Contribution ID: **127** Type: **Contributed poster**

Focusing and wavefront measurements of intense XUV pulses

Monday, 25 June 2018 18:45 (15 minutes)

In the High-order Harmonic Generation (HHG) process, an intense laser field is used to create subfemtosecond pulses with photon energies up to hundreds of eV. At the High Intensity XUV beamline, high energy infrared (IR) pulses are used with a loose focusing geometry to produce intense extreme ultraviolet (XUV) attosecond pulse trains. The generated XUV radiation can be focused to high enough intensities to induce nonlinear interaction with atoms and molecules [1].

In order to reach such high intensities on target, corresponding to more than 10^{12} W/cm^2, we perform microfocusing of the XUV beam using double toroidal mirrors in a Wolter configuration. To investigate the focusing parameters of these optics, the size and shape of the XUV focal spot was measured on a scintillating crystal, as well as calculated by back propagation from wavefront measurements using an XUV wavefront sensor.

The wavefront sensor can also be used to optimize the focusing conditions, by identifying the main aberrations of the beam and minimizing them, using the toroidal mirrors or a deformable mirror (DM) for the IR beam.

After the optimization process, the XUV focal spot was measured to be smaller than 7×9 μm^2, corroborated by the back propagation calculations [2].

To take advantage of the high intensities provided, we present plans for a XUV-XUV [3] and an XUV-IR pump-probe setup, enabling investigation of a range of interesting phenomena in atoms and molecules by recording the 3D momentum distribution of electrons and ions using a double-sided velocity map imaging spectrometer [4].

References

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Session Classification: Poster session