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The Velocity Campaign for Ignition on NIF[1]

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Achieving ignition requires a high velocity implosion since the energy required for ignition scales like $1/v^8$. Beyond ignition, a higher velocity produces more robust performance, which will be useful for applications of ignition. In the velocity campaign, we will explore three methods for increasing implosion velocity: increased laser power and energy, optimized hohlraum and capsule materials, and optimized capsule thickness. The main issue with increasing the laser power and energy is the way in which LPI (laser plasma interactions) and hot electron preheat will change as we increase the laser power. Based on scalings from previous data and theory, we expect to couple 80-85% of 1.5 MJ at 475-500 TW. We can also increase the velocity by optimizing the hohlraum and capsule materials. In this campaign, we will explore depleted uranium hohlraums to reduce wall loss and optimize the capsule dopant by replacing the germanium dopant with silicon. Those two changes are expected to increase velocity by 6-7%. Finally, we will optimize the capsule thickness. The optimal capsule thickness is a trade-off between velocity and mix. A thinner capsule has higher velocity, but is more susceptible to mix of the ablator material into the hotspot due to hydrodynamic instabilities seeded by ablation surface imperfections. Once we have achieved adequate capsule areal density, we will optimize the velocity/mix trade off by varying the capsule thickness. We will also make direct measure of Rayleigh-Taylor instability growth by backlighting the growth of engineered features on the surface of the capsule. This will allow us to benchmark our models of mix. In this paper, we will describe the designs and experimental results of the velocity campaign.

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