Seminar

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Institute for Plasma Research

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Title: Linear and non-linear waves in spatially non-uniform 1D Vlasov-Poisson Plasmas

Speaker: Mr. Sanjeev Kumar Pandey
Institute for Plasma Research, Gandhinagar

Date: 04th July 2023 (Tuesday)

Time: 11:00 AM

Venue: Seminar Hall, IPR

Abstract

Excitation and evolution of electron plasma waves (EPW) has been a topic of extensive research for more than a century. Study of these waves in the presence of kinetic electrons and background finite amplitude ion density modulation poses interesting unsolved physics problems. For example, what will be the fate of linear and non-linear electron plasma wave (EPW) in the presence of immobile spatial ion non-uniformity? What will be the stability of such a system? What role does system size play on the dynamics of these EPW modes? Is it possible to couple an externally driven EPW mode to the plasma bulk via stationary ion inhomogeneity even when the phase velocity of the EPW mode is much larger than the bulk thermal speeds? What will happen to the EPW dynamics in the presence of inhomogeneous kinetic ions?

In the present study, several of the above mentioned problems are addressed using high resolution 1D1V Vlasov-Poisson (VP) simulations with capability to treat electrons and ions kinetically. In the first part of the presentation, evolution of linear as well as non-linear (large amplitude) EPW in the presence of simple immobile spatial ion equilibrium nonuniformity (constructed without any approximation) is addressed in different regimes and phenomena such as mode coupling, Landau damping, particle trapping and detrapping, trapped particle instability (TPI) and their interplay is demonstrated. Further, role of the system size on the temporal dynamics of the long-wavelength linear EPW mode is discussed. In the later part, numerical experiments are carried out to investigate the dynamics of driven electron plasma waves in the presence of immobile as well as kinetic inhomogeneous ions and coupling of externally driven EPW mode to the plasma bulk is discussed. Finally, several unresolved problems in this Thesis work are identified, pointing towards plausible future directions.