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Assessing hohlraum radiation preheat asymmetry at the ICF capsule via Mo ball fluorescence imaging*

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Lawrence Livermore National Laboratory, P.O. Box 808, Livermore, CA 94550 USA

Corresponding Author Email: dewald3@llnl.gov

On the National Ignition Facility capsule implosions for inertial confinement fusion (ICF) are ablatively driven in the indirect drive approach using High-Z hohlraums heated by energetic laser beams with intensities above 10^{15} W/cm². Since the intensity of the outer laser beams at the wall is 3x higher than for the inner beams, laser beam induced radiation preheat (>2 keV, so called “M-band”) is expected to be capsule pole hot rather than symmetric. In addition, there is the potential for multi-keV emission from stagnating plasmas between hohlraum wall and capsule ablator blowoff in current low gas-fill hohlraums [1]. Asymmetric M-band preheat will lead to asymmetric ablation front and ablator-fuel interface hydrodynamic instability growth factors, potentially complicating the comparison of simulations to Rayleigh Taylor experiments usually conducted at the capsule equator [2]. Until now there was no experimental evidence to quantify the calculated effects. We have developed a carefully shielded and collimated experimental platform to directly infer the hohlraum M-band preheat asymmetries at the capsule by using differentially filtered gated imaging of Mo L-shell fluorescence at 2.3 keV. This platform employs a keyhole target geometry in which a 0.65 mm diameter Mo shell is centered inside a full thickness \sim 2 mm diameter ICF capsule to infer the preheat asymmetry history from rise to end of peak power at the ice-ablator interface. We will show the first time-resolved results of modal decomposition of the preheat asymmetry in low density (0.3 mg/cc) Au hohlraum experiments driving diamond ablaters. The inferred time-resolved preheat P0, P1, P2, P4 and m1 asymmetries are used to shed light on the evolution of hohlraum x-ray albedo, spot motion, interception of inner beams by the Au blow-off [3] and random asymmetries, and are compared to simulations. The prospects for expanding and improving on this technique to infer capsule preheat asymmetry dependence on hohlraum material, geometry, gas fill density and ablator material will also be discussed.

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2. V.A. Smalyuk, D.T. Casey *et al*, “First Measurements of Hydrodynamic Instability Growth in Indirectly Driven Implosions at Ignition-Relevant Conditions on the National Ignition Facility”, *Phys. Rev. Lett.* **112**, 185003 (2014).
3. J.E. Ralph, O. Landen *et al*, “The influence of hohlraum dynamics on implosion symmetry in indirect drive inertial confinement fusion experiments”, *Phys. Plasmas* **25**, 082701 (2018).

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