Intermittent Fluctuation Property of Edge Plasmas in JT-60U and LHD

H. Miyoshi[1], N. Ohno[2], S. Takamura[1], V. P. Budaev[3], Y. Uesugi[4], N. Asakura[5], Y. Miura[5],
S. Masuzaki[6], A. Komori[6]

1. Dpt. of Energy Engineering and Science, Graduate School of Engineering,

2. Center for Integrated Research in Science and Engineering,

Nagoya University, Nagoya 464-8603, Japan

3. RRC Kurchatov Institute, 123182, Kurchatov Sq.1, Moscow, Russia

4. Dpt. of Electrical and Electronic Eng., Kanazawa Univ. Kanazawa 920-8667, Japan

5. Japan Atomic Energy Research Institute, Naka 311-0193, Japan

6. National Institute for Fusion Science, Toki 509-5292, Japan

From experiment on fusion devices is now a lot of evidence that plasma turbulence is highly intermittent. Intermittent events are well-known to play a crucial role in transport dynamics. Intermittent transport resulted from rare, large events is accompanied by coherent structures such as vortices, zonal flows, streamers and blobs, leading to the losses above ones predicted by classic heat diffusive scaling. The cross-field transport in the scrape-off layer is directly related to the heat deposition width on the divertor target plate, which is crucial to determine the averaged heat flux on it. The fluctuations observed in edge plasma of tokamaks, stellarators and linear machines are self-similar, the self-similarity parameter varies little from one device to another suggesting the universality of self-similarity properties in edge of magnetized plasmas. Focusing on a probabilistic approach to plasma turbulence and transport, rather than anomalous transport coefficients, allows to consider most important questions in the prediction of transport, including self-similarity scaling and non-locality of transport in edge plasma turbulence.

We will report the analysis of edge plasma statistics in JT-60U tokamak and Large Helical Device (LHD). Probability density function (PDF) of fluctuation in ion saturation current and floating potential measured in scrape-off layer of JT-60U and LHD has been analyzed. Self-similarity parameters have been observed to depend on edge plasma domain of observation in the LHD. The fractal properties of fluctuation in LHD have been analyzed regarding to magnetic structure and profile of the connection lengths of the magnetic field lines. It was observed that edge turbulence LHD possesses multifractal statistics with typical coarse time scale ~50-100 μs of coherent structures.

In the JT-60U, waiting-time statistics of ELM events is also analyzed to be compared with that of LHD device. We have also investigated the radial and parallel transport of the intermittent density bursts including ELM in the SOL by analyzing the correlation between the fluctuation of ion saturation currents measured at mid-plane, X-point probe and divertor probe array.