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Zonal flow dynamics and transport characteristics in mixed-scale MHD and ITG turbulence

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Nonlinear interaction of multi-scale turbulence in magnetic confinement plasma may result in new driving or sink of fluctuating energy so that the plasma heat transport is characterized by a multi-scale process and intermittency. In micro-turbulence like ion temperature gradient (ITG) driven one, the zonal flow (ZF) dynamics have been intensively explored to suppress anomalous transport. On the other hand, it is noticed that the ZF is not effectively excited by the MHD mode with magnetic reconnection. To understand the effect of nonlinear interaction of multi-scale fluctuations on the transport as well as the ZF dynamics, we have proposed a mixed MHD and ITG turbulence simulation in a slab configuration based on gyrofluid model. Both MHD mode and ITG instability are excited in an integrated system [1]. A prominent oscillatory ZF has been observed in slab geometry for the first time, which is an unusual phenomenon. Meanwhile, the ion thermal transport is not efficiently suppressed by the robust ZFs.
This work will analyze the ion heat transport property associated with the dynamics of oscillatory ZFs based on gyrofluid simulation of mixed-scale MHD and ITG turbulence. The transport level observed in the simulations is directly compared with the theoretical estimate on the suppression role of the oscillatory zonal flow in turbulence [2], showing a remarkable reduction of the shearing decorrelaion of the ZFs in multi-scale turbulence. Further, magnetic island dynamics is discussed companying with the characteristics of the oscillatory ZFs.

1 Jiquan Li, *et al.*, Nucl. Fusion 49, in printing (2009)
2 T.S. Hahm, *et al.*, Phys. Plasmas 6, 922(1999)
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