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Multiphysics Analysis of a Non-Resonant Internal Mode in NSTX

J.A. BRESLAU, M.S. CHANCE, J. CHEN, G.-Y. FU, S. GERHARDT, N. GORELENKOV, S.C. JARDIN, J. MANICKAM, Princeton Plasma Physics Laboratory — One class of tearing modes in the National Spherical Torus eXperiment (NSTX) occurs without any evidence of the usual triggering modes. Using several components of the SWIM framework [1], we have performed extensive linear and nonlinear MHD and hybrid MHD-kinetic analyses showing that these may be accounted for by a non-resonant mode with toroidal mode number $n = 1$ that develops at moderate normalized β_N when the shear is low and the central safety factor q_0 is close to but greater than one. This mode, which is related to previously identified “infernal” modes [2], will saturate and persist, and can develop poloidal mode number $m = 2$ magnetic islands in agreement with experiments. Our analysis includes a free-boundary transport simulation of an entire discharge showing that, with reasonable assumptions, we can predict the time of mode onset. Implications for ITER hybrid and AT regimes will be discussed.

[1] See web site <http://cswim.org>.

[2] J. Manickam, et al., *Nucl. Fus.* **27**, 1461 (1987).

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