Seminar

Institute for Plasma Research

Title : Effect of Short Gas-puff Pulses and Biased-electrode on Transport, MHD Instabilities, Plasma-Wall Interaction and Runaway Electrons in ADITYA-U Tokamak

Speaker: Mr. Tanmay Macwan
Institute for Plasma Research, Gandhinagar

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Time : 03.30 PM

Venue : Online - Join the talk:
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Abstract :

Suitable tailoring of the edge plasma region of a tokamak is absolutely essential to safeguard both the core-plasma and the material boundary surfaces as it isolates the hot core plasma from the metal boundary of the machine. The edge parameters which need to appropriately adjusted are mainly the radial profiles of temperature and density, the plasma rotation and the radial electric field. These edge parameters control the macro- and micro-instabilities, which enhances the transport of particle and energy across the magnetic field lines. The edge plasma parameters also decide how a perturbation triggered in the edge, reaches to the plasma core, such as the cold pulse propagation and how to detach itself from the boundary surfaces to protect the plasma boundary material. The edge parameters are also effective in controlling the runaway electrons, which can cause severe damage to the vessel walls and peripheral components. In this thesis, the edge region of the medium-sized ADITYA-U tokamak is altered systematically by applying shot bursts of gas-puffs and also by introducing a biased electrode to study the influence of edge parameters on particle and heat transport, MHD instabilities, particle exhaust and runaway electron confinement.

One of the important results of the thesis is the improved understanding of the cold-pulse phenomena (CPP) in terms of linear-Ohmic-confinement regime (LOC) to saturated-Ohmic-confinement (SOC) transition. It has been shown that the CPP can be triggered by fuel gas injection in the edge region and can be explained by local transport models. The observed sharp density rise in the core plasma during CPP has been found to be due to the increased inward pinch and a reduction in the ion-orbit loss. Modifying the edge plasma poloidal rotation with a biased electrode, it has been shown that the Drift-tearing (DT) mode rotation and their growth rate can be effectively controlled. Hence, it has been proven experimentally that the plasma poloidal rotation does impact the DT mode rotation. The radial electric field modification with biased electrode is also shown to influence the runaway electron dynamics. The runaway electrons can by force be confined after the complete termination of the plasma current by biasing an electrode appropriately during the disruption phase of the discharge. The edge region of the ADITYA-U plasma is also suitably modified to obtain transient plasma detachment events using gas-injection. If the plasma remains in LOC, the global confinement is increased in the detached state, whereas, if the same detached state is obtained in a plasma in SOC regime, the global confinement degrades. There exists an upper limit to the duration of detached plasma state, which is dependent on the overall plasma parameters as well as the modified edge plasma in the detached state.