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Hot spot conditions achieved in DT implosions on the NIF

P.K. PATEL, D.A. CALLAHAN, C. CERJAN, D.S. CLARK, T.R. DITTRICH, T. DOEPPNER, M.J. EDWARDS, S. HAAN, D.E. HINKEL, L.F. BERZAK HOPKINS, O.A. HURRICANE, A.L. KRITCHER, J.D. LINDL, T. MA, A.G. MACPHEE, A.E. PAK, H.S. PARK, H.F. ROBEY, J.D. SALMONSON, B. SPEARS, P.T. SPRINGER, N. IZUMI, S. KHAN, Lawrence Livermore National Laboratory — We describe a 1D model that uses experimentally measured data to derive the thermodynamic conditions at stagnation of the hot spot, dense fuel, and ablator, in deuterium-tritium (DT) layered implosions on the National Ignition Facility (NIF). Neutron measurements—spectrally, spatially and temporally resolved—are used to infer the hot spot burn-averaged pressure, density, areal density, ion temperature, volume, and internal energy. X-ray spectral measurements are used to infer electron temperature, radiative energy loss, and the presence of ablator mix in the hot spot. In addition, we can calculate the fraction of alpha-particle energy trapped in the hot spot and, hence, estimate the degree of self-heating. Recent DT layered implosions using the high-foot design [Hurricane et al., Nature 506, 343 (2014)] have achieved areal densities and temperatures in the hot spot whereby a significant fraction of the internal energy at stagnation can be attributed to alpha-particle self-heating. This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.

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