Fourth International Conference on
SUPERSTRONG FIELDS IN PLASMAS
October 2010, Sunday 3 to Saturday 9
Villa Monastero, Varenna, Italy

Proton Radiography of Cylindrical Laser-Driven Implosions

L. Volpe[1], R. Jafer[1], B. Vauzour[2], Ph. Nicolai[2], J.J. Santos[2], F. Dorchies[2], C. Fourment[2], S. Hulin[2], C. Regan[2], F. Perez[3], S. Baton[3], K. Lancaster[4], M. Galimberti[4], R. Heathcote[4], M.Tolley[4], Ch.Spindloe[4], P. Koester[5], L. Labate[5], L.A. Gizzi[5], C. Benedetti[6], A. Sgattoni[6], M. Richetta[7], J. Pasley[8], F. Beg[9], S. Chawla[9], D.P. Higginson[9], A. MacKinnon[10], A.G. MacPhee[10], D. Batani[1], M. Koenig[3]

[1]Università di Milano-Bicocca, Italy, [2]CELIA-CNRS, Université de Bordeaux, France, [3]LULI, CNRS, France, [4]RAL, STFC, UK, [5]INO-CNR, Pisa, Italy , [6]University of Bologna, Italy, [7]University of Rome "Tor Vergata" Italy, [8]University of York, UK, [9]UCSD, USA, [10]LLNL, USA

ABSTRACT

e-mail: luca.volpe@mib.infn.it

web site: http://virgilio.mib.infn.it/~plasmibatani

Here we present the analysis of Proton Radiography (PR) experimental results obtained in the first phase of an experiment performed at the Rutherford Appleton Laboratory to study fast electron propagation in cylindrically compressed targets, a subject of interest for fast ignition in the framework of the HiPER project (the European High Power laser Energy Research facility Project). In the experiment, protons accelerated by a ps-laser pulse were used to radiograph hydrodynamic evolution of cylinder imploded with ~200 J of green laser light in 4 symmetrically incident ns beams. 3D Monte Carlo simulations using MCNPX code is performed in order to reproduce the complete hydrodynamical history of the imploding target. The MC code is able to reproduce the initial experimental setup, i.e. the spatial and energy proton beam distribution, the target density profiles, at different times and detector geometry, density and chemical composition (RCF layers). Initial spatial and energy proton beam distribution is obtained by deconvolution of experimental data (images on RCF) while target parameters such as density, temperature and ionization degree profiles is obtained by 2D hydrodynamic code CHIC. We show that PR results need a more careful analysis with respect to other diagnostic such as X-ray radiography due to the influence of Stopping Power and Multiple Scattering. Finally with respect to this problem we develop a simple analytical model to estimate the performance of PR for given implosion conditions.