Simple model for indirect target compression under conditions close to the NIF laser facility at 1.5. MJ energy

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A one-dimensional model for indirect target compression is proposed, which corresponds to the compression conditions of NIF facility, and allows one to analyze the experimental results. The model reproduces the known from literature data on the measured radiation temperature in the cavity and the shell motion velocity.

The model is based on the RADIAN code. The physico-mathematical model used in this code contains the equation of motion, equation of continuity, the equation of energy balance for the electron and ion components, the matter equation of state for the ions and electrons. The electron-ion exchange and a classical Spitzer heat conductivity are taken into account, and there is a possibility to decrease the heat conductivity aimed at better correspondence with the experimental results. A possibility is provided to use different equations of state. Spectral radiation transport is considered in a multi-group approximation, and the number of groups may reach 1300. In particular, the existence of an optical database allows one to make use of this model for the analysis of the processes observed in thermonuclear targets, where the radiation is an important factor.

Formulation of a problem includes modification of the heating pulse (“low-foot” and “high-foot” regimes), the change of the ablator, size and target layer composition. The model makes it possible to trace the temperature, density, Fermi adiabat and other parameters of the target at the stage of compression and burning, which affect the final thermonuclear yield. The simulations reproduce the main characteristics and parameters of plasma and target compression dynamics under the action of an x-ray pulse published in literature. The target size fitting allowed us to find the correspondence between the simulation and experimental results. Thus, the developed model realizes a platform which helps to trace the main tendencies in the processes and the role of various factors affecting the compression parameters.