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ビーム放射分光のヘリオトロンJ密度変調実験への適用
Application of beam emission spectroscopy to density modulation experiments in Heliotron J

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Beam emission spectroscopy (BES) provides the experimental information of the density fluctuation at a local region where the sightline intersects the path of the neutral beam (NB). When we apply the BES diagnostic to the density modulation experiments, the beam integration effect due to the beam absorption should be taken into account in the case of the analysis on the modulation amplitude and its phase.

Recently, we have installed the BES diagnostic to the Heliotron J device, having a helical-axis magnetic configuration [1]. The radial profiles of the density fluctuation due to the fast-ion driven MHD activities have been measured. In this study, we investigate the response of the BES intensity to the density modulation to discuss the applicability of the BES diagnostics to the transport analysis.

Figure 1 shows the temporal evolutions of plasma parameters obtained in the density modulation experiments. The plasma was heated by ECH+NBI. The gas puffing was changed with the modulation frequency of 50 Hz. The line-averaged electron density was $\bar{n}_e$ = 8.7×10^{18}m^{-3} and the modulation amplitude was $\Delta\bar{n}_e$ = ±5.4×10^{17}m^{-3} (i.e. $\Delta\bar{n}_e/\bar{n}_e$ ~ ±0.06) A modulation of the BES intensity was observed.

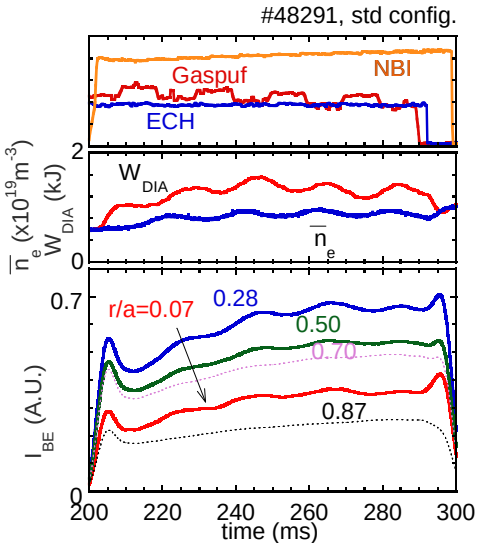

Fig. 1. Time evolution of the heating, gas fueling, density, stored energy and BES intensity obtained in the density modulation experiments.

We applied the fast Fourier transform analysis to evaluate the modulation amplitude and its phase. Figure 2 shows the radial profile of the modulation amplitude normalized by the mean value of the BES intensity and the phase difference to the gas puffing signal. The BES modulation amplitude at the core region ($\Delta I_{BE}/I_{BE}$ ~ ±0.025) was about the half of the modulation amplitude for the line averaged density. To know the absolute value of the modulation amplitude, the radial profile of the density is required. As compared with the phase obtained by the microwave reflectometer in the previous density modulation experiments, the change in the phase difference at r/a>0.5 was much larger than that by the reflectometer [2], which may be due to the beam integration effect. We will investigate the sensitivity of the density modulation to the BES intensity using a numerical calculation including the beam absorption calculation.

[1] S. Kobayashi, et al., RSI **83** 10D535 (2012).
[2] 向井, 他 第 27 回年会 02P50 (2010).

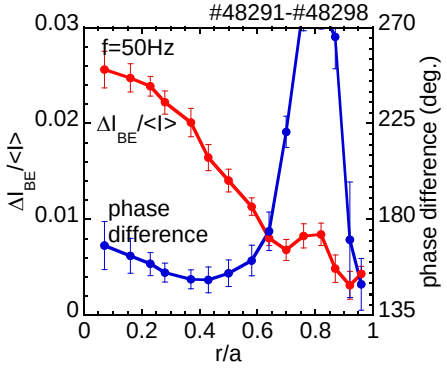

Fig. 2. Radial profile of the normalized modulation amplitude and phase difference to gas fueling.