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Long-term Alfvén instability nonlinear simulations and high-bandwidth linear eigenmode surveys
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ABSTRACT
- Fast ion driven Alfvén instabilities are often observed to persist at sustained/steady amplitudes in experiments for 10^3 to 10^4 Alfvén times (t_{Alfven} \approx R_0/v_a).
- Nonlinear saturation effects and mechanisms that lead to self-organized states are important since they influence the mode intermittency and associated fast ion transport levels.
- Gyro-Landau fluid models (TAEFL/FAR3D) have achieved very long simulation times for these instabilities (up to 50,000 Alfvén times).
- The GTC model is also used for long time gyrokinetic-PIC simulations

Simulation results
- Bursting amplitudes if fast ion nonlinearities turned off => no profile flattening – only zonal flows/currents => Source instantly fills in losses.
- Neoclassical flow damping effects (Hinton/Rosenbluth) increases amplitude and intermittency
- Longer time simulations (up to 3 msec) show repeating predator-prey phenomena - DIII-D # 176523 (Through recent collaboration with M. Van Zeeland – See Mike’s talk I-1 at this conference on Sept. 3)

Simulations show the importance of
- Source/sink modeling => intermittency effects, diffusive transport over resonance regions
- Regulation of mode growth by nonlinear driven n = 0 components
- Neoclassical flow damping effects important
- Long-term nonlinear effects distort linear mode structure, introduce frequency chirping, modify fast ion profiles, and drive zonal flows

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