§45. Development of Two-Dimensional Lithium Beam Probe for Edge Density Measurement in CPD

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Detailed measurement of the edge plasma is essential to promote studies of edge physics and edge control. In that sense, imaging diagnostics is quite useful to acquire an overall picture and a comprehensive knowledge of the phenomenon. Recently a two-dimensional lithium beam probe (2D-LiBP) has been developed in NIFS for the edge plasma measurement on LHD, and has started to provide 2D-density profiles on the poloidal plane. 1)

The 2D density profiles are obtained by observing 2D Li I (670.8 nm) emission profiles due to the Li-electron impact excitation. The sheet shaped Li beam is injected to the plasma through two rectangular apertures of which width is 6 mm. The beam flux profile was measured by an absolutely calibrated quartz crystal monitor on the test stand, and compared with a result from the Monte Carlo simulation, as shown in Fig. 1. It was found that a high quality beam with radial uniformity within ± 15% and toroidal FWHM of 35 mm is achieved as expected by the simulation, and its maximum flux at the center is ~ 2 × 10^{14} $cm^{-2}s^{-1}$.

The 2D-LiBP was installed in CPD which is a compact ST device with the divertor configuration. The sheet shaped 2D-beam is injected to the plasma from the bottom port through the X-point, as depicted in Fig. 2 (a). The 2D-image of Li I emission (0.3 m × 0.5 m) is detected by a CCD camera coupled with an interference filter (670.8 ± 5 nm). The time and spatial resolutions of the optical system are 1 ms and 1 mm, respectively.

Preliminary results were obtained in the first plasma experiment on CPD. Since CPD had not fixed its operational conditions to achieve the ST configuration at that time, no flux surface to confine the plasma existed during the discharges. The plasmas was initially produced by 8.2 GHz ECH on the resonance layer then spread over around the vacuum vessel. Figure 2 (b) shows a 2-D emission profile obtained after the plasma diffused out to the vessel wall. It is found that the beam attenuation due to relatively high electron density is taken place at the region.

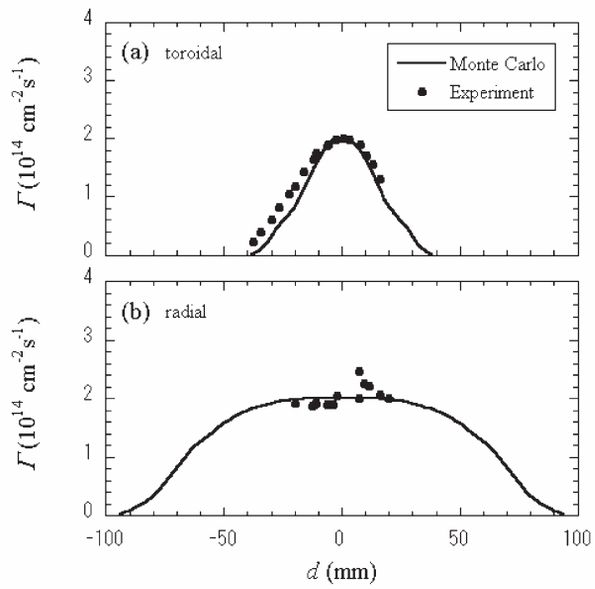

Fig. 1. (a) Toroidal and (b) radial flux profiles of sheet-shaped Li beam.

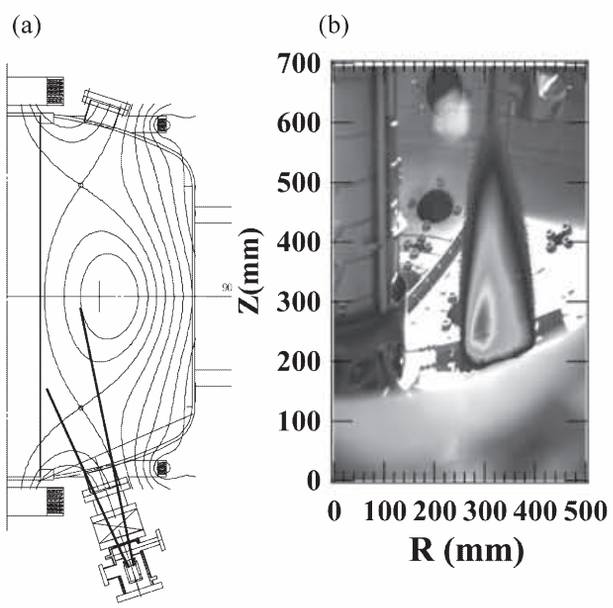

Fig. 2. (a) Schematic of 2D-LiBP diagnostics installed in CPD. (b) Observed 2D Li I emission profile superimposed on a normal camera view from the window port.

References

1) Takahashi, Y., Morisaki, T., Toi, K., LHD Experimental Group, Plasma and Fusion Res. **1**, (2006) 013.