Seminar

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Institute for Plasma Research

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Title: Breaking of Large Amplitude Electrostatic Waves in Inhomogeneous Plasmas

Speaker: Ms. Nidhi Rathee
Institute for Plasma Research, Gandhinagar

Date: 21st December 2022 (Wednesday)

Time: 10:30 AM

Venue: Seminar Hall, IPR

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Abstract

Study of large amplitude waves in a plasma and their breaking is a topic of intense research and is a subject of immense interest to both plasma physicists and astrophysicists. Since laboratory as well as naturally occurring plasmas are in general inhomogeneous, and are associated with magnetic fields, in the present thesis, spatiotemporal evolution of electrostatic waves in inhomogeneous, unmagnetized as well as magnetized plasmas is studied analytically using Lagrangian hydrodynamics, and numerically using in-house developed 1-1/2 D Sheet and Particle-in-Cell simulation codes. These waves have potential applications in plasma-based particle acceleration schemes, laser assisted fusion schemes, collisionless heating of laboratory plasma, heating of solar corona etc.

In unmagnetized plasmas, it is found that in contrast to the conventional wisdom, interplay between inhomogeneity and thermal pressure results in a critical value of electron temperature beyond which electrostatic waves do not break. This study has been further extended, albeit in the homogeneous case, to include the effect of warm ions on the wave breaking amplitude.

In magnetized plasmas, the effect of inhomogeneity (in both ion background and external magnetic field) on the spatiotemporal evolution of electrostatic mode *viz.* upper hybrid mode has been analyzed. It is found that irrespective of inhomogeneity in magnetic field and/or in background ion density, oscillation frequency of the mode becomes a function of space resulting in breaking of the excited wave/oscillation via the process of phase mixing. Inclusion of relativistic effects for the special case of homogeneous plasmas leads to a very interesting result; it is found that there exists a travelling wave solution, similar to the Akhiezer-Polovin mode in unmagnetized cold plasmas, which exhibits phase-mixing only when longitudinally perturbed. Further, in the non-relativistic limit, inclusion of ion motion using Zakharov formalism shows that the coherent motion is destroyed due to coupling between high frequency oscillations in electrons and low frequency oscillations in ions. In this talk the above results would be presented in detail.