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Gyrokinetic simulation of driftwave instability in field-reversed configuration

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Following the recent remarkable progress in MHD stability control in the C-2U advanced beam driven field-reversed configuration (FRC)[M. Binderbauer et al 2015], turbulent transport has become the foremost obstacle on the path towards an FRC-based fusion reactor. Significant effort has been put into expanding kinetic simulation capabilities in FRC magnetic geometry. The Gyrokinetic Toroidal Code (GTC) has been upgraded to accommodate realistic magnetic geometry from the C-2U experiment and to optimize the field solver for the FRC's field line orientation. Initial linear electrostatic GTC simulations find ion-scale instabilities are not present in the FRC core due to the large gyroradius of thermal ions, while electron drift-interchange modes are driven by the electron temperature gradient and bad magnetic curvature. Simulation in the FRC scrape-off layer finds density gradient driven ion scale fluctuations. Estimated instability thresholds from linear GTC simulations are qualitatively consistent with critical gradients determined from experimental Doppler backscattering fluctuation data, which also find ion scale modes to be depressed in the FRC core. Beyond GTC, a new kinetic code has been developed to accurately resolve the magnetic field separatrix and address the interaction between the core and scrape-off layer regions, which ultimately provide boundary conditions for the plasma confinement. Initial results and future development targets are discussed.