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A 3-field electromagnetic gyro-fluid model for tokamak edge turbulence[1] P.W. XI, Peking University / LLNL, X.Q. XU, LLNL — To investigate the L-H transition of low-high confinement mode, the H-mode pedestal structure and edge-localized modes, a set of 3-field gyro-fluid equations is derived based on an electromagnetic gyro-fluid model. By evolving gyrokinetic vorticity density, ion density and Ohm's law, this set of gyro-fluid equations correctly describes a range of plasma instabilities relevant to edge plasmas, such as low to intermediate n peeling-ballooning mode and high-n drift ballooning mode. Meanwhile electron acoustic wave is also taken into account. Utilizing Padé approximation for modified Bessel function, this set of equations is implemented under BOUT++ framework with full ion gyro-radius effects and the simulation results are compared with previous two-fluid model with ion diamagnetic drift, which retains the first-order finite ion gyro-radius correction. This simple 3-field gyro-fluid model does not take Landau damping into account. Linear simulations show a consistent diamagnetic stabilization with two-fluid model and reveal several new features at high-n modes due to kinetic effects and nonlinear simulations demonstrate the importance of kinetic effects on ELM crash as well as turbulent transport in H-mode recovery phase. A more comprehensive gyro-fluid model is also developed by using the gyrokinetic equations for edge plasmas.

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