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Simulation of MHD Instabilities with Runaway Electron Current using M3D-C1 CHEN ZHAO, CHANG LIU, STEPHEN JARDIN, NATHANEIL FERRARO, PPPL, M3D-C1 TEAM — Runaway electrons can be generated in a tokamak during the start up, during normal operation and during a plasma disruption. 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, the nonlinear effect of runaways on low beta sawteeth and the runaway current generation during disruption. For this study, we have developed a fluid runaway electron model for the 3D MHD code M3D-C1. The code employs high-order C1 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 in the inner layer region. We have reproduced the reduced-MHD linear tearing mode results (with runaway electrons) in a circular cylinder presented in previous studies. This work is also extended to full MHD. We also have carried out the result of nonlinear low-beta sawteeth with runaways and the runaway current generation during disruption using DIII-D parameters.

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