Kinetic MHD Simulation in Tokamaks

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Kinetic modifications of MHD modes introduce new paradigms in MHD theory. Previous studies of the (collisionless) m=1/n=1 kinetic internal kink mode with electron diamagnetic effects revealed that there is a weakly unstable mode even in the region in which theory predicts complete stabilization [1,2]. The mode pattern has m=1 sheared poloidal flow which generates vortices due to the Kelvin-Helmholz instability [3]. These studies have been carried out in cylindrical geometry using the gyro-reduced-MHD(GRM) code. The relevance to toroidal geometry is quite critical to the theory of the sawtooth crash because the mode-coupling due to toroidal effects may dominate the nonlinear development of the instability. A modified version of the FAR code including kinetic effects is being developed to study the effect of vortex generation on the internal kink mode. In the cylindrical limit, the linear mode pattern and the complex frequency obtained with the modified FAR code coincide with the results obtained with the GRM code. Nonlinear calculations in toroidal geometry has been started and results will be reported as available.

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[3] H. Naitou, T. Kobayashi, M. Yagi, T. Matsumoto, S. Tokuda, Y. Kishimoto, Book of Abstracts, 19th IAEA Fusion Energy Conference (Lyon, France, 14-19 October 2002) p.138.