the photoelectron has an instantaneous kinetic energy equal to 60 percent of its rest mass. All species studied, including charge states as high as Xe^{11+}, exhibit correlated multielectron ionization, which increases with the atomic number. High order, i.e. (e,4e), electron correlation processes in Ar, Kr, and Xe are shown to exist even between electrons in different shells with a higher yield than observed for (e,2e) correlated ionization in He under similar experimental conditions. The data is compared to a 3D relativistic tunneling ionization and "rescattering" model, which is a physical mechanism behind correlated, nonsequential ionization and high harmonic generation in nonrelativisitic, strong fields $< 10^{16}$ W/cm^2. In rescattering the electron that is tunnel ionized by the strong laser field is driven back into the parent ion by the oscillating laser field. The model captures several features of ultrastrong field ionization, indicating that rescattering is still a prominent physical mechanism, but the details are not currently known. Possible excitation mechanisms in ultrastrong field rescattering, including the generation of inner shell holes, are discussed.

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