Interaction between magnetic island, plasma perpendicular flow and turbulence in HL-2A ohmic plasmas

M. Jiang[1], W.L. Zhong[1], Y. Xu[2], Z.B. Shi[1], W. Chen[1], X.Q. Ji[1], X.T. Ding[1], Z.C. Yang[1], P.W. Shi[1], A.S. Liang[1], J. Wen[1], J. Q. Li[1], Y. Zhou[1], Y.G. Li[1], D.L. Yu[1], Y. Liu[1], Q.W. Yang[1] and M. Xu[1]

[1] *Southwestern Institute of Physics, P.O. Box 432, Chengdu 610041, People's Republic of China*

[2] *Institute of Fusion Science, School of Physical Science and Technology, Southwest Jiaotong University, Chengdu 610031, People's Republic of China*

Corresponding author: jiangm@swip.ac.cn

The multi-scale physics such as the interaction between large scale MHD modes and turbulence were reported to play a crucial role in the transport regulation in the core plasma [1, 2] and the interaction between sheared zonal flow and turbulence was considered to be the key ingredient for the low-to-high confinement mode transition [3, 4]. In this work, we present the first experimental observations of the interaction between magnetic island, plasma perpendicular flow and turbulence in the presence of the naturally rotating m/n = 2/1 tearing mode in the HL-2A ohmic plasmas using a hopping Doppler backward scattering reflectometer system, which provides direct experimental evidence for the simulations. It has been observed that across the O-point cut the perpendicular flow is near zero at the center of the island and strongly enhanced around the boundary of the island, resulting in a large increase of the flow shear in the outer half island, while across the X-point cut the flow is almost flat in the whole island region. Meanwhile it was found that the density fluctuations drop near the O-point region while elevated at the X-point region, which is in agreement with the gradient drive of the turbulence. The results indicate that both the perpendicular flow and the density fluctuation level are modulated by the naturally rotating tearing mode near the island boundary. The cross-correlation between the perpendicular flows and the oscillating electron temperature further reveals that the modulation of the perpendicular flow occurs mainly inside and in the vicinity of the island.

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