In recent years significant progress in satellite-based observations of plasma states and associated electromagnetic phenomena in space have resulted in the accumulation of much evidence of various plasma instabilities. Plasma instabilities are believed to be responsible for electromagnetic radiation as well as for many of the macroscopic dynamics of plasmas in space.

Parametric instabilities have been currently recognised as widely occurring nonlinear phenomena. Under an action of a strong high frequency electromagnetic or electrostatic pump various plasma oscillation modes may become coupled, and may grow in time and space before being saturated at large amplitudes. It is due to this nonlinear plasma response that the external energy is converted into the plasma internal energy, thereby heating the plasma. From this point of view alone, the study of nonlinear effects also establish their importance.

In the present thesis, we have investigated some of the nonlinear wave interactions in plasmas. Taking the pump to be an electrostatic ion cyclotron wave, the parametric excitation of a kinetic Alfvén wave has been studied.

The generation of electromagnetic radiation by an electrostatic lower-hybrid pump wave and upper-hybrid pump wave respectively has also been investigated. The effect of a finite
ion temperature on the nonlinear mode conversion in a two
electron temperature plasma has been analytically investigated
using the fluid theory and the concept of ponderomotive inter-
actions.

Stimulated Brillouin scattering is one of the
important methods of studying collective modes in plasmas.
Stimulated Brillouin scattering is caused due to the electro-
striction and due to the presence of second order nonlinearities
in the basic equations. This study has been done taking the
pump as a magnetosonic wave in a multi-ion species plasma. The
effect of the presence of the second ion species has been analyzed

We have in this thesis studied the low frequency
electrostatic waves which are characterized by a wide spectrum
of frequencies. Waves of this nature are found at low attitudes
in the auroral regions, in the earth's distant magnetosphere, on
auroral field lines, on boundaries such as the plasma pause and
the plasma sheet boundary layer, in the magnetotail and the
dayside magnetosheath. Anomalous plasma heating has also been
reported in JFT-2 experiments, Wega, MTX tokamak, ProtoCleo
Stellarator, ELMO Bumpy Torus experiments etc. Our study may
be useful in understanding nonlinear interactions taking place
in space plasmas.