§19. Study of Dα Line-Emission Spectroscopy and Edge Neutral Transport in Non-Axisymmetric System

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In magnetically confining plasma devices, investigation of neutral transport is an important subject for understanding edge plasma behavior and for the estimation of particle confinement characteristics. Especially in improved confinement mode plasmas, neutral particles in periphery region also play a crucial role on pedestal formation near the edge transport barrier (ETB) region. In non-axisymmetric plasmas, such as helical devices, the analysis of neutral transport becomes complex due to the three-dimensional configuration of the system. The objective of this study is focused on the neutral behavior in the above three-dimensional non-axisymmetric plasma and leads to the understanding of improved confinement with such plasmas. In this research, detailed measurements of Dα emission profile have been performed in Heliotron J device[1].

Figure 1 shows the schematic view of Hα/Dα detector array system. Multi-sightline covering the almost entire plasma cross-section of Heliotron J enables to precisely measure the profile of Dα emission using bundle fiber and connecting lens with photomultiplier system[2].

Figure 2 shows the time behavior of the averaged plasma density and stored energy in the period of L-H transition observed in ECH plasma. It is found that a noticeable increase of the density associated with a rapid reduction of the Dα signal (#32, etc.) at t = 208.7 ms. On the other hand, it is also observed that the increase of the Dα signal of a specific channel (#28), whose sightline intersects a X-point. This case suggests significant plasma-wall interactions near the sightline of this channel. Dα behavior during L-H transition is also investigated in NBI plasmas as shown in Fig. 3. In NBI plasmas a similar behavior is observed.

From the above results, a distinctive feature in neutral particle behavior in non-axisymmetric system is confirmed and it is needed that more systematic and various approach in L-H transition phenomena.

1) F. Sano et al., Nucl. Fusion **45** 1557 (2005)
2) S. Kobayashi et al., 11th IAEA TCM on H-mode and Transport Barriers, 26-28 September (2007), Tsukuba, Japan, P4-03.

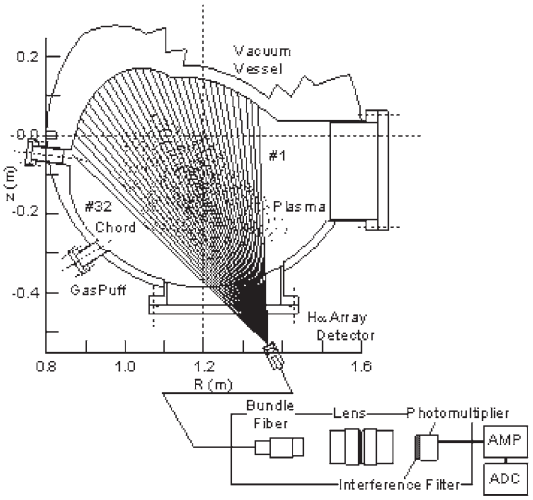

Fig. 1 Schematic view of Hα/Dα detector array and the block diagram of the detector system.

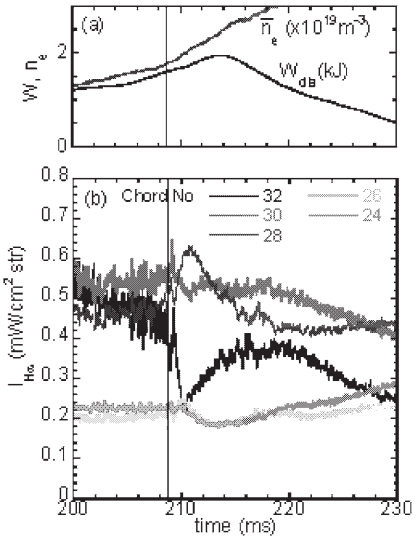

Fig.2 Time evolution of L-H transition observed in ECH plasma; (a) average electron density and the stored energy, (b) emission intensity of Hα/Dα.

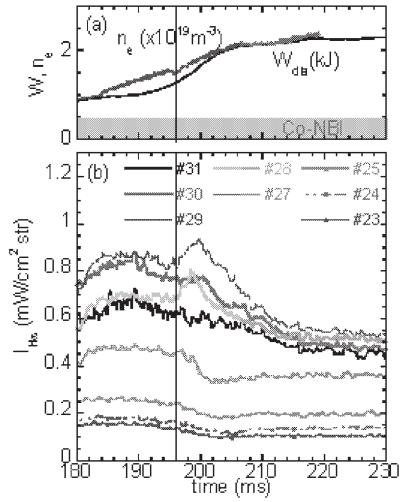

Fig.3 Time evolution of L-H transition observed in a NBI plasma; (a) and (b) are the same as Fig.2.