Higher-Order Nonlinear Effects on Wave Structures in a Multispecies Plasma with Nonisothermal Electrons

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In the present investigation, we have studied ion-acoustic solitary waves in a plasma consisting of warm positive and negative ions and nonisothermal electron distribution. We have used reductive perturbation theory (RPT) and derived a dispersion relation which supports only two ion-acoustic modes, viz. slow and fast. The expression for phase velocities of these modes is observed to be a function of parameters like nonisothermality, charge and mass ratio, and relative temperature of ions. A modified Korteweg-de Vries (KdV) equation with a (1+1/2) nonlinearity, also known as Schamel-mKdV model, is derived. RPT is further extended to include the contribution of higher-order terms. The results of numerical computation for such contributions are shown in the form of graphs in different parameter regimes for both, slow and fast ion-acoustic solitary waves having several interesting features. For the departure from the isothermally distributed electrons, a generalized KdV equation is derived and solved. It is observed that both rarefactive and compressive solitons exist for the isothermal case. However, nonisothermality supports only the compressive type of solitons in the given parameter regime.

Key words: Ion Acoustic Solitons; Multispecies Plasma; Nonisothermal Distribution; Renormalization Technique.