Dynamic Behavior of Peeling-Ballooning Modes in a Shifted-Circle Tokamak Equilibrium.

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Progress in understanding edge localized modes (ELMs) has been made by investigating the stability properties of peeling-ballooning modes using linear ideal MHD calculations[i, ii]. In this study we focus on the linear and nonlinear evolution of the peeling-ballooning instabilities over the entire spectrum for a class of shifted-circle tokamak equilibria, using time dependent computations with the extended-MHD code NIMROD[iii]. The equilibrium is generated by the TOQ code and is intended to model an H-mode plasma with a defined pedestal pressure region and a self-consistent parallel driven current. The effect of a vacuum region is modeled by the introduction of a prescribed resistivity profile that transitions from a small value to a very large value at a flux surface location outside of the pedestal region. By adjusting the location of the transition region we are able to manipulate the unstable modes that govern the pedestal evolution. Instabilities more ballooning-like in character are found to dominate cases with a distant vacuum region, whereas peeling mode physics is expected to become more prominent as the vacuum region approaches the pedestal. Of particular interest is the dependence of mode dominance and behavior on pedestal width and height, as well as vacuum location, in terms of the potential active control of the ELM behaviors in experiments. A comprehensive nonlinear study is planned in addition to a full linear analysis. We present our linear results and preliminary nonlinear computational comparisons with the recent theory development on the nonlinear regimes of ballooning instability[iv].

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