Seminar

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Institute for Plasma Research

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Title: Study of Electrostatic and Electromagnetic Waves Instabilities in Plasma and Complex Plasma

Speaker: Dr. Amit Kumar
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Date: 06th September 2024 (Friday)

Time: 03.30 PM

Venue: Seminar Hall, IPR

Abstract

Our work presents the analytical and numerical results of the instability analysis of several wave modes due to existence of electrons, ions and dust grains in a plasma. Complex plasma is a low temperature plasma comprising dust particles of size ranges from nanometre to micrometre. In universe, dust -plasma systems are ubiquitous. Thus "Complex plasma" acquired the distinction of signifying the most general form of laboratory, space as well as industrial plasmas. The study of "Complex plasma" covers a wide range of topics from charging of dust grains, waves and instabilities to the creation of coulomb crystal.

Furthermore, due to plasma fluxes at its surface, a dust grain can be charged positively or negatively, depending on the charging mechanism involved. The significance of these dust grains charging processes is to alter some basic plasma properties and introduce wave excitation phenomena in plasma. In the present work, we present theoretical models of different waves & instabilities in dusty or complex plasma. For example, we present an analytical model on the generation of whistler wave by parametric instability in a complex plasma. The modification in the whistler wave excitation phenomena occurs due to the existence of dust grains. We also present the effect of dust grains on the parametric up conversion of lower hybrid wave into an ion cyclotron wave and a side band wave in two ion species tokamak plasma. The presence of negatively charged dust grains, their shape, size, radius and density influence the instability. The growth rate of instability is calculated and it is observed that the growth rate increases with the relative density of dust grains, number density of dust grains, oscillatory velocity of electrons as well as amplitude of pump waves. However, the growth rate decreases with the increase in size of dust grains and electron cyclotron frequency. Also, the study on Weibel instability due to temperature anisotropy of electrons and ions in a plasma is reported in the presence of cold as well as warm ions. Numerical calculations of the normalized growth rate are carried out, when the frequency of electromagnetic wave is greater than or less than the thermal velocity of electrons, for the typical existing plasma parameters. The present work explores the effect of dust grains on the growth rate of lower hybrid wave, whistler wave and ion cyclotron wave in a complex plasma. The theoretical results summarized in the present study are efficiently able to elaborate the complexity produced in the plasma properties in a tokamak due to the dust-plasma interactions. Hence to observe the complexities of plasma, the current research work has been carried out.