Effect of Low Frequency MHD on the Fast Ion Population in NSTX Plasmas Based on FIDA Observations

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It is known that energetic particle confinement in tokamak plasmas deteriorates in the presence of low frequency, low wavelength MHD instabilities. In different devices, enhanced transport or losses of fast ions have been measured using neutral particle analyzers, neutron detectors and fast ion losses detectors. However, these type of diagnostic suffer from limited spatial resolution. On NSTX, a Fast Ion D_α (FIDA) diagnostic routinely provides 16 local measurements of the fast ion D_α emission with 5 cm radial resolution and 10 keV energy resolution.
This work addresses the effect of the low frequency MHD on the fast ion population in NSTX, NBI heated discharges. The analysis is restricted to plasmas where a dominant tearing mode (n=1, m=3-5) develops after a quiescent phase, in presence of little Alfvénic activity. Although the resonant surface is often located close to the pedestal region, after the mode onset, a collapse of FIDA density profile is observed, with central values reduced by as much as 30%. The size of the effect depends on the amplitude of the mode and, possibly, the strength of coupling to sideband perturbations. The entire measured profile is affected (R=0.9-1.45 cm, R_{axis}~1 m). However, the fast ion depletion appears to be strongest in the low-field-side mid-radius region (R=1.2 m).
The observations will be compared with the results of the full orbit code SPIRAL, used to simulate the effect of a given magnetic field perturbation on fast ion orbits and predict the distortion in the fast ion distribution function.

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