§23. Lithium Beam Probe (LiBP) Imaging Using CCD Camera

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In the present LiBP diagnostic system in CHS, eight channel APD detectors have been used to measure light emission from the neutral lithium beam. The emission intensity profiles can only be obtained along the beam line. Two-dimensional measurements are performed by changing the beam injection angle shot by shot.
A new detector system using a CCD camera (656x494 pixels) has been installed on CHS to observe light emission as a two-dimensional picture. The time resolution can be increased up to 2 ms by the use of the binning function of the camera. The view of the CCD camera is set to be 150 mm x 200 mm at the position of R = 1200 mm, where R is the major radius, which covers the plasma area from inside the last closed flux surface and the outer separatrix region of the helical magnetic field configuration. The full emission profile can be taken densely along the beam in a single shot. Although a real two-dimensional observation is impossible with the present beam, the detector can straightly be extended to two-dimensional measurements or imaging measurements in future.

An example of beam emission measured by the CCD camera system in an NBI plasma is shown in Fig. 1. The picture is taken by binning pixels over 4x4 with the exposure time of 29 ms. The bright straight line shown in the right half of the picture is the emission from the injected lithium beam. The beam energy is 15 keV and equivalent beam current is one hundred microamperes. The average electron density is about $1x10^{19}$ m^{-3} in the present experiment.

Figure 2 shows the emission intensity profiles along the beam for different exposure time. The gradual decrease of the emission intensity is due to beam attenuation. The emission intensity decreases as the exposure time does. The exposure time of 9 ms is too short to resolve the emission profile clearly. Electron density profiles reconstructed by the use of beam attenuation method are shown in Fig. 3. The emission profiles obtained with longer exposure time than 19 ms gives consistent and reasonable electron density profile along the beam. However, the electron density calculated from the emission data with the exposure time of 9 ms deviates from other results. Higher beam intensity is required to improve time resolution.

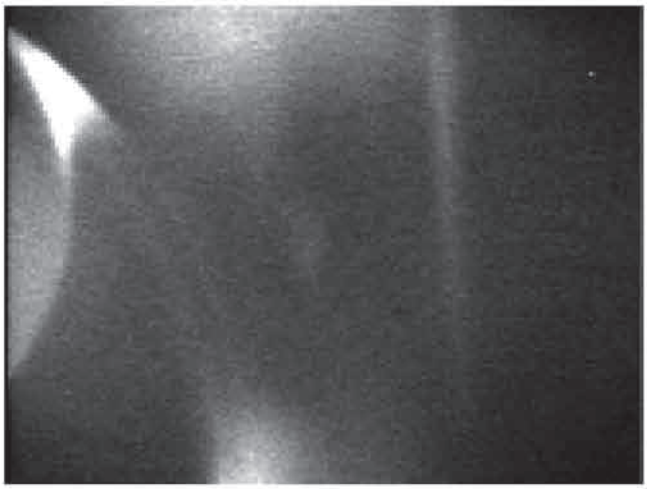

Fig. 1 Beam emission measured by CCD camera.

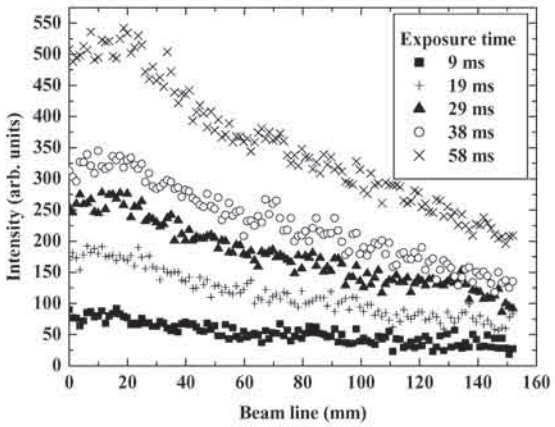

Fig. 2 Beam emission profiles for different exposure time of the CCD camera.

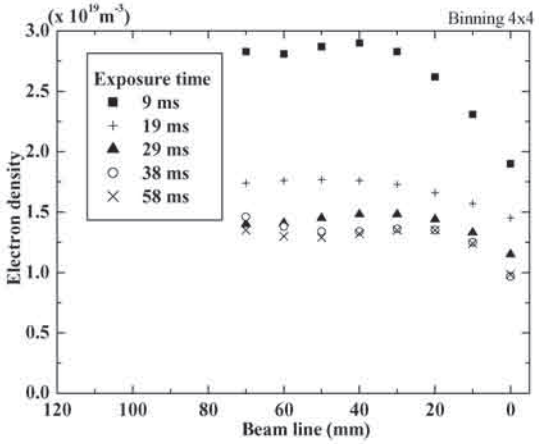

Fig.3 Electron density profiles reconstructed from the emission profiles in Fig. 2.