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Photoion and photoelectron spectroscopy applied for in situ characterization of femtosecond XUV pulses[1] S.J. ROBATJAZI, S. PATHAK, KANAKA RAJU P., J. POWELL, W.L. PEARSON, D. ROLLES, A. RUDENKO, J.R. Macdonald Laboratory, Department of Physics, Kansas State University, Manhattan KS 66506, USA — Accurate knowledge of the pulse duration and temporal structure of extreme-ultraviolet (XUV) pulses is crucial for time-resolved experiments employing free-electron lasers like FLASH, SCSS and FERMI, or light sources based on high-harmonic generation (HHG). Since all-optical techniques are typically challenging for the XUV domain, ionization-based methods are often employed for XUV pulse characterization. Here we report on a comparative study of temporal properties of femtosecond HHG pulses in a broad photon energy range (from 17 to 100 eV) performed using photoion and photoelectron spectra obtained in the XUV pump – near-infrared (NIR) probe experiments. For lower photon energies, the XUV pulse duration and the exact position of the temporal overlap between the XUV and NIR pulses can be retrieved from the delay-dependent double-to-single ionization ratios for Xe atoms or CO_2 molecules, whereas for higher energies, the ratio of Xe^{3+} to Xe^{2+} ion yields after inner-shell (Xe 4d) photoabsorption can be exploited. We compare the results obtained using these schemes to the outcome of electron sideband measurements, and discuss applications of this setup to photoion-photoelectron coincidence experiments.

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