ECPD 2021
European Conference on Plasma Diagnostics

Evaluation of electron temperature and density for the Thomson scattering system with a high repetition rate Nd:YAG laser on LHD

H. Funaba [1], R. Yasuhara [1], I. Yamada [1], H. Uehara [1], D. J. Den Hartog [2], E. Yatsuka [3], R. Sakamoto [1], Y. Takemura [1], N. Kenmochi [1], N. Tamura [1], M. Osakabe [1], S. Sakakibara [1], and LHD Experiment Group

1) National Institute for Fusion Science, National Institutes of Natural Sciences, Toki, Gifu 509-5292, Japan

E-mail : funaba.hisamichi@nifs.ac.jp

2) Department of Physics, University of Wisconsin-Madison, Madison, WI 53706-1390, USA

3) National Institutes for Quantum and Radiological Science and Technology, Naka, Ibaraki 311-0193, Japan

In order to evaluate the electron temperature (T_e) and density (n_e) during fast phenomena in plasmas, a high-repetition frequency Nd:YAG laser and fast digitizers are installed in the Thomson scattering system on the Large Helical Device [1, 2]. This laser was newly developed in Wisconsin University based on Refs. [3, 4] and can be operated with 2 repetition frequencies, one of which is 1 kHz with 30 laser pulses and the other is 20 kHz with 100 laser pulses.

The temporal development of the scattered light signals are acquired by the fast digitizers of the switched-capacitor type with 1 GS/s. The minimum read-out time of these digitizers is shorter than 50 μs in order that the signals in the 20 kHz operation of the laser can be acquired. Since the data which are obtained by the switched-capacitor type digitizers require some kinds of corrections, the cell-size and peak corrections are made. Some methods of the evaluation of the background level and the time integration are tested. After these data processing processes, the T_e profiles are derived by the χ^2-method. The results can be compared with the results by the charge-integrated type digitizers which are used in the existing Thomson scattering system. Recently, as the gas scattering calibration for the new laser was made by Raman scattering, the n_e profiles will also be evaluated.

The temporal development of the T_e profiles are derived in the pellet injected plasmas or the plasmas where some MHD phenomena are expected. From the first result of the pellet injected plasmas, the T_e profile changes within 1 ms. It is found that the time interval of 50 μs has enough temporal resolution. The estimation of the errors in the data processing is also be discussed.

This work is supported by NIFS20ULHH005 and JSPS KAKENHI 15KK02451.

References

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