Seminar

Institute for Plasma Research

Title : Collective phenomena in strongly coupled dusty plasma medium

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Time : 02.30 PM

Venue : Committee Room 3 (New Building), IPR

Abstract:

A simplified description of dynamical response of strongly coupled medium is desirable in many contexts of physics. The dusty plasma medium can play an important role in this regard due to its uniqueness, as its dynamical response typically falls within the perceptible grasp of human senses. Furthermore, even at room temperature and normal densities it can be easily prepared to be in a strongly coupled regime. In the present work the viscoelastic behaviour of the strongly coupled dust fluid has been described by the generalized hydrodynamic (GHD) fluid model. This model introduces strong coupling effects in terms of relaxation parameter τ_m and the viscosity η.
The dynamical response of any medium is best understood in terms of its collective behaviour. We, therefore, focus on the influence of strong coupling on certain collective properties, namely (i) Coherent structures (ii) instabilities and (iii) turbulent transport and mixing within the framework of the GHD model. We have shown numerically, in particular, for the smooth rotating vorticity profile the emission of transverse shear waves traveling with phase velocity $\sqrt{\eta/\tau m}$ as expected analytically from GHD model. It is observed that the existence of transverse shear waves in the GHD fluid significantly modifies the evolution characteristics of coherent structures. Our studies show that due to the existence of such transverse shear waves in the strongly coupled medium, the mixing and transport behaviour in these fluids are much better than in Newtonian hydrodynamic systems. Furthermore, it is demonstrated that the visco-elasticity of the strongly coupled medium leads to a suppression of the Rayleigh-Taylor instability. A conservation theorem has also been constructed, which gives an important tool to have an insight in our system. A detailed numerical simulation studies have been carried out to elucidate all these effects.

[1] P. K. Kaw and A. Sen. “Low frequency modes in strongly coupled dusty plasmas,” Phys. Plasmas 5(10), 3552 (1998).