Mo-7.

Laser-based ion acceleration: a short review of experimental evidences

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Recent advances in laser technology have led to laser systems with high contrast and extreme intensity values, which have opened up new perspectives in the field of laser–matter interactions. We will discuss recent results obtained in the high power (300 TW) Astra-GEMINI laser system at the Rutherford Appleton Laboratory (RAL). These development enabled access to unprecedented intensities (above 10^{20} W/cm^2), an order of magnitude higher than the previously achieved with ultra-short (~ 50 fs) laser pulses. The interaction of such an intense and high contrast (~ 10^{10}) laser pulses with matter still has to be explored carefully and the experiments aiming to obtain scaling laws or conversion efficiencies are essential.

The measurements provided for the first time the opportunity to extend scaling laws for the acceleration process in the ultra-short regime beyond the 10^{20} W/cm^2 threshold, and to access new ion acceleration regimes. Comprehensive on-line diagnostics with high resolution led to a full characterization of the ion emission process and accelerated beam characteristics. The scaling of accelerated proton energies was investigated by varying a number of parameters such as target thickness (down to 10 nm), target material (C, Al), laser light polarization (circular and linear) and angle of laser incidence (oblique - 35^0, and normal). A pronounced increase in the ion energies has been observed for ultra-thin targets (10 - 100 nm) at normal laser incidence, with peak energies (~ 20 MeV for protons, ~ 240 MeV for C) significantly higher than previously reported with ultrashort laser pulses. The transition to a "new" regime of ion acceleration, the so-called Radiation Pressure Acceleration (RPA) regime, was also identified, showing quasi-monoenergetic proton spectra and a more favorable ion energy scaling with laser intensity. The experiment was carried out in the framework of the LIBRA project.

Mo-8.

News and views from the attosecond generation, characterization and applications frontier

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We report on recent results in the generation, characterization and applications of energetic attosecond pulse trains and ultra-broad coherent XUV continua [1]:

1) Generation: 1a) We report experimental results confirming contribution of both long and short trajectories in on-axis harmonic generation before, at and after an atomic gas jet, i.e. under three different phase matching conditions. The contribution of both trajectories is manifested through their interference leading to a modulated harmonic (and side band) yield as a function of the driving intensity.

1b) We report the generation of sub-fs pulse trains at the 40μJ pulse energy level from laser surface plasma, measured through 2nd order intensity volume autocorrelation (2nd order IVAC) [2].

2) Characterization: We present comparative studies between RABITT and 2nd order IVAC in on axis harmonic generation before, at and after an atomic gas jet. We find that the two techniques give fairly different results that are compatible with the differently weighted but unavoidable presence of the long and short trajectory in the generation process in all three phase matching conditions. We show that the relative contributions of the two

trajectories can be estimated through RABITT measurements, while spatiotemporal mean pulse durations can be extracted from 2nd order IVAC traces.

3) Applications: 3a) We present time resolved VUV spectroscopy of ultrafast dynamics in molecular ethylene [3].

3b) We present time resolved XUV spectroscopy at the 1fs temporal scale and ultra-broad band XUV Fourier Transform Spectroscopy in a manifold of doubly excited autoionizing and inner-shell Auger decaying states excited simultaneously through a coherent broadband XUV continuum.

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Mo-9.

Extreme Light Infrastructure: the laser sources and major challenges

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Extreme Light Infrastructure (ELI), the first research facility hosting an exawatt class laser will be built with a joint international effort and form an integrated infrastructure comprised at last three branches: Attosecond Laser Science (in Szeged, Hungary) designed to make temporal investigation at the attosecond scale of electron dynamics in atoms, molecules, plasmas and solids. High Field Science will be mainly focused on particle acceleration and X-ray generation (in Prague, Czech Republic) as well as laser-based nuclear physics (in Magurele, Romania). The location of the fourth pillar devoted to Ultra High Field Science, which will explore laser-matter interaction up to the non linear QED limit including the investigation of vacuum structure and pair creation, will be decided in 2012.

The primary objective of ELI project is to provide the worldwide scientific community a unique laser based research infrastucture, allowing them to investigate an unexplored domain of laser-matter interaction at the highest intensity level ever achieved, of the order reaching up to 1025 Wcm-2, which is more than three orders