Study of laser hole-boring using foam target

G.Malka, C.Beaucourt, E.D'humières, L.Hallo, Ph.Nicolai, V.Tikhonchuk

Centre Lasers Intenses et Applications (CELIA)
Université de Bordeaux 1 - CEA - CNRS
351 Cours de La Libération, 33405 TALENCE Cedex, France

The hole-boring effect is a one of the key issue in the fast ignition concept of a DT target. It corresponds to a fast push of a critical front density of the plasma under the ponderomotive force associated to an ultra-intense laser beam. A hole of few tens of microns can be created in few tens of picoseconds. The distance between the generations of supra-thermal electrons by UHI beam to the target's heart droops, limited the energy balance induced by the large divergence of fast electrons.

We present a new way to study experimentally the hole-boring effect induced by the interaction of ultra-intense laser pulse with a few times critical density plasma.
This plasma is created by X-rays interacting with dense CH foam. X-rays are generated by the interaction of a ns laser beam with a Cu solid target, set behind the foam. In this case, numerical simulations show:
i) That the plasma is relatively homogeneous and the density can be scanned between 1 to few times the critical density (for 1 micron laser wavelength), according to the delay.
ii) That no long under-dense is present at the plasma limit, avoiding laser-plasma parametric instabilities.

Then, the red Doppler Shift of the backscattered light of the UHI beam, focused on the foam plasma, can be used as a diagnostic of the hole-boring, without signal coming from Brillouin and Raman instabilities. Doppler shifts are estimated for different laser and target parameters. PIC simulations allow estimates of the depth of the hole for 100TW laser pulse.