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Simulation of MHD Instabilities with Runaway Electron Current using M3D-C1 CHEN ZHAO, CHANG LIU, STEPHEN JARDIN, NATHANIEL FERRARO, Princeton Plasma Physics Laboratory — Runaway electrons can be generated in a tokamak during a plasma disruption and can be accelerated to high energies, potentially damaging the first wall. To predict the consequences of runaway generation during a disruption, it is necessary to consider resonant interactions of runaways with the bulk plasma. Here we consider the interactions of runaways on low mode-number tearing modes. For this study, we have developed a fluid runaway electron model for the 3D MHD code $M3D - C^1$[Jardin et al., 2012]. The code employs high-order C^1 continuous finite elements in 3 dimensions. It can be switched into reduced MHD or full MHD, linear or non-linear, cylindrical or toroidal geometry. The code allows localized mesh adaptation around certain rational surfaces so that it can better resolve the near-singular behavior of the runaway electron current. To benchmark, we have reproduced the reduced-MHD linear tearing mode results (with runaway electrons) in a circular cylinder presented in previous studies [Matsuyama et al., 2017]. This work is being extended in several ways including generalization to full MHD, nonlinear evolution, and generalizing the kinetic runaway electron model.
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