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Reduced model of runaway electrons in NIMROD[1] GE WANG, C.R. SOVINEC, CPTC, University of Wisconsin-Madison — Disruption poses a serious threat to the continuous operation of tokamaks. The thermal quench cools the plasma quickly, and the resulting change in resistivity can transfer current to a runaway electrons (RE) population. The REs can drive or suppress MHD instabilities during the current quench phase, which in turn may improve or deteriorate the confinement. Studying the interaction of REs with low-frequency MHD modes via full-scale explicit PIC simulation will be computationally expensive because of the CFL time-step constraint when solving the equations of motion of REs, which travel at relativistic speeds. However, approximating the RE distribution in velocity space as a delta function leads to a passive convective-like equation for RE density, which governs the evolution of their spatial distribution, subject to high parallel speed and perpendicular drift motion. The equation for RE density is solved by using the least-squares finite element method in the framework of NIMROD. The implicit implementation relaxes the time-step constraint, although the convection speed is as large as the speed of light. The REs contribute a resistance-free current in the momentum equation and in the MHD Ohm's law, which is used during the advance of magnetic field.

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