High efficiency High Density Carbon implosions at the National Ignition facility

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Building on our experimental and modelling effort over the last three years, we have found a capsule/hohlraum combination enabling us to drive a symmetrical implosion to convergence 27 with minimal Laser Plasma Interaction (LPI). The experimental platform consists of a low gas fill (0.3g/cc of helium) unlined DU hohlraum driving a W-doped High Density Carbon (HDC) capsule. The gas fill density (0.3 mg/cc) was chosen to be in a hydrodynamic regime while staying under the LPI threshold. This should bring the experimental data in closer agreement with the radiation-hydrodynamics simulations.

Indeed, the symmetry has been measured to be better than 5% of round at all time for a cryogenic layered DT implosion. The highest thermonuclear yield is ~ 7e15 neutrons with a down-scattered ratio ≈ 3.2%. Given the low laser energy (1 MJ vs. 1.9 MJ for the highest performing "High Foot" implosions), this shot achieved a new NIF yield efficiency record. With the symmetry of the implosion in control in this hohlraum environment, the campaign is now moving forward with capsule physics issues such as the impact of engineering features or mix studies.

In parallel, the HDC campaign is working to increase neutron yield by increasing the energy absorbed by the capsule. A straightforward way to couple more energy to the capsule is to increase its surface area while increasing the hohlraum diameter by the same ratio to keep the capsule environment similar. A series of experiments have been carried out first to test how the symmetry of the implosion was preserved at larger capsule and hohlraum scale and then to test the performance of the high convergence cryogenic DT-layered implosion. The latest results and hydrodynamic simulations of this effort will be presented.

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