SYNOPSIS

Index No: **243/15/Phys./24**

Title of Thesis: Theoretical estimation of cross field interaction in plasma

Plasma is an ionized gas where sufficient energy is provided to free electrons from atoms or molecules and to allow both ions and electrons to coexist. In order to understand the phenomena in a certain plasma region, it is necessary to map not only the magnetic but also the electric field. The interaction of these two fields in plasma produces a drift mode, the **E** x **B** drift which generally slowed down by neutral drag. The drifts cause asymmetries in the plasma equilibrium. The basic results can be understood by dividing the drifts into three categories diamagnetic, **E** x **B**, and Δ**B**. The dominant effect near the divertor plates is from the **E** x **B** drifts, while the weaker Δ**B** drifts cause an increase in the magnitude of the radial electric field. The study of such waves is important in magnetically confined inhomogeneous plasma devices because low frequency unstable drift wave instabilities reduce plasma confinement. On the other hand at plasma boundaries in upper atmosphere, lower hybrid drift waves (LHDWs) are often seen. The LHDW are mainly electrostatic current aligned waves, propagating perpendicularly to the ambient magnetic field. The free energy that drives these waves exists in density gradients and magnetic field gradients. Many studies of the LHDW have been done, both in space and in laboratory. In this thesis the investigations are concerned with the observation of drift waves in the low frequency domain. Here, we consider three different cross field interactions in different plasma regions.

The first problem consists of a finite density gradient and magnetic shear in a resistive domain where an analytical model of the **E** x **B** or drift instability for plasmas in plane slab geometry is proposed. A differential equation has been derived, gives an eigen mode which is shifted off the mode rational surface whereas the sheared magnetic field localizes the mode structure about the rational surface in the stabilized region. It is observed that magnetic sheared-driven stabilization of the growth rate occurs which is weakly dependent on the collision frequency at a smaller wavenumber region.

Here, in the second problem we have investigated the dynamics of waves that propagate in plasma of auroral ionosphere. The model we have consider contains stationary ions, cold electron fluid, neutrals, and hot electrons. Here, it has been shown that drift modes associated wi.h lower-hybrid and electron-acoustic waves become stable under the influence of ion collisional damping by the cold electrons, but that unstable waves can develop when the electrons in the system are warm. At the same time it has been shown that lower-hybrid drift dissipative wave is not affected much in the presence of cold electrons. Finally, it means, that when the solar activity will very high the aurora generates in the higher latitude will affect more through the electron acoustic drift-dissipative mode.

In the third problem, momentum, trace impurity transport, and intrinsic rotation in tokamaks is trying to be studied using an electrostatic, collisionless fluid model for ion-temperature-gradient and trapped-electron mode driven turbulence in presence of radio frequency fields in the lower hybrid range of frequencies. The four-wave parametric process involving a lower hybrid source wave and ion temperature gradient (ITG) mode and lower hybrid sidebands, respectively, are considered. Explicit expressions for the non-linear growth rate and the associated ion thermal conductivity are derived. The parametric coupling between the pump wave and ITG produce sideband waves in the lower hybrid range of frequencies are trying to be studied. The pump and the sidebands exert a ponderomotive force on electrons, modifying the eigenfrequency of the drift wave and influencing the growth rate.

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