Seminar

Institute for Plasma Research

Title:	Analysis of ECRH Shot Data and Predictive Characterization of Wave Propagation in Aditya-U
Speaker:	Dr. Anshu
Date:	24th June 2025 (Tuesday)
Time:	10:30 AM
Venue:	Seminar Hall, IPR

Abstract

The Electron Cyclotron Resonance Heating (ECRH) is a key technique for heating plasma in tokamaks. It offers several advantages such as reliable start-up of tokamak at low-loop voltage, heats the plasma by heating the electrons, drive the plasma current by electron cyclotron current drive (ECCD), controls the plasma by suppressing the sawtooth and stabilise the NTM etc.

In SST-1 and Aditya-U tokamaks, a 42GHz ECRH system is used to carry out the ECRH assisted pre-ionization, start-up and heating experiments at 0.75T (second harmonic) and 1.5T (fundamental harmonic) operation. In Aditya-U, the ECRH assisted low-loop voltage plasma start-up experiments have been carried out at various magnetic field, the 42GHz ECRH system is used mainly for off-axis breakdown in tokamak as the typical operating magnetic field during the experiments is varied from 1.1T to 1.4T. The ECRH power in fundamental O-mode is launched from low field side of tokamak, the power is varied from 75kW to 200kW and duration is varied from 50 ms to 100 ms respectively. The multi-pulse operation is also carried out in Aditya-U for plasma breakdown and heating simultaneously.

In this study, the data analysis for ADITYA-U has been carried out; the best shots have been selected for the analysis. The data has been classified in terms of magnetic field. As per the ECRH experiments carried out on the tokamak, the simulation has also been carried out using the GRAY code. In the Aditya-U tokamak, the low-loop voltage start-up is successful but heating of plasma is not very conclusive. The data analysis shows the density of plasma in various plasma shots is around $1 \times 10^{19} \text{m}^{-3}$ or more which is close to cut-off and ECRH power absorption is not good, the simulation also shows that as the density increases beyond the $1 \times 10^{19} \text{m}^{-3}$, the EC ray reflects back and no significant ECRH power absorption is seen during these plasma shots. This confirms that density plays critical role in the EC power absorption. The systematic analysis of EC wave propagation would be present for tokamak Aditya-U.

In the future plan, the data analysis would also be carried out for SST-1plasma shots and it will be validated with various codes (GRAY and GENRAY). The Aditya-U ECRH plasma shots analysis would also be validated with GRAY code and accordingly systematic experiments would be projected with desired parameters for Aditya-U tokamak. The ECRH experiments with 42GHz ECRH system would also be carried out as per the plan.