Collective absorption of laser radiation in plasma at sub-relativistic intensities

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Processes of laser energy absorption and electron heating in a hot plasma in the range of irradiances $I \lambda^2 = 10^{15} - 10^{16}$ W $\mu$m$^2$/cm$^2$ are of prime importance for the shock ignition scheme of inertial confinement fusion. We studied these processes with large scale kinetic simulations [1, 2] and identified particular zones of plasma where laser absorption takes place and hot electrons are produced. Strong laser reflection due to the process of stimulated Brillouin scattering (SBS) and significant collisionless absorption related to the process of stimulated Raman scattering (SRS) near and below the quarter critical density have been observed and analyzed. They are induced by strong laser beam self-focusing and modulational instabilities. These processes are complemented with the parametric decay instability and resonant excitation of plasma waves near the critical density. All these processes result in excitation of high amplitude electron plasma waves and electron acceleration. The spectrum of scattered radiation is significantly modified by the secondary parametric decay instability, which provides information on the spatial localization of nonlinear absorption and hot electron characteristics.

The considered domain of laser and plasma parameters has been studied in a series of experimental campaigns carried out on the PALS facility in Prague [3] at the first and third harmonics of the iodine laser. A comparison with experimental results will be discussed.

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