Experimental studies of turbulence and zonal flow in edge plasmas of the HL-2A tokamak

J. Q. Dong*, K. J. Zhao L. W. Yan, W. Y. Hong, C. X. Yu[a], A. Fujisawa[b], J. Qian, J. Chen, A. D. Liu, T. Lan[a], H. L. Zhao[a], D. F. Kong[a], Yi Liu, Y. Huang, Q. Li, X. M. Song, Q. W. Yang, X. T. Ding, X. R. Duan, Yong Liu

Southwestern Institute of Physics, P. O. Box 432, Chengdu, China
[a] *Department of Modern Physics, University of Science and Technology of China, Hefei, China*
[b] *National Institute for Fusion Science, 322-6 Oroshi-cho, Toki 509-5292, Japan*
* *also at Institute for Fusion Theory and Simulation, Zhejiang University, Hangzhou, China*

jiaqi@swip.ac.cn

Measurements with a three dimensional set of Langmuir probe arrays have unambiguously demonstrated the coexistence of intensive low frequency zonal flows (LFZFs) and geodesic acoustic modes (GAMs) in the edge of HL-2A tokamak plasmas, by verifying the spatial characteristics and the nonlinear couplings with ambient turbulence (AT). The intensity of the LFZFs is observed to increase and decrease with increases of ECRH power ($\sim$ 300-700 kW) and safety factor q ($\sim$ 3.5-6.2), respectively, while it is the opposite for the GAMs. The radial wave number-frequency spectra of the LFZF show that the LFZF packets propagate outwards and inwards as equally likely events, while the GAM packets propagate predominantly outwards. The spectra of the AT and its interaction with the zonal flows (ZFs) are investigated in detail. The analysis of modulation in AT envelopes has revealed that their structures are identical with that of ZFs including the GAMs. The findings provide concrete evidences that the envelope modulation should be caused by the zonal flows[1–7].

The authors thank the HL-2A Team for operation of the machine. This wok is supported by NSFC Grant Nos. 10775044 and 10675041, the Sichuan Youth Foundation of Science and Technology, Grant No 09ZQ026-079, the National Basic Research Programme of China under Grant Nos. 2008CB717806 and 2009GB105005, and the JSPS-CAS Core-University Program.

References

[1] K. J. Zhao et al., Phys. Rev. Lett. **96**, 255004 (2006).

[2] L. W. Yan et al., Nucl. Fusion **47**, 1673 (2007).

[3] K. J. Zhao et al., Phys. plasmas **14**, 122301 (2007).

[4] T. Lan et al., Plasma Phys. Controlled Fusion **50**, 045002 (2008).

[5] K. J. Zhao et al., Nucl. Fusion **49**, 085027 (2009).

[6] J. Cheng et al., Nucl. Fusion **49**, 085030 (2009).

[7] A. D. Liu et al., Phys. Rev. Lett. **103**, 095002 (2009).