Abstract for an Invited Paper
for the DPP07 Meeting of
The American Physical Society

Alfvén Cascade modes at high β_e in the National Spherical Torus Experiment–structure and suppression[1]

NEAL A. CROCKER, UCLA

Beam ions and/or fusion alphas are expected to excite Alfvén Cascade (AC) modes (i.e. reversed-shear Alfvén eigenmodes) in ITER reversed-shear advanced scenarios. The National Spherical Torus eXperiment (NSTX), where fast-ions with comparable v/v$_{Alfv\acute{e}n}$ ($\sim 2-4$) excite ACs, is an ideal device in which to observe ACs and their impact. Its wide range of β_e(ratio of electron to magnetic pressure) enables tests of AC theory up to, and beyond, a critical β_e where suppression is predicted. A value for critical β_e, $\sim [4q_{min}^2$o1+(7/4)(T$_i$/T$_e$))]$^{-1}$, may be derived from the theory of Breizman, et al. [*Phys. Plasmas* ***12*** *(2005) 112506*]. Observations of suppression and frequency evolution in NSTX, including onset and saturation, agree well with this theory and calculations by the NOVA-K linear stability code. The dependence of AC frequency on minimum safety factor (q_{min}) enables a sensitive determination of q_{min} from the AC spectrum that agrees well with the minimum of the q profile measured using the motional Stark effect. AC structure measurements near critical β_e from three fixed frequency (i.e. spatially localized) reflectometers and three tangential interferometers show a structure consistent with predicted localization near the q_{min} radius. Magnetic measurements indicate shear-wave polarization at q_{min}. Fast-ion response is monitored with neutral particle analyzers, a fast lost ion probe and neutron detectors. Profile measurements of q, density, electron and ion temperature, and rotation are used by NOVA-K to predict mode structure and frequency, or suppression, for direct comparison with the mode measurements. These novel observations of ACs near critical β_e are well explained by theory, allowing us to extrapolate our understanding of this physics with confidence.

[1]Supported by U.S. DOE Contract # DE-FG03-99ER54527 and DE-AC02-76CH03073