English Summary

Title: Study of Dust-Acoustic Waves and Double-Layers in a Non-Ideal Dusty Plasma

Student name: **kawkab Ali Mohammed Ali Al_Sa'adi**

Summary

In this thesis, the small-amplitude dust-acoustic (DA) solitary waves and double layers structures of the dust-acoustic waves have been investigated in the framework of Gardner approach, in a non-ideal dusty plasma system consisting of electrons, ions and negatively charged dust grains. The non-ideal effects are examined by incorporating the van der Waals equation of state for the dust grains. The Gardner's equation that describes the nature of the DA solitary waves and double layers structures is derived using reductive perturbation technique. The current non-ideal dusty plasma model admits only rarefactive DA solitary waves. The existence regions for double layers structures in the current plasma model is investigated numerically in the presence of thermal and superthermal electrons and ions. It is found that due to the existence of superthermal electrons and ions in such dusty plasma model, the domain of the existence of DA double layer structures is enhanced. The effects of the non-ideal parameters as well as ion and electron superthermally on the evolution of DA solitary waves and double layer structures are investigated in some detail. It is found that the amplitude and width of both solitary waves and double layers are significantly modified by the non-ideal parameters as well as ion and electron superthermally. Also, it is shown that the wave phase velocity undergoes a significant change due to the presence of non-ideal effects in

the plasma system. In the presence of thermal electron and ion, the non-ideal dusty plasma model admits only compressive DA double layers. Additionally, it has been found that the contribution of ion component superthermally can lead to the formation of the either compressive or rarefactive double layers depending on the values of the superthermal index.

Moreover, the DA solitary waves and formation of electrostatic double layers structures have been studied in this thesis, in a non-ideal magnetized dusty plasma consisting of some electrons, positive ions, negative ion and positively charged dust grains. The positive charge on the grains is considered to be achieved by replacing (most of) the plasma electrons with negative ions of a larger mass than the positive ions. The non-ideal effect is modeled by incorporating the van der Waals equation of state in the momentum equation of dust component. Using reductive perturbation technique, the modified Zakharov–Kuznetsov equation was derived for small amplitude regime, in the presence of dust charge variation. The modified Zakharov–Kuznetsov equation is analyzed to examine the existence regions of the solitary waves and double layers. It is found that the solitary waves and double layers structures strongly depend on the non-ideal parameters, variation of dust charge, magnetic field strength, and the wave propagation angle. The presence of variation of dust charge in such dusty plasma model is necessary for the formation of electrostatic double layers structures. Because there is some free electrons in this plasma model, the effect of dust charge variation becomes more important. Further, it is found that for large values of non-ideal parameter (i.e., α), there is a possibility of negative double layers existing. The magnetic field strength as well as the propagation angle only changes the width of the double layers structures.