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Toroidal Axisymmetric Extended-MHD Steady-States with Flow N.M. FERRARO, S.C. JARDIN, Princeton Plasma Physics Laboratory, A.C. BAUER, Rensselaer Polytechnic Institute — Axisymmetric steady-states of the full extended-MHD (X-MHD) equations, including two-fluid effects, flow, and gyroviscosity, are obtained by evolving the X-MHD equations from an initial ideal-MHD equilibrium. Steady-states for both large aspect-ratio limited plasmas and NSTXlike diverted plasmas are presented. Self-consistent Pfirch-Schlüter flows are observed, and spontaneous spin-up is observed to develop even when a simple resistive single-fluid model is used, in agreement with previous theoretical and numerical results. In the steady-state, resistive and thermal losses are offset by inductive current drive. These accurate and self-consistent steady-states may be used as the initial equilibrium for non-axisymmetric X-MHD linear stability calculations, for example. The axisymmetric steady-states are obtained using $M3D-C^1$, a parallel, implicit, nonlinear, high-order finite element code. Cylindrical coordinates are used instead of flux coordinates, eliminating difficulties arising from the coordinate singularity at the magnetic x-point in diverted plasmas. The vacuum region is modeled as a high-resistivity plasma, allowing the same physical equations to be applied throughout the simulation domain. An unstructured, adaptive triangular mesh is used to maximize computational efficiency without degrading spatial resolution. This work was supported by US DOE contract DE-AC02-76CH03073.

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