DPP08-2008-000824

Abstract for an Invited Paper
for the DPP08 Meeting of
the American Physical Society

3D perturbed tokamak equilibria and the importance of plasma response[1]

JONG-KYU PARK, Princeton Plasma Physics Laboratory

Tokamaks are sensitive to deviations from axisymmetry as small as dB/B $\sim$ 0.01%. In light of the importance of the 3D effects, the Ideal Perturbed Equilibrium Code (IPEC) [1] has been developed to study 3D perturbed tokamak equilibria. Comparisons of IPEC predictions with experiments have highlighted the importance of plasma response effects such as poloidal coupling and amplification of perturbations. These effects are essential to explain error field correction results on NSTX and DIII-D [2], and to evaluate the tolerances to error field and Locked Mode (LM) thresholds in ITER. Also, IPEC predicts that the variation of the field strength including the plasma response can make a large difference in calculating Neoclassical Toroidal Viscoscity (NTV), which has been systematically tested in tokamaks by measuring rotational damping [3]. The impact of the plasma response on NTV torque will be discussed and compared with the n=3 braking experiments on NSTX and DIII-D spanning different ranges of collisionality. Although IPEC can improve modeling of NTV torque, the result is not self-consistent since the currents associated with the torque are missing in the ideal perturbed equilibrium. The shielding by the torque is essential to explain measured amplifications of n=1 travelling waves in high beta-N NSTX plasmas, but is expected to be weak when n>1. The non-ambipolar transport driven by NTV is also important to understand Resonant Magnetic Perturbation (RMP) experiments for Edge Localized Mode (ELM) control. IPEC predictions for NSTX and DIII-D RMP experiments will be discussed including implications for ITER. [1] J.-K.Park, Phys. Plasmas 14, 052110 (2007) [2] J.-K.Park, Phys. Rev. Lett. 99, 195003 (2007) [3] W.Zhu, Phys. Rev. Lett. 96, 225002 (2006)

[1]This work supported by U.S. DOE Contract # DE-AC02-76CH03073, DE-FG02-03ERS496 and DE-FC02-04ER54698.