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Laser-driven proton imaging for High-density plasmas

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Generation of high intensity and well collimated multi energetic proton beams from laser-matter interaction extend the possibility to use protons as a diagnostic to image imploding target in Inertial Confinement Fusion experiments in the framework of experimental road map of Hiper project (the European High Power laser Energy Research facility Project). Point projection proton backlighting was recently used to image a cylindrical imploding target at Vulcan laser system at Rutherford Appleton laboratory (UK). Due to the relatively low energy (Ep from 1 to 10 MeV) and to the very large mass densities reached during implosion processes (Areal density ~ from 0.005 to 0.1 g/cm2) , protons traveling through the target undergo a very large number of collisions which deviate protons from their original trajectory reducing Proton Radiography resolution. Here we present a simple analytical model to study the Proton Radiography performance as a function of the main experimental parameters such as proton beam energy and target areal density. This approach leads to define two different criteria for PR resolution ("strong" and "weak" condition) describing different experimental conditions. Finally numerical simulations using both Hydrodynamic and Monte Carlo codes are presented to validate analytical predictions for the energy and density values available at the moment (Ep < 50 MeV and Areal density~0.2 g/cm2).

references

L. Volpe et, al; "Proton radiography of laser-driven imploding target in cylindrical geometry"
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