ABSTRACT

The in-situ observations of space plasmas reveal that the anisotropic velocity distributions usually show skewness rather than symmetry and possess tails in direction of background magnetic field. This kind of asymmetry can be addressed by introducing a hybrid non-Maxwellian distribution function named as kappa-Maxwellian distribution function. The employment of hybrid kappa-Maxwellian distribution seems to alter the dispersion characteristics of plasma waves dramatically in comparison to bi-Maxwellian distribution or bi-kappa distribution because of its different structure. In this dissertation, the hybrid kappa-Maxwellian distribution function is employed to investigate the dispersion characteristics of EMEC waves that are ubiquitous in space plasmas and may be driven by streaming electrons or kinetic anisotropies.

The sensitivity of wave growth rate to various plasma parameters of auroral region has been investigated by solving the modified general dispersion relation of EMEC waves numerically. It has been found that growth rate is obtained only when drift speed of trapped electrons exceeds some threshold value. The presence of suprathermal particles in the velocity distributions indicates the highly nonthermal state of plasma having large amount of free energy which is expected to enhance the kinetic instabilities. However, most of studies on EMEC waves using bi-kappa model showed the inhibiting effect of suprathermal particles on the instability. To address this issue in kappa-Maxwellian plasma, two variants of kappa-Maxwellian model named model-I and model-II have been employed to investigate the effects of suprathermal particles on EMEC instability. Numerical results showed that that model-I truly depicted the destabilizing effect of suprathermal particles on instability rather than the model-II in contrast to bi-kappa model.

In space plasma, electric field connected to wave phenomenon was first predicted by Alfven and Falthammar and according to numerous observations such an electric field occurs mainly along the background magnetic field. Over a couple of decades this electric field has been regarded as an important constituent of auroral plasma. The presence of electric field therein may affect the morphological features of EMEC waves induced by streaming electrons. Thus the effect of parallel electric field and trapped electron speed and their interplay on the dispersion characteristics of EMEC waves by using kappa-

Maxwellian distribution in auroral plasma has been presented. Parallel electric field has been found to act as another source of free energy for the excitation of instability and growth can be obtained even when the electron drift speed is zero. However, when electron drift speed surpasses certain threshold value, it controls the instability.

Different regions of earth's magnetosphere such as auroral zone and radiation belts possess relativistic electrons which cause the excitation of various kinds of electromagnetic instabilities like cyclotron maser instability or Whistlers. The investigation of EMEC waves induced by these relativistic electrons requires relativistic treatment. Thus we present the investigation of EMEC waves induced by trapped relativistic electrons in kappa-Maxwellian distributed auroral plasma. Moreover, the dispersion relation has been solved numerically to unveil the relativistic effects on the wave growth rate and to give a comparison between relativistic and non-relativistic limits. In conclusion, relativistic approximation provides higher growth rate and causes reduction in the wave frequency which corresponds to maximum growth. The relativistic effects have been found to be more noticeable at smaller values of drift speed of trapped electron and perpendicular thermal velocity.