Numerical study of asymmetrically driven cone-guided target on GEKKO-XII

Hiroshi Sawada

Recent sophisticated three-dimensional radiation hydrodynamic simulations have revealed detailed information of a high density imploded core on National Ignition Facility [1]. Compared to relatively uniform x-ray radiation in indirect-drive inertial confinement fusion (ICF), a capsule implosion by direct laser illumination in direct-drive ICF requires better controls on beam power balance, timing and spatially uniform beam profiles in order to maintain the implosion symmetry. [2] In direct-drive, cone-guided Fast Ignition [3,4,5] in which a re-entrant cone is attached to a spherical target to maintain a plasma free path for an intense ignition short-pulse laser, non-symmetrically arranged beams are used to avoid direct laser irradiation onto the cone. To accurately simulate the core formation of a fast ignition target, a three-dimensional simulation including individual laser parameters is required. We investigate effects of non-symmetric GEKKO-XII (GXII) laser configurations on the fuel compression by considering the exact beam number and the beam locations in a three-dimensional hydrodynamic simulation using an IMPACT-3D code. [6] A 200 µm diameter deuterated carbon (CD) sphere is driven by 12 beams, while a cone-sphere target is simulated with 9, 6 and 4 beams. The complex 3D shapes of the cores are analyzed by post-processing with a radiation transport code Spect3D to produce synthetic 2D x-ray radiographic images in two orthogonal directions. The simulated x-ray images show significant differences in the core shape between the two viewing directions and rotation of the stagnating core axis in the top view for the axisymmetric 9- and 6-beam configurations. The peak areal density (pL) decreases by 25% and 50% for 9- and 6-beam drives compared to the core driven by 12 beams. Details of the simulations and findings will be discussed at the workshop.

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References