Modeling of Resistive Wall Mode with Full Kinetic Damping *

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Magnetohydrodynamic (MHD) stability of the plasma depends critically on the frequency and wave length of the perturbation. Future tokamaks are expected to operate in regimes where the external macro-scale perturbations have much lower frequencies than the intrinsic dynamical time scales of the particles [1]. This situation calls for a detailed re-examination of the assumptions on previous models of the response of the plasma to MHD perturbations [2]. We have developed a full drift kinetic version of MARS-F based on the kinetic formulation of MHD response [3]. The kinetic integrals are evaluated in a general toroidal geometry with flow, and self-consistently incorporated into the MHD formulation. In particular, the energy and momentum flux across the plasma surface is expressed in terms of the MHD perturbations. The new code has been tested on a Soloviev analytic equilibrium. It is observed that most of the kinetic damping comes from the particle precession drift resonances, from particles with nearly vanishing drift frequency. The RWM eigenmode structure is modified by the new kinetic terms. These kinetic terms may provide strong stabilization for high-pressure plasmas, such as those from DIII-D. Implication on the stability and plasma response [4] relevant for the resistive wall mode, with its time scale dramatically slowly by the external resistive wall, is discussed.

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