Seminar

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Institute for Plasma Research

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Title: Zeeman Polarization Spectroscopic Diagnostics on ADITYA-U Tokamak

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Date: 08th August 2025 (Friday)

Time: 02:00 PM

Venue: Seminar Hall, IPR

Abstract

Understanding magnetic fields in magnetically confined plasma is fundamental to diagnosing, controlling, and optimizing the performance of fusion devices such as tokamak. One of the most critical plasma parameters derived from the magnetic field is the safety factor (q) profile. While the q profile is typically inferred using techniques, such as Motional Stark Effect (MSE) spectroscopy. This technique cannot be applied to ADITYA-U tokamak as it does not have the neutral beam injection (NBI). Therefore, a Zeeman polarization spectroscopic (ZPS) diagnostic has been developed for the ADITYA-U tokamak to determine the edge q of Aditya-U plasma. The Zeeman split H_α line at 656.28 nm from the plasma edge will be monitored using the developed diagnostic. Its major components are the quarter wave plates, polarizing beam splitters, half wave plates and a high-resolution spectrometer. In a magnetic field, atomic spectral lines split into π and $\sigma\pm$ components. These components show specific shifts and polarizations, which depend on the strength and direction of the magnetic field. When the plasma is viewed tangentially and the magnetic field is inclined relative to the line of sight, the intensity difference between the two circularly polarized σ components depends on the angle between the magnetic field and the viewing direction. This angle can be used to determine the safety factor of the tokamak plasma. An overview of the progress in developing the ZPS diagnostic, which includes the details of diagnostics setup and its implementation on ADITYA-U tokamak, will be discussed.

In addition to that, an investigation of temperatures of neutral hydrogen and O^{4+} and C^{5+} ions, has been carried out to understand their behaviors with plasma and machine parameters. The Doppler broadened spectral lines at 656.28 nm of neutral hydrogen, at 650 nm of O^{4+}, and at 529 nm of C^{5+} are recorded using a high resolution and space resolved visible spectrcopy diagnostics. It has been found that C^{5+} ion temperature decreases with increasing plasma current. It is also seen that spatial variation of neutral temperature mostly follows the O^{4+} ion temperature.
