Effect of magnetic shear on drift-tearing and resistive drift modes in plasma slab*

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In this work, we consider two categories of non-MHD effects that are important for two-fluid tearing instability: (1) electron and ion diamagnetic flows caused by equilibrium pressure gradients and (2) electron and ion decoupling on short scales associated with kinetic Alfven and whistler waves. The relationship between the expected stabilizing response due to the effects (1) and the destabilizing contribution caused by the dispersive waves (2) is investigated. We have developed an analytical theory and also performed simulations using the NIMROD code, both of which include these non-MHD effects. The analytic theory accommodates finite parallel thermal conduction and arbitrary equilibrium which reduce to previously known analytic solutions in both the infinite parallel thermal conduction and adiabatic limits. Linear numerical simulations were performed for plasma slab with cold ions and hot electrons in a doubly periodic box bounded by two perfectly conducting walls. Configurations with magnetic shear were shown to be unstable to current-driven drift-tearing instability and drift effects were observed to be stabilizing at sufficiently large equilibrium diamagnetic flows. A second linearly unstable mode with largely electrostatic perturbations, possibly a resistive-drift type mode, was also observed in some simulations. The resistive-drift mode is suppressed by magnetic shear in unbounded domains. We investigate the effect of magnetic shear and determine if differences in configuration, including the finite slab thickness and the perfectly conducting boundary conditions, account for the lack of suppression.

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