Development of in-situ Density Calibration for Thomson Scattering Measurement by Microwave Reflectometry on LHD

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Most popular method for the density calibration of the Thomson scattering is a gas scattering method which utilizes Raman or Rayleigh scattering of molecule. However, the calibration in parallel with the density measurement is difficult, because the gas scattering method has a drawback: a vacuum vessel needs to be filled with N_2, Ar or H_2 gases close to an atmospheric pressure level. Therefore, an in-situ density calibration for a Thomson scattering measurement by a microwave reflectometry based on Bayesian estimation was proposed in the previous paper[1]. The reflectometer is able to determine the calibration factor without any assumption (e.g. plasma magnetic structure), because the reflectometer directly measure the location of a cut off layer in plasma cross-section. Simultaneous measurement of the multipoint Thomson scattering and the reflectometer provide the calibration factor of the Thomson scattering system during the plasma discharge. We propose also the new Bayesian method for the accurate density calibration using the reflectometer. The Bayesian estimation provides a sequential analysis for the calibration factor determination taking an accuracy of the reflectometer measurement into account. The calibration factor is modified and come close to the real value with the number of the times of the simultaneous measurements. An accurate density calibration factors can be derived from a few reflectometer measurements by the Bayesian method, which is confirmed by a Monte-Carlo simulation. We develop new FM type reflectometer for the LHD experiments. This FM reflectometer is designed to adopt LHD and the YAG Thomson Scattering system. A small and simple system are preferable as the reflectometer due to the small space around the Thomson scattering device. Thus, we designed the compact FM type reflectometer for this purpose. In this paper, present status of the research is reported.

[1] T.Minami, H.Funaba, K.Narihara, I.Yamada, H.Hayashi, T.Kohmoto, Proceeding of the High Temperature Plasma Diagnostic Conference in 2008.