Electrostatic drift-waves in the FRC: destabilized in the scrape-off layer, robust stabilization in the core

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Gyrokinetic simulations using the gyrokinetic toroidal code (GTC) has been performed for the advanced beam driven C-2 field-reversed configuration (FRC) experiment. With pressure gradient drives up to $\frac{R_0}{L_n} = \kappa_n < 5$ and the range of wavelengths up to $k_\zeta \rho_e < 0.3$, radially local fluxtube simulations find that electrostatic drift-waves are stable in the core. The stabilization mechanisms include finite Larmor radius (FLR) effects, magnetic well (negative grad-B), and electron kinetic effects. In the scrape-off layer (SOL), collisionless electrostatic, ion-to-electron-scale drift-waves are destabilized by electron temperature gradients from resonance with locally barely trapped electrons. Collisions can suppress this instability, but a collisional drift-wave instability can still exist at realistic pressure gradients. These simulation results are in qualitative agreement with C-2 FRC experiments. In particular, the lack of ion-scale instability in the core is consistent with experimental measurements of a fluctuation amplitude spectrum showing both lower amplitudes than the SOL and a depression in the ion-scale. The pressure gradient thresholds for the SOL instability from simulations are also consistent with thresholds observed in experiments.