Studies of ablator-fuel mix using the 2-Shock platform at the National Ignition Facility

S.A. MacLaren[1], D.D. Ho[1], S.F. Khan[1], G.A. Kyrala[2], T. Ma[1], L.P. Masse[1], J.E. Pino[1], J.E. Ralph[1], J.D. Salmonson[1], R.E. Tipton[1]

1) *Lawrence Livermore National Laboratory, USA*

E-mail: maclaren2@llnl.gov

2) *Los Alamos National Laboratory, USA*

The 2-Shock platform at the National Ignition Facility (NIF) is a non-igniting indirect-drive target designed to produce a near 1D-like implosion for hydro-code validation and mix investigation. Mixing ablator material into the fuel of an ICF implosion will cool the hot spot due to enhanced radiation and negatively affect performance. The 2-Shock implosions are intended to study mixing from hydrodynamic instability at the fuel-ablator interface; however, combined with variations in low-mode symmetry, feedthrough from the ablation front can overwhelm this source of mixing. The 2-Shock platform avoids ablation-front feedthrough using a sub-scale (675 μm outer radius) capsule in a standard (2.875 mm radius) near-vacuum or low-fill hohlraum, providing a case-to-capsule ratio 63% larger than that of a standard ignition target. Additionally, the low aspect ratio (3.9) of the capsule shell combined with the temperature of the foot pulse dramatically reduces ablation front instability growth. The result is a platform that is well suited to the study of mixing at the gas-ablator interface without the complicating factors of shell perforations due to ablation front instability feed-through.

Applying the CD Symcap [1] technology, i.e. a layer of CD plastic on the inner 3 μm of the CH capsule shell together with a capsule gas fill of hydrogen and tritium, to the 2-Shock platform allows us to infer the mixture of ablator material into the gas through the ratio of DT to TT neutron production. By comparing this ratio across series of experiments, the 2-Shock platform has been used to measure the sensitivity of ablator-gas mixing to a comprehensive variety of implosion parameters. Through modifications to the capsule, sensitivity to inner surface roughness, implosion convergence ratio, and radial origin of the mix mass have been examined. By adjusting the hohlraum fill and laser power history, ablator-gas mixing as a function of low mode symmetry and shock merger location have been measured. We present results of mix measurements from these scans, as well as comparison with simulations. This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.

References

[1] V.A. Smalyuk et al., PRL 122, 025002 (2014)