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# Nonlinear Dust Acoustic Excitations in Non-Maxwellian Space Plasma

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Dust is an ineluctable ingredient in space and astrophysical environments. From the last many years, there has been a swiftly growing interest in understanding the physics of dusty plasma and associated low frequency dust acoustic modes because of their essential role in space and astrophysical plasmas (e.g., in planetary rings, interior of heavy planets etc) and in laboratory plasmas. On the other hand, it is revealed from the satellite data that high energy tail non-Maxwellian particles are most appropriate particles for modeling the space and astrophysical plasmas. Recently, there has been an increasing interest in the study of the effect of polarization force on the linear and nonlinear dust dynamics processes. Physically, the polarization force comes from the deformation of the spherical Debye screening of the dusty grains. The polarization force induced by non-Maxwellian hybrid ions is obtained. It is shown that the superthermality/non-thermality of background ions affect the Debye screening of dust grains as well as the polarization force significantly. The effects of this polarization force are significantly modified due to the presence of the non-Maxwellian ions. In particular, an increase in superthermality index of ions and nonthermal parameter leads to a decrease in polarization parameter. In this investigation, the modulational instability (MI) of dust acoustic waves under the influence of polarization force, which is induced by superthermal ions, are examined. Using the reductive perturbation method, the nonlinear Schrödinger equation that governs the MI of the DAWs is obtained. It is found that the effect of the polarization term $R$ is to narrow the wave number domain for the onset of instability. In Fig 1, the shaded (white) region is analogous to themodulationally unstable (stable) domain of the carrier wave. For any value of R, the boundary point between the shaded and the white region provides the relative values of the critical wave number kc. The boundary line between the shaded area (P/Q>0) and the white area (P/Q<0) provides the critical wave number $\mathbf{k_c}$ at particular R. The rise in R leads to the deviation of $\mathbf{k_c}$ for large values (i.e., the influence of R is to narrow the wave number region in the advent of instability). The amplitude of the wave envelope decreases as $R$ increases, meaning that the polarization force effects render weaker the associated DA rogue waves. The DA rogue wave profile is very sensitive to any change in the restoring force acting on the dust particles. The polarization force has emphatic influence on rogue waves profile. It is intensified that results of this investigation may be useful in understanding the nonlinear wave dynamics in the magnetospheres of planets, such as Jupiter and Saturn as observed by the Nozomi satellite. Moreover,, the role of polarization force on head-on collisions between the DA waves may not be ignored, because it plays an important role in understanding physical scenarios of dusty plasmas. Being motivated by the potentiality of the problems related to the astrophysical space, and laboratory plasmas, we have first time investigated head-on collision among the DA single- and multi-solitons and their phase shifts in polarized plasmas consisting of massive negatively charged mobile dust with non-Maxwellian ions distribution.The expressions for collisional phase shifts after head-on collision of two, four and six-($DA$) solitons are derived under the influence of polarization force. It is emphasized that the real implementation of our present results is in laboratory experiments as well as in different regions of space and astrophysical environments especially in Saturn's magnetosphere and comet tails, etc.

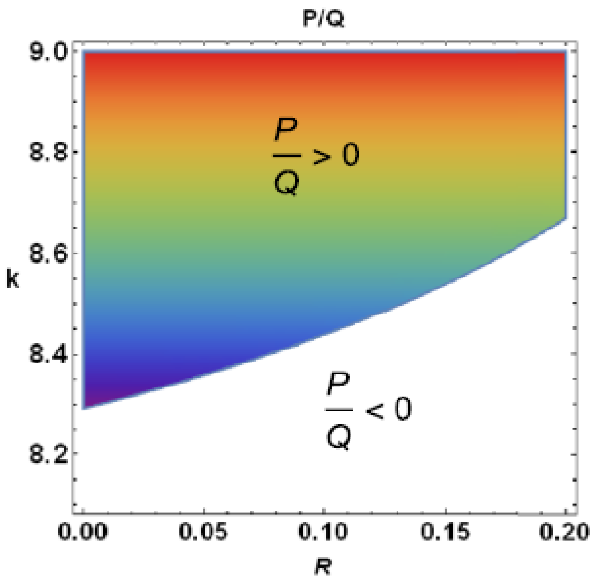


Fig. 1: Region plot of P/Q in k-R plane

References

K. Singh, N. Kaur, and N. S. Saini, Phys. Plasmas 24, 063703 (2017).

K. Singh, Y. Ghai, N. Kaur, and N. S. Saini, Eur. Phys. J. D 72, 160 (2018).

K. Singh, P. Sethi, and N. S. Saini, Phys. Plasmas 25, 033705 (2018)

K. Singh and N. S. Saini, Phys. Plasmas 26, 1137052(2019).