Multiple states of broadband frequency shearing in a self-consistent one-dimensional edge turbulence model

K. Miki[1] and P.H. Diamond[1,2]
1 WCI Center for Fusion Theory, National Fusion Research Institute, Daejeon, Korea
2 CASS and CMTFO, UCSD, La Jolla, CA 92093, USA

There are experimental results indicating links between changes in transport and turbulence fluctuation levels, zonal flow(ZF), geodesic acoustic mode(GAM), and also mean flow activity[1,2]. To theoretically understand these phenomena, we define *self-consistent* states of coexistence/stand-alone of ZF and/or GAM shears, using a multiple frequency shearing predator-prey model [3]. This work also discussed possible bistability of ZF and GAM states and thus a zonal hysteresis phenomenon exhibited by power ramp-up and down. These arguments showed the importance of GAM's self-consistent turbulence regulation as well as GAM driven by turbulence.

In this study, we discuss how the mean flow affects on ZF and GAM mode competition, as well as turbulence regulation. First, a modified model including more general shearing effects, i.e. direct ZF and GAM interaction, is introduced. The model exhibits a new possible state with higher turbulent energy but a finite ZF energy. The state is stabilized when ZF shearing produces a steeper slope of radial spectrum. This situation can correspond to the case with small-scale ZF shearing fields interacting with a large-scale shearing field, such as mean flow.

Next, to analyze another aspect of the mean flow coupling with the pressure gradient, we also examine a one-dimensional self-consistent turbulent transport dynamics based on a predator-prey model including mean flows[4]. By studying power ramp up and down, hysteresis and a dithering cycle as they appear in a one-dimensional model will be discussed. This work aims to elucidate the parameters which determine criticality in edge turbulence.

This work was supported by the WCI Program of the National Research Foundation of Korea (NRF) funded by the MEST of Korea [WCI 2009-001].

References:

[1] G.D. Conway *et al.*, Phys. Rev. Lett. **106**, 065001 (2011).
[2] K.J. Zhao *et al.*, *Proc. of the 23rd IAEA Fusion Energy Conference* (Daejeon, Korea) (2010).
[3] K. Miki and P.H. Diamond *in the 23rd IAEA Fusion Energy Conference* (Daejeon, Korea) (2010).
[4] E.J. Kim and P.H. Diamond, Phys. Rev. Lett. **90**, 185006-1 (2003).