§22. Study of Peripheral Plasma in Heliotron J Using Fast Camera

Nishino, N., Fukuyama, Y., Kondo, E., Fukamizu, T., Abe, T. (Hiroshima Univ.),
Kondoh, K., Mizuuchi, T., Sano, F. (Kyoto Univ.)

2-d imaging technology using a fast camera is applied in Heliotron J plasma to study peripheral turbulence. Langmuir probe and fast camera measurement are the powerful methods in the research field of plasma turbulence [1, 2]. We have been using a fast camera as an imaging tool since 2004, and we were already successful to find harmonic oscillation just after L-H transition [3] using a combination of carbon limiter and a fast camera. This year we demonstrated a new fast camera, which is capable to take a picture with 160,000 frames per second (FPS). The local gas puff was uesd to brighten the plasma for spontaneous emission due to the electron impact collision. The radius of Heliotron J plasma is about 20cm, and neutral atoms can penetrate to the plasma core. However, the results show that only the adjacent area from the local gas puff is britened. Therefore, we believe peripheral plasma is mainly britened by the local gas puff. Figure 1 shows the filamentary structure in Heliotron J plasma with local gas puff. Without gas puff the same phenomena are seen by fast camera, but SN ratio is not sufficient.

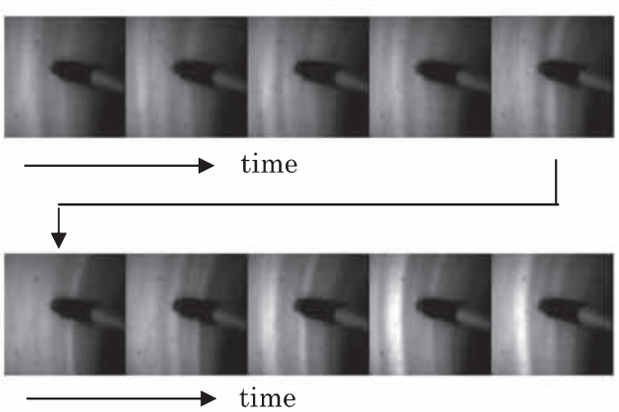

Fig.1 Filamentary structure in Heliotron J plasma
Speed of record is 105,000 FPS

These filamentary structures are frequnetly observed in ST/Tokamak plasmas. However, it is first time to find these penomena in Heliotron J plasma. It may suggest that these phenomena are the basic physics of plasma in the magnetic field. Recently these peripheral turbulences might be related to the energy/particle confinment. In this serious study of Heliotron J the ion saturation current of the probe are coincedence of the bright emission region of the images. It is suggested that the bright emission region of the filamentary structure is relative high density/temperature region. These filamentary structure moves across the magnetic field. The direction of the motion is the electron diamagnetic direction, and it is opposite to the negative ExB direction. The results of the density scan experiment show the motion of the filamentary structure was very fast in low electron density plasmas and it was insufficient to catch the precise movement of them even with the speed of 105,000 FPS. However, in very high density plasma ($ne>3x10^{19}m^{-3}$), the motion was slower and the movement of them was seen clearly (see Fig.2). Typical lifetime of them in high density plasma is 500-700 microseconds. These results are presented in the international meeting [4]. Physics models of the filamentary structure are proposed by several theoretical groups. Therefore, the further study is nessasary to investigate the peripheral turbulence, and it is needed to compare the theories and the experiments.

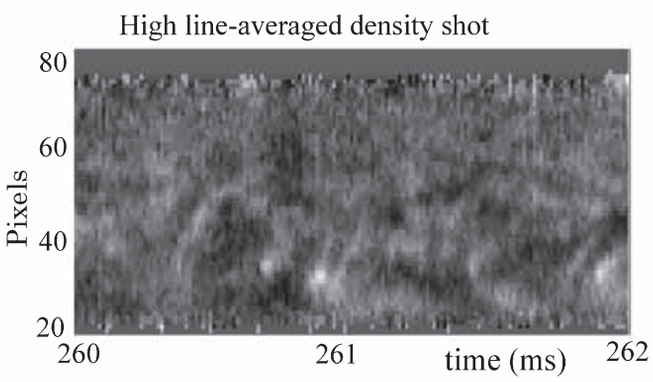

Fig.2 Time slice image along the line shown in Fig.1

References

1). T.Mizuuchi, et al.: J Nucl. Mater. **337-339** 332(2005)
2). N.Nishino, et al.: J. Plasma Fusion Res. **1278** 179 (2004)
3). N. Nishino, et al.: J Nucl. Mater. **337-339** 1073(2005)
4). Nishino, N., et.al.: 17th Plasma-Surface Interaction