§1. Development of a New Detection System for the Thomson Scattering Measurement in the Forward Scattering Configuration

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A new detecting system for the LHD Thomson scattering system [1] is developed in order to detect the scattered light in the both backward and forward configurations separately. Although the new forward scattering configuration was installed for measuring the higher electron temperature [2] , it is impossible to detect the both backward and forward scattering signals separately by the existing FAST-BUS system only, since the delay time of the forward scattering signal from the backward scattering signal is almost 100 ns.

Figure 1 shows this new system which consists of the charge-integration type AD convertors (CAEN V792). It is intended to detect backward and forward signals with both FAST-BUS and this new system.

The gate pulse for V792 and the backward and forward scattered signals are shown in Fig. 2. The gate is adjusted for the backward signal in Fig. 2 (a) and for the forward signal in Fig. 2 (b). The pulse width of the gate is 140 ns.

The electron temperature, $T_{\rm e}$, is evaluated from the signals which were detected by the new system. Figure 3 (a) shows the results of the evaluation of $T_{\rm e}$ at $R = 3.689$ m for different 4 timings. In Fig. 3 (b), temporal development of $T_{\rm e}$, which is evaluated from the new system (◯) is shown and they are compared with the $T_{\rm e}$ values which are derived from the signals of the FAST-BUS system (*). The same calibration data are used in these evaluations. No significant difference is found between them.

The operation of the new system was tested in order to adjust the data acquisition to the laser timings of the LHD Thomson scattering system which consists of one 30 Hz laser and two 10 Hz lasers or the duration of the plasmas which varies from a few seconds to more than one hour.

It is planned to introduce another digitizer of CAEN V1742, which is a switched-capacitor-type digitizer with 32+2 channels and $1 \sim 5$ GS/s. Since the duration of this detector is $200 \sim 1000$ ns, the temporal evolution of the Thomson scattering signals with both in the backward and forward configurations can be observed by this detector.

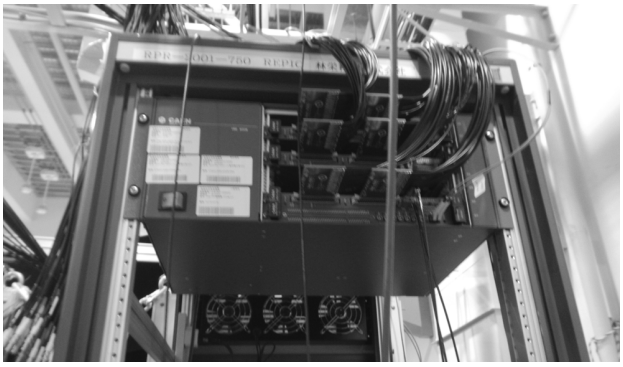

Fig. 1: The newly installed charge-integration type AD convertors, CAEN V792.

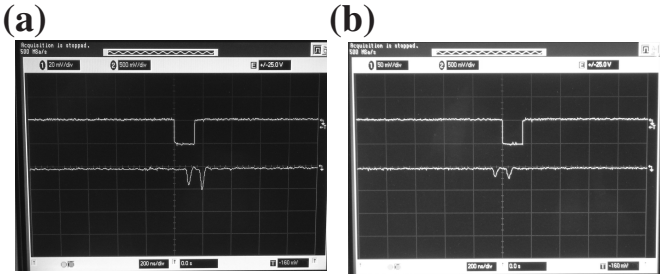

Fig. 2: The gate pulse for V792 (upper) and the backward and forward scattered signals (lower). The gate is adjusted (a) for the backward scattered signal and (b) for the forward scattered signal.

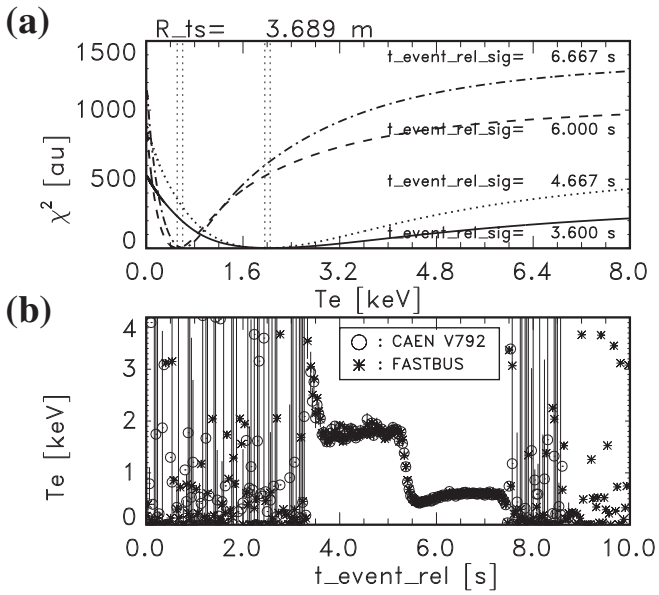

Fig. 3: (a) The evaluation of $T_{\rm e}$ at $R = 3.689$ m for different 4 timings. (b) temporal development of $T_{\rm e}$, which is derived from the new system (◯) and from the FAST-BUS system (*).

1) K. Narihara, *et al.*, Rev. Sci. Instrum., Vol. 72, 1122, (2001).
2) I. Yamada, *et al.*, Proc. 40th EPS Conf. on Plasma Phys, O2.112, (2013).