Gyrokinetic-Vlasov simulations of the ion temperature gradient turbulence in tokamak and helical systems

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Keywords: Transport, Plasma turbulence, Gyrokinetic simulation
PACS: 52.25.Fi, 52.35.Ra, 52.65.Tt

Abstract. Gyrokinetic theory and simulation of plasma turbulence in magnetic confinement fusion have advanced physical understandings on the anomalous transport mechanism. The gyrokinetic-Vlasov simulation code (GKV code) has confirmed the statistically steady state of the toroidal ion temperature gradient (ITG) turbulent transport in tokamaks in terms of detailed calculation of the entropy balance [1]. It has widely been recognized that zonal flows play a critical mechanism to suppress plasma turbulence and transport. The GKV simulation carried out on the Earth Simulator clearly captures nonlinear processes in generation of zonal flows in the ITG turbulence.

Damping processes of zonal flows in helical systems are analytically investigated [2,3] based on the gyrokinetic theory as a generalization of the work by Rosenbluth and Hinton for tokamaks. Recently, in order to elucidate how the helical geometry can be optimized to enhance the residual zonal flow level, the collisionless damping of the zonal flow and the geodesic acoustic mode in multi-helicity configurations is investigated by means of the helical version of the GKV code with high phase-space resolution. Accordingly, the GKV simulation extended to take account of helically-trapped particles is also applied to the ITG turbulence in helical systems, which demands huge computer resources and is realized by use of the Earth Simulator. The recent progress of the GKV simulations of the ITG turbulence in tokamak and helical systems will be presented in the workshop.

Acknowledgments. This work is supported in part by grants-in-aid of the Ministry of Education, Culture, Sports, Science and Technology (No. 16560727, 17360445, and 17·05373), and in part by the National Institute for Fusion Science (NIFS) Collaborative Research Program (NIFS05KKMT001, NIFS06KTAT038, NIFS06KDAD006, and NIFS06KNXN060). Numerical simulations are carried out by use of the Earth Simulator under the support by Japan Agency for Marine-Earth Science and Technology, and by use of the Plasma Simulator and the LHD numerical analysis system at NIFS.

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