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Exploring the limits of case-to-capsule ratio, pulse length, and picket energy for symmetric hohlraum drive on NIF[1]

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Over the past two years, we have been exploring low gasfill hohlraums (He fill at 0.3-0.6 mg/cc) as an alternate to the high gasfill hohlraums used in NIC and the High Foot campaigns (He fill at 1-1.6 mg/cc). These low fill hohlraums have significantly reduced laser-plasma instabilities and increased coupling to the target as compared to the high fill hohlraums and take us to a new region of parameter space where the hohlraum is limited by hydrodynamic motion of the hohlraum wall rather than by laser plasma interactions. The outer cone laser beams interacting with the hohlraum wall produce a "bubble" of low density, high Z material that moves toward the center of the hohlraum. This gold or depleted uranium bubble eventually intercepts the inner cone beams and prevents the inner cone beams from reaching the waist of the hohlraum where they are needed to get a symmetric implosion. Thus, the speed of the bubble expansion sets the allowable pulse duration in a given size hohlraum. Data and simulations suggest that the bubble is launched by the early part of the laser pulse (picket) and the gold/gas interfaces moves nearly linearly in time toward the axis of the hohlraum. The velocity of the bubble is related to the square root of the energy in the picket of the pulse thus the picket energy and pulse duration set the allowable hohlraum size and case-to-capsule ratio. In this talk, will discuss a data based model to describe the bubble motion and apply this model to a broad set of data from a variety of ablators (CH, HDC, Be), pulse durations (6-14 ns), case-to-capsule ratios (rhohl/rcap of 3-4.2), hohlraum sizes (5.4-6.7 mm diameter), and hohlraum gasfill densities (0.3-0.6 mg/cc). We will discuss how this model can help guide future designs and how improvements in the hohlraum (foam liners, hohlraum shape) can open up new parts of parameter space.

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