NONLINEAR ELECTROSTSTIC STRUCTURES IN HOMOGENEOUS AND INHOMOGENEOUS PAIR-ION PLASMAS

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The nonlinear electrostatic structures such as solitons, shocks were studied in homogeneous, unmagnetized pair-ion plasma. The dissipation in the system was taken through kinematic viscosities of both pair-ion species. The one dimensional (Korteweg-de Vries-Burgers) KdVB equation was derived using reductive perturbation method. The analytical solution of KdVB equation was obtained using tanh method. It was found that solitons and monotonic shocks structures were formed in such type of plasmas depending on the value of dissipation in the system (Fig. 1). Both compressive and rarefactive structures of solitons and monotonic shocks were obtained depending on the temperatures of negative and positive ions. The oscillatory shock structures in pair-ion plasmas were also obtained and its necessary conditions of formation were discussed. The acoustic solitons were also investigated in inhomogeneous unmagnetized pair-ion plasmas. The Korteweg-de Vries (KdV) like equation with an additional term due to density gradients was obtained by employing the reductive perturbation technique. It was found that amplitude of both compressive and rarefactive solitons was found to be enhanced as the density gradient parameter was increased. The Landau damping rates of electrostatic ion waves were studied for non-Maxwellian or Lorentzian pair-ion plasmas. The Valsov equation was solved analytically for weak damping effects in pair-ion plasma. It was found that Landau damping rate of ion plasma wave was increased in Lorentzian case in comparison with Maxwellian pair-ion plasmas. The numerical results were obtained by taking into account the parameters of pair-ion plasmas produced in laboratory experiments, Japan [1, 2].

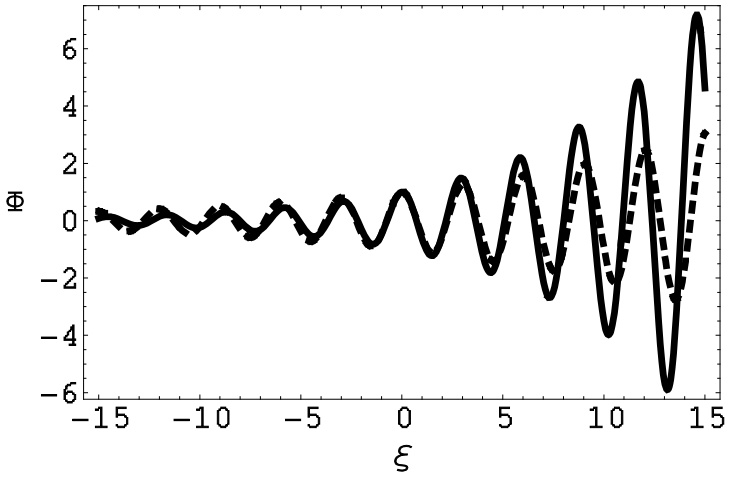

Fig. 1 The oscillatory shock structures in pair-ion plasmas, when +ve ion temperature is greater (solid curve) and smaller (dotted curve) than negative ion temperature, where Φ is normalized potential and ξ is normalized space coordinate

References

1. W. Oohara and R. Hatakeyama, Phys. Rev. Lett. **91** (2003) 205005.
2. W. Oohara, Y. Kuwabara and R. Hatakeyama, Phys. Rev. E **75** (2007) 056403.