§7. Fluctuation Measurements in the Stochastic Layer of LHD

Kobayashi, M., Tanaka, H., LHD Experiment Group

Understanding of a cross-field transport in a magnetic stochastic layer is important issue for a control of edge plasma transport, where the cross-field and the radial projection of parallel transport along braiding magnetic field lines compete each other. The experiments have been conducted for three different magnetic configurations, R_{ax}=3.60 m (thin stochastic layer), 3.75 m (medium width stochastic layer) and 3.90 m (thick stochastic layer). Fluctuations have been measured by a Langmuir probe, which was inserted into the plasma, magnetic probes and reflectometer. A radial electric field profile was measured by a CX spectroscopy. The measurements have been conducted in the rather low power NBI (NBI#1 with ~ 2MW) in order to protect the scanning probe from the excessive heat load. The density was scanned from 1 to 5 x 10^{19} m^{-3}. The detachment was also observed with clear reduction of divertor particle flux in some high density discharges.

Figure 1 shows magnetic field connection length distribution for R_{ax}=3.60 m and 3.75 m together with the trajectories of scanning Langmuir probe, which passes through the divertor legs and reaches the stochastic layer.

Figure 2 shows an example of power spectrum of ion saturation current obtained by the Langmuir probe and of the magnetic signal by the magnetic probes, for R_{ax}=3.60 m (thin stochastic layer). In both the ion saturation current and in the magnetic signal, there appears a clear peak at ~2.4 kHz accompanied by higher harmonics. In the ion saturation current, this fluctuation is observed only in the low density range (1~2 x 10^{19} m^{-3}), while at the higher density there is no clear peak observed. On the other hand, the magnetic fluctuation exhibits clear peaks around 2 to 3 kHz independent of the density range, while the toroidal mode number changes from n=3 to 2 as the density increases. In the reflectometer, we observe similar peaks as the magnetic fluctuation for all density range.

In R_{ax}=3.75 (medium width stochastic layer) and 3.90 (thick stochastic layer) m configurations, the magnetic probe always detected coherent fluctuation around 1 to 4 kHz depending on the density, while in the reflectometer and the ion saturation current there were no clear peaks observed in the range in the fluctuation spectrum. Figure 3 shows power spectra of the ion saturation current and magnetic probe signals in R_{ax}=3.75 m.

The results suggest that the fluctuation originates from an MHD activity, and whether or not it is observed in the ion saturation current and the reflectometer depends on the propagation process into the outer radius, where the scanning probe scans, or on a coupling to an electrostatic mode. The determination of the poloidal mode number of the fluctuation is underway, in order to localize the radius of the MHD activity.

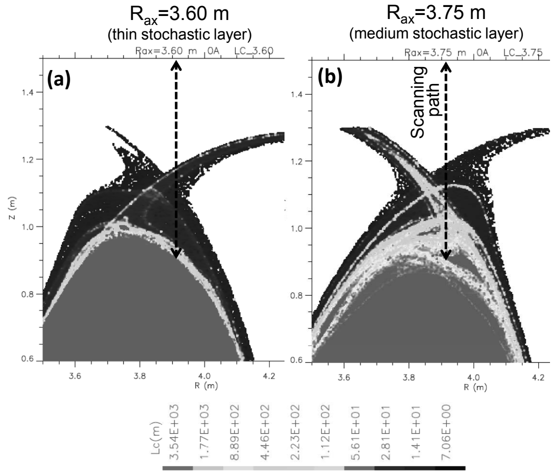

Fig.1. Magnetic field connection length distributions for (a) R_{ax}=3.60m and (b) 3.75 m. The trajectories of the scanning probe are indicated with vertical dashed lines.

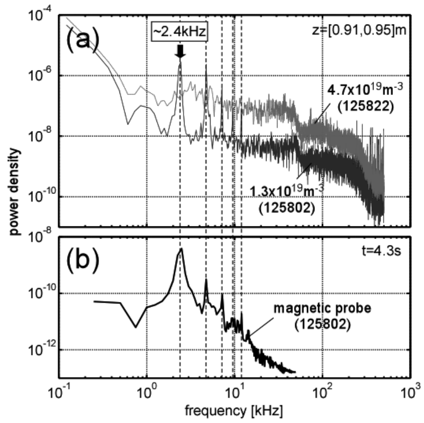

Fig.2. Power spectra of (a) ion saturation current measured by the scanning Langmuir probe in the stochastic layer during the low-density (#125802) and high-density (#125822) discharges. (b) Power spectrum of magnetic probe signal during the low-density discharge (#125802).

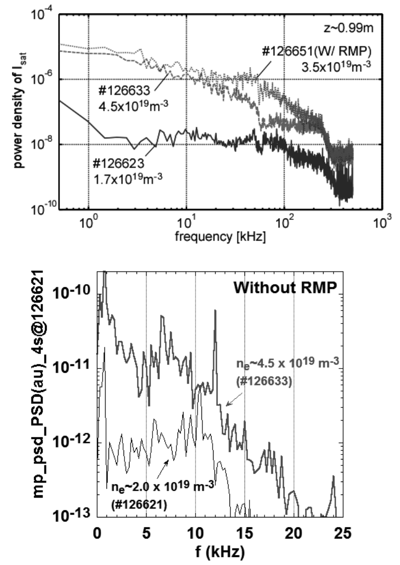

Fig.3 Power spectra of ion saturation current (upper) and magnetic probe signals (lower) in R_{ax}=3.75 m.