Seminar

Institute for Plasma Research

Title : Low edge safety factor disruptions in the Compact Toroidal Hybrid: Operation in the low-q regime, passive disruption avoidance and the nature of MHD precursors

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Date : 10th January 2017 (Tuesday)

Time : 11.30 AM

Venue : Seminar Hall, IPR

Abstract :

The nominally axisymmetric (2-D) magnetic configuration in the form of a tokamak has proven to be the best candidate for a future reactor, and yet it is susceptible to instabilities which lead to a complete loss of the confined plasma. Some of these instabilities are on account of the toroidal plasma current required to establish a magnetic cage to hold the plasma. On the other end of the spectrum is the non-axisymmetric (3-D) magnetic configuration of the stellarators in which the a robust magnetic cage is provided by the external coils, with no need for a plasma current. For the application as a fusion reactor, non-axisymmetric shaping of toroidal plasmas is expected to be incorporated in the design of future experiments (Spong, Physics of Plasmas, 2015, 22, 055602-1).

The work presented here is part of research for doctoral thesis carried out on Compact Toroidal Hybrid device (CTH) located at Auburn, AL, USA. We will present an understanding of the 3-D structure of the MHD modes observed in the current carrying plasmas of the CTH device. Also presented is the 3-D shaping effect of stellarator fields on the stability of current carrying plasmas. CTH is a stellarator-tokamak hybrid device designed to investigate the stability of current-carrying plasmas. The magnetic configuration of CTH is non-axisymmetric like that of a stellarator, while on account of a toroidal plasma current, some of the equilibrium properties are similar to that of a tokamak. The flexible CTH magnetic configuration allows varying the amount of 3-D shaping by modifying the rotational transform.

In current carrying CTH plasmas when the rotational transform, assumes rational values, fluctuations in equilibrium magnetic field are measured by the arrays of magnetic probes. These modes observed when the rational surfaces are close to plasma edge, are modeled as helical current _laments within the 3-D plasma equilibrium of CTH, bearing a flute-like structure. Also studied is the effect of increasing amounts of vacuum rotational transform, that is the rotational transform generated by the external magnet coils, on the stability of current-carrying discharges is an important research topic on CTH. CTH discharges can operate without loss of confinement, even if $q(a) < 2$, if sufficient amounts of 3-D shaping is applied. It is observed that increasing the amount of 3-D shaping by 10% is sufficient to successfully stabilize the CTH discharges operating in the low edge safety factor regime. Additionally, it is observed with the magnetic probes that the unstable modes implicated in the loss of confinement, have mode structures characterized by m=n = 3=2, and 4=3.