Abstract

In many physical situations where a laser or electron beam passes through dense plasma, hot low-density electron populations can be generated, resulting in a particle distribution function consisting of a dense cold population and a small hot population. Presence of such low-density electron distributions can alter the wave damping rate. Kinetic model is employed to study the Landau damping of Langmuir waves when a small hot electron population is present in the dense cold electron population with non-Maxwellian distribution functions. Departure of plasma from Maxwellian distributions significantly alters the damping rates as compared to the Maxwellian plasma. Strong damping is found for highly non-Maxwellian distributions as well as plasmas with higher dense and hot electron population. Existence of weak damping is also established when the distribution contains broadened flat tops at the low energies or tends to be Maxwellian. These results may be applied in both experimental and space physics regimes.

Using non-Maxwellian generalized (r, q) distribution function electron acoustic instability has been investigated in magnetized and unmagnetized four component plasma. We analyzed electron velocity distribution function using Cluster data when Cluster was traversing from the dayside mid-latitude cusp to plasma sheet boundary region in the southern hemisphere. Observed distribution is fitted with the generalized (r, q) distribution, and the values of spectral indices for cold, hot and beam electron components obtained from fitting are used in the numerical results. We then investigated the effects of beam density, beam temperature, beam velocity and propagation angle on the real frequency and growth rate of the EAW for both magnetized and unmagnetized cases. These results are compared with Maxwellian results and found that using observed distribution and plasma parameters, real frequency and growth rate remain higher than the Maxwellian or kappa values exhibit significantly different behavior from the ideal conditions.

Nonlinear Landau damping of Langmuir waves in two electron component plasma is studied. The numerical results show a significant difference between the Maxwellian and non-Maxwellian instantaneous damping rates when generalized (r, q) distribution function is used. Normalized amplitude of the nonlinear damping rate for the generalized (r, q) distribution function and also for Maxwellian distribution remain high when the distribution contains two electron populations as compared to one electron population. It is found that maximum instantaneous amplitude for generalized (r, q) distribution function is higher than the Maxwellian instantaneous amplitude.