Seminar

Institute for Plasma Research

Title : Experimental Study on ETG Turbulence Induced Plasma transport in Large Volume Plasma Device

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Date : 30th October 2018 (Tuesday)

Time : 11.00 AM

Venue : Seminar Hall, IPR

Abstract :

We present the experimental results on particle and electron thermal transport observed in the finite beta laboratory plasma of Large Volume Plasma Device (LVPD) and on the identification of Electron Temperature Gradient (ETG) turbulent transport. ETG turbulence is considered as one of the importanat cadidate to understand the physics of anomalous electron thermal energy loss in fusion devices. The small scale nature of ETG mode inhibits its direct measurement in fusion devices and inferences are drawn largely from the indirect measurements and theoretical models. Basic plasma devices come handy in bringing these scales to measurement limits by using conventional probe diagnostics but lacuna they face is that the plasma produced in them suffers from the very process of its production; hence making unambiguous identification of ETG becomes difficult. The removal of responsible unutilized primary ionizing and non-thermal electrons and control of gradient scale length in electron temperature are all achieved by placing a large Electron Energy Filter (EEF) in the middle of the LVPD, which divides the plasma in source, filter and target regions.

The finite plasma beta conditions in LVPD have helped in identifying electromagnetic ETG induced instability in the core plasma of the target region. We have established the turbulence by measuring the fluctuations in (density, magnetic, temperature and potential), and by measuring its various spectral characteristics(power-spectra, correlation, phase angle, propagation, wavenumber-frequency spectrum) and beta scaling in suitable equilibrium plasma conditions for two selected EEF configurations. The observed turbulence is characterized by broadband spectra following the power law in the lower hybrid (LH) range of frequencies.

Experiments are carried out in detail on the measurement of turbulent particle and heat flux and results are compared with theoretical predications of ETG driven turbulent transport. It is observed that the non-adiabatic ion response is responsible for plasma particle transport and the phase velocity opposite to electron diamagnetic drift direction is responsible for inward particle flux. In addition to this, electromagnetic radial particle flux is also measured which are induced by finite electromagnetic fluctuations. The conductive and convective heat flux measurements provides estimation of ETG turbulence induced heat flux in LVPD. It was observed that despite having convective flux radially inward, the net energy flux remains directed radially outward. Detailed results highlighting significance of this study will be presented. Finally in this work, we also have developed a theoretical model for electromagnetic ETG driven particle and heat flux including the role of parallel ion dynamics to compare our experimental findings.