Seminar

Institute for Plasma Research

Title : Collective phenomena in strongly coupled dusty plasma medium

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Date : 24 August, 2016 (Wednesday)

Time : 11.00 AM

Venue : Committee Room 4, (New Building), IPR

Abstract:

The visco-elastic 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 response of lighter electron and ion species to the dust motion is taken to be instantaneous i.e. inertia-less. Thus the electron and ion density are presumed to follow the Boltzman relation. In the incompressible limit (i-GHD) the model supports Transverse Shear wave in contrast to the Hydrodynamic fluids.

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 this effect.

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