A return [current instability] visit to the NIC empty hohlraums of 2009, to the Omega Au spheres of 2006, and to NIF ignition scale hohlraums.*

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The first full energy shots on the National Ignition Facility (NIF) were into empty cylindrical Au hohlraums, performed in the summer of 2009 [1]. This was the beginning of the National Ignition Campaign (NIC). The hohlraum drive, derived from the x-ray emission emerging from the laser entrance hole, was measured by the broad-band multi-channel Dante x-ray detector. The drive was surprisingly high when compared to pre-shot simulation predictions, which used an average atom XSN non-LTE model along with a restrictive flux limiter, f, of 0.05 [2]. That value of f was a traditional one, based on decades of experimental analysis. A High Flux Model (HFM) [3] using a detailed configuration accounting DCA atomic physics model [4], and a more liberal flux limit of 0.15, (or its functional equivalent, a non-local model [5]), matched the data much better. As the data analysis was further refined, the HFM was found to slightly overestimate the drive [2]. Now, eight years later, we re-do those calculations with the latest DCA model, to see what electron transport model its best. An f=0.05 flux limited model is somewhat too low, and the f=0.15 model is somewhat too high. We apply a newly implemented in-line model that incorporates estimates of the effects of enhanced scattering from the ion acoustic turbulence resulting from the return current instability (RCI), on both enhanced ("anomalous") absorption as well as on effective flux limitation [6], and we find that this in-line RCI can match the 2009 NIC empty hohlraum drive data. We also show that the same computational model can come close to explaining the 2006 Au sphere x-ray emission results, taken at the URLLE OMEGA laser in 2006 [7]. We also discuss the possible implications of RCI for ignition scale hohlraums.

References

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[1] Kline et al PRL **106**, 085003 (2011)
[2] Olson et al Physics of Plasmas **19**, 053301 (2012)
[3] M.D. Rosen, et al, HEDP **7**, 180 (2011)
[4] H. Scott and S. Hansen, HEDP **6**, 39 (2010)
[5] G. Schurtz, X. Nicolai and M. Busquet, Phys. of Plasmas **7**, 4238 (2000)
[6] V. Yu. Bychenkov and W. Rozmus, Phys. of Plasma **24**, 012701 (2017)
[7] E. L. Dewald, M. D. Rosen, S. Glenzer, et al, Phys. of Plasma **15**, 072706 (2008)

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