Contribution of Higher-Order Dispersion to Nonlinear Dust Ion Acoustic Waves in Inhomogeneous Mesospheric Dusty Plasma with Dust Charge Fluctuation

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The propagation of dust ion acoustic waves (DIAWs) in a weakly inhomogeneous, weakly coupled, collisionless, and unmagnetized four components dusty plasma are examined. The fluid system considered in this work consists of cold positive ions, cold negatively and positively charged dust particles associated with isothermal electrons. For nonlinear (DIAW) waves, a reductive perturbation method was employed to obtain the variable coefficients Kortewege-de Vries (KdV) equation for the first-order potential. For local inhomogenity, the present system admits the coexistence of rarefactive and compressive solitons. As a matter of fact, when the wave amplitude enlarged, the width and velocity of the wave deviate from the prediction of the KdV equation. It means that we have to extend our analysis to obtain the variable coefficients Kortewege-de Vries (KdV) equation with fifth-order dispersion term. For locally constant parameters, the higher-order solution for the resulting equation has been achieved via what is called perturbation technique. The effects of positive and negative dust charge fluctuations on the higher-order soliton amplitude and width of electrostatic solitary structures are outlined.

Key words: Inhomogeneous Dusty Plasma; Dust Ion Acoustic Waves; Positive and Negative Dust Charge Fluctuation; Variable Coefficients KdV Equation; Higher-Order Solution.