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Study of quasi-static equilibrium, fluctuation and confinement in a current-less toroidal device using two different plasma sources in the presence of plasma flow

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A current-less toroidal device (CTD) is one in which plasma is confined by the application of toroidal and vertical magnetic field only resulting in absence of a conventional effective rotational transform. Such devices provide a simple and well diagnosable test-bed for studies related to equilibrium, fluctuations and particle confinement for Tokamak edge. The device BETA at the Institute for Plasma Research (IPR) is one such CTD with a plasma major radius of 45 cm and minor radius of 15 cm and a maximum toroidal field of 0.1 Tesla. Quasi-static equilibrium in a CTD is controlled by the nature of fluctuation and flow [1, 2]. As observed in hot cathode discharges studied earlier [1, 2], density gradient provide fluctuation in the plasma and hence the instabilities [2], whereas radial electric field provides poloidal flow. Thus, the conditions are akin to Tokamak edge.

In addition to hot cathode source, Microwave plasma source is also available for producing plasma. The hot cathode source uses thermionic emission of electrons to produce the plasma and the discharge is struck between the grounded wall and the hot cathode. Plasma produced by Microwave source involves launching of Microwave of frequency of around 2.45 GHz with average launched power of around 1 kW. It has been observed that using these two sources in tandem in the presence of an external vertical field can provide a control over density profile [3]. This helps in controlling the density gradient on the outboard side and hence controlling the nature of instabilities. Additionally, the presence of flows significantly affects the nature of quasi-static equilibrium and fluctuation. The detailed experimental study of controlling the nature of plasma profiles using two sources and external vertical field in presence of flows will presented.

References:-

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