§50. H_α Intensity Profile Measurement on the Divertor Plates with a CCD Camera

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The magnetic field line trace with a random walk process predicts that the complicated pattern of the particle deposition on divertor plates. It also shows that the deposition pattern is significantly changed with the magnetic field configuration in LHD. A Langmuir probe array embedded in a lower divertor plate observed the ion saturation current profile which is consistent with the calculation in various magnetic field configurations.

To experimentally confirm the complicated pattern of the particle deposition on the divertor plates, an H_α intensity profile on the lower divertor plates was tangentially observed by a CCD camera with an H_α interference filter. Because the emissivity of the H_α light linearly depends on the electron density, the H_α intensity qualitatively expresses the plasma density on the divertor legs (no significant variation of the neutral particle density is assumed on the divertor legs). Thus, we can approximately estimate the particle deposition profile from the H_α intensity profile.

Figure 1 (a) and (b) show the measured H_α intensity profiles when the radial position of the magnetic axis (R_{ax}) was 3.50m and 3.75m in high magnetic fields (B~3T), respectively. In the inward magnetic axis configuration (R_{ax}=3.50m), whisker magnetic field lines was observed outside of the peripheral plasma. We can identify the bright divertor leg which is shown in the right side in the figure. In the outward magnetic axis configuration (R_{ax}=3.75m), the intensity profile on the divertor legs was significantly changed. The bright region of the H_α intensity was moved to the left side. These measurements indicate that the particle deposition pattern on the divertor plates in the outward configuration differs from that in the inward configuration.

Figure 2 (a) and (b) illustrate the images of the three-dimensional magnetic field line structure on the divertor plates, which is viewed from the CCD camera position in both magnetic axis configurations, respectively. These images are made by plotting the magnetic field lines traced from the uniformly distributed position located just outside the last close magnetic surface (LCMS). These images quite agree with the measured H_α intensity profiles in both magnetic configurations.

The comparison between the measurements and calculations in both magnetic axis configurations shows that the particle deposition profile on the divertor plates can be qualitatively explained by the magnetic field line distribution from the LCMS, which suggests no significant plasma transport across the magnetic field line in the ergodic layer and divertor legs in the high magnetic fields. In near future, the H_α intensity profile in low magnetic fields will be investigated by comparing the calculations of the magnetic field line trace including the effect of the finite plasma beta and plasma transport across the magnetic field lines.

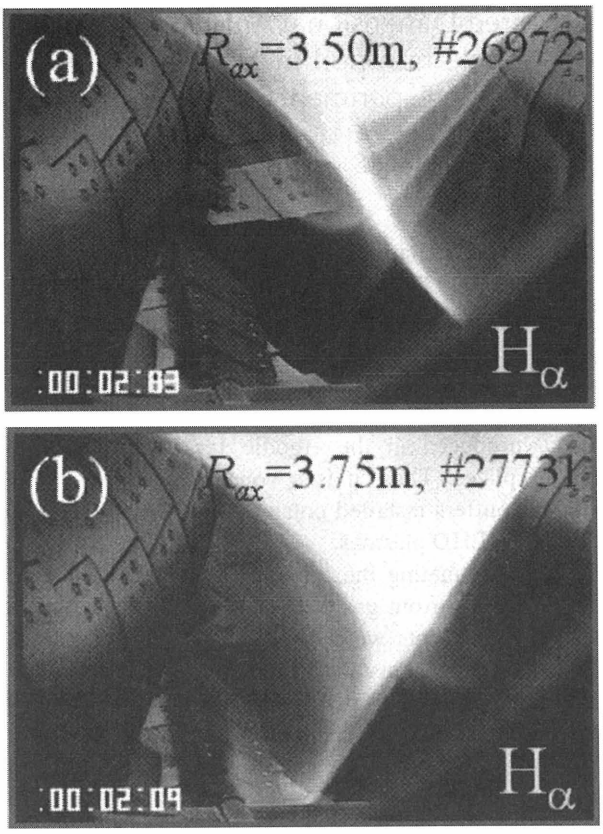

Fig.1. H_α intensity profiles measured with the CCD camera in the inward magnetic axis (a) and the outward magnetic axis (b) configurations, respectively.

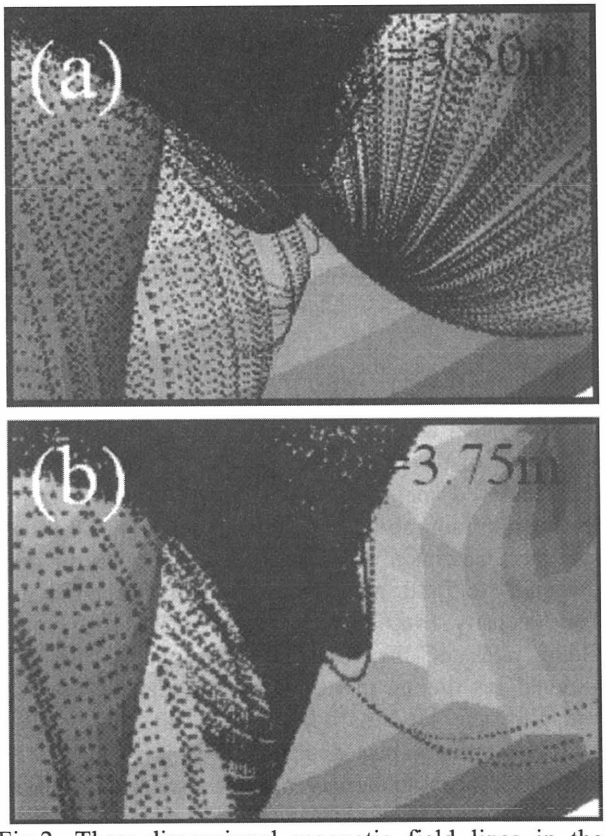

Fig.2. Three-dimensional magnetic field lines in the inward magnetic axis (a) and the outward magnetic axis (b) configurations, respectively.