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Coupled Tearing and Internal Kink Modes and Their Effect on Fast Ion Transport in NSTX

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A synergetic effect of coupled tearing and internal kink modes on fast ion transport is observed in NSTX. Changing the relative phase of the tearing and internal kink modes can affect the fast ion pressure by up to 10% and the neutral beam induced current density by up to 20%. The interaction of fast ions with tearing modes [1] or kink modes [2] has been reported previously, but the interaction with coupled tearing and internal kink modes is reported here for the first time.

The analysis uses the "Kick" model [3] where fast ion dynamics in perturbed magnetic field are computed using the gyro-center particle-following code ORBIT. The input perturbed magnetic field is provided by analytic eigenfunctions of tearing and kink modes scaled by measurements with the 30-channel soft X-ray array in NSTX (figure 1). [4]. Using the experimental mode amplitude as input and no other free parameters in the "Kick" model, the computed neutron rate agrees with the measured neutron rate, whereas with the classical model the neutron rate is overestimated by 20% (figure 2). The relative phase of tearing and internal kink modes is observed to be fixed, with island 'O' points aligned at midplane when the core is displaced to the high field side. When the relative phase is scanned numerically, it is found that the fast ion pressure and neutral beam induced current density change significantly. It is also found that the energy transfer between instabilities and fast ions would change for the cases where the instability is tearing, internal kink, or the coupled tearing and internal kink modes. The synergetic effect of the tearing and internal kink modes in fast ion transport suggests that fast ion distributions may contribute to the mode coupling as well.

References
[1] Heidbrink et al., Nucl. Fusion **58** 082027
[2] Menard et al., Nucl. Fusion **45** 539
[3] Podestà et al., Plasma Phys. Control. Fusion **56** 055063
[4] Stutman et al., Rev. Sci. Instrum. **74** 1982

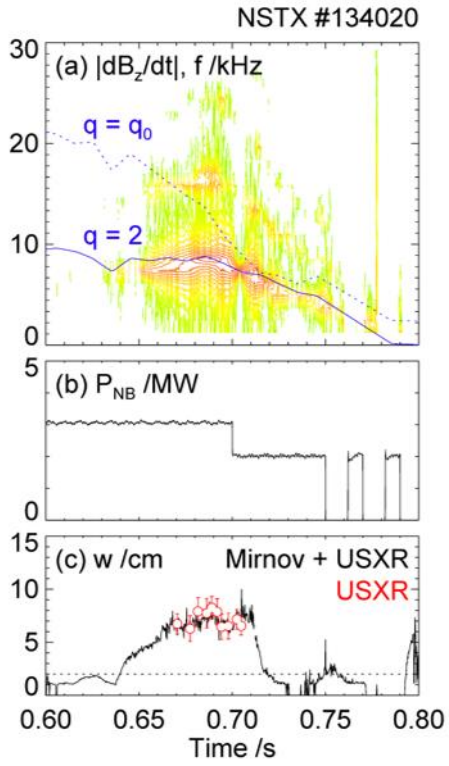

Figure 1 Summary of synthetic soft X-ray measurement: (a) Spectrogram (b) Neutral beam power (c) Island width from Mirnov coil (black line) scaled by SXR (red circle)

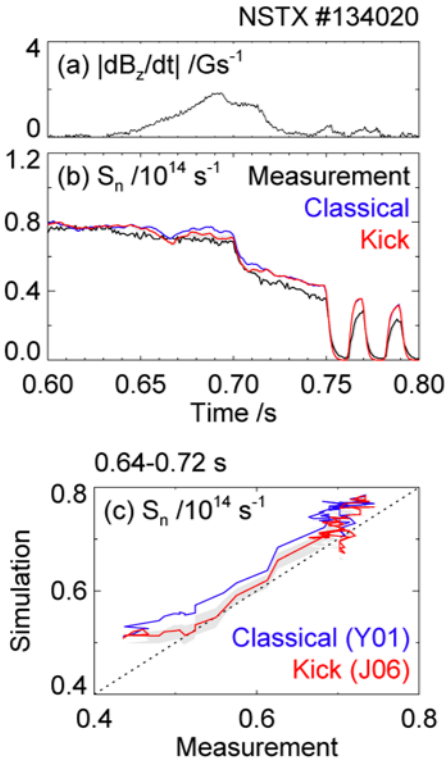

Figure 2 Simulation of neutron rates using the "Kick" model. (a) MHD activity from Mirnov coil signal (b) Neutron rate from measurement (black), classical model (blue) and kick model (red) (c) Comparative view of data from (b)