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Long-term Alfvén instability nonlinear simulations and high-bandwidth linear eigenmode surveys[1] DONALD SPONG, Oak Ridge National Laboratory, JACOBO VARELA, National Institute for Fusion Science, LUIS GARCIA, Universidad Carlos III de Madrid — Fast ion driven Alfvén instabilities are often observed to persist at sustained/steady amplitudes in experiments for 10^5 to 10^6 Alfvén times ($\tau_{\text{Alfvén}} = R_0/v_A$). Nonlinear saturation effects 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 sustained nonlinear state requires a balance between transport of the fast ion component into the resonance regions and transport out by nonlinear flattening of the distribution function; also, zonal flows (with neoclassical damping) and currents aid in regulating the amplitudes. Time series frequency analysis (spectrograms) of the evolving modes indicate that the zonal flows/currents are associated with transitory low frequency activity; this can provide a clue for diagnosis of such effects. In the linear regime, the eigenmode solver option facilitates mode surveys over wide frequency ranges and parameter variations. Such techniques are useful in understanding nonlinear dynamics and mode couplings.

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