§47. Edge Density Profile Measurements with Two-dimensional Lithium Beam Probe

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The two-dimensional lithium beam probe (2D-LiBP) is a useful instrument which provides 2D-density profiles of the edge plasma. Such an imaging diagnostics can provide an overall picture and a comprehensive knowledge of the phenomenon. After the first application to LHD,[1] the 2D-LiBP was installed in CPD and some preliminary results have been obtained with it.[2] The injected 2D-beam, i.e. observing region in the poloidal cross section in CPD, is depicted in Fig. 1 (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), as shown in Fig. 1 (b), which is a top view of the torus. The time and spatial resolutions of this system are 1 ms and 1 mm, respectively.

In Fig. 2, 2D-emission profiles of Li I light in (a) OH discharge and (b) RF discharge in the simple torus configuration are shown. The center stack, equatorial plane and injection port (bottom of the vacuum vessel) are at $R \sim$ 100 mm, $Z \sim 0$ mm and $Z \sim$ -580 mm, respectively. The area of the sheet-shaped beam is depicted with fanned lines. It is found from the emission profile along the beam in the OH discharge that the density scale length at the edge region is several mm. The clear boundary can be seen at $Z \sim$ -400 mm, which suggests the existence of the region where confinement property, i.e. magnetic structure, changes. From Fig. 2 (b) it can be seen that the plasma spreads over the vacuum vessel in the simple torus configuration. In this RF discharge where the resonance layers locate at $R \sim$ 165 mm (1st) and R = 330 mm (2nd), the plasma exists from 1st resonance layer over 2nd one. It has been found that the plasma density there exceeds the X-mode cutoff density. Thus it can be expected that the mode conversion to the Electron Bernstein Wave takes place.

In the experiments, some issues or problems to be solved for the future work have arisen. A relatively large error in the absolute value of the reconstructed electron density is caused by the ambiguity of the electron temperature, especially below 10 eV, where the temperature dependence of the rate coefficient is large. Combination with Langmuir probe measurements must be necessary, although it only provides a 1D-information.

References

1) Tsuchiya, H., Morisaki, T. *et al*., Rev. Sci. Instrum. **77**, (2006) 10F526.
2) Zushi, H., Morisaki, T. *et al*., J. Nucl. Mater. **363-365**, (2007) 1429.

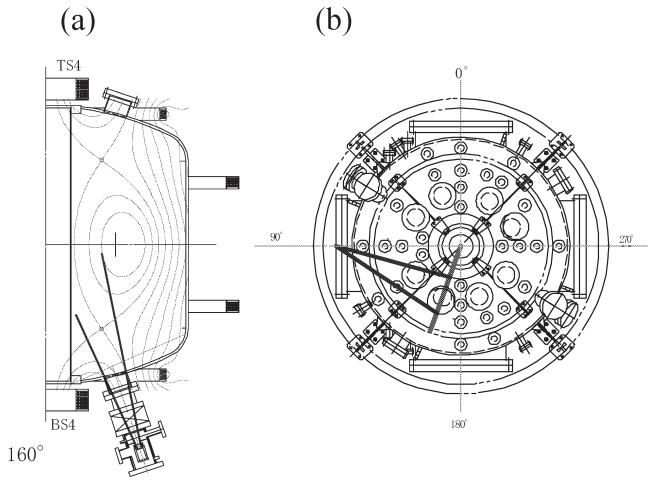

Fig. 1. (a) Observing area of 2D-LiBP on poloidal cross section. (b) Geometry of 2D-beam (observing poloidal cross section) and optical detector.

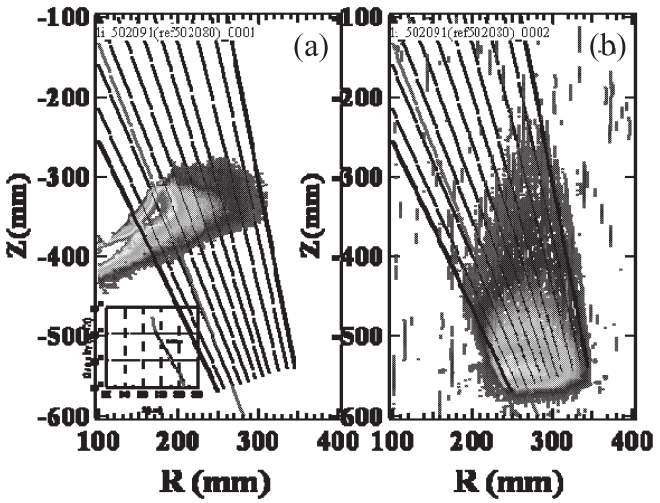

Fig. 2. 2D-images of Li I emission from injected sheet beam. (a) OH discharge, (b) RF discharge in the simple torus configuration.