Dust-acoustic solitary waves and shocks in nonthermal plasmas

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Low temperature plasmas containing massive charged dust particles are relevant in astrophysical and space environments (such as cometary tails, planetary rings, interstellar clouds and lower parts of Earth's ionosphere.) as well as in laboratory and technological studies [1-3]. The presence of these charged dusts in electron-ion plasmas modifies the propagation of dust ion-acoustic wave (DIAW) or dust-acoustic wave (DAW) depending on whether the charged dusts are static or mobile. The nonlinear propagation of such waves can give rise to the formation of solitons or shocks with negative or positive wave amplitudes. Furthermore, electrostatic solitary waves and shocks have been observed in several regions, including the Earths magnetotail, bow shock/solar wind, and polar magnetosphere [4]. Furthermore, the observations in space plasma environments indicate the presence of nonthermal or superthermal and trapped electrons and ions. Such nonthermal or trapped particles significantly alter the nonlinearity of a plasma system, thereby bringing momentous modification in the dynamical evolution of solitary and shock wave phenomena in dusty plasmas [5-8].
We present a theoretical investigation on the characteristics of small-amplitude dust-acoustic solitary waves and shocks in dusty nonthermal plasmas that are relevant in space and astrophysical plasmas. The influence of dust charge fluctuations, nonthermality and trapped particle distributions of electrons and ions on the propagation characteristics of DA waves and shocks are studied. The amplitude modulation of low-frequency electrostatic waves in dusty superthermal plasmas and its relevance in space plasmas are also studied.

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