Turbulence, Zonal Flow and Limit Cycle Oscillation on HL-2A Tokamak

J. Q. Dong* for HL-2A Team
Southwestern Institute of Physics, P.O. Box 432, Chengdu 610041, China

E-mail: jiaqi@swip.ac.cn

Abstract

The aim of the HL-2A tokamak experimental programme is to make contributions to the establishment of physics bases for ITER experiment such as H-mode operation and energetic particle confinement in recent years. Turbulent transport mediated by interaction of turbulence and flows in tokamak edge plasmas is one of the most important research topics in magnetic fusion plasma physics as well as for ITER experiment. Significant progress has been made in the HL-2A tokamak in understanding the turbulence and shear flow dynamics, blobs and their generation mechanism, and the limit cycle oscillation in L-H transitions. In particular, the spatial-temporal characteristics of low frequency zonal flows (ZF) and geodesic acoustic modes (GAM), the absolute rate of nonlinear energy transfer between turbulence and zonal flows were measured. The secondary mode competition between ZFs and GAMs was identified, which demonstrated that ZFs plays an important role in the L-H transition. The spontaneously generated E×B shear flow were identified to be responsible for the generation of large scale coherent structure (LSCS), which provides unambiguous experimental evidences for LSCS generation mechanism. The nonlocality of thermal transport of electrons and spontaneous formation of density transport barrier were investigated in detail. In addition, the supersonic molecular beam injection (SMBI) and cluster jet injection (CJI) were applied to mitigate the edge localized modes (ELMs) in HL-2A successfully for the first time. The low frequency beta induced Alfven eigenmode (BAE) excited by energetic electrons were observed in high ECRH power discharges. The coexistence of multi-frequency modes was observed in the high temperature and low density plasmas. The major experimental results on the subjects mentioned above will be introduced in this presentation.

*also at Institute for Fusion Theory and Simulation, Zhejiang University, Hangzhou, China