The Effect of Higher-Order Corrections on the Propagation of Nonlinear Dust-Acoustic Solitary Waves in a Dusty Plasma with Nonthermal Ions Distribution

Hesham G. Abdelwahed, Emad K. El-Shewy, Mohsen A. Zahran, and Mohamed T. Attia

Theoretical Physics Research Group, Physics Department, Faculty of Science, Mansoura University, Mansoura, P. O. Box 35516, Egypt

Reprint requests to M. A. Z.; E-mail: m_zahran1@mans.edu.eg

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Propagation of nonlinear dust-acoustic (DA) waves in a unmagnetized collisionless mesospheric dusty plasma containing positively and negatively charged dust grains and nonthermal ion distributions are investigated. For nonlinear DA waves, a reductive perturbation method is employed to obtain a Korteweg-de Vries (KdV) equation for the first-order potential. As it is well-known, KdV equations contain the lowest-order nonlinearity and dispersion, and consequently can be adopted for only small amplitudes. As the wave amplitude increases, the width and velocity of a soliton can not be described within the framework of KdV equations. So, we extend our analysis and take higher-order nonlinear and dispersion terms into account to clarify the essential effects of higher-order corrections. Moreover, in order to study the effects of higher-order nonlinearity and dispersion on the output solution, we address an appropriate technique, namely the renormalization method.

Key words: Mesospheric Dusty Plasma; Dust-Acoustic Waves; KdV-Type Equation; Renormalization Method; Solitary Solution.