Asymmetries in Inertial Confinement Fusion

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Résumé

Inertial Confinement Fusion is based on the idea of compressing a small capsule of thermonuclear fuel (deuterium and tritium) with intense laser beams. This is the goal for which the two biggest laser facilities in the world have been built: the National Ignition Facility (NIF) in the US and the Laser Megajoule (LMJ) in France.
In order to achieve ignition, the implosion must take place in a symmetric way so to create a "central hot spot" where nuclear fusion reactions start and from which a "thermonuclear burn wave" originates involving all the remaining fuel.

The slightest non-uniformities in laser irradiation and/or target fabrication destroy the symmetry of implosion. Such non-uniformities are amplified by hydrodynamics instabilities (Rayleigh-Taylor) bringing to target distortion, mixing of the fuel with the materials of the wall of the capsule, failure of generating the hot spots.

The recent "National Ignition Campaign" done at NIF has failed to reach ignition mainly due to asymmetries in implosions induced by Rayleigh Taylor instability.

On the other side, the development of such asymmetries is very interesting from the physical point of view, allowing to the simulation at short spatial scales in the laboratory of large-scale astrophysical events related for instance to supernova explosions.

In the talk, we will summarize the status of current experiments done in order to limit the impact of hydro instabilities showing both experimental and simulation results.
Reference: D. Batani, S. Baton, A. Casner, S. Depierreux,M. Hohenberger, O. Klimo, M. Koenig, C.Labaune, X. Ribeyre, C. Rousseaux, G. Schurtz, W. Theobald, V. T. Tikhonchuk "Physical issues in shock ignition" Nuclear Fusion, **54** (2014) 054009

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