

§13. Development of Polarization Controlled Multi-pass Thomson Scattering System in the GAMMA 10 Tandem Mirror

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In the GAMMA 10 tandem mirror, typical electron density is comparable to the peripheral plasma of torus type fusion devices. Then the effective concept for increasing of Thomson scattering (TS) signals is required for improvement of signal quality. We have been developing the multi-pass TS method of a polarization based system based on the GAMMA10 yttrium-aluminium-garnet (YAG)-TS. To evaluate the effect of the polarization based configuration, the multi-pass system is installed in the GAMMA 10 YAG-TS system, which can demonstrate the double pass scattering. We carried out the Rayleigh scattering experiment and applied this double pass scattering system to the GAMMA 10 plasma. Then integrated scattering signal has increased to about twice by the double pass system.

A schematic diagram of the newly multi-pass method of the polarization based system is shown in the Fig. 1. This system is based on the GAMMA10 TS system which has successfully observed the electron temperature and density of the GAMMA10 plasma. Horizontal polarized laser light from the YAG laser is focused onto the plasma center by the first convex lens from the down side port window after passing a short pass mirror, the two Faraday rotators for isolator, a half wave plate, mirrors, a polarizer, and iris. After the interaction with plasma, the laser light emits from the upper side port window and collimated by the second convex lens. A pair of lenses is a key component of this optical system. It makes the image relaying optical system from iris to reflection mirror to maintain the laser beam quality during the multi-pass propagation. Laser light reflected by the reflection mirror for the second pass and focused again onto the plasma. A Faraday rotator is used for a polarization control device.

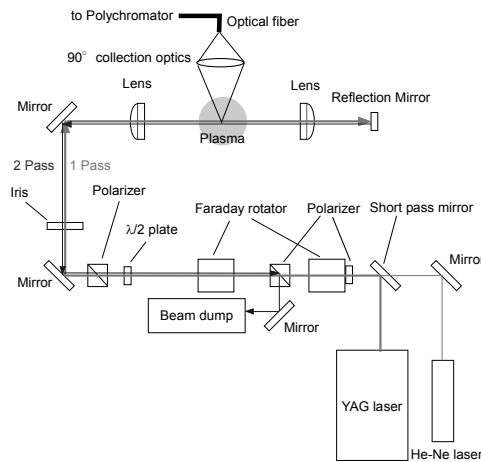


Fig. 1. Schematic diagram of the double pass system.

It switches horizontal polarization to vertical at the second pass traveling of laser light. Vertical polarized laser light is absorbed on the beam dump. We carried out the Rayleigh calibration experiments for setting and stray light in the evaluation of the double pass system. Moreover, we applied this system to the GAMMA 10 plasma. Figure 2 shows the typical channel A signal of polychromator. The peak scattering signals of double pass configuration are 1.6 times as large as those of single pass configuration. The integrated scattering signals are about twice as large as

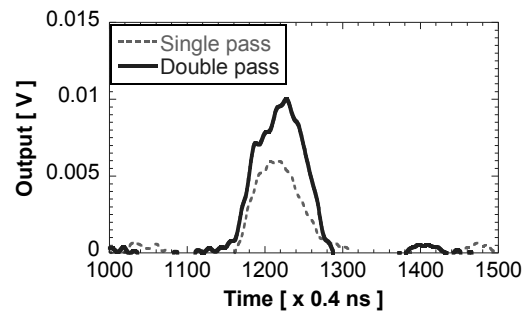


Fig. 2. Output signals of 1 pass and 2 pass TS systems.

those of single pass. The obtained electron temperatures by using the double pass and single pass TS systems are 32 ± 1 eV and 30 ± 3 eV, respectively, thus they are the same. The error in the double pass system is about 1/3 as that in the single pass system. It shows us the improvement of data quality of GAMMA 10 TS system and the feasibility of the proposed polarization based multi-pass system.