Abstract Submitted
for the DPP11 Meeting of
The American Physical Society

Nonlinear Frequency Chirping of beta-induced Aflven eigenmode
HUASEN ZHANG, Fusion Simulation Center, Peking University, Beijing China 100871 — The β-induced Alfvén eigenmode (BAE) is studied using global gyrokinetic toroidal code GTC. Linear simulations show that kinetic effects modify BAE mode structure and reduce the frequency relative to the MHD theory. Both passing and trapped energetic particles contribute to BAE excitation through transit and bounce- precessional resonance, respectively. Nonlinear simulations show that the unstable BAE saturates due to nonlinear wave-particle interaction with both thermal and energetic particles. The saturated amplitude exhibits a coherent oscillation with an asymmetric growing and damping phase. Wavelet analysis shows that the mode frequency has a strong chirping associated with the oscillation of the mode amplitude. Analysis of nonlinear wave-particle interaction shows that the frequency chirping is induced by the nonlinear evolution of coherent structures in the energetic particle phase space of toroidal angle and precessional frequency. Controlled simulations further find that thermal particle nonlinearity plays a key role in controlling the saturation amplitude. We will also report self-consistent energetic particle transport from turbulence simulation with wave-particle and wave-wave nonlinearity treated on the same footing for the first time. Work in collaboration with W. Deng, I. Holod, Z. Lin, Y. Xiao and supported by DOE SciDAC GSEP Center and INCITE Program.

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Date submitted: 14 Jul 2011 Electronic form version 1.4