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The X-Target: A novel high gain target with single-sided heavy-ion beam illumination[1]

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A new inertial-fusion target configuration, the X-target, using one-sided heavy ion axial illumination has been explored [1]. It takes advantage of the unique energy deposition properties of heavy ion beams that have a classical, long penetration range. This class of target uses heavy ion beams to compress and ignite deuterium-tritium (DT) fuel that fills the interior of metal cases that have side-view cross sections in the shape of an "X". X-targets that incorporate inside the case a propellant (plastic) and a pusher (aluminum) surrounding the DT are capable of assembling fuel areal densities $\sim$2 g/cm^2 using two MJ-scale annular beams to implode quasi-spherically the target to peak DT densities $\sim$100 g/cm^3. A 3MJ fast-ignition solid ion beam heats the fuel to thermonuclear temperatures in $\sim$200 ps to start the burn propagation, obtaining gains of $\sim$300. The main concern for the X-target is the amount of high-Z atomic mixing at the ignition zone produced by hydro-instabilities, which, if large enough, could cool the fuel during the ignition process and prevent the propagation of the fusion burn. Analytic estimates and implosion calculations using the radiation hydrodynamics code HYDRA in 2D (RZ), at typical Eulerian mesh resolutions of a few microns, have shown that for the relatively low implosion velocities, low stagnation fuel densities, and low quasi-spherical fuel convergence ratios of the X-target, these hydro-instabilities do not have a large effect on the burning process. These preliminary studies need to be extended by further hydrodynamic calculations using finer resolution, complemented with turbulent mix modeling and validated by experiments, to ascertain the stability of the X-target design. We will present the current status of the X-target.

[1] E. Henestroza and B. G. Logan, Phys. Plasmas **19**, 072706 (2012)

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