§1. On-demand Density Correction Using Steady-state Plasmas in the LHD Thomson Scattering

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The LHD Thomson scattering [1][2] has been applied successfully to the measurements of electron temperature profiles of LHD plasmas. In order to obtain absolute electron density profiles, we have tried Raman and Rayleigh calibrations using gaseous nitrogen and/or dry air [3][4]. The calibration factors obtained in the gas calibrations are valid as far as all components are completely stable after the calibration. However, it will be difficult to fix whole conditions completely for a long-term. Even if slight misalignment of some optics occurs, it may cause huge errors in measured densities. Then, the gas calibration is required to be carried out at some intervals, however it is difficult in large fusion devices such as LHD. Therefore, we propose a new method to obtain correction factors to the errors originated from misalignment. In the method, LHD steady-state plasmas are used as targets.

In order to check the status of alignment and estimate the errors due to misalignment, we have newly installed a laser beam scanning system on the LHD Thomson scattering. Before the gas calibration, the laser beam path and light collection optics are optimized as to get maximum signal intensity. When laser beam is scanned during a steady-state plasma discharge, Thomson scattering signal intensities vary according to the beam position as shown in Fig.1. We can know both the beam position where signal intensity reaches maximum value, and the maximum intensity for each spatial channel. From the data, we estimate light collection efficiency, i.e. the ratio of signal intensity at the previously set position and maximum signal intensity at the point, as shown in Fig.2. Once the light collection efficiencies are determined, we can make corrections to measured electron densities. Figure 3 shows an example of raw and corrected density profiles. The corrected profile shows symmetrical profiles as expected whereas the raw profile was asymmetrical as the light collection efficiency,

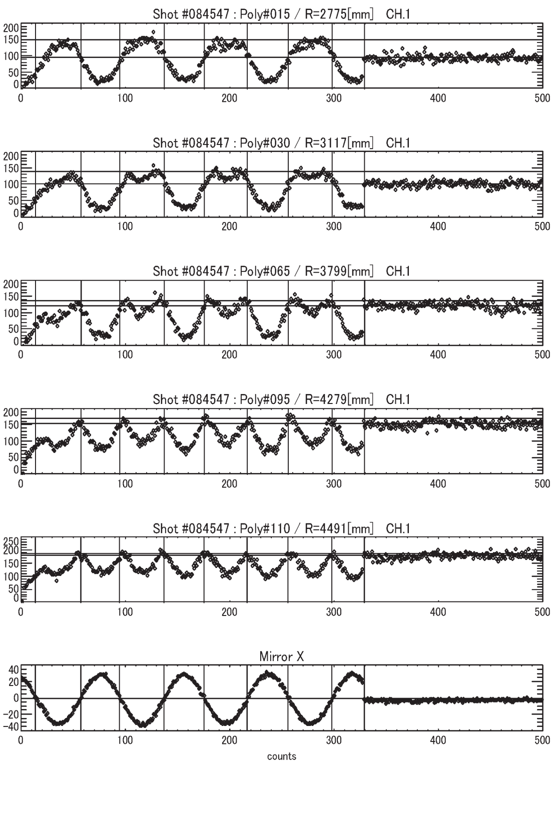

Fig. 1. Signal intensities detected by five selected polychromators in a steady-state discharge. The laser beam was scanned with a sinusoidal waveform as the bottom figure.

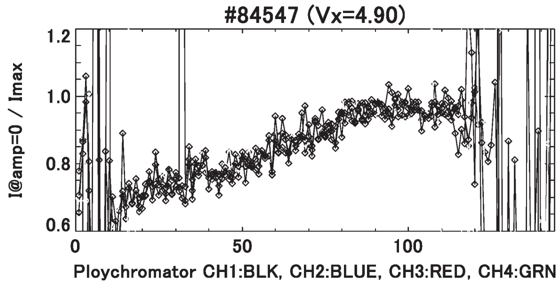

Fig. 2. An example of the correction factors for all polychromators.

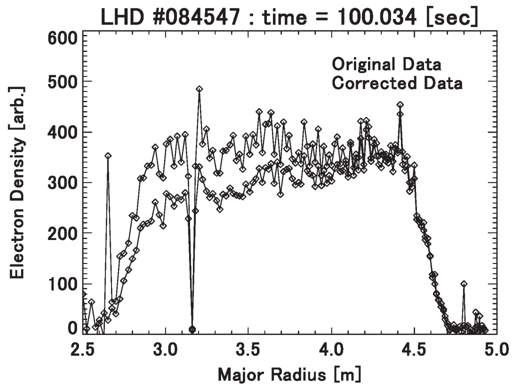

Fig. 3. Raw (lower) and corrected (upper) density profiles. Corrected data shows symmetrical profile as expected.

Necessary discharge time for the density correction method using steady-state plasmas is not long, about 3-5 sec. Since such steady-state plasmas are easily generated in LHD, the on-demand density correction can be frequently carried out, and more reliable density profiles will be obtained.

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