Nonlinear MHD Study of Error Field Effects on Magnetic Islands

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In order to better understand the effects of the time-varying error field in NSTX on RWM stabilization by plasma rotation [1], we model the plasma response to an applied low-n external field perturbation using the resistive MHD model in the M3D code [2]. As an initial benchmark, we compare the predicted long-term island responses of a non-rotating model DIII-D equilibrium to a prescribed 2,1 flux perturbation at the plasma boundary with those predicted by the ideal linear code IPEC [3]. The codes show good agreement when the perturbation is small, i.e., in the linear regime; for larger perturbations, the nonlinear code predicts an upper limit on the island width beyond which stochasticity sets in. The nonlinear resistive analysis also enables scaling studies that show the effects of finite resistivity and of plasma rotation on the island response.

[1] J.E. Menard, et al., Nucl. Fus. 47, S645 (2007).

[2] W. Park, et al., Phys. Plasmas 6, 1796 (1999).

[3] J.K. Park, poster presented at Sherwood Fusion Theory Conference, Annapolis, MD, April 2007.