Assessing the predictive capability of physics-based models for hohlraum radiation drive and symmetry*

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The high flux model (HFM) [1] was first developed to match emission levels observed [2] from Au spheres illuminated symmetrically at the UR-LLE OMEGA laser. It utilizes a modern non-LTE atomic physics model and an electron thermal flux limiter of 0.15 or its functional equivalent, a non-local electron transport model [3]. When the HFM is applied to capsule implosion experiments the predicted x-ray bang time is earlier than measured, from which we infer that the x-ray drive is over-predicted by ~10-30% during peak laser power. Also, the radiation drive symmetry, inferred from backlit images of the imploding capsule and self-emission of the stagnated hot spot, can't be matched without making ad hoc adjustments to the relative power of the inner and outer cones [4].

Uncertainties remaining in the computational models of emissivity, laser absorption, heat transport, etc. used in our hydrodynamic codes can significantly affect predictions. In this work, we test various physically-plausible adjustments to these models to find a more predictive model for radiation drive in the regime with little or no measured backscatter or expected cross beam energy transfer. We utilize measurements of radiation drive, bang time, and capsule shape in implosions to compare against high resolution hydrodynamic calculations using the various adjusted-physics models. We also compare the models against the data from two relatively new diagnostics: (1) spectroscopic measurements of the plasma temperature at various locations in the hohlraum [5], and (2) the gated LEH imager that provides time-resolved information on LEH closure, wall motion, and relative laser spot brightness [6]. We find that more detailed non-LTE models improve the agreement for total drive and drive spectrum. We also find that a more restricted electron heat transport (i.e. flux limiter < 0.15) can improve the agreement with some of the data. We investigate whether some of the restricted heat transport could be due to self-generated magnetic fields.

References

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