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Stabilizing Effects of Edge Current Density on Peeling-Ballooning Instability[1] P. ZHU, C.C. HEGNA, C.R. SOVINEC, University of Wisconsin-Madison — Resistive MHD computations using the NIMROD code find a strong dependence of low-n edge instabilities on the edge parallel current density distribution. Here n is the toroidal mode number. The low-n edge-localized-modes can be driven unstable by increasing the edge current density across the peeling-ballooning stability boundary. When edge peak current density is sufficiently large, the corresponding safety factor q profile obtains an edge region with zero or reversed magnetic shear, and the low-n edge instabilities are partially or fully stabilized. These results are consistent with previous analytic theory on peeling modes which indicates that zero or reversed magnetic shear can be stabilizing. Nonlinear simulations indicate that the stabilizing effects of edge current density on the low-n peeling-dominant modes through zero and reversed shear can persist throughout the nonlinear exponential growth phase. Near the end of this nonlinear phase, the radial extent of the filament exceeds the pedestal width, and disconnected blob-like substructures start to develop within the filaments. Relative pedestal energy loss from these radially extending filaments can reach $20-30\%$. Both filament size and pedestal energy loss from the nonlinear low-n peeling-dominant instabilities can be reduced and regulated by the equilibrium edge current density distribution.

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