Simulation of Reverse Shear Alfven Eigenmodes using a gyrokinetic ion/fluid electron hybrid model*

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We present simulation results of beam driven Reverse Shear Alfven Eigenmodes (RSAE) observed in DIII-D. Simulations are carried out with the Particle-in-Cell gyrokinetic code GEM [1]. Bulk ions and energetic particles are gyrokinetic, but electrons are described by a mass-less fluid model, which has been recently implemented in GEM and benchmarked with analytic theory for linear and nonlinear evolution of a single Toroidal Alfven Eigenmode (TAE) [2, 3]. Here we study the beam driven RSAEs observed in DIII-D discharge 142111. The equilibrium density and temperature profiles for the bulk ions and electrons and the equilibrium magnetic configuration are input from experimental data. Alfven eigenmode in the vicinity of reverse shear (q_{min}) are observed in the simulation, with a frequency that is sensitive to the q_{min} and decreases as the beam pressure increases, suggesting the mode is an RSAE. However, the simulated mode frequency, 20KHz<f<40KHz, is lower than the experimental data (> 50KHz). At low beam particle pressure the frequency spectrum often shows the co-existence of several eigenmodes. RSAE at r/a<0.5 and TAE at r/a>0.5 can be clearly identified, but a puzzling high frequency mode, f~400KHz, is often present in the low shear region. This mode is present only with a uniform elongation, κ=1.6. It disappears if the elongation in the core region is reduced to κ<1.3. The beam particles distribution is currently assumed to be slowing-down and isotropic in pitch-angle, but more realistic distributions will be used to study the beam's non-perturbative effect.

- In collaboration with Tobin Munsat and Michael Van Zeeland.

[1] Y. Chen and S. E. Parker, J. Comp. Phys. 220, 839 (2007)
[2] J. Lang et. al. Phys. Plasmas 16, 102101 (2009)
[3] Y. Chen and S. E. Parker, Phys. Plasmas, in press.