Simulation of Zonal Flow Evolution Based on a Collisionless Kinetic-Fluid Closure Model

H. Sugama[a,b] and O. Yamagishi[a]

[a] *National Institute for Fusion Science, Toki 509-5292, Japan*
[b] *The Graduate University for Advanced Studies, Toki 509-5292, Japan*

Zonal flows are intensively investigated in the fusion research as an attractive mechanism for realizing a good plasma confinement. An accurate theoretical description of zonal-flow evolution is a key issue for correctly predicting the turbulent transport of fusion plasmas. In fact, unless the residual zonal flow [1] is properly treated in a gyrofluid model, the gyrofluid simulation cannot reproduce the same turbulent transport as given by the gyrokinetic simulation. A collisionless kinetic-fluid closure model of zonal flows in tokamaks was presented by Sugama *et al.* [2], which can describe the residual zonal-flow level given by Rosenbluth and Hinton [1]. In the present work, fluid simulations of zonal flow evolution are done by using the kinetic-fluid closure model in order to investigate effects of the magnetic geometry and source flows on the residual zonal-flow level. We confirm that the fluid simulations can correctly reproduce these effects which are analytically predicted by the gyrokinetic model.

[1] M. N. Rosenbluth and F. L. Hinton, Phys. Rev. Lett. **80**, 724 (1998).
[2] H. Sugama, T.-H. Watanabe, and W. Horton, Phys. Plasmas **14**, 022502 (2007).