講演番号をこちらに

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Present Status and Future improvement of Multi-pass Thomson Scattering System on Heliotron J

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A multi-pass Thomson scattering (MPTS) system has been developed on Heliotron J, which has realized over 16-pass by one laser shot from the measurement of stray light. The system has dual scattering angles (160º and 20º) because the optical path of original single-pass system is designed obliquely, to keep optical path of laser beam away the helical coils twisting around the vacuum vessel and form a large scattering angle so that the measurement accuracy becomes higher in low temperature plasmas measurement.

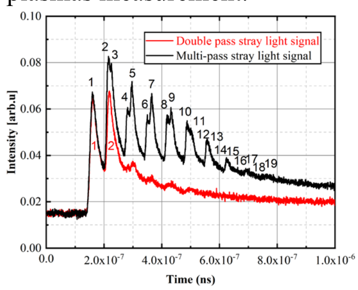

Fig. 1 Comparison of stray light signal between multi-pass system and double-pass system.

The scattered light signal produced from an ECH plasma (n_e~0.5×10^{19}m^{-3}) has been measured by double-pass and 4 pass mode of multi-pass Thomson scattering system (MPTS) on Heliotron J, which both show at least doubled signal-to-noise ratio in such a low density condition, comparing with the one measured by single-pass system. However, scattered light signals corresponding to two continuous incidences with a 160º and a 20º scattering respectively, overlap with each other completely due to an insufficient length of optical path caused by limited room providing for layout of Thomson scattering system.

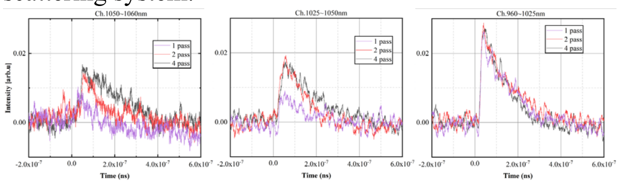

Fig. 2 Scattered light signal detected by different mode of MPTS.

Because the existence of signals' overlap, anisotropic electron temperature measurement by analyzing signal separately, for reaching a better understanding of transport mechanism of super-thermal electrons, can't be proceeded. To solve this problem, a MPTS with signal separation function is proposed. Design of optical path is given out based on Gaussian beam analysis, which determines the specific position of each optical component, by maintaining spot size and power density evolution of laser beam under the limit of entry diameter, exit diameter and power threshold of each component. Besides, since dual scattering angles existing in our system make effect on their corresponding profile of scattered spectrum which further determining signal-to-noise ratio of result, thus, polychromator is redesigned by optimizing filter combination for both scattering angles simultaneously, which reduces T_e measurement error for both scattering angles lower than 10% in 100~10 keV of T_e and in 1~10×10^{19}m^{-3} of n_e.

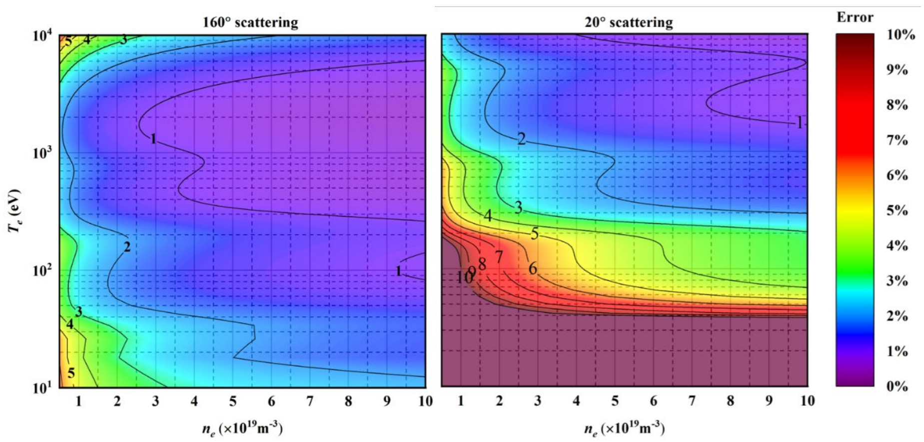

Fig. 3 Estimated errors of T_e measurement corresponding to 160º and 20º scattering as a function of T_e and n_e.