Effects of particles with large gyroradii on magnetohydrodynamic stability

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Abstract

Fast ions in tokamaks are known to have a significant influence on global plasma instabilities. In normal mode analyses for tokamaks, the perturbed electric and magnetic fields have been evaluated at the position of the particle's guiding center. We consider the effect of spatial variation of the perturbed fields *within* the gyroradius for internal magnetohydrodynamic (MHD) modes. We investigate the resulting tearing mode stability for the reversed field pinch (RFP) and the internal kink mode in tokamak. Such effects are important for neutral beam injected particles in current RFP experiments and for fusion-generated alpha particles or ion cyclotron frequency heated ions in tokamaks. The fast particle dielectric response is evaluated from the linearized Vlasov equation, and inserted into a cylindrical MHD model for the bulk plasma. In the initial model the response is found for a simplified particle distribution function assuming that the equilibrium magnetic field is uniform within the gyro-orbit. The effect of large gyroradii is strong, and can be either stabilizing or destabilizing (depending on the radial distribution of the fast particle density). The effect is maximal when the fast particles reside near the tearing-resonant surface. The outline of more accurate modeling (being developed now) will be presented.