Gyrokinetic Simulation Study of Micro-Physics for Symmetry Breaking and Intrinsic Rotation Generation in Electrostatic Turbulence

J.M. Kwon[1], S-M. Yi[1], T. Rhee[1], P.H. Diamond[1,2], and J.Y. Kim[1]

[1] WCI Fusion Theory Center, National Fusion Research Institute, Korea
[2] CMTFO and CASS, UCSD, USA

Previous numerical simulation studies of electrostatic turbulence have demonstrated that symmetry breaking in fluctuation spectrum acting in synergy with boundary condition can lead to the spontaneous generation of toroidal plasma rotation. Here we present gyrokinetic simulation studies of dynamical symmetry breaking and intrinsic rotation generation. We demonstrate that both ***ExB*** flow shear and turbulence intensity gradients, which are coupled via a Predator-Prey feedback loop [1], can induce the symmetry breaking. Detailed analysis of fluctuation spectrum is performed to understand the local physics origin of the varying symmetry breaking mechanisms for different equilibrium parameters, e.g. collisionality, ion temperature gradient, q-profile structure. Particular focus is placed on the role of q-profile structure in causing symmetry breaking and its relation to the apparent current dependence of intrinsic rotation scaling found in experiments [2]. It is found that both high q-values and low magnetic shear can enhance the symmetry breaking effect and lead to stronger intrinsic rotation generation. This suggests that flat-q hybrid mode plasmas may exhibit stronger intrinsic rotation. Gyrokinetic code *gKPSP* is used for the study, which employs bounced averaged kinetic model for efficient simulation of non-adiabatic electron responses [3].

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