§1. Verification of the Data Reliability and Long-Term Stability of the LHD YAG Thomson Scattering

Yamada, I., Narihara, K., Hayashi, H., Funaba, H., LHD Experimental Group

The LHD Thomson scattering [1][2] has been applied successfully to the measurements of electron temperature profiles of LHD plasmas. However, a few difficulties still remain in obtaining reliable absolute electron densities from the LHD Thomson scattering. For measuring reliable absolute electron density, it is required that the Thomson scattering system has been calibrated absolutely [3][4], all components are used under proper conditions, and then it has long-term stability.

In high-density plasma discharges, a fear arises that performance of avalanche photo diode (APD) detectors is degraded due to intense background light, resulting in large error in both measured electron temperature and density. Then, we installed a new system for monitoring plasma light intensity on all detectors. The plasma light monitor system has worked through the 10th LHD experimental campaign. Figure 1 shows an example of raw data of Thomson scattering signals and background lights detected by a polychromator with five wavelength channels. The upper and lower rows of circles are Thomson signals from high and low power lasers, respectively, and the dots are plasma radiation. At the middle stage of the discharge, strong plasma light appeared suddenly, and the APD outputs were saturated completely in the wavelength channels #3, #4 and #5. It is noted that the maximum output voltage of the detectors is about 3 V [5]. In the period, Thomson signals disappeared due to the detector saturation. We have found that the intense background light is observed by only specific polychromators that see a divertor plate, and not independent core plasma parameters. Therefore, we believe that the background light originates from divertors. Although it is difficult to suppress the divertor light influence efficiently, we can properly judge the data reliability, and provide reliable Thomson data by referring the newly installed background light monitor system.

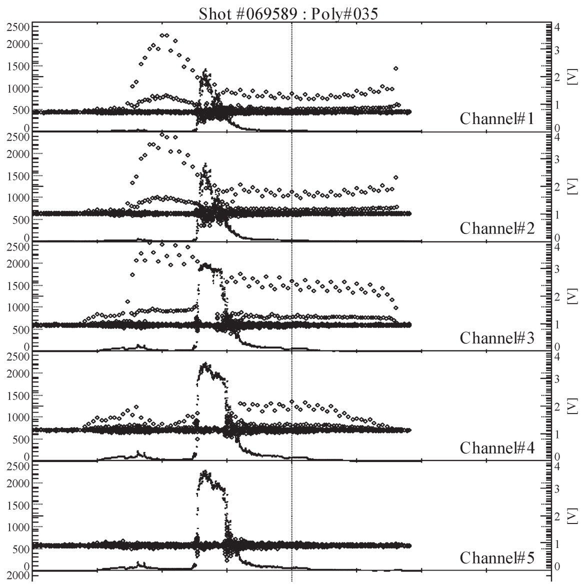

Fig. 1, Thomson signal and plasma radiation signal detected by the polychromator.

Next, we have checked long-term stability of the Thomson scattering by comparing electron line densities obtained from Thomson scattering and measured by the MMW diagnostics. Both of them measure electron density at the LHD horizontally elongated sections, so the data can be compared directly without any assumption and/or additional analytical procedure. Figure 2 shows the ratios between line densities measured by Thomson scattering and MMW through the 10th experimental campaign. Upper three symbols and lower symbols show the ratios between MMW data and of Thomson data from three high power lasers and a low power laser, respectively.

The variation of Thomson density data through the 10th campaign was within 24 %. The variation in a plasma discharge is less than a few percent, and typical weekly variation is estimated to be less than 6 %. Therefore, we can conclude that the short-term stability of the LHD Thomson scattering is good, and daily or weekly calibration is recommended.

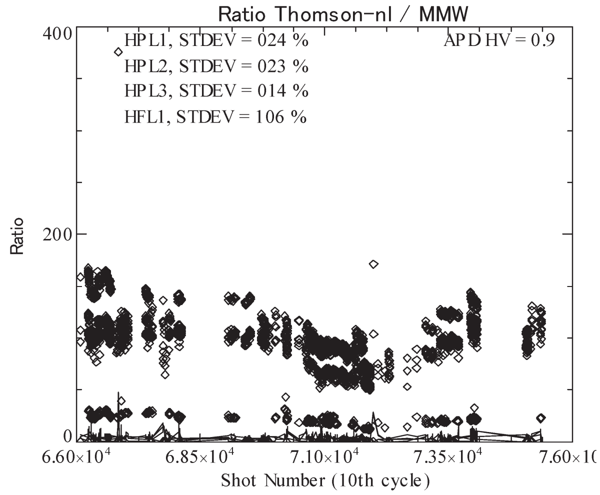

Fig. 2, Variation of the ratio of line densities from Thomson scattering and MMW diagnostics through the LHD10th cycle.

References
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