ANALYSIS OF EXPERIMENTS on indirect irradiation of targets foR THERMONUCLEAR IGNITION at THE NIF facility

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The results of megajoule experiments at the NIF facility (LLNL) on laser compression of indirect irradiation targets, in which the yield of thermonuclear energy reached twice the kinetic energy of a compressing capsule when moving to the center, were published in [1]. In these experiments, a three shock laser pulse irradiates the inner walls of a hohlraum made of depleted uranium. An inside capsule is compressed by the X-ray radiation produced on the hohlraum walls. An ablator layer of the capsule is made of a high-density carbon (the carbon in the phase close to diamond).

Numerical simulation of these experiments is of great interest because a step-by-step improvement of the geometry of the experiments and the irradiation and compression regimes of the capsule makes it possible to increase the neutron yield, which today is of 1.9.1016. Numerical simulation of the experiment was performed using a one-dimensional RADIAN code [2].

In the 1D RADIAN program, the two-temperature hydrodynamic equations (equations of motion, continuity, equations of energy change for the electron and ion components, equations of state for ions and electrons) are solved together with the multi-group spectral radiation transfer equations. The spectral absorption coefficients of radiation were calculated using the THERMOS program (IPM RAS). Electron-ion exchange, classical or reduced Spitzer thermal conductivity are taken into account. The laser energy is absorbed in the Bremsstrahlung manner. Laser radiation that has reached the critical density point is completely absorbed in it. The contribution of the energy of α-particles to the energy equation is taken into account.

In the reported calculations it is possible to trace the change in the neutron yield, including an increase due to the change in the geometry of the experiment, target material, and the time dependence of the laser pulse. The calculated data satisfactorily agree with the results of the measurements, and they correspond to the range of the observed parameters.