Numerical simulations of electron heating during energy transfer in a laser driven collisionless shock

S. Davis[1], R. Capdessus[1], E. d'Humires[1], S. Jequier[1], V. Tikhonchuk[1], A. V. Brantov[2], and S. Bochkarev[2]

[1]CELIA, University Bordeaux CNRS CEA, 33405 Talence cedex, France
[2]Lebedev Physics Institute, 53, Leninskii prospect, Russian Academy of Sciences, Moscow, Russia

March 22, 2012

Abstract

We present results of two dimensional simulations of the Weibel instability arising from collisionless shock formation simlar in scale to those seen in astrophysics. In this paper, using 2D particle-in-cell simulations, we present the interaction of a sub-relativistic, laser-generated neutralized proton beam with a preformed plasma of the same density. Our major interest is to study the energy transfer from the ion stream to the electrons, electric and magnetic fields under the conditions where the particle collisions do not play any role. The origin of the strong electron heating and ion slowing down is the Weibel-like beam filamentation driven by the ion drift. The process of collisionless shock formation is explained by a stochastic electron heating followed by generation of quasistatic electric field. This yields insight on the processes occurring in the interstellar medium (ISM) and gamma-ray burst afterglows.