Multicomponent plasma expansion into vacuum in the presence of non-Maxwellian electrons

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The expansion of a collisionless plasma into vacuum has been widely studied since the early works of Gurevich *et al* [1] and Allen and coworkers [2]. It has received momentum in recent years, in particular in the context of ultraintense laser pulse interaction with a solid target [3-5].

In most present day experiments, laser produced plasmas contain several ion species, due to increasingly complicated composite targets. Anderson *et al* [6] have studied the isothermal expansion of a two-ion-species plasma. As in most earlier works, the electrons were assumed to be isothermal throughout the expansion. However, in more realistic situations, the evolution of laser produced plasmas into vacuum is mainly governed by nonthermal electrons. These electrons are characterized by particle distribution functions with high energy tails, which may significantly deviate from the Maxwellian distribution [7].

In this contribution, we present a theoretical model for the free expansion of a two-ion plasma into vacuum. The electron population, assumed to be in a nonthermal (non-Maxwellian) state, is modelled by a kappa-type distribution function [7]. The effect on the ion density, velocity and the electric field is investigated. It is shown that energetic electrons have a significant effect on the expansion dynamics of the plasma. Various special cases are considered, as regards the relative magnitude of the ion mass and/or charge state.

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