Atomic photoionization in intense XUV and optical laser fields

Michael Meyer
European XFEL GmbH, Albert-Einstein-Ring 19, D-22761 Hamburg, Germany

The combination of intense femtosecond X-ray and NIR pulses produced by Free Electron Lasers (FEL) and synchronized optical lasers, respectively, offers various new possibilities to investigate the dynamics of atomic photoionization. Some recent results obtained at the XUV-FEL FLASH in Hamburg and the first X-ray FEL, the LCLS in Stanford, will be presented.

In the experiments at FLASH, the strong dressing field ($>10^{12}$ W/cm^2) produced by the optical laser, give rise to the so-called two-color Above Threshold Ionization (ATI), which could be studied for the first time in a regime free from unwanted interference effects [1]. In addition, the NIR field can modify also the dynamics of the resonant Auger decay. For the resonant Kr 3d-5p excitation at 91.2 eV, we have investigated by electron spectroscopy the laser-induced shift of the resonance position and have observed competition between resonant and direct Auger decay caused by the ionizing of the excited 5p electron in the NIR field.

Recent experiments at LCLS have taken advantage of the very short (2-5 fs) pulse durations delivered by this FEL. The duration coincides with the lifetime of the Ne 1s core hole state and with the temporal width of one optical cycle of the 800 nm radiation from the NIR dressing laser. The analysis of the angle-resolved KLL Auger decay in atomic reveals strong interference effects, which result from the coherent emission of electrons produced during one cycle of the superimposed optical field. The experimental results are in excellent agreement with recent theoretical work [2].

[1] M. Meyer et al., Phys. Rev. Lett. **101**, 193002 (2008).

[2] A.K. Kazansky, N.M. Kabachnik, J.Phys.B **42**, 121002 (2009); **43**, 035601 (2010).