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Progress towards a more predictive model for hohlraum radiation drive and symmetry[1]

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The high flux model (HFM)[2] was first developed to match emission levels observed[3] 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 a non-local electron transport model. Shortly thereafter, the HFM was also found to better match the radiation drive observed through the laser entrance hole of laser-heated vacuum hohlraums on the NIF.[4] Subsequent capsule implosion experiments driven by hohlraums filled with 1-1.6 mg/cc of He, having case-to-capsule ratios of ∼2.6, and pulse lengths ∼15-20 ns have been characterized by relatively large amounts of laser backscatter losses (up to 18% of the input laser energy). They have also utilized cross beam energy transfer (CBET) to transfer power to the lasers depositing energy near the hohlraum waist. When the HFM is applied to these experiments, the hohlraum x-ray drive is over-predicted by ∼20-30% during peak laser power, and the drive symmetry cannot be matched without making ad hoc corrections.[5] More recent experiments using hohlraum fills from 0-0.6 mg/cc He, case-to-capsule ratios 3-4, and pulse lengths 6-10 ns have little or no CBET or backscatter and are in better agreement with calculations using the HFM, although discrepancies remain. 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 or alternatives to these models in order to find a more predictive model for radiation drive in the regime with little or no backscatter or CBET. We utilize measurements of the radiation drive, shape and trajectory of the imploding shell, shape of the stagnated hot spot, and bang time in capsule implosions and spectroscopic measurements of the hohlraum plasma conditions to compare against high resolution hydrodynamic calculations using the various adjusted-physics models. The goal of this work is to find a physically based model that can better predict the radiation drive and symmetry in this regime.

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