INTERACTION OF PICOSECOND LASER PULSES WITH A THIN TARGET

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Generation of relativistic sub−picosecond laser pulses by advanced tera- or petawatt laser devices gives rise to a forerunner pulse with a duration of 10 ps–1 ns and intensity on the order of 10^{16}–10^{12} W/cm^2. Fore-runner–target interaction is of interest, since it considerably affects the generation of hot relativistic electrons and fast ions when the main part of the pulse interacts with a plasma. Pico-, nano−second laser pulses are also used for acceleration of thin targets, during acceleration the development of hydrodynamic instability is possible.

In this work, we study interaction between a pulse of duration 5 ps and intensity 10^{16} W/cm^2 with thin aluminum foil. When a plasma is exposed to an intense laser radiation, vigorous waves are excited in the plasma, which are governed by the self-consistent plasma field. The duration of the pulse is large compared with the mean free time of particles in the plasma. Therefore, to study the plasma dynamics under such conditions, both the self-consistent field and particle−particle collisions should be taken into account.

Interaction between a picosecond laser pulse of non−relativistic intensity with a thin target is studied in terms of the kinetic theory of laser plasma, which is based on constructing propagators for the plasma particle distribution functions. Allowance is made for both the self-consistent plasma field and particle−particle correlations (collisions).

Interaction of a picosecond (5 ps long) laser pulse of nonrelativistic intensity (10^{16} W/cm^2) and a thin (1 μm in thickness) aluminum target causes strong acceleration of the electrons to relativistic energies (to 0.8 MeV). This acceleration is due development of oblique instability of electron beam. Electron beam with anormally high energy is non−uniform and is located within the target volume. This beam causes strong non−uniform hearting of the target (of the order of 20 kev) and absorption of laser pulse. The above processes develops after short time of the order of 100 fs. Another effect, which is beyond hydrodynamic description is charge separation.