Topic: EX-W

Investigation of Collective Fast Ion Instability-induced Redistribution or Loss in NSTX*

S. S. Medley, E. Fredrickson, D. Darrow and the NSTX Team email: medley@pppl.gov
Princeton Plasma Physics Laboratory, Princeton University, Princeton, NJ 08543

Abstract

The National Spherical Torus Experiment (NSTX) is particularly well suited to investigate fast-ion driven instabilities because large values of the dimensionless parameters $v_{fast}/v_{Alfvén}$ and $\beta_{fast}(0)/\beta_{tot}(0)$ required to drive such instabilities occur routinely in neutral beam heated plasmas. The instabilities can be divided into three categories; chirping Energetic Particle Modes (EPM) in the frequency range 0 – 120 kHz, the Toroidal Alfvén Eigenmodes (TAE) with a frequency range of 50 – 200 kHz and the Global and Compressional Alfvén Eigenmodes (GAE and CAE, respectively) between 300 kHz and the ion cyclotron frequency. These modes are of particular interest because of their potential to cause substantial fast ion redistribution or loss. Both the volume-integrated neutron and the line-integrated charge exchange neutral particle diagnostics show signal depletion due to fast-ion driven instabilities, but cannot distinguish between fast-ion redistribution or loss. Two recently implemented diagnostics on NSTX, the Motional Stark Effect (MSE) and scintillator Fast Lost Ion Probe (sFLIP), facilitate separation of redistribution and loss effects. Outward redistribution of the core-peaked energetic beam ions modifies the beam-driven current profile and hence the core q-profile. MSE-constrained q-profiles are being used to assess this effect. sFLIP measures the pitch and energy of fast ions that are ejected from the plasma and intercept the wall-mounted probe thus identifying fast-ion loss. Observations and TRANSP simulations of a range of fast ion instability-induced redistribution/loss phenomena in NSTX will be presented.

*This research was supported by U.S. DOE contract DE-AC02-76-CH03073.