Seminar

Institute for Plasma Research

Title : Effect of In-homogeneous magnetic field on helicon antenna produced expanding plasma

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Abstract :

Helicon plasma is being studied over few decades. Initial studies were concentrated around phenomena related to wave excitation, propagation and absorption. This kind of plasma shows significant high ionization efficiency. Hence, it has found various applications, though the exact mechanism of power absorption is not yet understood well. Historically, conventional helicon plasma is produced in a uniform magnetic field of the order of 200 Gauss or more for 13.56 source frequency. However, there is another class of helicon mode operation where the magnetic field is of the order of 10 to 50 Gauss, usually called low B (magnetic field) helicon. This also shows high plasma production efficiency. This is an economically attractive option compared to conventional helicon plasma. In the present work, it is shown that for low B operation with the nonuniform magnetic field, the plasma production efficiency is even higher than uniform magnetic field case. It is shown that the antenna-plasma coupling efficiency increases with the increasing magnetic field nonuniformity near the antenna. Fundamentally, it opens up another area of wave coupling and absorption in a nonuniform magnetic field. Present study aims to understand the enhanced plasma production efficiency in presence of non-uniformity in low magnetic field. When efficient helicon plasma source is combined with the diverging magnetic field configuration, which is similar to the magnetic nozzle, it generates the plasma flows 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. It is observed that the hollow density profile generated in the expanding plasma in non-uniform (diverging) magnetic field causes a reduction of total thrust. The occurrence of hollow density profile is observed only after the magnetic divergence. Hollow density occurs above a characteristic field value when the ions become magnetized in the expansion chamber. Rotation of tail electrons in the azimuthal direction due to the gradient-B drift within magnetic expansion 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 discusses both the source plasma production efficiency and hollow density formation inhomogeneous (diverging) magnetic field.