Space-time characterization of intense laser source in ATTOLab

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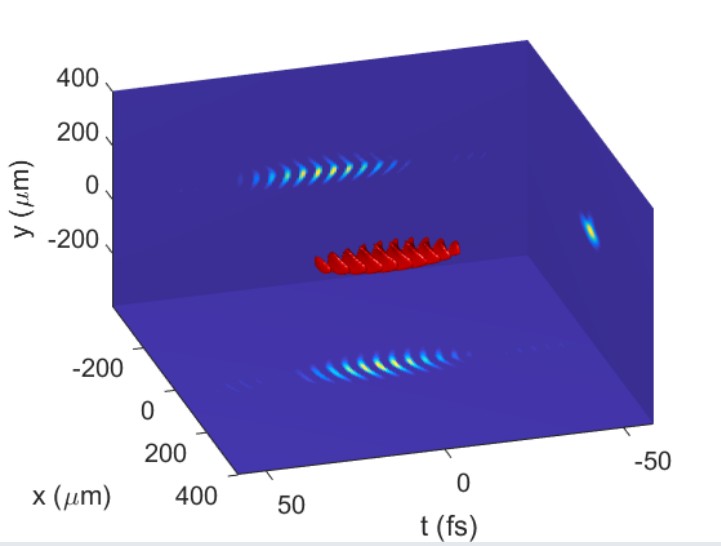
The new platform ATTOLab at CEA-Orme des Merisiers is designed to carry out ultrafast dynamic studies in condensed and gas phases. The SE1 laboratory aims at providing a versatile source of attosecond light bursts adapted to experiments requiring intense pulses. The first XUV photons in ATTOLab has been produced in autumn 2016. After a first phase of optimization, we started in 2017 to carry out studies on time-resolved photoionization in atoms.

The control and knowledge of the intense femtosecond laser pulses which are used to generate the attosecond sources are of upmost importance for the quality of the interaction. So far, such lasers are only characterized consecutively in space and in time, and assumed to be homogeneous. This is often not the case, especially on beams exhibiting large spectrum and large diameters.

In order to tackle this problem, we have developed a novel technique for complete space-time characterization at focus of intense lasers, precisely where the laser-matter interaction takes place. This technique, called INSIGHT, combines Fourier-transform spectroscopy and alternative-projection phase-retrieval algorithm, and gives access to the space-time structure of the laser with high resolution. This technique has been applied to measure the laser system FAB1 (1 kHz, 15 mJ, 23 fs) of ATTOLab. The measurement reveals couplings between space and frequency that are invisible to conventional metrology techniques (such as wavefront sensors or local temporal measurements for instance). This characterization provides precise insights which will be used to improve the quality of the laser beam for improved laser-matter studies in ATTOLab



Complete space-time reconstruction of the electric field of FAB1 at focus. Opposite curvatures of the spatial phase in the vertical and horizontal direction (see pannels) are characteristic of astigmatism

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