Seminar

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Institute for Plasma Research

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Title: Study of Nonlinear Excitations by Charged Debris

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Date: 12th September 2024 (Thursday)

Time: 10:30 AM

Venue: Seminar Hall, IPR

Abstract

The charged space debris, ranging from micrometres to millimetres, typically with supersonic speed in plasma, excites precursor solitons, which serve as promising tools to tackle the problem of space debris. These nonlinear excitations have been predicted in numerical simulations [1] and observed in many laboratory dusty plasma experiments [2,3]. The propagation characteristics of precursors observed in laboratory experiments [2] were in agreement with the forced Korteweg-de Vries (fKdV) model [1]. However, the fKdV model equation fails to explain the geometrical features of the experimental findings of the excitation of 2D/3D precursor solitons [3]. In this work, we have investigated the evolution of 2D precursors using the forced Kadomtsev–Petviashvili (fKP) model equation [4]. Based on the geometry of the charged object, the precursor solitons have been modelled using various profiles of the charged object in the fKP model. The model equation is also employed to examine the effect of the charge density of the object and it is found that the number of precursor solitons increases with the increase in charged density. We have also observed that the amplitude of precursor solitons decays in time in the presence of damping. The structure of precursors generated using the fKP model show a qualitative agreement with the laboratory experiment performed with 2D/3D charged objects [2] and the kinetic simulations [5]. We have also done the SPIS simulations, a sophisticated PIC simulation code to simulate spacecraft plasma interactions [6]. We have studied the charging of the debris, in various space plasma environments using the SPIS. The dynamics of such nonlinear excitations in a fully nonlinear plasma medium and their kinetic origin will be investigated in future.

References:

[1] A. Sen, S. Tiwari, S. Mishra, and P. Kaw: Adv. Space Res. **56**, 429-435 (2015).
[2] S. Jaiswal, P. Bandyopadhyay, and A. Sen: Phys. Rev. E **93**, 041201(R) (2016).
[3] K. Kumar, P. Bandyopadhyay, S. Singh, and A. Sen: Phys. Plasmas **31**, 023705 (2024)
[4] A. Truitt, and C. Hartzell: J. Spacecr. Rockets, **58**, 848 (2021).
[5] V. Dharodi, A. Kumar, and A. Sen: Phys. Rev. E **107**, 025207 (2023).
[6] R. M. Albarran, and A. Barjatya: J. Spacecr. Rockets **53**, 393-400 (2016).

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