

## Abstract

The thesis studies the behavior of small amplitude solitons in a multi-species plasma containing dust impurity and characterized by kappa distributed two-temperature electrons. By applying a reductive perturbation method, the study derives equations such as the Kadomtsev–Petviashvili (KP), modified KP, and coupled KP equations. Through the application of a single-variable transformation, solutions for these equations are obtained to analyze how various plasma parameters and higher-order effects impact the properties of dust ion-acoustic (DIA) solitons. The scope of investigation also encompasses determining the range of parameters in which positive and negative potential solitons exist, using insights from the nonlinear coefficient of the KP equation. Additionally, the thesis delves into the stability analysis of soliton solutions derived from the KP, MKP and CKP equations. Notably, the study underscores that diverse physical parameters play a significant role in shaping the characteristics of distinct types of small amplitude DIA solitons.