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Kinetic RWM Stabilization Physics and RWM State-Space Control in NSTX High Beta Plasmas[1] J. BIALEK, J. BERKERY, S. SABBAGH, O. KATSURO-HOPKINS, Columbia U., R. BETTI, U. Rochester, R. BELL, S. GERHARDT, B. LEBLANC, PPPL, Y. LIU, CCFE — Steady-state operation of spherical torus fusion devices can be disrupted by resistive wall modes (RWMs). Present research on NSTX aims for a greater understanding of passive kinetic stabilization physics and improved active control techniques to reduce disruptions. Calculations with MISK indicate that resonance between the mode and precession of thermal ions can explain experimental marginal stability. The stabilizing effect from energetic particles depends on their anisotropic distribution. MISK has been benchmarked with other codes, including MARS-K, and the physics is shown to be equivalent through comparison of results from Solov'ev and ITER equilibria. An RWM state-space controller has been used in long-pulse discharges that have exceeded $\beta_N = 6.4$, and $\beta_N/l_i = 13$. It includes a 3D model of the unstable RWM eigenfunction and currents induced in nearby conducting structures. This model is reduced using optimal control techniques to less than 20 states for use in real-time. Effects of varying the gain matrix and feedback phase are experimentally examined. Comparisons between sensor measurements and the model show agreement with a sufficient number of states and details of the 3D wall. The system can allow for $n > 1$ plasma control through inclusion of $n > 1$ eigenfunctions.

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