Stability of Alfvén gap modes in burning plasmas

R. Betti and J. P. Freidberg
Massachusetts Institute of Technology, Plasma Fusion Center, Cambridge, MA 02139

A stability analysis is carried out for energetic particle-Alfvén gap modes. Three modes have been identified: the Toroidicity, Ellipticity and Noncircular Triangularity Induced Alfvén Eigenmodes (TAE, EAE and NAE). In highly elongated plasma cross sections with $\kappa - 1 \sim 1$, the EAE may be a more robust mode than the TAE and NAE. It is found that electron Landau damping in highly elongated plasmas has a strong stabilizing influence on the $n = 1$ EAE, while ion Landau damping stabilizes the $n = 1$ TAE in high density regimes. Furthermore, the NAE turns out to be stable for all currently proposed ignition experiments. The stability analysis of a typical burning plasma device, Burning Plasma Experiment (BPX) [Phys. Scr. T16, 89 (1987)] shows that $n > 1$ gap modes can pose a serious threat to the achievement of ignition conditions.