Seminar

Institute for Plasma Research

Title : Development of a permanent magnet based helicon plasma source

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Date : 21st May 2018 (Monday)

Time : 10.00 AM

Venue : Seminar Hall, IPR

Abstract :

Helicon plasma sources are known to be extremely efficient plasma sources in terms of ionization percentage. In a Helicon plasma source, an electromagnet arrangement is used conventionally for producing such fields and invokes additional interfaces (power supplies and water connections). A helicon plasma source is developed using permanent ring magnet instead of electromagnet. This development may reduce maintenance requirements and electrical interfaces for similar sources to be used for neutral beam ion sources and space quality thrusters in future.

The conceptual design of the source is carried out using HELIC code and its performance is validated experimentally. In the present helicon source, discharge is performed by a 13.56 MHz, 1kW RF power supply connected to a single loop antenna by exciting m = 0 mode in Argon plasma and characterized thoroughly. Later a Nagoya type helicon antenna is used to excite m = +1 mode inside the hydrogen plasma. The plasma is allowed to expand in a diverging field into an expansion chamber where it is confined by cusp magnets, a conventional plasma confinement scheme used in an ion source. A plasma density of ~ 5×10^{12} cm −3 is attained in which negative hydrogen ion density of 10^9 cm $^{-3}$ is measured in volume mode operation (without applying Caesium vapor to enhance surface negative ion production). Few non-intrusive diagnostics are utilized to measure the line integrated negative hydrogen ion density: (i) H_α / H_β line ratio method based on OES diagnostic and (ii) Cavity ring down spectroscopy (CRDS) technique and compare with theoretical estimation based on particle balance. In addition, axial magnetic field dependent different power absorption modes in the downstream region are observed. All of the above works will be discussed in the talk.