

Multi-scale interactions among micro-turbulence, macro-MHD, and zonal flow

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Effects of micro-turbulence and macro-MHD on magnetically confined plasma are investigated separately so far, however, they appear in the same time and interact each other. Mutual interactions between micro-turbulence and macro-MHD are investigated by numerically solving a reduced set of two-fluid equations[1,2]. Our numerical simulation starts from an equilibrium that is unstable against kinetic ballooning modes and tearing modes, and then turbulent equilibrium including micro-turbulence and zonal flow is formed. It is found that the tearing mode, i.e. macro-MHD, arises in the turbulent equilibrium. Then the tearing mode transforms the equilibrium into a new equilibrium not only including the turbulence but also including magnetic islands. In the new equilibrium the turbulence is altered by the tearing mode because the tearing mode globally violates the magnetic surfaces and produces magnetic islands. The new equilibrium exhibits enhanced thermal transport around the resonant surface of the tearing mode.

- [1] A. Ishizawa and N. Nakajima, Physics of Plasmas **14**, (2007) 040702
- [2] A. Ishizawa and N. Nakajima, Nuclear Fusion **47**, (2007) 1540