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GeFi Simulation of Electron-Ion Hybrid Instability LEI QI, Ph.D student, Auburn University, YU LIN, Professor, Auburn University, XUEYI WANG, Assistant Research Professor, Auburn University, AMI DUBOIS, Ph.D student, Auburn University, EDWARD THOMAS, Professor, Auburn University
— Shear flow instabilities play an important role in laboratory as well as space plasmas. Excitation of the electron-ion hybrid (EIH) instability in a magnetized plasma with a transverse electric field and thus a localized electron cross-field flow is investigated using our gyrokinetic electron and fully-kinetic ion (GeFi) particle simulation model. Regime with $\rho_e < L_E < \rho_i$ is considered, where ρ_i and ρ_e are the electron and ion Larmor radii, respectively, and L_E represents the scale length of the shear flow profile. Both linear and nonlinear physics are studied. First, for the shear flow profile in a slab geometry, the simulation model is benchmarked by comparison of the eigen mode structure obtained from the linear GeFi results in a uniform plasma density with that from the linear theory [e.g., Ganguli, Lee, and Palmadesso, 1987], and good agreement is obtained. Vortex-like structures are also observed in the electrostatic potential. Second, in the nonlinear GeFi simulation, the EIH mode instability saturates in a time scale $t=0.2/\Omega_i$ (Ω_i is the ion gyrofrequency), and it nonlinearly evolves to a lower hybrid mode. Third, linear and nonlinear EIH instabilities in a plasma with a nonuniform density is also simulated. Finally, the GeFi simulation is carried out in a cylindrical geometry for conditions of the Auburn Linear Experiment for Instability Studies (ALEXIS) experiment. The results are compared with the ALEXIS measurements of the EIH instability.

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