DPP10-2010-000361

Abstract for an Invited Paper
for the DPP10 Meeting of
the American Physical Society

Quantitative Analysis Of The 2009 National Ignition Facility Ignition Hohlraum Energetics Experiments[1]

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A series of thirty experiments on the National Ignition Facility (NIF) to study energy balance and implosion symmetry in reduced- and full-scale ignition hohlraums were shot in late 2009 at energies up to 1.05 MJ. Preliminary [1,2,3] and ongoing analysis of these hohlraums indicates they meet the requirements for ignition. Here we report the findings of quantitative analysis of the ensemble of data that has refined our understanding of those experiments and produced an improved model for simulating ignition hohlraums. Last year we reported the first observation in a hohlraum of energy transfer between cones of beams as a function of wavelength shift between those cones [1,3]. Detailed analysis of hohlraum wall emission as measured through the laser entrance hole has allowed us to quantify the amount of energy transferred versus wavelength shift. We find the change in outer beam brightness to be quantitatively consistent with LASNEX simulations using the predicted energy transfer when we take into account possible saturation of the plasma wave mediating the transfer. The effect of the predicted energy transfer on implosion symmetry is also found to be in good agreement with gated x-ray framing camera images. Hohlraum energy balance, as measured by x-ray power escaping the LEH, is quantitatively consistent with revised estimates of backscatter and incident laser energy combined with a more rigorous NLTE atomic physics model with greater emissivity than the simpler average-atom model used in the original design of NIF targets.

[1] S. H. Glenzer, et al., Science, 327, 1228 (2010).
[2] N. B. Meezan, et al, Phys of Plasmas, 17, 056304, (2010).
[3] P. Michel, et al, Phys of Plasmas, 17, 056305, (2010).

[1]This work performed under the auspices of the U.S. Department of Energy by LLNL under Contract DE-AC52-07NA27344.