ANALYSIS OF EXPERIMENTS ON INDIRECT DRIVE TARGET COMPRESSION AT NIF LASER FACILITY USING 1D MODEL AND THE CAUSE OF THE FAILURE IN REACHING THE IGNITION

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Analysis and interpretation of the results on the NIF ignition having significant discrepancies between the LLNL simulations and measurements, have been made with account of 1D → 2D → 3D hydrodynamic effects, namely, 1D simulations; 2D simulations for asymmetrical compression; 2D simulations for surface roughness of DT-ice and ablator layers; 2D simulations for a target tent and a DT filling tube; 3D simulations. However, despite endless attempts to consider all sources of the deviation from symmetry the considerable deviations still exist. The neutron yield is 3–10 times lower; DT gas pressure and density in the capsule center at the moment of collapse is 2–3 times lower; size of a hot region is 1.5–2 times higher; density and optical thickness ρR (g/сm2 is also called the surface density) of DT-ice shell is below the calculated values by 1.5–2 times; one observed considerable deviations of the neutron escape symmetry under a single neutron scattering in a compressed DT-ice shell. All these effects become evident in the form of a low mode that covers considerable parts of a compressed capsule. Perhaps such a compression of the target might be due to its non-hydrodynamic origin.

In this paper we consider a possibility of “non-ignition” of a target under indirect compression on the NIF facility due to the radiation transfer. It can be explained as follows. The data on the spectral coefficients of absorption are not clearly understood. As a result, an ablator material proves to be more transparent for the typical radiation quanta in the experiment, and the heating of a DT layer at compression turns out to be higher than in the calculations that simulate the processes.

The processes of instability, mixing, and heating of part of an ablator adjoining the DT layer are increasing the transparency of the ablator as a whole object, and they increase the flows of the radiation inside the target, thus providing an increased heating of the layers containing the DT fuel.

Multiple attempts to take into account the 2D and 3D processes and initial conditions for them are known to be so far unsuccessful. The initial deviations from symmetry must be 3–5 times higher than in reality. May be a combination of a possible effect of the ablator “transparency” and a consideration of the 2D and 3D processes under real initial conditions should lead to an agreement between the simulation and experimental data and to a more accurate and clear statement of the “ignition” conditions.