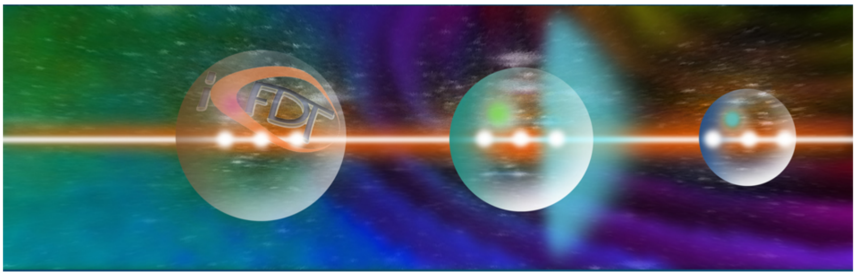

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Spectral characterization by CVD diamond detectors of energetic protons from high-repetition rate laser for aneutronic nuclear fusion experiments

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The use of high-power femtosecond lasers to accelerate particles through the Target Normal Sheath Acceleration (TNSA) process is one of the most active fields of research of the last years. Protons have been produced in facilities worldwide, with energies up to tens of MeVs. For some applications the main requirement is to maximize the particle flux in a specific energy range. For aneutronic p+11B fusion reaction, the most suitable proton energies are of the order of a few hundreds of keVs, corresponding to resonances in the fusion reaction cross-section. Prominent candidates to give reliable results in terms of time-of-flight diagnostics of the accelerated protons in this range of energies are the Chemical Vapor Deposition (CVD) monocrystalline diamonds detectors we developed, which are also specifically designed to operate in harsh environments where large ElectroMagnetic Pulses (EMPs) are generated during laser-target interaction.

In this work we describe the results of experiments performed at the femtosecond ECLIPSE laser facility at CELIA in Bordeaux. We irradiated targets constituted by aluminum foils of various thicknesses and, by means of the diamond detectors, we characterized the accelerated protons with energies in the range of interest for p+11B nuclear fusion. The 1 Hz high repetition rate used for the ECLIPSE laser allowed the collection of a large number of similar shots, giving therefore a large statistics to accurately characterize the energy spectrum of the laser-plasma accelerated protons. The laser repetitivity at a relatively small intensity permits to improve the signal to noise ratio of the detection of the products of low cross-section reactions, as the p+11B fusion reaction, by their collection over a large number of similar shots.

Summary

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