Performance of JT-60SA Thomson scattering data analysis system

M. Akimitsu[1*], Y. Ohtani[1], H. Tojo[1], H. Funaba[2], F.A. D'Isa[3], H. Sasao[1], T. Nakano[1], M. Yoshida[1]

[1] *National Institutes for Quantum Science and Technology (QST) Naka, 311-0193, Japan,*
[2] *National Institute for Fusion Science, National Institutes of Natural Sciences Toki, 509-5292, Japan*
[3] *Consorzio RFX (CNR, ENEA, INFN, Università di Padova, Acciaierie Venete SpA), C.so Stati Uniti 4, 35127 Padova, Italy*

A data analysis system has been developed for high spatial resolution and high-precision electron temperature and density Thomson scattering measurements in the JT-60SA project [1]. The performance of the system, including the noise from 1 GS/s digitizer and high efficiency polychromator [2], has been analyzed. In JT-60SA, various discharges with different electron temperatures, electron densities, and discharge durations are planned (T_e = 0.1–30 [keV], $n_e < 1 \times 10^{20}[\mathrm{m}^{-3}]$). Currently, our data analysis system can analyze data taken from the polychromators for the core (46 spatial channels at 50 Hz) and the edge (49 spatial channels at 100 Hz) plasma in one system. The requirement for the density and temperature calculation is to be finished within a nominal repetition time, which is 3000[s] for 100[s] flattop of the plasma current. Hence, evaluations of the time from the beginning of data acquisition to the end of calculation of T_e and n_e must be investigated. Each polychrometer (6 spectral channels) data is required to be calculated within 4.2ms assuming sequential computation.

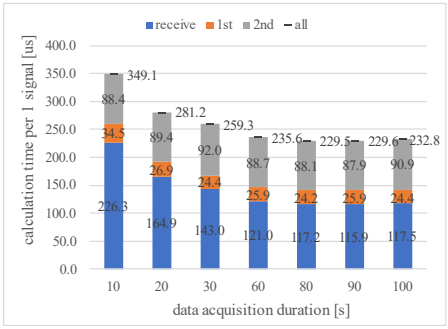

Fig. 1 processing time per a signal

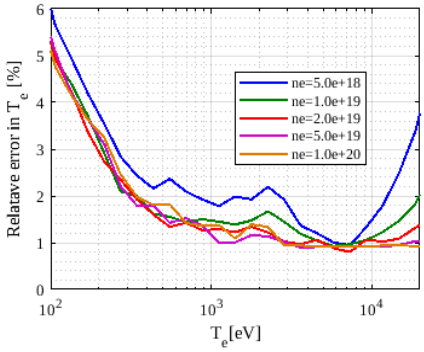

Fig. 2 result of phantom test

We applied the simple summation method to JT-60SA discharge conditions with the parameters of the Thomson scattering measurements and investigated their performance. Figure 1 shows the averaged computation time per a signal data including receiving raw data and writing processed data file (1st : raw data, 2nd : scattered intensity). Figure 2 shows the relative error from the phantom test. The computational performance was evaluated in terms of computation time and error. Using simple summation, the determination of the scatted intensity finishes with 233 μs x 6 [ch] ~ 1.4 [ms] at 100 [s] of the data acquisition duration and within the limitation duration (4.2[ms]). The relative error in T_e < 6% at $n_e > 5 \times 10^{18}[\mathrm{m}^{-3}]$. Evaluations of curve fitting method to obtain the scattered intensity [3] in low signal-to-noise ratio conditions and calculation method of density and temperature determination will be presented.

[1] H.Tojo *et al* Rev. Sci. Instrum. 92, 043556 (2021)

[2] F.A. D'Isa *et al.,* Fusion Engineering and Design 192, 113591 (2023)

[3] H. Funaba, *et al.,* Plasma and Fusion Res. 17, 2402032 (2022)

*Presenting author: akimitsu.moe@qst.go.jp