Study of the characteristics of dust acoustic solitary waves and dust acoustic shock waves in electron free dusty space plasma

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In this paper a theoretical investigation of small amplitude nonlinear dust acoustic wave propagation in electron free Lorentzian dusty plasma has been studied considering positively charged cold, inertial dust grains and Kappa distributed inertia less positive and negative ions . Dust grains are positively charged as negative ion flux to the dust grains is less than positive ion flux because higher negative ion mass. OML theory has been used to calculate positive and negative ion currents. Charges on the dust grains is not fixed . This dust charge variation may be of adiabatic or non adiabatic type. For adiabatic dust charge variation dust charging frequency is very high compared to dust plasma frequency and hence dust charging time is very low which causes the grain charging very fast. On the other hand for nonadiabatic dust charge variation dust charging frequency is low compared to the case of adiabatic dust charge variation and hence the charging process is comparatively slower. In this paper both adiabatic and nonadiabatic dust charge variation has been considered. For adiabatic dust charge variation propagation of dust acoustic wave is governed by KdV equation possessing soliton solution whereas for nonadiabatic dust charge variation it is governed by KdV-Burger equation possessing shock solution. Numerically it has been found that for adiabatic dust charge variation in the permissible range of normalized grain charge number compressive dust acoustic soliton exists whose amplitude decreases and width increases with increasing number of suprathermal positive ions. If some region in such electron free dusty space plasma exists where number of suprathermal positive ions is fixed, increasing negative ion population will increase the amplitude and decrease the width of the compressive dust acoustic soliton. Numerical estimation also shows that for nonadiabatic dust charge variation in electron free ion-ion Lorentzian dusty plasma with positively charged dust grains, dust acoustic shock wave is monotonic. This montonicity is low for high suprathermal positive ion population.

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