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Inertial confinement fusion implosions at 500 TW laser drive on NIF

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The scaling of nuclear performance with increasing laser power and hohlraum drive has been measured in high-velocity implosions of inertial confinement fusion capsules filled with equimolar deuterium-tritium fuel. These experiments use the highest laser powers employed to date to demonstrate signatures of alpha heating and significant 14.1 MeV fusion neutron yield. Besides laser power, the experiments further scale the capsule ablator thickness and hohlraum wall material. Specifically, the first depleted uranium hohlraums for layered implosion experiments have shown an unambiguous improvement in capsule drive, which is equivalent to 25 TW over gold hohlraums at laser peak powers of 320 TW. To assess proximity to the ignition regime, we analyze measurements of the primary DT yield and the ratio of down scattered neutrons that are observed at energies of 10-12 MeV and which are a signature of the areal density of the implosion. We report on DT areal densities of 1.2 g cm^{-2} exceeding 90% of the required value for fully tuned ignition implosions. This achievement is the result of recent hohlraum and capsule tuning experiments by fielding long-drive laser pulses that avoid coasting of the implosion. The data indicate pressures of more than 100 Gbar. Comparisons with radiation-hydrodynamic simulations indicate that this value is currently within a factor of three required for reaching the ignition regime and that further improvements in implosion performance can be achieved at higher power drive.