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Role of plasma edge region in global stability on NSTX[1]

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Kinetic resonances have recently been identified to play an important role in the stability of the resistive wall mode (RWM) in NSTX and other tokamaks. Agreement between measured and predicted RWM stability thresholds has improved substantially, but differences are still sometimes observed. Key to this physics is the ExB drift frequency which is typically calculated by computing the radial electric field from radial force-balance from measured impurity density, temperature, and velocity. In the limit of large toroidal velocity and small poloidal velocity, the ExB rotation frequency is well approximated by the carbon impurity toroidal frequency. However, in the limit of reduced toroidal rotation typical of magnetic braking or reduced torque input, the toroidal and neoclassical poloidal velocities become comparable near the plasma edge. Recently, in NSTX and MAST the measured poloidal velocity has been shown to be consistent with neoclassical predictions enabling more accurate calculations of the ExB frequency. Importantly, for NSTX plasmas in which error-field correction has been employed to increase the toroidal rotation in the plasma edge region ($r/a > 0.8$), the poloidal rotation can modify the inferred ExB rotation frequency (normalized to the Alfven frequency) by 0.2-0.5% which is the same order of magnitude as the toroidal rotation frequency. Thus, edge poloidal rotation is sufficiently high to play a role in RWM marginal stability. The H-mode pedestal structure and the resistivity in the edge region can also influence stability. Previous modeling has shown that self-consistent calculations of the mode eigenfunction can modify RWM stability compared to perturbative methods - especially near the plasma edge. Comparisons between the measured marginal stability and predictions from the MARS-F and MARS-K codes including these effects will be presented.

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