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PIC simulations of a three component plasma described by Kappa distribution functions as observed in Saturn's magnetosphere

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In plasmas out of thermodynamic equilibrium the particle velocity distribution can be described by the so called Kappa distribution. These velocity distribution functions are a generalization of the Maxwellian distribution. Since 1960, Kappa velocity distributions were observed in several regions of interplanetary space and astrophysical plasmas.
Using KEMPO1 particle simulation code, modified to introduce Kappa distribution functions as initial conditions for particle velocities, the normal modes of propagation were analyzed in a plasma containing two species of electrons with different temperatures and densities and ions as a third specie.This type of plasma is usually found in magnetospheres such as in Saturn. Numerical solutions for the dispersion relation for such a plasma predict the presence of an electron-acoustic mode, besides the Langmuir and ion-acoustic modes. In the presence of an ambient magnetic field, the perpendicular propagation (Bernstein mode) also changes, as compared to a Maxwellian plasma, due to the Kappa distribution function. Here results for simulations with and without external magnetic field are presented. The parameters for the initial conditions in the simulations were obtained from the Cassini spacecraft data. Simulation results are compared with numerical solutions of the dispersion relation obtained in the literature and they are in good agreement.