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2-D Nonlinear structures in a non-Maxwellian strongly coupled dusty plasma

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Dust is ubiquitously present in universe such as in the interplanetary space, interstellar clouds, noticulent clouds cometary tails, planetary rings etc. The existence of dust in an electron-ion plasma significantly modifies its characteristics and gives rise various modes in plasma. Dust acoustic waves are low frequency waves in which the inertia is provided by the dust and the inertialess electrons and ions provides the restoring force [1]. In a dusty plasma, the dust component is in a strongly coupled state because the interaction energy of neighboring dust particles due to shielded Coulomb forces is much larger than their thermal energy. Strongly coupled plasmas has attracted the attention of plasma community due of its applications in laboratory environments, such as electrons trapped on the liquid He surfaces, plasmas produced by the laser compression of matter, cryogenic traps containing charged particles, in condensed matter systems and in astrophysical objects such as supernova cores, neutron star crusts [2,3]. Davey–Stewartson-I equation is a generalization of the 1-D nonlinear Schrodinger equation in two dimensions that admits a dromion solution. Dromions find extensive applications in hydrodynamics, optics and plasma physics. Dromions are exponentially localized multidimensional (2-D) structures and in contrast to solitons can exchange energy but do not preserve their form upon interaction [4,5,6]. Various external agents such as wave-particle interaction and turbulence can cause the plasma to have non-thermal equilibrium. Thus, most of the plasmas in laboratory and space environments are often found to be deviated from thermal equilibrium and follow certain non-Maxwellian distributions. In this investigation, we have considered the dynamics of dust acoustic dromions in a non-Maxellian strongly coupled dusty plasma comprising of inertial dust fluid and non-Maxwellian electrons and ions are considered. By use of standard reductive perturbation technique, coupled nonlinear evolution equations of (2 + 1) dimensions are derived also known as Davey-Stewartson (DS-I) equation. In order to derive the analytical solution of the DS-I equations known as "Dromions", we have employed the Hirota bilinear method. The effect of various physical parameters such as dust density ratio, temperature ratio of electrons to dust etc. on the characteristics of dust acoustic dromions is studied. It is remarked that such physical parameters have great influence on the characteristics of Dromions. The present investigation might be useful to understand the underlying physics of nonlinear structures in outer space and laboratory.

References

[1] P. K. Shukla and A. A. Mamun, *Introduction to Dusty Plasma Physics*. IOP Publishing Ltd., Bristol. 2002.
[2] Nakamura, Experiments on ion-acoustic shock waves in a dusty plasma Phys. Plasmas,9, 440 (2002).
[3] V. E. Fortov, I. T. Takubov, and A. G. Kharpak, *Physics of Strongly Coupled Plasma*. Oxford, U.K.: Clarendon Press, 2006.
[4] M. Boiti, J. J. P. Leon, L. Martina, and F. "Pempinelli ,Scattering of localized solitons in the plane",Phys. Lett. A,132, 432–439,1988.
[5] N. S. Saini, Y. Ghai and R. Kohli, "Dust acoustic dromions in a magnetized dusty plasma with superthermal electrons and ions", Journal of Geophysical Research: 121(6), 5944–5958,2016.
[6]A. Davey and K. Stewartson "On three-dimensional packets of surface waves", Proc. R. Scoc. A., 338, 101, 1974.