Hybrid MHD/particle simulation study of sub-cyclotron Alfvén Eigenmodes in NSTX

J.B. Lestz, E.V. Belova, and N.N. Gorelenkov
Princeton Plasma Physics Lab

High frequency compressional (CAE) and global (GAE) Alfvén Eigenmodes are often driven unstable by super-Alfvénic beam ions in NSTX. Strong activity of these modes has been linked to anomalous electron temperature profile flattening in beam-heated NSTX plasmas [1]. Multiple theoretical mechanisms have been proposed to explain how these modes may be responsible for this undesirable flattening, including CAE to kinetic Alfvén Wave (KAW) energy channeling [2] and stochasticization of electron orbits [3]. 3D hybrid simulations using the HYM code [4] are conducted to self-consistently study the stability properties of such CAE and GAE modes in realistic scenarios based on the well-diagnosed H-mode NSTX discharge 141398. HYM uses a delta-f particle treatment of the energetic beam ions coupled to a single fluid resistive MHD model of the bulk thermal plasma. Normalized beam energy (V_b/V_A) and central pitch ($\lambda = \mu B/E$) parameters in the equilibrium beam ion distribution function are varied in order to explore their influence on mode stability. Unstable modes occupy wide regions of this parameter space at every simulated toroidal mode number ($|n| \leq 16$). CAE are found to be stable below a threshold value of $V_b/V_A = 4$, whereas GAE may be driven unstable with V_b/V_A as low as 2.5. In general, co-propagating GAE are fastest growing, followed by counter-GAE, and then co-CAE, with the most unstable modes having $|n| = 6 - 10$. An overview of the properties of these modes (linear growth rate, mode structure, direction of propagation, inferred wave-particle resonance conditions) and their ongoing analysis will be presented.

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[3] N.N. Gorelenkov, D. Stutman, K. Tritz, et al., Nucl. Fusion **50**, 084012 (2010)

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