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MODELING OF THE EVOLUTION OF HYDRODYNAMIC INSTABILITIES AND MIXING IN DIRECT IRRADIATION LASER TARGETS USING TIGR-3T AND OMEGA-3T COMPLEXES *)

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In experiments with single-cascade targets carried out at the NIF facility using an indirect irradiation scheme, a thermonuclear energy yield of ≈1.3 MJ was obtained at a laser energy ≈1.9 MJ [1]. The possibility of thermonuclear ignition of direct irradiation targets using megajoule laser installations remains to be determined. The main difficulties on this path are the evolution of hydrodynamic instabilities [2] and the processes of turbulent mixing caused by them [3]. Using two-dimensional software systems TIGR-3T and OMEGA-3T [4], the influence of these processes on the compression and thermonuclear combustion of single- and double-cascade direct irradiation targets was studied. According to the calculations of a single-stage target [5], long-wave perturbations with harmonic numbers 4-12 and amplitude 1% in the asymmetry of the absorbed laser energy do not lead to a strong decrease in thermonuclear energy in this case. For this target, short-wave disturbances turn out to be extremely dangerous: amplitudes 0.1% for harmonic number 60 or disturbances specified at the initial moment of time at the boundary of the fuel and ablator with an amplitude of only $\delta_{60} \sim 10^{-6}$ cm lead to a decrease in thermonuclear energy by 2-3 times. When compressing two-cascade targets of the type [6], effective smoothing of disturbances occurs in the process of their transmission from the external cascade to the internal one. As a result, for disturbances in the asymmetry of absorbed laser energy, long-wave disturbances with amplitude 1% for harmonic number 12 turn out to be dangerous, which lead to a decrease in thermonuclear energy by a factor of 2-3. For such targets, it is important to correctly describe the processes of development of instabilities and mixing at the boundaries of the internal cascade made of high-Z material. The report compares the results of mixing calculations using the semi-empirical kε-model of turbulent mixing [7], carried out to study their effect on compression and combustion of laser targets [5,6].

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