§30. A Study of Peripheral Plasma in Heliotron J by a Fast Camera

Nishino, N. (Hiroshima Univ.),
Mizuuchi, T., Sano, F., Kondo, K. (Kyoto Univ.)

1. Introduction

It is very important to study peripheral turbulence due to the relationship between the energy confinement and H-mode physics. Fast cameras had been installed in Heliotron J [1] to get information on the peripheral plasma behavior under Bi-directional collaboration between Kyoto and Hiroshima University. Recently the turbulent structures during the L-mode and H-mode were observed with/without a directional gas puff. It was clear that the spatial structure of peripheral turbulence during the L-mode was diffrent with that of the H-mode.

2. Experimental Set Up

The tangential port was provided with the fast camera to observe peripheral plasma behavior easily. Fig.1 shows the locations of the tangential port (this experiment, green) and horizontal port (past experiments, blue) for the fast camera.

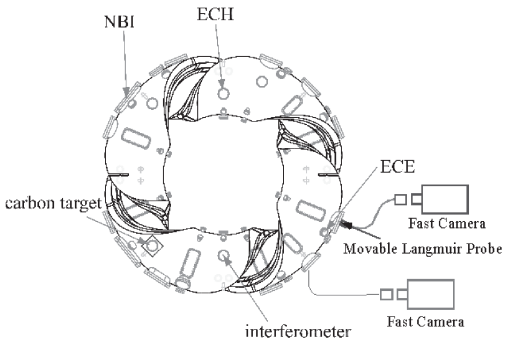
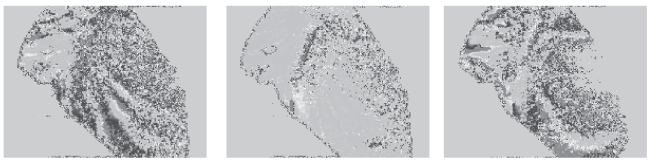


Fig.1 Fast camera location in Heliotron J

3. Results and Discussion

In high density ECH discharges the abrupt drops of Dα signal were observed and the H-mode plasmas were obtained. In these shots the reproducibility was very good. H-mode began at 252.8ms and the diamagnetic signal increased rapidly from the L-H transition. Typical period of the H-mode in these shots was about 5ms. During H-mode the electron density also increased rapidly, and this increment was not controllable. Therefore the hot plasma was extinguished with the radiation collapse after H-mode in several shots. The emission from the peripheral plasma region was relatively clear in the H-mode, and the volume of the H-mode plasma was somewhat larger than that of the L-mode in the images. From this tangential view the filamentary structures in the peripheral region were observed clearly in both modes (white arrows in Fig.2). These filamentary structures are widely seen in the various machines such as tokamaks/ST and stellarator, and it is believed that they are parallel to the magnetic field. In these H-mode experiments, motion of the filamentary structures perpendicular to the magnetic field was recognized in the camera images in the L- and H-modes and motion was stopped during the L-H transition. The direction of motion during L-mode is opposite to that of H-mode. If the motion would be poloidal rotation, the rotation direction was counterclockwise during the L-mode, and the rotation direction during the H-mode was clockwise. To see this motion easily the time-dependent FFT analysis are often used. Fig.2 shows the phase images of L to H mode.



L-mode L-H transition H-mode

Fig.2 2-D phase image of 8.75kHz component

4. Summary

Using the fast camera, peripheral turbulence of Heliotron J plasma was measured successfully. In particular, the motion of the filamentary structure near the plasma edge was seen. If this motion would be poloidal rotation, the direction of the motion suggests that E_r was negative in the H-mode and E_r was positive in the L-mode. Moreover, the deduced E_r value was consistent with the results of the past H-mode experiments. The dithering phase was also identified and the transition period can be estimated by the fast camera images.

1. T. Obiki, T. Mizuuchi, K. Nagasaki, et al., Nucl. Fusion **41** 883 (2001).