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Performance of high-density-carbon (HDC) ablator implosion experiments on the National Ignition Facility (NIF)[1]

ANDY MACKINNON, Lawrence Livermore National Laboratory

A series of experiments on the National Ignition Facility (NIF) have been performed to measure high-density carbon (HDC) ablator performance for indirect drive inertial confinement fusion (ICF). HDC is a very promising ablator material; being 3x denser than plastic, it absorbs more hohlraum x-rays, leading to higher implosion efficiency . For the HDC experiments the NIF laser generated shaped laser pulses with peak power up to 410 TW and total energy of 1.3 MJ. Pulse shapes were designed to drive 2, 3 or 4 shocks in cryogenic layered implosions. The 2-shock pulse, with a designed fuel adiabat of $\sim$ 3 is 6-7ns in duration, allowing use of near vacuum hohlraums, which greatly increases the coupling efficiency due to low backscatter losses. Excellent results were obtained for 2,3 and 4 shock pulses. In particular a deuterium-tritium gas filled HDC capsule driven by a 4-shock pulse in a gas-filled hohlraum produced a neutron yield of 1.6 x 10^{15}, a record for a non-cryogenically layered capsule driven by a gas-filled hohlraum. The first 2-shock experiment used a vacuum hohlraum to drive a DD gas filled HDC capsule with a 6.5ns, laser pulse. This hohlraum was 40% more efficient than the gas-filled counterpart used for 3 and 4 shock experiments, producing near 1D performance at 11x convergence ratio, peak radiation temperature of 317eV, 98% laser-hohlraum coupling, and DD neutron yield of 2.2e13, a record for a laser driven DD implosion. The HDC campaigns will be presented, including options for pushing towards the alpha dominated regime.

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