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A Gyrokinetic Study of Global Alfvén Eigenmodes*

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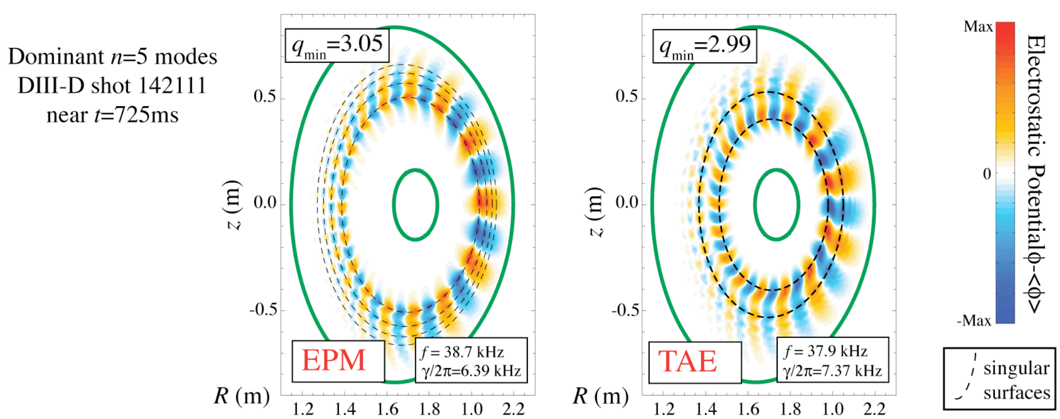
Alfvén eigenmodes (AEs) are considered a likely cause of convective transport, particularly for hot fusion products and other energetic particles (EPs). Here, we present a study of the linear properties of unstable global AEs in a beam-heated, shear reversed DIII-D discharge (142111) using the gyrokinetic code GYRO [1]. The discharge is known to have active toroidal Alfvén eigenmodes (TAEs) and reverse shear Alfvén eigenmodes (RSAEs), destabilized by EPs in the heating beams. We approximate the multi-beam source as an isotropic distribution of Maxwellian deuterium ions with an effective temperature T_{EP} that varies in space. Previous investigations [2] of EP-excited AEs in GYRO were restricted to radially-periodic fluctuations in a local model that neglected profile shearing. The present global simulations include effects of varying density, temperature, and safety factor q over most of the plasma core ($0.17 < \rho < 0.8$). All three species (ions, electrons, and EPs) are treated gyrokinetically. Unstable TAEs, RSAEs, and energetic particle modes (EPMs) all appear (see figure). High EP pressure ($\beta_{\text{EP}} \approx \beta_e$) in the tested experimental discharge distorts AEs from the canonical (pure MHD) form. As seen in local simulations [2], this effect somewhat blurs the distinction between the TAE and EPM. The RSAE is often sub-dominant and thus difficult to resolve with initial value runs. An existing full-spectrum eigenvalue solver, previously usable only on small local cases, has been adapted for use in the present large, global case. With the new solver, we demonstrate a clear connection between local and global eigenmodes. In particular, the global frequency, growth rate, and (to a lesser extent) eigenfunction shape can be bounded from a scan of local mode growth rates across flux surfaces.



[1] J. Candy and R.E. Waltz, Phys. Rev. Lett. **91**, 045001 (2003).
[2] E.M. Bass and R.E. Waltz, Phys. Plasmas **17**, 112319 (2010).

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