Diagnosing the Effect of Radiation Asymmetries and Isolated Defects on an ICF Hot Spot

K. McGlinchey [1], J.P. Chittenden[1], B. Appelbe[1]
1) Centre for Inertial Fusion Studies, Imperial College London
E-mail: km2313@ic.ac.uk

Radiation asymmetries and hydrodynamic instabilities lead to strong variations in the areal density of an imploding ICF capsule [1], inducing residual flow and driving the stagnation conditions away from spherical compression. We report on simulations of ICF experiments using the radiation-hydrodynamic code Chimera to investigate the influence of these mechanisms.

Large scale multi-dimensional simulations with radiation asymmetries, tent scars and the fill tube are presented, looking at the each individual perturbation and their combined role in either enhancing or diminishing each other. Each perturbation is evaluated in terms of its effect on hot spot conditions, and their viability to be diagnosed through x-ray backlighting and neutron detectors.

When combined, the alignment of the tent scar relative to the radiation asymmetries can cause large deficits in areal density; foreknowledge of the asymmetries can influence the positioning of the tent to mitigate its influence. We search for an optimum configuration of these features to minimize their combined influence on the hot spot over a variety of different asymmetries.

The fill tube acts as a large isolated defect that can inject ablator material into the hot spot. Additionally, during the fabrication and curing of the capsule, the fill tube can cause a modulation of the oxygen content present within the capsule, leading to unequal ablation pressure in certain regions. We aim to quantify this in terms to the ablation conditions produced and assess the viability to view this via radiography.

References

[1] D. Clark et al., Three-dimensional simulations of low foot and high foot implosion experiments on the National Ignition Facility, PoP, 2016