Ion-acoustic solitons in the kinetic description of the electron component of collisionless nonisothermal plasma

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Based on the Vlasov equation for describing the electron component, the nonlinear motion of collisionless nonisothermal plasma is investigated. Under the condition of an appropriate choice of the velocity distribution function of trapped electrons, it corresponds to an ion-acoustic soliton in the Sagdeev formulation in a plasma model with a Boltzmann electron energy distribution and ions described by the equations of cold hydrodynamics. Correspondence is achieved when the contribution of trapped electrons to the total concentration of plasma electrons located in the soliton region compensates for the terms with fractional powers in the expansion series in terms of the scalar potential of the concentration of passing electrons.
The ion-acoustic soliton in the Sagdeev formulation and the corresponding soliton in the kinetic description of the electron component of plasma have practically identical characteristics in all parameters except for the electron current. The kinetic approach to the study of nonlinear motion of nonisothermal collisionless plasma based on the Vlasov equation reveals the presence of a current of passing electrons in the ion-acoustic soliton, which is a consequence of the lack of symmetry of the distribution function of passing electrons. The current of passing electrons is comparable in magnitude to the current of trapped electrons and redistributes plasma electrons during the propagation of a soliton in it in such a way that the quasi-neutrality of the plasma after the passage of the soliton is preserved.
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