DPP20-2020-000027

Abstract for an Invited Paper
for the DPP20 Meeting of
the American Physical Society

Validation of heat transport modeling using directly driven beryllium and gold spheres[1]

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Simulations of inertial-fusion hohlraums are not yet predictive due to the complex interaction of atomic physics, radiation transport, kinetic plasma effects, magnetic fields, laser-plasma interactions, and microturbulence. It has been hypothesized that restricted heat transport is altering plasma conditions at the waist of the hohlraum, enhancing "glint" (specularly reflected light that exits the hohlraum), and that this can account for the drive-deficit. In an effort to determine whether restricted heat transport is occurring in relevant plasma conditions, a series of experiments in which either a beryllium or gold sphere was directly driven were performed on the OMEGA facility. Optical Thomson scattering was used to measure plasma conditions at several positions, and laser coupling was assessed using several calorimeters distributed throughout the machine. When driving gold spheres, the irradiated x-ray flux and spectrum are also measured using the Dante diagnostic. Radiation-hydrodynamic simulations in 2D are performed in order to account for heating of the plasma due to the presence of the probe beam. Simulations show that probe heating can alter the electron temperature by 20% in beryllium at lower drive-intensities. It is found that the plasma conditions can be matched when driving a beryllium sphere at lower drive intensities (10^{14} – 2.510^{14} W/cm^2) without restricting the heat flux. Laser-coupling is underpredicted by the simulations, but using a power multiplier to match the coupling data does not greatly alter the simulated plasma conditions. This same framework is also applied to the directly driven gold spheres with similar results.

[1]This work was supported by the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344, supported by DOE Fusion Energy Sciences user FWP100182.