

## **Nonlinear and non-ideal effects on FRC stability**

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New computational results are presented which advance the understanding of the stability properties of the Field-Reversed Configuration (FRC). We present results of hybrid and two-fluid (Hall-MHD) simulations of prolate FRCs in the strongly kinetic and small-gyroradius, MHD-like regimes. The  $n=1$  tilt instability mechanism and stabilizing factors are investigated in detail including nonlinear and resonant particle effects, particle losses along the open field lines, and Hall stabilization. It is shown that the Hall effect determines the mode rotation and the change in the linear mode structure in the kinetic regime; however, the reduction in growth rate is mostly due to finite Larmor radius effects. Resonant particle effects are important in the large gyroradius regime regardless of the separatrix shape, and even in cases when the large fraction of particle orbits are stochastic. Particle loss along the open field lines has a destabilizing effect on the tilt mode, and contributes to the ion spin up in toroidal direction. The nonlinear evolution of unstable modes both in the kinetic and the small-gyroradius FRCs is shown to be considerably slower than that in MHD simulations. Our simulation results demonstrate that a combination of kinetic and nonlinear effects is a key for understanding the experimentally observed FRC stability properties.