

Dust Acoustic Structure in Hybrid Nonthermal-Nonextensive Planetary Magnetospheric Plasmas

Sadiq Usman¹, Samra Azeem¹

¹University Of Wah, Wah Cantt., Pakistan

This study investigates the dynamics of dust acoustic solitons in a three-component, collisionless, unmagnetized dusty plasma consisting of negatively charged dust, Maxwellian ions, and electrons that adhere to a hybrid Cairns–Tsallis distribution. The research highlights how the nonthermal and nonextensive characteristics of the electron group, along with the impacts of polarization force, affect the size and extent of solitons. Utilizing the reductive perturbation technique, the Korteweg–de Vries equation that regulates the nonlinear acoustic waves in dust have been derived. It has been observed that the interaction among microscopic dust-particle forces, energetic particle distributions, and thermal imbalances helps in shaping the characteristics of dust acoustic solitary waves. The interplay of polarization effects and generalized electron distributions yields a more precise and physically meaningful depiction of solitary wave behavior in space plasmas.