EXPLORING SYMMETRY CONTROL IN NEAR-VACUUM HOHLRAUMS

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Recent experiments with near-vacuum hohlraums, which utilize a minimal but non-zero helium fill, have demonstrated performance improvements relative to conventional gas-filled (0.9 – 1.6 mg/cc helium) hohlraums – minimal backscatter, reduced capsule drive degradation, minimal suprathermal electron generation, and enhanced beam propagation relative to nominal radiation-hydrodynamics simulations [1].

Given these promising initial results, this platform has been utilized to study neutron yield production with cryogenic deuterium-tritium layers in high-density carbon capsules [2]. In this reduced laser-plasma interaction system, implosion symmetry is controlled through direct adjustment of the laser beam power balance rather than through cross-beam energy transfer [3]. A significant challenge in extending this platform to high-yield designs is achieving adequate symmetry control of the drive throughout the pulse, and achieving this control has the added challenge that nominal radiation-hydrodynamics simulations have not proven predictive on symmetry of the final hotspot in this regime.

Experimental efforts have focused on developing an understanding of symmetry control in near-vacuum hohlraums concurrently with efforts focused on understanding the discrepancy between simulated and measured symmetry. This talk will summarize our experimental work exploring laser pulse duration and power in three hohlraum size scales and with two capsule size scales. Improvements in simulation techniques will also be noted. These two efforts together have led to the development of a platform with an increased case-to-capsule ratio, resulting in a well-controlled, round implosion, measured through experiments, as well as a new series of full-scale designs geared toward increasing neutron yield production in this platform.

[1] L.F. Berzak Hopkins et al., "First high-convergence cryogenic implosion in a near-vacuum hohlraum," Phys. Rev. Lett. (forthcoming 2015).
[2] A.J. MacKinnon et al., "High-density carbon ablator experiments on the National Ignition Facility," Phys. Plasmas **21**, 056318 (2014).
[3] P. Michel et al., "Tuning the Implosion Symmetry of ICF Targets via Controlled Crossed-Beam Energy Transfer," Phys. Rev. Lett. **102**, 025004 (2009).

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