A spherical convergent shock wave formed due to a matter heating by a fast electron’s flux for an ignition of a laser fusion target

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The results of numerical and theoretical investigations of a spherical convergent shock wave formation in a homogeneous ball are presented. The ball consists of the equimolar mixture of hydrogen isotopes (D and T). The shock wave formation is implemented due to an outer ball layer heating by a flux of monoenergetic fast electrons with a fixed energy. Under this setting there are the next problem parameters: an initial radius, a density of a ball, fast electron energy, which determines the initial thickness of the heated layer, energy density of the fast electron flux. The an areal density of this layer stays a constant and is the initial ball density multiplied by the heating depth.

A practical size of this problem applies to one of the most perspective way of a laser fusion target ignition, that is an ignition of a preliminary compressed target by a convergent shock wave (shock ignition) due to a final stage of a laser pulse effect with an intensity of I = 1015–1016 W/cm2. Such an effect is accompanied by the fast electrons generation.

Numerical calculations were fulfilled using the hydrodynamic code FLORA. These simulations were carried out within the different assumptions to determine the roles of the separate processes. For example, an accounting or no of a heat conductivity, two temperature approximation and so on. In result the dependencies of the pressure, temperature, density at a shock wave front as well as in a rarefied region are constructed. The cumulation laws of a shock wave convergence that is formed by a heating of a spherical ball layer with a fixed areal density are discussed to compare with the famous solutions of Landau-Staniukovich-Guderley ones. The ranges of the parameters of the preliminary compressed target and the fast electron flux, which corresponds a formation of such a shock wave that can provide an initiation of a thermonuclear burn wave from the target center are determined.