Seminar

Institute for Plasma Research

Title : Effect of In-homogeneous magnetic field on Helicon Antenna Produced Expanding Plasma

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Date : 25th January 2019 (Friday)

Time : 11.00 AM

Venue : Seminar Hall, IPR

Abstract :

The helicon plasma source is well known for their generation of high density plasma at relatively low powers and magnetic field. Normally helicon sources operate at a magnetic field which corresponds to an electron cyclotron frequency 20 to 40 times of source frequency, this require around 200 G magnetic field using 13.56 MHz source. However, helicon sources have shown resonance abortion even around a particular low magnetic field, around 20-30 G means $f_{ce} \sim 5$ times source frequency. The ionization efficiency of helicon plasma discharge is explored by changing low magnetic field divergence near the helicon antenna. The highest plasma density is found for a most possible diverging magnetic field near the antenna. The increased efficiency can be explained on the basis of multiple resonances for multimode excitation by the helicon antenna in presence of in-homogeneous (diverging) magnetic field near the antenna. The high density helicon source in an expansion geometry (both geometrically and magnetically) is seen to produce flow and hence thrust. The efficiency of thrust generation not only depends on plasma production efficiency but it also depends on the radial profile of plasma density. Formation of hollow density profile in magnetic expansion is serious concern, it causes reduction of total thrust. Experimentally the density profile in the magnetic nozzle of a helicon based plasma device is seen to be modified from centrally peaked to hollow nature as the external magnetic field is varied. Hollow density occurs above a characteristic field value when the ions becomes magnetized in the expansion chamber. Rotation of tail electrons in the azimuthal direction due to the gradient-B drift in the expansion chamber leads to an additional off-axis ionization and forms the hollow density profile. It seems if the ions are not magnetized, then the off-axially produced additional plasma is not confined and the density profile retains the on-axis peak nature. The present experimental work discuss both the source plasma production efficiency and hollow density formation in-homogeneous (diverging) magnetic field which may be significantly contribute to the design of an efficient helicon plasma based thruster.