§47. High-resolution Measurements of Hα Spectral Line Profiles in LHD Plasmas

Kondo, K., Arimoto, H. (Kyoto Univ.),
Oda, T. (Hiroshima Kokusai Gakuin Univ.),
Takiyama, K. (Hiroshima Univ.),
Masuzaki, S., Shoji, M., Goto, M., Morita, S.,
Noda, N., Ida, K., Sato, K., Ohyabu, N., Sudo, S.

Divertor region is the main source of neutral hydrogen due to intensively concentrated ion flux. To achieve a well controlled particle balance, generation processes and behavior of neutral hydrogen atoms in divertor region should be surveyed. In this study, the spatial distribution of Hα spectral line profiles along the inboard divertor array has been measured by a high–resolution spectrometer.

Figure 1 shows the spot positions of the sight lines and the footprint distributions on the divertor plates for the magnetic axis configurations $R_{ax} = 3.60$ m and 3.65 m. The edge magnetic field structure changes according to the position of the magnetic axis R_{ax}. For $R_{ax} = 3.60$ m, the footprints with the longer connection length are localized at one of the divertor plates in the observed area (plate No.119), and the sight line #3–1 can view this divertor plate. For the case of $R_{ax} = 3.65$ m, the footprints are almost evenly distributed as contrasted with $R_{ax} = 3.60$ m. The ion flux toward the divertor region have been measured by the probe array installed at one of the gaps between the plates (as indicated by DPA in the figure).

The observed Hα line spectral profiles are composed of two Gaussian components. One in a narrow shape corresponds to Doppler temperature of ∼3 eV and the other in a broad shape corresponds to several tens of eV. The narrow component is considered to represent the contribution of the emissions from the dissociated atoms, and the broad component can be ascribed to the charge–exchanged or reflected atoms.

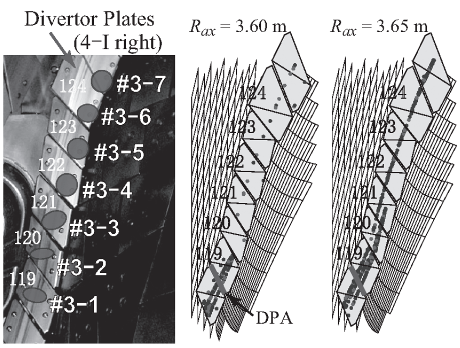

Fig. 1: The spot positions of the sight lines and the footprints distributions on the inboard divertor plates.

Figure 2 show the line–averaged electron density $\overline{n}_e$ dependences of the (a)ion saturation current measured by the divertor probe array, Hα line intensity observed at the sight line #3–1 in (b)$R_{ax} = 3.60$ m and (c)$R_{ax} = 3.65$ m configurations. For $R_{ax} = 3.60$ m, the divertor flux almost linearly increase with the $\overline{n}_e$ increase up to $\sim 5.0 \times 10^{19}$ m^{-3}, then decrease with the further increase of $\overline{n}_e$. The line intensities of both components show the similar dependences on $\overline{n}_e$ as shown in Fig. 2(b). At another sight line which views the divertor plate with scarce footprints, the Hα line intensities are almost proportional to $\overline{n}_e$ for the whole $\overline{n}_e$ range. For $R_{ax} = 3.65$ m, the divertor flux are almost proportionally increased with $\overline{n}_e$, and the line intensities of both component follow this tendency of the divertor flux toward $\overline{n}_e$. In these inward shifted configurations, the particle flux are intensive toward the inboard side of the torus compared to the other configurations. These observations suggest there is some correlation between the ion flux onto the divertor and the neutral hydrogen generation in the vicinity of the divertor plate to which the magnetic field lines are thickly connected.

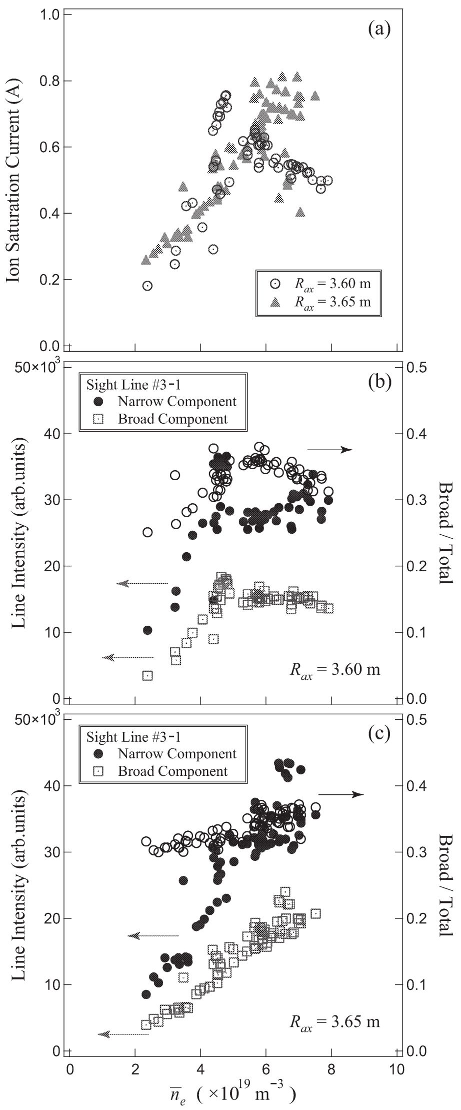

Fig. 2: $\overline{n}_e$ dependence of (a)ion saturation current, Hα line intensity for (b)$R_{ax} = 3.60$ m and (c)$R_{ax} = 3.65$ m configurations.