Seminar

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Institute for Plasma Research

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Title: Dynamics of Incoherent Nonlinear Waves in Plasmas

Speaker: Dr. Shatadru Chaudhuri
Jadavpur University, Kolkata

Date: 27th April 2023 (Thursday)

Time: 03:30 PM

Venue: Join the talk online:
https://meet.ipr.res.in/join/9988026549?be_auth=MDk2NTM0
(Conference ID: 9988026549; Password: 096534)

Abstract

Research in plasma physics, both theoretical and experimental, has been boosted due to the recent possibility of plasma fusion, which has an infinite possibility for an alternative source of energy. The classical, quantum and dusty plasma are being analyzed with emphasis on the nonlinear events in each case in order to attain an alternative source of energy. But in each situation, one is of supreme importance and in a very practical situation, it is almost impossible to guarantee uniform and constant density to start with. In other words, some inhomogeneity is always inhabitable and works as a source of incoherence. Such incoherence leads to a statistical fluctuation in the system as such one should consider ascertaining the stability in the nonlinear domain. This proposal is based on the analysis of the statistical stability that occurs in a nonlinear classical and quantum plasma, due to incoherence in the density of the various types of species in it. The formalism utilizes the Wigner quantization and the Moyal bracket. The effect of incoherence is taken into account by analyzing the time evolution of the density correlation function $<n(x,t)\ n*(x',t')>$. It turns out the resulting evolution equation is a new Nonlinear Schrodinger equation with quantum corrections, whose modulational stability is analyzed abinitio. Moreover, as the work is concerned with the nonlinear interactions occurring, in this regard it is quite necessary to analyze the dynamical behaviour of plasma system. In order to do the later, one needs a set of ordinary differential equations (ODE) while a theoretical model of plasma consist of partial differential equations. So, apart from executing the traditional reductive perturbation analysis, some new mathematical techniques needed to be applied, such as Galerkin approximation or three wave interaction method etc. The set of ODE's thus obtained can be solved numerically using various simulation methods to obtain the nature of equilibrium of the system and also in which condition the system can become chaotic. In fact the multistability is a fascinating phenomenon of a dynamical system which has been recently explored. Researchers can work experimentally on the multistable phenomena in plasmas, including the condition for coexisting attractors, the existence of chaos and its various related applications. The above-mentioned analysis is very important in order to know how to use plasma for controlled nuclear fusion or for the analysis of the nature of interstellar objects which are observed by space telescopes but many light years away from us.