Seminar

Institute for Plasma Research

Title : Development of a permanent magnet based helicon plasma source

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Time : 11:30 AM

Venue : Board Room, New Building, IPR

Abstract :

Helicon plasma sources are known to be extremely efficient plasma sources in terms of ionization per unit power consumed. Conventionally, an electromagnet arrangement is used for producing magnetic fields in a helicon plasma source, which invokes additional interfaces (power supplies and water connections). A helicon plasma source is developed using permanent ring magnet instead of electromagnet. This reduces the maintenance requirements and electrical interfaces for similar sources to be used for neutral beam ion source and space quality thrusters in future. The conceptual design of the source is carried out using HELIC code. Based on the design, a plasma source is fabricated and characterized using a 13.56 MHz, 1kW RF power supply connected to a single loop antenna by exciting m = 0 mode in Argon plasma. A Nagoya type helicon antenna is used to excite m = +1 mode inside the hydrogen plasma. The plasma is made 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 hydrogen plasma density of ~ 2×10^{12} c m $^{-3}$ is attained in which negative hydrogen ion density of 10^{10} cm $^{-3}$ is measured in volume mode operation (without injecting Caesium vapor for the surface negative ion production). Non-intrusive diagnostics are utilized to measure the line integrated negative hydrogen ion density: (i) Hα / Hβ line ratio method based on OES diagnostic and (ii) Cavity ring down spectroscopy technique and compared with theoretical estimation based on particle balance. In addition, axial magnetic field dependent different power absorption modes in the downstream region are observed.