Seminar

Institute for Plasma Research

Title : Investigations on the modulational instability of ion wave in a negative ion plasma sources

Speaker: Dr. Pallabi Pathak
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Date : 4th June 2021 (Friday)

Time : 10:30 AM

Venue : Online - Join the talk:
https://meet.ipr.res.in/Pallabi_Pathak_PDF_ExtensionTalk

Abstract :

The negative ion source consists of a plasma having ions of different masses and charge states. In addition, the plasma volume comprises of plasma production region, transverse magnetic filter region and a beam extraction region. The plasma is virtually separated by the strong transverse magnetic filter field. Due to the presence of spatially varying transverse magnetic fields, plasma density gradient and plasma temperature gradient can be very strong and generates different instabilities, which influences the plasma diffusion across the transverse magnetic filter field. Out of these instabilities, E×B drift instability is one of them, which triggers electrostatic ion acoustic waves near the extraction region. Due to having ions of different masses and charge states, it is interesting to study instabilities in a negative ion source.

Modulational instability is one of the process which classifies the qualitative behaviour of nonlinear modulated waves. In the talk, we present the numerical investigation of the modulational instability of ion acoustic waves in a realistic negative ion source plasma. The nonlinear Schrodinger equation describing the modulational instability of ion waves in the presence of negative ions and multispecies positive ions is derived from fluid equations for such plasma system. The effective mass of positive ions is found to have a key role in the modulationally unstable ion wave in electronegative plasma. The numerical study of modulational instability of ion waves in such plasma reveals a universal parabolic relationship between the critical density ratio of negative to positive ions and effective ionic mass ratio. This relation can be utilized to study the modulational instability experimentally in any realistic negative ion plasma source on a large scale. It is also interesting to see, if these plasma instabilities are also getting transported to the extracted beam. To study the instabilities in the beam, different beam diagnostics are available. Beam tomography is one of them.
A tomographic diagnostics system to measure the time resolved 2D beam profile is under preparation. It will be tested initially at the Permanent-magnet based Helicon Experiment for Negative Hydrogen Ion (HELEN) device. The main target of the visible tomography diagnostics is the measurement of beam uniformity and its evolution throughout the pulse duration with sufficient spatio-temporal resolution.