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Ultrafast K-Shell Hole Creation from Laser Rescattering: Optimized Wavelength and Intensity Yields for Lithium to Uranium[1]
BARRY WALKER, ZACHARIAH GERMAIN, DAVID MILLIKEN, LIAM KELLEY, JAKOB NIESSNER , Univ of Delaware — We present the yields of k-shell hole creation due to laser rescattering in strong and ultrastrong fields. Laser driven rescattering at higher energies, where k-shell ionization can occur, involves relativistic effects and the Lorentz force from the laser magnetic field. The predicted demarcation of higher energy rescattering interactions has been described by a Lorentz deflection parameter [2] in atomic units $\Gamma_R = U_p^{3/2} V_{IP}^{1/2}/(3c^2\omega) = 1$ for ionization of an electron from a binding energy V_{IP} by an external field, frequency ω and ponderomotive energy U_p. Surprisingly, laser driven rescattering near $\Gamma_R \sim 1$ is able to create k-shell holes in all atoms from lithium to uranium and extends rescattering physics from the deep IR ($\lambda = 10\mu m$) to 4th generation x-ray FEL sources ($\lambda = 1nm$). Our results compare favorably with measurements in krypton and neon [3]. We report the laser intensity and wavelength needed to create the greatest number of k-shell holes, which can be as great as 10^{-4} (k-shell holes / optic cycle) and provide examples across the periodic table including Li, Ne, Kr and U.

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[2]M. Klaiber, et al, **Phy. Rev. Lett** 118, 093001
[3]Y. Deng, et al, **Phy. Rev. Lett** 116, 073901

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