HYDRODYNAMIC STABILITY OF BERYLLIUM IMPLOSION EXPERIMENTS AT THE NATIONAL IGNITION FACILITY[1]

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Beryllium is an alternative ablator material for ignition capsule experiments, which generates higher ablation pressures than carbon-based ablators [1] and improves resilience to capsule hydro-instability growth in ICF implosions. Due to a lower opacity, undoped beryllium also creates a higher ablation velocity at NIF-relevant radiation temperatures [2]. As a result, beryllium capsules have enhanced ablative stabilization of Rayleigh-Taylor instabilities at the ablation front [3,4]. Beryllium is also a lower Z material than carbon, so that less radiative cooling due to Bremsstrahlung losses can be expected per mass of ablator material mixed into the hotspot. Therefore, beryllium capsule implosions are expected to suffer less performance degradation due to capsule hydro-instabilities.

We have designed a beryllium target for experiments on NIF that, in addition to intrinsic beryllium material properties, utilizes the high foot [5] and adiabat shaping [6] techniques to further suppress capsule hydro-instability growth. Simulations of capsule instability growth factors indicate that the beryllium capsule should be less unstable at the ablation front than CH capsules. A series of shots have been carried out to test the performance of beryllium capsules in a hohlraum environment very similar to that of the high foot CH experiments (e.g., N130501). In addition, a hydro-growth radiography [7] (HGR) experiment is planned for August 2015. The HGR experiment will directly measure the ablation front instability growth of a beryllium capsule, and test the predicted growth factors. Here, we present our analysis of the capsule stability properties for the first beryllium target fielded on NIF and analyze the results of the HGR experiment. Simulations are compared to experimental data from the first beryllium target experiments as well as from high foot CH implosions fielded with similar laser energies.

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