§11. Electron Temperature Measurements by Using the Thomson Scattering System in GAMMA 10

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An yttrium-aluminum-garnet (YAG) Thomson scattering (TS) system was constructed and applied to the tandem mirror GAMMA 10 device to measure the electron temperature and density [1-2]. A large solid-angle TS light-collection system was achieved by use of a spherical mirror system and large numerical aperture of bundled optical fiber. A five-channel polychromator with avalanche silicon photo diodes was used. Calibration experiment for TS optical system was performed by Rayleigh and Ramman scattering. An electron temperature increases from 40 eV to 80 eV was observed with application of electron cyclotron heating (ECH) in the plug/barrier (P/B-) cells. We successfully obtained the radial electron temperature profiles without and with P/B-ECH.

The YAG-TS system is constructed with the laser, the incident optics, the light collection optics, the signal detection electronics, and the data recording system. Details of the system is shown in elsewhere. We applied the YAG-TS system to measure the electron temperature of GAMMA 10 plasma. The plasma is produced from t = 50 to 240 ms with heated by the ICH from t = 51 to t = 240 ms and the confinement potential by applying B -ECH with power of 150 kW from t = 150 to 200 ms and P-ECH with power of 200 kW from t = 151 to 181 ms, respectively. We changed the measuring position of electron temperature by changing the bundled optical fiber position shot-by-shot. Figure 1 shows the radial electron temperature in GAMMA 10. Moreover, we tried to measure multi-position of Thomson scattering signals in a single plasma shot. We used a delay lines for making the two output signals which are the two polychromator channel output signals into one signal line onto the single oscilloscope channel. The output signals are shown in Fig. 2. There are two polychromator signals are shown in the one oscilloscope. Then we can obtain the electron temperatures of two radial positions in a single plasma shot.

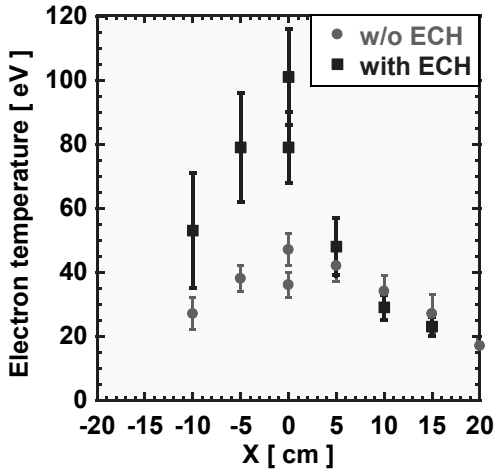

Fig. 1. Radial electron temperature profile with and without ECH.

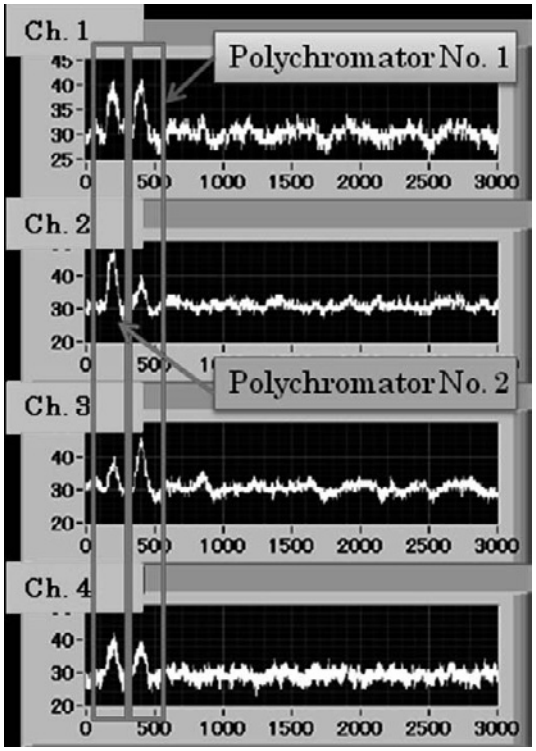

Fig. 2. Two position measurement by using delay line system.

1) Yoshikawa, M., et al.: Plasma Fusion Res. 6, 09095 (2011) 1202095.
2) Yoshikawa, M., et al.: JINST. 7 (2012) C03003.