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TH/P6-06: Fully Gyrokinetic Modeling of Beam-driven Alfvén Eigenmodes in DIII-D Using GYRO

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Linear properties of a spectrum of Alfvén eigenmodes (AEs) have been investigated in a benchmark DIII-D shear-reversed discharge using the gyrokinetic code GYRO [1]. GYRO's gyrokinetic global eigenvalue solver tracks a linearly interacting spectrum of two toroidal Alfvén eigenmodes (TAEs) and a reverse-shear Alfvén eigenmode (RSAE), all at n=3, as they evolve over a short time slice of the discharge. Predicted frequencies agree well with experiment over most of the RSAE frequency sweep range. As the discharge evolves, RSAEs and TAEs are shown to exchange identity and even hybridize into modes with identifying features of both types. Observed kinetic corrections to eigenfunction structure, most notably a twist of the eigenfunction in the poloidal plane that experiments confirm [2], have likely implications for mode stability, and thus energetic particle (EP) confinement [3], in ITER and future fusion devices. Although driving EPs certainly induce the eigenfunction twist, this and other work [4] shows relative insensitivity to the EP profile for unstable modes. In experiment and present simulations, the twist direction always turns around near the first resonant surface outside the minimum in q. Most modes also exhibit some degree of EP-induced broadening of poloidal harmonics, most visible in regions of high magnetic shear. This broadening is characteristic of energetic particle modes (EPMs) [5] and illustrates a transition from parallel velocity dominance to drift orbit frequency dominance in the driving EP resonance condition across the extended mode footprint. The present results also shed light on details of the experimental spectrogram controlled by interaction of observed unstable modes and more weakly driven modes not visible in the experiment.

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[3] R.B. White, et al., Phys. Plasmas 17, 056107 (2010).
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[5] E.M. Bass and R.E. Waltz, Phys. Plasmas 17, 112319 (2010)

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Country or International Organization of Primary Author

USA

Primary author: Mr BASS, Eric M. (USA)

Co-author: Dr WALTZ, Ron E. (General Atomics)

Presenter: Mr BASS, Eric M. (USA)

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