ANALYSIS OF NIF EXPERIMENTS WITH THE MINIMAL ENERGY IMPLOSION MODEL

B. Cheng[1], T.J.T. Kwan[1], Y.M. Wang[1], F. Merrill[1], C. Cerjan[2], and S.H. Batha[1]
[1]Los Alamos National Laboratory, Los Alamos, New Mexico, U.S.A.
[2]Lawrence Livermore National Laboratory, Livermore, California, U.S.A.
bcheng@lanl.gov

We have applied a recently developed analytical model of implosion [1] and thermonuclear burn criteria [2] to inertial confinement fusion capsule experiments performed at the National Ignition Facility (NIF) using low-foot and high-foot laser pulse formats. Our model predictions are consistent with the experimental data. Our studies, together with neutron image analysis, reveal that the adiabats of the cold fuel in both low-foot and high-foot capsule experiments are similar. That is, the cold deuterium-tritium shells in those experiments are all in a high adiabat state at the time of the peak implosion velocity. The major difference between low-foot and high-foot capsule experiments is the amplitude of the shock-induced instabilities developed at the material interfaces. We have also compared the NIF capsules performance with the ignition criteria and analyzed the alpha particle heating in the NIF experiments. Our analysis demonstrates that the alpha particle heating was appreciable in only high-foot experiments. Based on our work, we will discuss paths and parameters to reach ignition at NIF (LA-UR-15-22429).

This work was performed under the auspices of the U.S. Department of Energy by the Los Alamos National Laboratory under Contract No. W-7405-ENG-36.

[1] B. Cheng, T. J.T. Kwan, Y.M. Wang, and S. H. Batha, Phys. Rev. E 88, 041101 (2013).
[2] B. Cheng, T. J.T. Kwan, Y.M. Wang, and S. H. Batha, Phys. Plasmas 21, 10270 (2014).