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Atomic photoionization with synchronized X-ray and optical lasers

MICHAEL MEYER, European XFEL, Hamburg, Germany

Photoionization is the dominant processes after the interaction of atoms with photons of short wavelength. New possibilities to obtain dynamical information about this extremely fast process were opened up in the last years due to the development of Free Electron Lasers, such as FLASH in Hamburg and LCLS in Stanford, with their unprecedented characteristics, especially the ultra-short temporal width of the pulses, which can be as short of a few femtoseconds, and the extremely high number of photons per pulse (about 10^{12}-10^{13} photons/pulse) [1,2]. In a series of experiments at FLASH, the combination of XUV FEL radiation and synchronized NIR laser pulses was used to study the Above Threshold Ionization (ATI) in rare gases for the first time in a regime free from unwanted interference effects. Especially, the polarization dependence of the sideband structures in the electron spectra yields detailed insights into the photoionization dynamics, in particular into the distribution of angular momenta for the outgoing electrons [3]. Recent experiments at the LCLS have taken advantage of the very short (2-5fs) pulse durations, which are delivered by this new X-ray Free Electron Laser. This temporal width coincides with the lifetime of core hole states governing the dynamics of the Auger decay, and with the temporal width of one cycle of the electric field in the optical wavelength regime. By applying angle-resolved electron spectroscopy, the KLL Auger decay in atomic Ne was studied after excitation with few-fs X-ray (1 keV) pulses in the presence of an optical (800 nm) dressing field. The experimental spectra are marked by strong interference effects caused by the coherent emission of electrons produced during one cycle of the superimposed optical dressing field, in excellent agreement with recent theoretical work.

[1] C. Bostedt et al., Nucl. Instrum. Meth. A **601**, 108 (2009).
[2] N. Berrah et al., J. Mod. Opt. **52**, 1015 (2010).
[3] M. Meyer et al., Phys. Rev. Lett. **101**, 193002 (2008).
[4] Y. Ding et al., Phys. Rev. Lett. **102**, 254801 (2009).
[5] A.K. Kazansky, N.M. Kabachnik, J.Phys.B **42**, 121002 (2009); **43**, 035601 (2010).