DETAILS OF NUMERICAL SIMULATIONS OF FUSION IGNITION EXPERIMENTS ON THE NIF LASER FACILITY

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Current cryogenic fusion targets for the NIF laser facility are largely susceptible to variations in various experimental parameters. The main reason for this is the limitations on the power and energy of the laser facility and the extreme optimization of targets, laser radiation profile, etc. to overcome the ignition threshold. The increase in the frequency of ignition experiments in recent years is directly related to the systematic increase in the energy of the NIF laser facility from 1.9 MJ (2021) to 2.3 MJ (2024) with virtually no changes in the target design. At the same time, despite a slight increase in the ignition margin (in the broad sense of this term), the target designs remain largely "stressed" today.

Considering the high compression rates and small target sizes, as well as the general target instability, numerical simulations of inertial confinement fusion systems impose special requirements on codes and task setting. In this work, we use numerical simulations of shot N210808 [1] to explore the influence on the final result of the choice of various models of equations of state of matter and radiation paths, spectral structure of light incident on the capsule and a number of other factors. We show that within the framework of the one-dimensional approximation, using the most accurate (in the physical sense) problem statement, it is possible to achieve a result that is almost identical to the experimental data. The results of two-dimensional simulations are discussed separately, as well as the question of obtaining a stable solution on fine grids in the multidimensional formulation using the kinetic approximation for X-ray transport.

References

1. **Kritcher, A. L.** Design of an inertial fusion experiment exceeding the Lawson criterion for ignition [Text] / A. L. Kritcher, A. B. Zylstra, et al. // Phys. Rev. E. – 2022. – 106. – 025201.