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| Ph. D. Thesis Title: | Self Organization in Plasmas in Interstellar Space and Laboratory |
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## ABSTRACT


The thesis deals with three and four wave parametric processes in plasmas with special reference to radio frequency heating in magnetically confined plasmas and laser produced plasmas.

An analytical formalism of oscillating two stream instability of a large amplitude electromagnetic wave in the ion cyclotron range of frequency in a plasma is developed. The instability produces electrostatic ion cyclotron sidebands and a driven low frequency mode. The nonlinear coupling arises primarily due to the motion of ions and is strong when the pump frequency is close to ion cyclotron frequency and the oscillatory ion velocity is a significant fraction of acoustic speed.

Parametric decay of a large amplitude electromagnetic wave in the ion cyclotron range of frequency into a compressional Alfven wave and an electromagnetic sideband wave in a magnetized plasma has been investigated. The pump wave propagates in the direction of ambient magnetic field whereas the decay waves propagate at oblique angles. When the pump wave is left circularly polarized the decay is not permitted kinematically

as the momentum of pump photon always exceeds the sum of momenta of the decay wave photons. For the right circularly polarized whistler mode pump the decay is permitted with sideband nearly right circularly polarized. The frequency and growth rate of the Alfven wave increase with the normalized pump frequency.

A local and non-local theory of four wave parametric processes of plasma wave via oscillating two stream instability by a laser pulse has been developed. The plasma wave couples to two short wavelength plasma wave sidebands. The pump plasma wave and the sidebands exert a pondermotive force on the electrons driving a low frequency quasimode. At large pump amplitude, the instability grows faster than the ion plasma frequency and the ions do not play a significant role. The growth rate is maximum for an optimum wave number of the quasi-mode and also increases with the pump amplitude. Nonlocal effects, however reduce the growth rate by about half. The parametric instability is relevant to laser wakefield accelerator.

We also explore the parametric instability of a lower hybrid wave in a two-ion species plasma. The pump decays into a low frequency mode or quasi mode in the ion cyclotron range of frequency and a lower hybrid wave sideband. The dominant channel of decay is the one for which the low frequency mode is an ion cyclotron wave with frequency $\omega$ close to the ion cyclotron frequency of either ion species. For a typical D-T plasma of a tokamak, the growth rate, for $\omega$ close to deuterium cyclotron frequency, increases with the wave number of the ion cyclotron wave and decreases as the ratio of deuterium to tritium density increases.