Double-pass Thomson scattering measurements in TST-2 Ohmic heated tokamak plasmas

Y. Peng[1*], A. Ejiri[1], K. Shinohara[1], N. Tsujii[1], S. Jang[1], O. Watanabe[1], K. Iwasaki[1], Y. Lin[1], Z. Jiang[1], Y. Tian[1], F. Adachi[1], T. Ido[2], K. Kono[2], and Y. Nagashima[2]

[1]*Graduate School of Frontier Sciences, The University of Tokyo, Kashiwa, 277-8561, Japan*
[2]*Research Institute for Applied Mechanics, Kyushu University, Kasuga 816-8580, Japan*

Most of electron heating mechanism can induce anisotropy in electron distribution in a specific condition, e.g. in early phase of ohmic heating, lower-hybrid wave heating, heating by electron cyclotron range of frequency wave, and so on. Therefore, measuring the electron temperature anisotropy can contribute to the understanding of the basic mechanism of electron heating. Double-pass Thomson scattering (TS) diagnostics offers the measurement of the anisotropy since the scattering angles are different between the forward and backward beam propagation. Here, a double-pass TS optical configuration was theoretically designed based on an optimization procedure [1], by tuning four parameters, d_0, d_1, d_2, and δ_p/a, where a is a plasma minor radius (Fig. 1) to a limitation from a TST-2 environment and available optical components. We experimentally confirmed the designed configuration by the measurement of forward and backward laser beam propagation (i.e., beam radius along the beam propagation). As a result, the safety requirement of the YAG laser device was satisfied, namely the residual backward power returning to the laser was less than about 0.2% (12 mW) of the laser output power. The double-pass TS configuration was applied to measure the temperature anisotropy in the Ohmic heated plasmas in TST-2 with various gas feeding amount and various loop voltages. The temperature anisotropy varies between (1.2 ± 0.5) and (-0.1 ± 0.2) in the edge region and between (0.01 ± 0.1) and (0.1 ± 0.08) in the central region under various gas feeding amount, as well as between (0.8 ± 0.4) and (0.4 ± 0.6) in the edge region and between (0.03 ± 0.04) and (-0.2 ± 0.05) under various loop voltage. It was found that the temperature anisotropy is qualitatively proportional to the ratio of electron temperature to electron density (T_e/n_e).

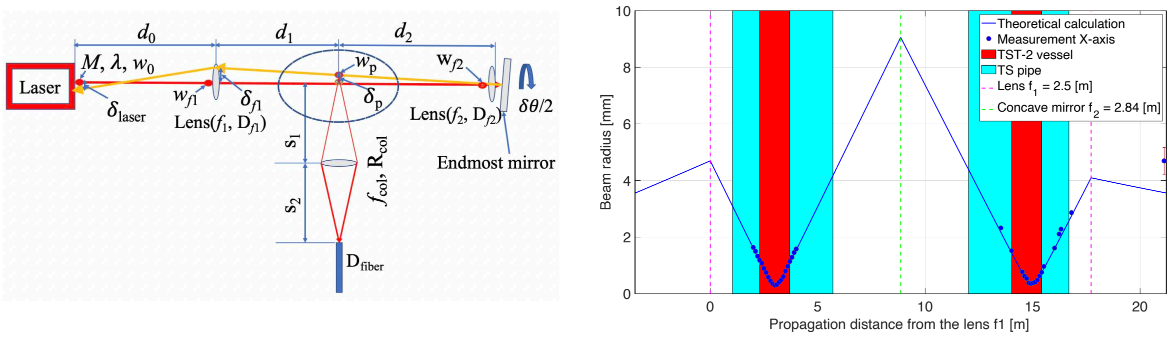

Figure 1. Schematic configuration of double-pass scheme (left), measurement and theoretical calculation of the beam radius along the double-pass optical path (right).

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*Presenting author: peng-yi@g.ecc.u-tokyo.ac.jp