# Seminar

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# Institute for Plasma Research

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**Title:** Study of edge plasma dynamics in tokamak Aditya-U

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**Date:** 22nd August 2024 (Thursday)

**Time:** 10.00 AM

**Venue:** Seminar Hall, IPR

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## Abstract

One of the critical physics challenge is the understanding of the edge plasma dynamics in tokamaks. Edge plasma dynamics is the interplay of magnetic field $B_0$, velocities perpendicular $v_\perp$ and parallel $v_\parallel$ to $B_0$ and the non-linear dynamics between local electron densities $n_{e0}$, and electrostatic plasma potential $\phi(k)$. Confinement of plasma in the core depends significantly on the edge dynamics as fuelling, external heating and exhaust occur only through the edge. A prime example is the observation of the H-mode when external heating crosses a certain threshold. The plasma edge in the H-mode is characterized by doubling of energy confinement time, a steep gradient in the density profile and significantly reduced turbulence. Energy transport of turbulence is a fundamental and key property which can help in controlling the anomalous transport and thus improve energy confinement in tokamaks. The properties of the tokamak plasma edge micro-turbulence can be described approximately by quasi 2D fluid dynamics. Particularly the Charney-Hasegawa-Mima (CHM) model approximates the dynamics of electrostatic field on the plane perpendicular to $B_0$. It incorporates the system size by using density gradient scale length which can be obtained by measuring the density profiles of the tokamak plasma. This thesis addresses the two requirements of measuring density profiles experimentally and using its results to estimate qualitatively the edge drift turbulence spectrum computationally. A diagnostic to measure the mean density profile ignoring the density fluctuations is implemented. The density profiles measured serve as an input to the computational fluid dynamics code developed. A numerical experiment is performed by application of CHM model to the Aditya-U tokamak by using the measured density gradient scale lengths provides the wave number spectrum of the coherent vertical structures which dominate the dynamics of the plasma edge. This process is closely connected to the energy transfer in the wave-number space. Wave number spectra is one of the few quantities which can be measured in the tokamak. For the future work a frequency hopping reflectometer is proposed which can measure such a spectra thus completing the loop. Also one of the assumptions of the CHM model is the zero phase between the density and electrostatic potential which can be relaxed by solving its modified form the Hasegawa-Wakatani model.