Modifications to Ideal Stability by Kinetic Effects for Disruption Avoidance

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Marginal stability points of global modes during high beta operation in NSTX can be found by computing kinetic modifications to ideal magnetohydrodynamic limits on stability. Calculations with the DCON code for nearly five thousand experimental equilibria show that the no-wall beta limit decreased with increasing aspect ratio and increasing broadness of the pressure profile, which has implications for NSTX-U. Kinetic modification to ideal limits calculations for several discharges as computed using the MISK code predict a transition from damping of the mode to growth as the time approaches the experimental time of marginal stability to the resistive wall mode. The main stabilization mechanism is through rotational resonances with the ion precession drift motion of thermal particles in the plasma, though energetic particles also contribute to stability. To determine RWM marginal stability for use in disruption avoidance, ideal stability limits need to be modified by kinetic effects in order to reproduce experimental marginal stability points. Guided by the full calculations, reduced stability models are investigated to inform automated disruption characterization and prediction analyses presently being developed using NSTX data for application to NSTX-U.

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