Seminar

Institute for Plasma Research

Title : The tomographic diagnostic of Helicon Experiment for Negative Hydrogen Ion (HELEN) device

Speaker: Dr. Pallabi Pathak
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Date : 09th June, 2022 (Thursday)

Time : 10.30 AM

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

Abstract :

The helicon plasma source is configurationally an inductively coupled plasma source with a strong axial static magnetic field. The presence of the magnetic field to the RF plasma can affect the plasma dynamics in various way. The transport of electrons across the field is restricted and there is a plasma temperature gradient which is suitable for an effective negative ion source. 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. It also influences the modes of power coupling. Due to having ions of different masses and charge states, it is interesting to study instabilities in a negative ion source in spatio-temporal domain. So far, we have numerically investigated the modulational instability of ion waves in a realistic negative ion source plasma.

Tomography is a non-invasive diagnostic technique which measures the emission (or absorption) of radiation coming from an object, using a large number of sights and it allows the reconstruction of 2D or 3D profile of emission or absorption. It is widely used to study the plasma density distribution, plasma temperature, the degree of dissociation and the distribution of different atomic and molecular species, negative ion density in negative ion sources etc. There are many algorithms proposed to solve the tomography problems which are based on analytic methods, iterative methods, pixel methods etc. For symmetric cross section, Abel inversion is generally used. For non-symmetric geometries, a modified Abel inversion, Fourier-Bessel functions, Zernike polynomial etc. are used in analytic method. In our study, we have used Fourier-Bessel inversion technique for tomography code. This technique depends on the number of line of sights and number of views from all angles. Since our helicon plasma is cylindrically symmetric and concentrated in the core region of the chamber, this method is adopted to get the maximum information of plasma dynamics through tomography with sufficient spatio-temporal resolution.

The conceptual design and correspondingly the selection of camera and its position, pinhole design and its position will be discussed in the talk together with the emissivity inversion algorithm. We have linear CCD cameras having 2048 detectors to record the plasma emission. From each detector, we get the line of sight (chord) and chord brightness parameters to reconstruct the plasma emission profile. From the numerically obtained parameters, we have reconstructed the plasma emissivity profile which shows very convincing results. We have planned the experiments accordingly and will try to complete during next year.