MF-I51

1st Asia-Pacific Conference on Plasma Physics, 18-23, 09.2017, Chengdu, China

Interplay of a magnetic island, flow and temperature profiles, and turbulence

M. J. Choi[1], J. Kim[1], J.-M. Kwon[1], H. K. Park[1, 2], Y. In[1], W. Lee[1],
K. D. Lee[1], G. S. Yun[3], J. Lee[2], M. Kim[2], W.-H. Ko[1], J. H. Lee[1],
Y.-S. Park[4], Y. S. Na[5], N. C. Luhmann Jr. [6], and B. H. Park[1]

[1]*National Fusion Research Institute, Daejeon 34133, Korea*
[2]*Ulsan National Institute of Science and Technology, Ulsan 689-798, Korea*
[3]*Pohang University of Science and Technology, Pohang, Gyungbuk 790-784, Korea*
[4]*Columbia University, New York, NY 10027, USA*
[5]*Seoul National University, Seoul 08826, Korea*
[6]*University of California at Davis, Davis, CA 95616, USA*

The electron heat transport near the magnetic island has been studied in the KSTAR L-mode diverted plasmas. An n=1 resonant magnetic perturbation field is applied to induce an m/n=2/1 magnetic island, and the electron cyclotron emission imaging (ECEI) diagnostics is used to measure 2D electron temperature (T_e) profile and fluctuation and to deduce the poloidal flow.
It is found that the 2D T_e profile and the 2D patterns of the T_e turbulence level and the poloidal flow are closely coupled. The magnetic island can play as either a barrier or a fast channel of the electron heat transport. In particular, the magnetic island plays like an electron heat transport barrier when the poloidal vortex flow forms [1,2]. The vortex flow speed is peaked near the separatrix of the magnetic island increasing towards the O-point region. The positive radial shear of the poloidal flow in the inner region (i.e. $r < r_{si}$ where r_{si} is the inner separatrix of the magnetic island) would suppress the T_e turbulence around the O-point region, and the T_e turbulence level is only significant in the narrow region close to the X-point region [1]. The negative radial shear of the poloidal flow across the magnetic island would prevent a turbulent eddy from growing across the X-point and from spreading into the island.
However, when the T_e gradient and turbulence level exceed critical levels, the transport bifurcation occurs and a massive heat transport event (minor disruption) follows. The role of the magnetic island on the electron thermal transport is more complicated than a direct thermal loss channel. This work clearly demonstrates multiscale nonlinear interaction between a large scale magnetohydrodynamic instability and small scale turbulence and its importance on the electron thermal transport.

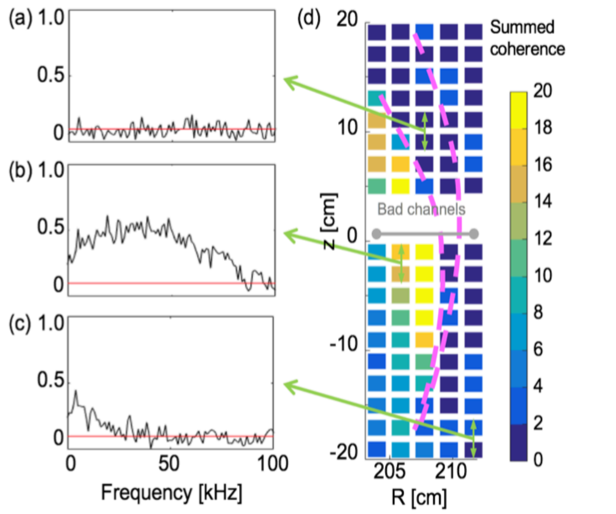

Figure 1. The $\delta T_e/\langle T_e\rangle$ cross coherence (a) inside the magnetic island and in the (b) inner and (c) outer regions. (d) The 2D summed coherence image (turbulence level) is estimated using pairs of two vertically adjacent ECEI channels.

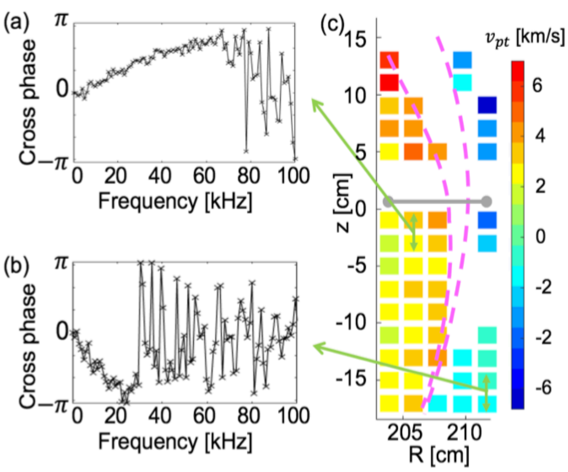

Figure 2. Cross phase between two vertically adjacent ECEI channels measured in the (a) inner and (b) outer regions. (c) The 2D vertical pattern velocity (poloidal flow) profile is measured using the slope of the coherent cross phase versus the frequency.

References
[1] W. A. Hornsby et al., Physics of Plasmas 17, 092301 (2010).
[2] A. Bañón Navarro, et al., Plasma Physics and Controlled Fusion 59, 034004 (2017).