Seminar

Institute for Plasma Research

Title: Exploring 3D Ideal Geometric Effects on Bootstrap Current and Impurity Accumulation

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Date : 20th July 2018 (Friday)

Time : 03.30 PM

Venue : Committee Room 3, (New Building), IPR

Abstract:

We investigate the presence of 3D ideal MHD instabilities, particularly a saturated 1/1 ideal internal kink, on neoclassical phenomena such as the bootstrap current and heavy impurity transport. The MHD equilibria are generated using the ideal MHD equilibrium solver VMEC under free-boundary conditions and is used as a basis for the neoclassical calculations performed. The bootstrap current and the parallel flows are examined using the Shaing-Callen 3D neoclassical formulation. For a non-resonant 1/1 ideal internal kink which avoids the q=1 resonance, the bootstrap current is observed to be strongly augmented in the helical core region, returning to match the axisymmetric values in the near-axisymmetric region outside the helical core. A similar augmentation is observed for background ion flows as well, including the presence of a finite poloidal flow. Heavy impurities such as tungsten face friction because of the impurity particles colliding with the background ions, and therefore the magnitude of this flow becomes of paramount importance. The VENUS-LEVIS orbit-following code is used to follow the impurity particles with additional effects provided by the centrifugal and Coriolis forces while colliding them in the correct frame of the background ion distribution. This is successfully benchmarked with known results in neoclassical theory concerning impurity transport. Without flows in axisymmetry, an on-axis peaked impurity distribution is observed. With flows, an off-axis peaking of impurities is observed, following known neoclassical expressions. Furthermore, it is found that the impurity accumulation was strongly increased for the combined case of helical core with flows, leading again to a near-axis peaked density profile.