Effect of Fast-ion Distribution Function on Beam Driven Instabilities in NSTX*

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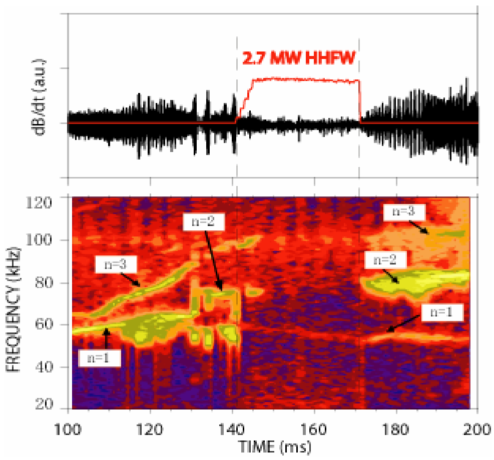
To study the effect of the distribution function on fast-ion driven instabilities in the National Spherical Torus Experiment (NSTX), the deuterium beam distribution function is modified from shot to shot while keeping the total injected power at ~ 2 MW. The experimental "knobs" are the beam energy (90 and 60 keV), the beam tangency radius, and the fraction of trapped beam ions, which is modified at a predetermined time
by applying over 2 MW of HHFW heating. The neutral beams are injected into a helium L-mode plasma and produce a rich set of instabilities, including TAE modes, instabilities in the TAE band (~100 kHz) with rapid frequency chirping, and strong, low frequency (10-20 kHz) fishbones. Fishbones are excited when $q_0 < 0$ and when the trapped beam-ion fraction increases; they are always present later in the discharge. TAE modes are excited only early in the discharge and depend on the beam parameters. The idea of the experiment was to test the Berk-Breizman hole-clump theory of frequency chirping[1] by using RF acceleration to increase the effective collision frequency and suppress the chirping instabilities. In contrast with a dipole experiment,[2] the cyclotron heating has no effect on the chirping instabilities. However, under some circumstances, TAEs with steady frequencies are suppressed by HHFW heating on a collisional time scale (see figure).



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1 H.L. Berk *et al.*, Phys. Plasmas **6** (1999) 3102.
2 D. Maslovsky, B. Levitt and M. E. Mauel, Phys. Plasmas **10** (2003) 1549.