Experiment On The Propagation Of A Shock Wave In Planar And Spherical Geometry

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We performed an experiment at LULI (Paris, France) in the framework of the "Shock Ignition" approach to ICF. The main goals were i) to study shock generation and shock dynamics in planar plastic targets as compared to "hemispherical" targets, ii) to optimize X-ray radiography as a diagnostics of shock dynamics. The experiment also served as a preliminary step towards the realization of an experiment on the multi-kJ laser LIL (Le Barp, France), where, however, X-ray radiography was not available.

For the LULI experiment, we used the two beams. A long pulse beam (526nm, 2ns) with an intensity of around 1.10^{14}W/cm² was used to create a strong shock in the plastic layer while a short pulse beam (1053nm, 1ps) was used to create a X-ray source at 4.9 keV for radiography of the shock during its propagation. By introducing a temporal delay between these two beams, it was possible to scan the shock front at different times.

We used tree kinds of targets. All the targets are multilayer, composed of 20µm of Mo and 250µm of quartz with AR coating at 532nm. The only change is at the front side: the laser interacted either with plastic cylinder or with a plastic hemisphere mounted on the multilayer target. We studied the shock using the shock breakout time at the backside of the target from SOP and VISAR diagnostics. From X-ray radiography, it was possible to record instantaneous images of the front shock propagation inside the plastic layer (cylinder or hemisphere).

The different diagnostics permit measuring the velocity of the shock and also its shape. We were able to compare the shape and the pressure of the shock with planar and spherical geometry. We also have an estimation of the jump of density due to the shock inside the plastic layer. Moreover, we compared the results with CHIC 2D simulations and we were able to infer the maximum pressure inside the target.