§8. IR Camera and Hα Image Measurement in LID Experiment

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An IR camera(JEOL Ltd. JTG-5700) and a CCD camera with the interference filter for Hα line were used to measure the heat load and Hα emission distributions on the LID divertor head, respectively. Figure 1 shows the scheme of the experimental set up. The IR camera looked the back plate of the head, that is, the plasma striking surface from the upper view port, through the window made of germanium. The CCD camera looked the lower part of the head from oblique view port. The IR camera's observation range of the wave length was 8-13μm. The fastest frame time was 0.3sec for 512×480×16bits mode.

For the case of the head with carbon tiles, the typical head surface temperature during a discharge was 30-50°C. The maximum temperature rise, δT, was 5-10°C. The heat load on the head, Q, can be estimated roughly from these results by the expression, $Q=q_s V d\delta T/t$, to be 18-36kW. The parameters are assumed as below, the specific heat of carbon tiles, q_s=0.2kcal/kg/°C, the wet area, $S=0.048m^2$, the heated volume, $V=S\times0.005m^3$, the density of carbon tile $d=1.82\times10^3kg/m^3$, and the plasma duration, t=100msec, respectively. The heat flux, q=Q/S, was $3.75\text{-}7.5\times10^5W/m^2$. From the measurement of Langmuir probes attached on the head, the typical ion flux was about 4×10^{22}ions/m^2/sec. The plasma heat flux can be estimated by the expression, $q=\gamma\Gamma kT_e$, where γ is the heat transmission factor and Γ is the ion flux, respectively. For Hydrogen plasma, γ can be assumed to be 7. For the case of T_e=15eV, the plasma heat flux is $9\times10^5W/m^2$, and it agrees with the above.

Figure 2(a) and (b) show the images of the CCD camera. The head edge position was R=1.258m, so called normal position. As shown by the insertion of Fig.2(c), the upper parts of Fig.2(a) and (b) are the lower part of the head, and the lower parts are the duct. The Hα radiation from the plasma is shown between the head and the duct. With B_{LID}, the bright region was extended because the island separatrix is connected to the head. Figure 2(c) shows the 1-D distribution of Hα intensity. There are two peaks for the case with B_{LID}. The first peak is the direct radiation from the plasma, and the second one is considered to be the effect of the island separatrix. Without B_{LID}, the Hα intensity decreased monotonously. This result is consistent with the measurement by Langmuir probes.

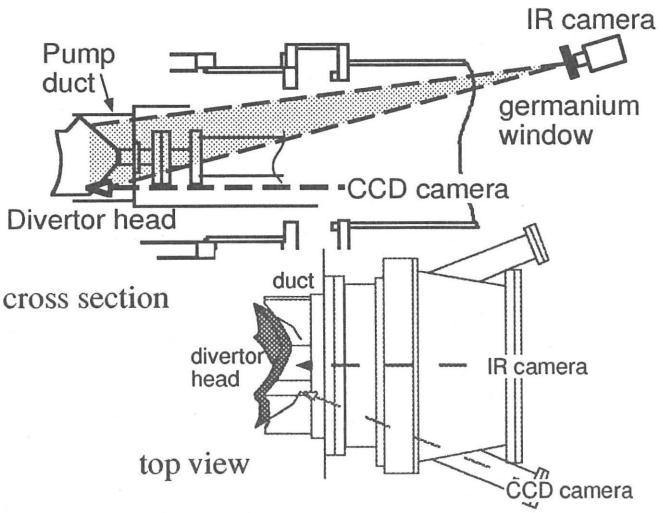

Fig.1 Experimental set-up

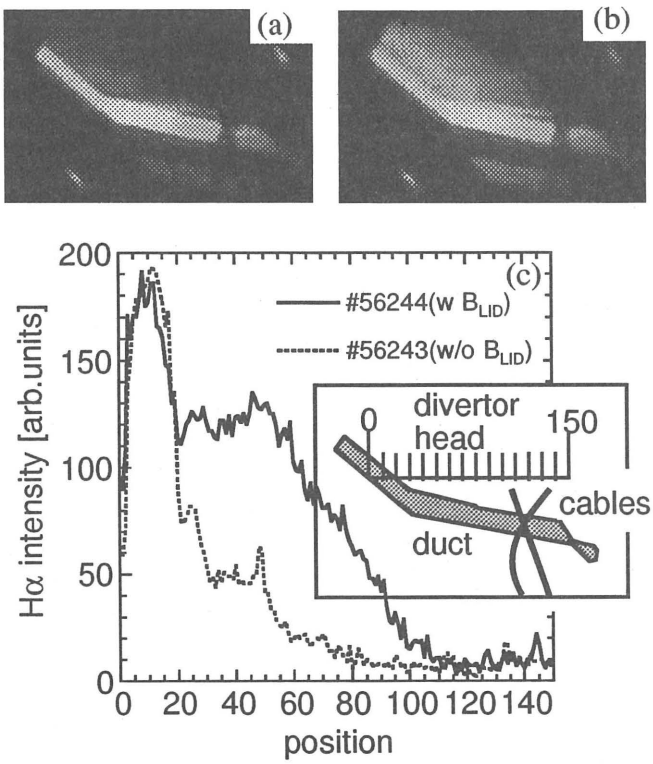

Fig.2 Hα image on the LID divertor head.
(a) without B_{LID}, (b) with B_{LID},
(c) 1-D distribution of Hα intensity.