A Categorization of tearing mode onset in tokamaks via nonlinear simulation

D.P. Brennan

*Massachusetts Institute of Technology, Cambridge, Massachusetts**

S.E. Kruger

Tech-X Corporation, Boulder, Colorado

T.A. Gianakon

LANL Los Alamos, New Mexico

D.D. Schnack

SAIC, San Diego, California

(Dated: March 11, 2005)

Abstract

A theoretical categorization of the onset of tearing modes in tokamaks is presented using DIII-D equilibrium reconstructions as initial conditions in the NIMROD nonlinear 3-D resistive magnetohydrodynamic (MHD) code [C.R. Sovinec, *et al*., J. Comp. Phys. **195**, 355 (2004)]. The onset mechanism of tearing modes are categorized into three types: spontaneous, mixed, and forced depending on the importance of linear instability versus forced reconnection. The physics of the early evolution of growing tearing modes in simulations with time varying linear instability drive, nonlinear coupling between modes, and neoclassical bootstrap drive are compared to experimental data to explain this qualitative categorization. Important effects, such as rotational shear and thermal anisotropy, are included and confirm that this categorization is consistent with the experimental observations in DIII-D.

*Electronic address: brennan@fusion.gat.com