

TST-2 球状トカマク装置における同軸マルチパストムソン散乱計測法の開発 Development of coaxial multi-pass Thomson scattering diagnostic system on the TST-2 spherical tokamak

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In the study of fusion plasmas, it is important to measure the profile of electron temperature and electron density and Thomson scattering (TS) diagnostics is often used. However, with conventional TS system, it is hard to measure the electron temperature of low density RF plasmas such as those obtained in the TST-2 spherical tokamak. To solve this problem, coaxial multi-pass TS system is under development. Using a polarizer and a Pockels cell and controlling the polarization of a laser light rapidly, the laser pulse can be confined between two concave mirrors, and then, the amount of scattered photons is multiplied [1].

In order to design the multi-pass TS optical system, we measured some parameters of YAG laser light used in TS measurement, that is, beam waist w_0 , divergence angle θ_0 and beam quality factor M^2 (defined as $M^2 = \pi w_0 \theta_0 / \lambda$, where λ is wavelength of laser). From these parameters, beam propagation in round trips between mirrors was calculated and the distance between mirrors which is suitable for laser confinement was determined.

Following the design, a multi-pass optical system was assembled and installed on TST-2 and the confinement test of YAG laser with 10 ns pulse width was performed. The signals of laser pulse were detected up to about 7 round trips using photo diode detector. Then we found the summation of the signals in round trips amounted to 2-2.5 folds compared to only first signal. This indicates the photon number of 4-5 folds will be obtained in TS measurement compared to a standard TS system.

We are now preparing for the multi-pass TS measurement in TST-2 plasmas.

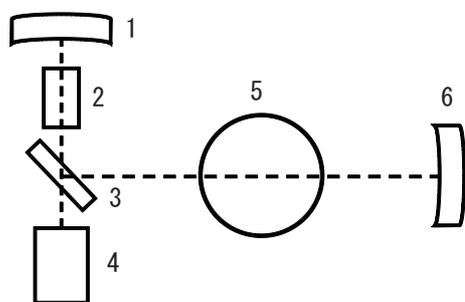


Fig.1 Schematic drawing of the multi-pass optical system:
(1) concave mirror #1, (2) Pockels cell, (3) polarizer, (4) Nd:YAG laser, (5) plasma volume, and (6) concave mirror #2

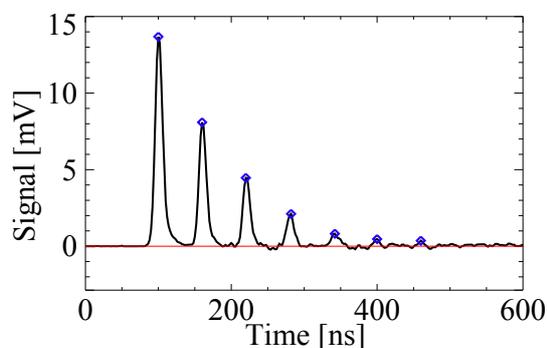


Fig.2 The signals of laser pulse in round trips measured behind the concave mirror #2