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An intense attosecond light source for XUV-XUV pump-probe experiments

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Short and intense extreme ultraviolet (XUV) pulses are a valuable tool to study ultrafast dynamics and non-linear processes in atomic and molecular systems. These XUV pulses can be generated by two complementary techniques, Free Electron Lasers (FELs) and High-order Harmonic Generation (HHG). The advantage of HHG is a pulse duration on the attosecond time scale, whereas, due to low conversion efficiency, the pulses are generally less intense compared to FEL sources, which makes it difficult to achieve non-linear ionization.

In order to investigate electron dynamics in molecules at the Lund Laser Centre, an intense XUV-XUV pump-probe setup has been developed. For this purpose, high-flux high-order harmonics are generated with photon energies up to 60 eV, pulse energies in the μJ regime and pulse durations on the attosecond time scale.
The beam is focused tightly by two toroidal mirrors in a Wolter configuration [1] up to intensities sufficient to induce multiphoton processes in atoms [2] and molecules. The resulting charged fragments are detected by a double-sided Velocity Map Imaging Spectrometer (VMIS) with the ability to record the kinetic energy distribution of electrons and ions as well as the mass-to-charge spectrum for ions in a synchronized fashion [3]. Recently, a split-and-delay unit has been implemented [4], opening up the possibility to do pump-probe experiments for studying electron dynamics in molecules. Future developments include the integration of an Infrared (IR)-XUV interferometer for further pump-probe studies or molecular alignment experiments.

I will present an overview of the Intense XUV Beamline at the Lund Laser Centre including the specifications and experimental possibilities, as well as a general outlook about ongoing developments.

References

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