Abstract

The primary orientation of this thesis is to explore some interesting features of static and dynamic potentials in magnetized quantum plasmas including the dust dynamics in the presence of wave field associated with different modes. These modes may be electrostatic in nature. These investigations find significance applications in small and large scale plasmas. This thesis contains some new extensions to dust-lower-hybrid modes in quantum dusty plasmas.

In chapter II, the effect of strong ambient static magnetic field on Shukla-Nambu-Salimullah (SNS) potential in a dusty quantum magnetoplasma has been investigated using quantum hydrodynamic (QHD) model. The potential is significantly modified by quantum statistical effects, density inhomogeneity and dust polarization drift effect. It is found that dust polarization drift effect pre-dominates the ion polarization drift effect in high magnetic field environments. The potential around a static test charge has been plotted for different parameters in high density quantum magnetoplasmas. We have seen that for increasing values of number density and inhomogeneity scale length, the modified SNS potential decreased due to the decrease in the Fermi Debye length.

Subsequently using the quantum hydrodynamic model for quantum magnetoplasmas, the Shukla–Nambu–Salimullah shielding potential and the far-field dynamical wake potential in a quantum dusty plasma with a nonuniform density and static magnetic field have been investigated in chapter III. The short-range screening potential and the long-range oscillatory wake potential are found to be significantly affected by the nonuniformities in the density and the static magnetic field. It is seen that SNS and oscillatory wake potentials increases with the increase of external magnetic field and for increasing values of number density and inhomogeneity scale length, the amplitude and effective length of wake potential decreased. The far-field oscillatory wake-field potential can explain attraction among the same polarity charges leading to the possible ordered structures or coagulation in the inhomogeneous quantum dusty magnetoplasma.

Finally in chapter IV, the dispersion relation of the dust-lower-hybrid wave has been derived using the quantum hydrodynamic model of plasmas in an ultracold Fermi dusty plasma in the presence of a uniform external magnetic field. The dust dynamics, electron Fermi temperature and the quantum correction give rise to significant effects on the dust-lower-hybrid wave of the magnetized quantum dusty plasmas. Numerically it is found that frequency of the quantum dust-lower-hybrid wave increases with increasing wavenumber and with the increase of magnetic field at the small angle of propagation. The summary and conclusions are in the end of the thesis.