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LHD トムソン散乱システムのためのレーザー・プロファイル・モニタ

Laser Profile Monitors for the LHD Thomson Scattering System

舟場久芳, 山田一博, 安原亮, 川端一男, LHD 実験グループ
FUNABA Hisamichi, YAMADA Ichihiro, YASUHARA Ryo, KAWAHATA Kazuo,
LHD Experiment Group

核融合研
NIFS

In the Thomson scattering diagnostics, the position of the laser beams in plasmas is directly related with the measured position of the temperature (T_e) and density (n_e) of electrons. Moreover, it affects the absolute value of n_e since the intensity of the scattered light decreases if the laser beam is shifted from the observed region. Therefore, the monitoring system of the alignment of the laser beams is important for the Thomson scattering systems, especially many lasers are contained in them. For example, such a system is developed in MAST [1] .

The Thomson scattering system for the Large Helical Device (LHD) [2] has the Nd:YAG lasers with three kinds of the repetition frequency of 10, 30 and 50 Hz. One 30 Hz laser with the output energy of 1.6 J and two 10 Hz lasers with the output energy of 2.0 J are mainly used. The distance between the lasers and the LHD vacuum vessel is about 40 m. The beam positions of the 30 Hz laser (Laser 2) and one 10 Hz laser (Laser 1) are completely overlapped by using a pockels cell, while another 10 Hz laser (Laser 3) beam is combined by using a mirror. In order to evaluate the stability of the position of these laser beams, laser position monitoring system is developed with a couple of CCD cameras (30 frame/s) on LHD. The profiles of the laser beams are also observed.

A target screen of aluminum nitride locates on a sampled laser beam line which is branched from the injection line to the vacuum vessel. A CCD camera monitors the laser image which appears behind of this screen. The position of the screen on the sampled line corresponds to the position inside the plasma where the major radius, $R = 4$ m. The magnetic axis position of the LHD plasmas are usually $R = 3.6 \sim 3.9$ m. Figure 1. shows an example of the signals detected by this CCD camera. The pulses of three Nd:YAG lasers are shown here. A reference He-Ne laser light is also overlapped. Although these 3 pulses of the Nd:YAG lasers are irradiated with intervals of several hundred micro seconds, they appear in a same frame since the frame rate is 30 frame/s. The positions of the pulses of Laser 2 (30 Hz) and Laser 1 (10 Hz) are same, while the position of the Laser 3 (10 Hz) pulse is slightly different at this point which corresponds to $R = 4$ m. The spatial profiles of the laser intensity are also observed in this system. Small fluctuation is observed in the position of the pulses of a single laser during the plasma discharge. The stability of the position of each laser pulse will also be reported.

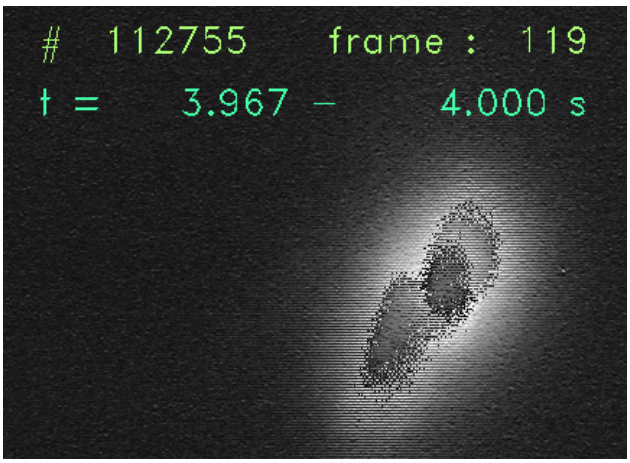

Fig. 1. An example of the spatial profiles of the 3 laser pulses which are observed by a CCD camera.

References

[1] J. Figueiredo, G. Naylor, *et al.*, Rev. Sci. Instrum., **81** (2010) 10D521.

[2] K. Narihara, *et al.*, Rev. Sci. Instrum., **72** (2001) 1122.