Seminar

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Institute for Plasma Research

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Title: Overview of the Density Interferometer Polarimeter Diagnostic System for ITER

Speaker: Dr. Rajwinder Kaur Sengupta
ITER Organization, France

Date: 02nd January, 2026 (Friday)

Time: 03:30 PM

Venue: Seminar Hall, IPR

Abstract

The Density Interferometer Polarimeter (DIP) diagnostic system (55FA) is a key diagnostic for the ITER tokamak, designed to provide robust and high-accuracy measurements of line-integrated and line-averaged electron density under reactor-relevant conditions. The system comprises two measurement chords - a radial chord and a tangential chord-each based on a dispersion interferometer architecture using fundamental and second-harmonic probing beams. In addition to interferometry, the tangential chord incorporates a polarimeter to enable simultaneous Faraday rotation measurements. Both chords employ medium-power (40W) CO_2 lasers operating at a wavelength of 9.271 μm, ensuring an adequate signal-to-noise ratio in the harsh ITER environment.

This talk presents an overview of the DIP system concept, optical configurations, and measurement principles. The distinct functional roles of the radial and tangential chords lead to different optical layouts. Key system elements include nonlinear frequency-conversion crystals, photoelastic modulators, polarization optics, and dedicated detection schemes optimized for ITER operation. The integration of interferometric phase measurements with polarimetric Faraday rotation measurements provides complementary access to plasma density and magnetic-field-weighted electron density, enhancing diagnostic reliability and physics capability.

The presentation also introduces the end-to-end diagnostic signal-processing workflow, encompassing signal acquisition, environmental and magnetic perturbation effects, and data interpretation strategies. Synthetic diagnostic simulations have been developed to validate system performance and processing methodologies, incorporating realistic plasma scenarios, magnetic equilibrium data, environmental sensor inputs, and temperature-dependent optical effects. These simulations demonstrate how raw detector signals are transformed into corrected interferometry and polarimetry observables and, ultimately, into line-integrated and line-averaged plasma parameters. Overall, the talk highlights the DIP system as a fully integrated diagnostic addressing optical design, measurement physics, and system-level robustness required for next-generation fusion experiments.
