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Nonlinear External Kink Computing with NIMROD[1] K. J. BUNKERS, C. R. SOVINEC, Univ of Wisconsin, Madison — Vertical displacement events (VDEs) during disruptions often include non-axisymmetric activity, including external kink modes, which are driven unstable as contact with the wall eats into the q-profile. The NIMROD code [Sovinec, et al., JCP 195, 335] is being applied to study external-kink-unstable tokamak profiles in toroidal and cylindrical geometries. Simulations with external kinks show the plasma swallowing a vacuum bubble, similar to [Rosenbluth, et al., Phys. Fluids 19, 1987]. NIMROD reproduces external kinks in both geometries, using an outer vacuum region (modeled as a plasma with a large resistivity), but as the boundary between the vacuum and plasma regions becomes more 3D, the resistivity becomes a 3D function, and it becomes more difficult for algebraic solves to converge. To help allow non-axisymmetric, nonlinear VDE calculations to proceed without restrictively small time-steps, several computational algorithms have been tested. Flexible GMRES, using a Fourier and real space representation for the toroidal angle has shown improvements. Off-diagonal preconditioning and a multigrid approach were tested and showed little improvement. A least squares finite element method (LSQFEM) has also helped improve the algebraic solve.

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