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ヘリオトロンJ装置におけるレーザールス遅延機構を有する マルチパストムソン散乱計測装置による非等方電子温度計測

Measurement of Anisotropic Electron Temperature by Multi-pass Thomson Scattering System with Signal Separation Function on Heliotron J

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Multi-pass Thomson scattering (MPTS) system has advantages in anisotropic electron temperature by utilizing two Thomson scattering spectra from different scattering angles. The information of electron velocity distribution corresponding to different incident directions of laser beam can be observed, which is helpful to have a better understanding on kinetic behavior of plasma such as Electron cyclotron heating (ECH) because electrons receive power unbalanced in different directions.

In the MPTS on Heliotron J, due to the insufficient space provided for the layout of Thomson scattering system, scattered light signals corresponding to two successive incidences with opposite incident directions are overlapping with each other, which hinders the further analysis on the relevant electron velocity distributions. To solve this problem, a signal separation system is added in the original path of MPTS to separate the overlapping scattered light signals. Beam of one laser shot after injected into plasma can be confined in a specific optical path before it's injected into plasma again so that signals can be separated by a longer incident interval.

The prolonged incident interval between two successive incidences is verified by the waveform of Raman scattering signal, as shown in Fig. 1. the incident interval can be prolonged as reciprocating number increases. Further the integral signal can be deduced by fitting methods based on the separated section of the signal.

By operating the signal separation system, an electron temperature (T_e) measurement in a low electron density (n_e~0.5×10^{19}m^{-3}) Heliotron J plasma has been firstly done. T_e corresponding to two inequivalent and complementary scattering angles measured by a double-pass mode has been analyzed. Fig. 2 shows the T_e measurement at three timings in the plasma. The results show that no clear deviation between T_e measured by two different scattering angles was appeared at core plasma, which means electron velocity distribution obeys Maxwellian distribution and velocity distribution is isotropic.

The reason why no clear difference between two T_e corresponding to these two different directions is found may be caused by the collision that may make the difference between two measured T_e not large. To figure the influence of collision on observation of anisotropy, in next stage, we would like to perform another anisotropic measurement in a lower density environment to verify whether the difference becomes clearer.

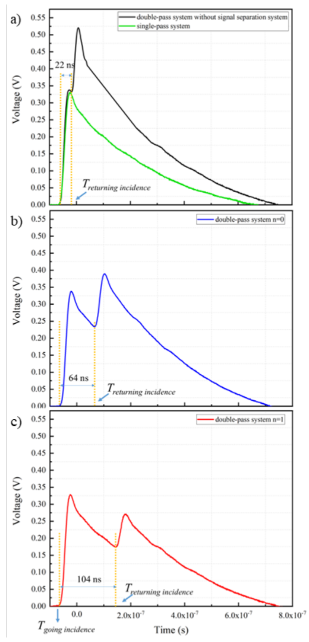

FIG. 1 (a) Raman scattering signals observed by multi-pass TS system without signal separation system. (b) with signal separation system when reciprocating number equal to 0. (c) with signal separation system when reciprocating number equal to 1.

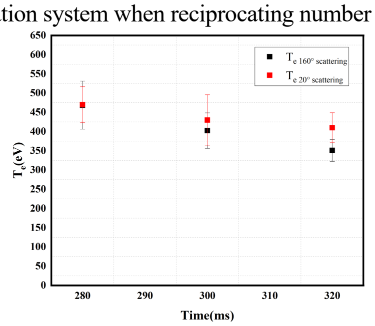

FIG. 2 T_e anisotropy measurement at 280, 300, and 320 ms.