§18. Statistical Analysis of Core and Edge Plasma Fluctuations in the GAMMA10

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The tandem mirror device GAMMA10 shares same magnetic field line inside the core and divertor region. To clarify the interdependency of the core plasma transport and edge plasma characteristics, this study investigated fluctuation correlation in between the core and edge regions.

High-temporal and spatial resolution measurements in both the region were carried out by using the gold neutral beam probe (GNBP)[1] and Langmuir probes. Figure 1 shows a divertor module that was constructed of V-shaped plate, which had an inner angle of 30 degrees. Five probes were aligned every 70 mm on one-sided plate. The divertor module and a measurement position of the GNBP had a distance of approximately 10 m across a baseball coil. Sampling intervals of them were set to be 3 μs.

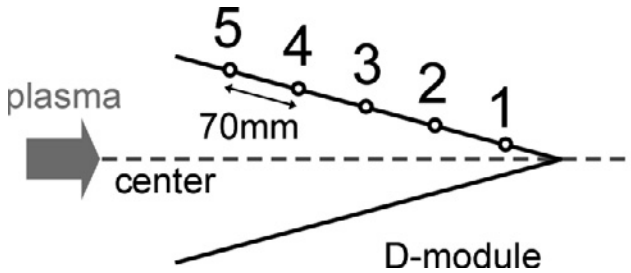

Fig. 1. Schematic diagram of divertor module with Langmuir probes.

Figure 2 shows spectrograms of beam current and ion saturation current (I_{sat}) measured at the center of the plasma column and divertor probe ch. 1, respectively (shot number: #224687). Periodic fluctuations at the frequency of approximately 4 kHz were clearly observed at $t \sim$ [142, 156] ms in both the signals. Fluctuations of beam current and I_{sat} mainly depend on fluctuation of electron density (n_e). Thus, some phenomenon associated with n_e fluctuation appeared in the core and edge regions.

In order to focus the periodic fluctuations, we applied band-pass filter of 3–4.5 kHz to the beam current and I_{sat}; then, cross correlation coefficients were calculated between the core and edge fluctuations. As shown in Fig. 3, correlation coefficients have maxima at $\tau \sim$ 50–80 μs. This result indicates that I_{sat} fluctuations were delayed for 50–80 μs compared with that of the beam current. Considering a travelling time of the beam that comes from the ionization point toward the micro-channel plate detector, propagation speed of the periodic fluctuation was estimated to be approximately 130 km/s along axis. Further, finite time delay was also confirmed between fluctuations at different channels on divertor plate.

In future, we plan to investigate the instability and condition when there is a strong correlation in the core and edge regions. In addition, we will analyze spatial behavior and potential fluctuation.

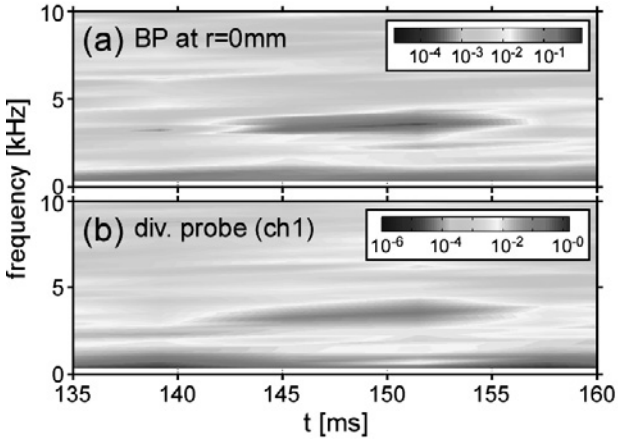

Fig. 2. Spectrograms of (a) beam current at the center and I_{sat} at ch. 1.

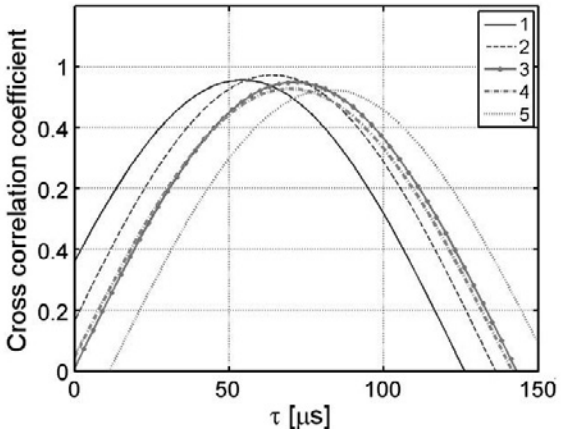

Fig. 3. Cross correlation coefficients between band-passed fluctuations of beam current and I_{sat} at ch. 1–5 (blue, green, red, cyan, and magenta).

1) Mizuguchi. M. et al.: Rev. Sci. Instrum. **79** (2008) 10F309.