

§18. Property of Density Fluctuations in Edge Plasma of Large Helical Device

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In edge and scrape-off-layer (SOL) region of fusion oriented devices, blob phenomena, which cause large radial transport of particles from the SOL to the vacuum wall, are one of the issues to figure out. In order to observe blobs which have no toroidal and/or poloidal symmetries, we have developed a two-dimensional thermal lithium beam probe to measure edge density and its fluctuations two-dimensionally in a poloidal cross section [1,2].

The lithium beam is injected from the lower port and a sheet-shaped beam is formed by spreading in the direction of the major radius. The emission light fluctuations, which are proportional to plasma density fluctuations, are observed by multi-channel photomultiplier tubes (PMT). The each-channel's view area size is about 2.5cm.

The emission light is also measured by CCD-camera for a density profile measurement. Fig.1(a) shows the edge density profiles of ECH and NBI discharge. Though the difference can not be seen in density profile, there is the significant difference of fluctuation level, as shown in Fig.1(b). With regard to the characteristics of both fluctuations, no coherent power peaks can be seen by the FFT analyses. However intermittent positive burst objects often appear in the

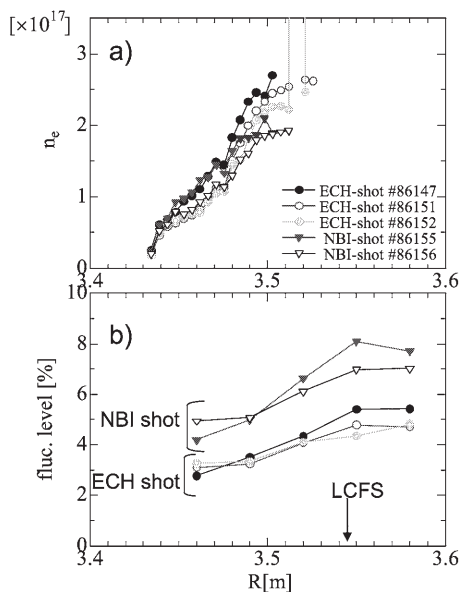


Fig. 1. a) Edge density profile reconstructed by Li-emission light. b) fluctuation level profile.

time series of each channel's. Positive spikes imply afflux of high density plasma into the view area.

In order to quantify the intermittent objects, the skewness, which is the probability density function (PDF)'s 3rd moment normalized by 2nd moment, is applied. It was found that there is a tendency of increasing skewness from SOL region to edge region at 11th LHD experiment campaign [3]. In this 12th campaign, the measurement area is set around LCFS. It is also found that there is a tendency of decreasing skewness from LCFS to SOL region. The skewness profile is summed up in Table. I. This result may imply that the blobs break out at SOL region and they are transported to edge region.

The property of density fluctuations depend on the heating method (Fig.2). The skewness and fluctuation level of NBI-shot are larger than those of ECH-shot, even if line-averaged-density or electron temperature is almost the same. In addition, it is also clear that the skewness don't depend on the local density gradient (Fig.1a).

Table. I Magnitude relation of skewness and fluctuation level

	edge	SOL	LCFS
skewness	Large	Small	Large
fluc. Level	Large	Small	Large

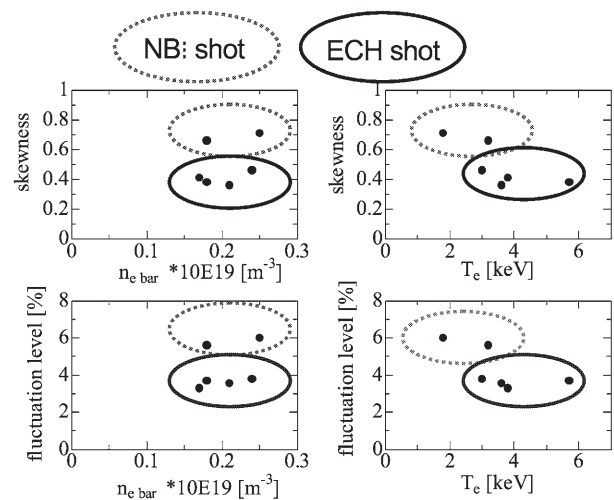


Fig. 2. The dependence of skewness and fluctuation level on the line-averaged-density($n_{e, \text{bar}}$) and electron temperature(T_e)

- 1) H. Tsuchiya, *et al.*, Rev. Sci. Instrum. **77**, (2006)10F526.
- 2) H. Tsuchiya, *et al.*, Plasma Fusion Res. **2** (2007) S1096.
- 3) Tsuchiya, H., *et al.*, Ann. Rep.NIFS(2007-2008) 38.