Abstract

In this thesis, author has studied ion-acoustic wave (IAW), dust-acoustic wave (DAW) and electron-acoustic wave (EAW) in multi-species plasma with different environments. Reductive perturbation method (RPM) and Sagdeev pseudopotential method have been used to study the small as well as large amplitude solitary wave structures respectively. Some problems are dedicated to the study of KdV solitons and envelope excitations in electron-positron-ion (e-p-i) plasmas. The nonlinear and dispersion coefficients of the Korteweg-de-Vries (KdV) equation are the function of number of parameters such as ratio of densities of positron and electron, relative temperature ratio of electrons to positrons and relativistic factor. Relativistic effects are more pronounced for equal electron-positron temperature but less relative density ratio. Further, the effect of magnetic field and ion temperature on the amplitude and width of solitons have also been studied. It is observed that presence of hot ions (external magnetic field) enhances the amplitude (width) of the solitons. Effect of these parameters on the envelope excitations with different type of distributions under different environments have also been studied in such plasma system. Nonlinear Schrödinger equation (NLSE) has been derived by using RPM. Different regions of stability and instability of excitations have been found which are significantly influenced by the plasma parameters. Both dark as well as bright envelope excitations occur in all the cases.

Author has investigated the effect of charged dust and ion temperature on the modulational instability (MI) of electrostatic (ES) envelope excitations in electron-positron-ion plasma in the presence of dust
particulate. The influence of the relevant physical parameters (ion temperature, dust and positron concentrations) on the dynamics of ES envelope excitations has been traced by observing the effect of these parameters on the instability domain. Further, the amplitude modulation of quantum ion-acoustic waves (QIAWs) in the presence of an external magnetic field is studied in a quantum electron-positron-ion magnetoplasma. Reductive perturbation technique (RPT) is used to derive the three-dimensional (3D) NLSE equation which governs the slow modulation of QIAW packets. Accounting for the effects of the electron to ion number density ratio, the normalized ion-cyclotron frequency as well as the ratio of the “plasmonic energy density ” to the Fermi energy, new regimes for the modulational instability of QIAWs are obtained and analyzed. It is also observed that the magnetic field effectively changes the stable and unstable regimes.

In two problems, dust-acoustic waves in four-component dusty plasma with superthermal electrons/ions have been studied. It is observed that coefficients of the KdV equation and Sagdeev potential $V(\phi)$ are the function of the number of physical parameters which significantly change the amplitude and width of the solitons. Further, the effect of these parameters on the envelope excitations also have been observed. With the addition of the positive dust, the MI sets at lower wave number. Similar behavior is observed for superthermality of electrons. But the trends is in contrast for the superthermality of ions. In the last problem, small amplitude electron acoustic solitons in an inhomogeneous plasma system have been studied. The modified Korteweg-de Vries (m-KdV) equation is derived which reduced to a simple form with the help of suitable transformation into a simple well known KdV equation. It is observed that the coefficients of the KdV equation depend upon the temperature, velocity of the cold electron and number density of the hot and cold electrons which have a strong effect on the amplitude and width of the solitons.