Nuclear fusion experiments with ultra-short multi-TW laser pulses

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CPA techniques [1] allow using ultra-short pulse, multi-TW table-top laser systems for laser-matter interaction studies. In these extreme physical conditions very large electric field gradients can develop in the laser produced plasma and acceleration of few hundreds MeV electrons and several hundreds keV ions can be easily generated [2]. So, a completely new scenario opens to investigate fusion processes in suitable designed laser matter interactions using modest size equipment in place of the large laser facilities dedicated to the achievement of the conditions for the Inertial Confinement Fusion. In fact, instead of producing a fusionistic plasma at temperatures of tens of keV, in short laser pulse experiments fusion events can be obtained by the direct interaction of nuclei accelerated to energies of tens or hundreds of keV. In this paper we present the results of an experiment dedicated to the study of two fusion processes p + ^{11}B [3] and D+D. In the first case, the accelerated protons, obtained by focusing on an aluminum target the beam of a Ti: Sapphire laser, are directed to a Boron sample and the alpha particles, produced in the reaction, are detected by means of a CR39 plate. In the second case the same laser is focused on a deuterated plastic target and the neutrons produced in the fusion process are detected with suitable scintillators coupled with photomultipliers.

References

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