Abstract

In this thesis we study the parametric decay instability problem (three wave interactions) in classical and quantum magneto-plasmas. Two combinations of the three wave interactions have been investigated. First, the parametric decay instability of upper hybrid wave into low-frequency electromagnetic shear Alfven wave and Ordinary mode radiation has been solved in an electron-ion plasma immersed in uniform external magnetic field. Incorporating quantum effect due to electron spin, the fluid model has been used to investigate the linear and nonlinear response of the plasma species. It is shown that the spin of electrons has considerable effect on the three-wave coupling interactions even in classical regime.

Secondly, the electron spin -1/2 effects on the parametric decay instability of oblique Langmuir wave into low-frequency electromagnetic shear Alfven wave and left-handed circularly polarized wave (LHCP) has been investigated in an electron-ion quantum plasma immersed in uniform external magnetic field. Incorporating the quantum effects due to electron spin, Fermi pressure and Bohm potential term, the quantum magneto-hydrodynamic (QMHD) model has been used to investigate the linear and nonlinear response of the plasma species for three-wave coupling interaction in a quantum magneto-plasmas. Nonlinear dispersion relations and growth rates have been derived analytically. It has been shown that the spin of electrons has considerable effect on the growth rate of parametric instability problem even when the external magnetic field B_0 is below the quantum critical magnetic field strength $B_Q = 4.4138 \times 10^{13} G$.

Finally, the parametric decay instability of oblique Langmuir wave into low-frequency electromagnetic shear Alfven wave and LHCP have also been investigated in high density (quantum) and low density (classical) magneto-plasma environments. QMHD model has been used to find the linear and non-linear response of the high density quantum magneto-plasma, and to compare the results with the low density classical plasma we have used classical limit $(\hbar \to 0,\ P_e \to P_{te})$ in the results of QMHD model. Nonlinear dispersion relations and growth rates of the problem have been derived analytically. The growth rate both for quantum and classical magneto-plasma environments has been plotted. The normalized growth rate as a function of number density in the high density degenerate magneto-plasmas increases exponentially while in the low density classical magneto-plasmas it increases logarithmically.