§42. Remote Experiments on Measurement of Edge Plasma Fluctuation in LHD with Super SINET

Takamura, S., Ohno, N., Miyoshi, H. (Nagoya Univ.),
Budaev, V. (Kurchatov Institute)
Masuzaki, S., Komori, A.

From experiment on fusion devices there is a lot of evidences that plasma turbulence is highly intermittent[1]. Intermittent events are well-known to play a crucial role in transport dynamics. Intermittent transport resulted from rare, large events is due to coherent structures, leading to losses above one predicted by neo-classical 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 and the first wall, which is crucial to determine the averaged heat flux on it. Recently, intermittent convective plasma transport, so-called "blobs" has been observed in the edge plasmas of several fusion devices, which are thought to play a key role for cross-field plasma transport. Intermittent bursty fluctuations of ion saturation currents (I_{sat}) and/or floating potentials measured with probes are analyzed to obtain a basic property of the blobs[2]. Detailed comparison of the fluctuation properties in the edge plasmas of tokamak and helical fusion devices is expected to give an understanding of the blobby plasma transport, because the blobby plasma transport is thought to be strongly influenced by the magnetic configuration.

In this report, we will show the statistical analysis of the intermittent edge plasma fluctuations in the Large Helical Device (LHD). The fluctuation property has been analyzed with probability distribution function (p.d.f.). We have employed several modern method for signal analysis, such as statistical data analysis on probability distribution function, wavelet decomposition etc. These analysis require time evolution of ion saturation currents (I_{sat}) with high sampling rate. The data size is quite large (500Mbyte/1shot). Super SINET, which is extremely rapid Internet connection, makes it possible to access these large data in the NIFS from Nagoya Univ.

Recent theory[3] predicts that the blobs propagate toward low field side in tokamaks because the blob motion is driven by charge separation in the scrape-off layer due to gradient B effect. On the other hand, in the LHD, the direction of the gradient in B is not uniform because the helical system has a complex magnetic configuration. Comparison between the intermittent bursty fluctuations in the edge plasma of tokamaks and helical devices makes it possible to understand the essential physics of the blob transport.

In the LHD, I_{sat} is measured by a Langmuir probe array (16 channels) embedded in the divertor plate, which is installed at inboard, outboard and bottom board. Fig. 1 shows the radial profiles of averaged I_{sat}, skewness and flatness. The averaged I_{sat} peaks near the probe position of 40 mm, which corresponds to the striking point where magnetic line of force with long connection length are concentrated. On the other hand, it is found that large positive spikes of I_{sat}, characterized by large skewness and flatness, are strongly localized near the striking point (~55mm) on the divertor plate. Away from the probe position of 55mm, the skewness and flatness decrease. This tendency is completely different from the observation in the tokamaks, such as JT-60U. Moreover, it should be noted that the absolute values of the skewness and flatness are much higher than those in tokamaks, which means that the p.d.f. of the I_{sat} fluctuation in the LHD strongly deviate from the Gaussian distribution in comparison with that of tokamak edge. Careful observation of the I_{sat} at the probe position of 55mm shows that time evolution of I_{sat} are mainly composed of the spiky signals without the dc level. These fluctuation properties could be related to the complex magnetic structure in the edge region of the LHD.

Reference
1) G. Y. Antar *et al.* Phys. Rev. Lett. **87**, 065001-1 (2001).
2) J. A. Boedo, D. Rudakov *et al.* Phys. Plasmas, **8**, 4826 (2001).
3) S. I. Krasheninnikov, Phys. Lett. A, **283**, 368 (2001).
4) N. Asakura *et al.* Nucl. Fusion **44** (2004) 503-512
5) S. Masuzaki *et al.* Nucl. Fusion **42** (2002) 750-758

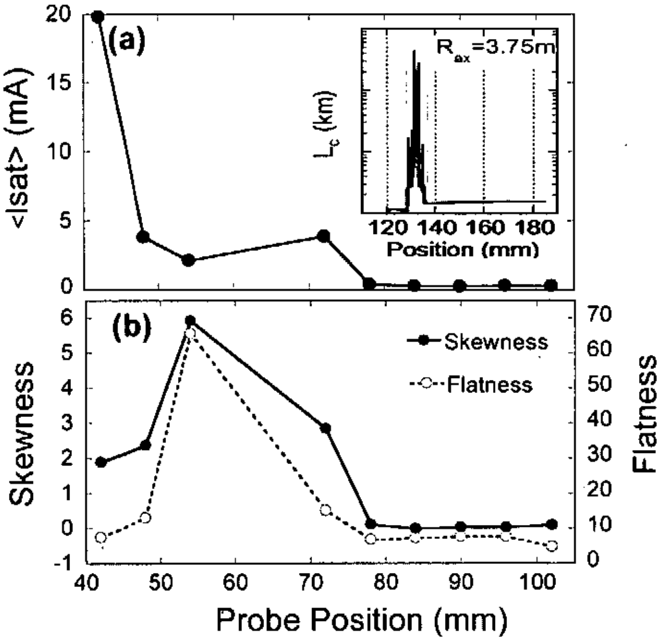

Fig 1. Radial Profiles of (a): averaged ion saturation current measured by the divertor probe array, (b): skewness and flatness.