Temporal characterization of a plasma-based seeded XUV laser using a laser-dressed photoionization technique

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Plasma-based XUV lasers operated in the seeded mode [1] have led to significant improvements of the beam properties, in particular its coherence or wavefront. On the other hand numerical simulations suggest that a better control of the seeding conditions is a promising way to achieve ultra-short, ultra-intense amplified pulses, beyond the picosecond timescale limit imposed by the amplifier spectral width [2]. Progress towards this goal requires that reliable temporal diagnostics, able to characterize the XUV pulse temporal profile with femtosecond resolution, possibly in a single-shot, become available.

The development of such temporal diagnostics is also a current challenge for other ultrashort XUV sources, namely free-electron lasers or high-order harmonics generated from plasma mirrors. Among the different methods which have been proposed or tested, those based on photoionization by the XUV pulse in a laser-dressing field, in the sideband or streaking regime, have become the most extensively explored [3, 4]. The main aim of our work is to implement this technique for seeded XUV lasers, using a home-made velocity map imaging spectrometer (VMI) as the central element of the diagnostic (more details will be presented in a companion paper at this conference [5]).

Here we present an experiment performed at the LASERIX facility (Université Paris-Saclay, France), aimed to measure the temporal profile a Ne-like Ti XUV laser emitting at 32.6 nm, seeded by the 25th order of a high-order harmonic source [6]. Photoionization of a target noble gas by the XUV pulse in the presence of an IR dressing pulse induces sidebands on each side of the detected photoline. By varying the IR-XUV delay a cross-correlation signal can be obtained [7]. We will discuss our experimental observations and compare them to the predictions of numerical simulations of the laser-dressed photoelectron spectra, calculated in the Strong Field Approximation (SFA).

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