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Kinetic-MHD hybrid equilibrium model using a Monte-Carlo calculation of runaway electron distribution function[1] AKINOBU MATSUYAMA, NOBUYUKI AIBA, MASATOSHI YAGI, Japan Atomic Energy Agency
— An axisymmetric MHD equilibrium model is studied to allow the inclusion of both beam inertia and energy spectrum for runaway electron beam. Following kinetic-MHD hybrid approach [1], we evaluate the RE beam current from the integrals of the RE distribution function. The distribution function is here evaluated by a relativistic guiding-center trace code ETC-Rel [2], where we have implemented the effects of collisions, radiations, and exponential growth into the code. Because to directly treat the Dreicer mechanism in particle simulations is time consuming, the primary RE source is modeled by a Monte-Carlo weighing scheme taking into account the instantaneous generation rate. This paper applies ETC-Rel to the parametric study of the MHD equilibrium with different RE beam parameters. Kinetic effects on the MHD equilibrium appears, e.g., as enhanced Shafranov shifts due to the inertia of highly relativistic electrons. A kinetic modification to the equilibrium becomes significant if the contribution of the beam inertia – being increased with the total electron mass of multi-MeV RE populations – becomes large enough to affect the radial force balance.

[1] E. V. Belova, et al., Phys. Plasmas 10, 3240 (2003);
[2] A. Matsuyama, et al., Nuclear Fusion 54, 123007 (2014).

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