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ヘリオトロンJにおけるレーザーパ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速度分布現象の研究の初期結果

First Result of Anisotropic Phenomenon Research Measured by a Thomson Scattering System with Signal Separation Function on Heliotron J

邱德川[1]、南貴司[2]、門信一郎[2]、松谷遼[1]、戸羽佑輔[1]、釼持尚輝[3],、大島慎介[2]、小林進二[2]、王晨宇[1]、罗茂源[1]、张朋飞[1]、岡田浩之[2]、水内亨[2]、木島滋[2]、安原亮[3]、稲垣滋[2]、長崎百伸[2]

Dechuan Qiu[1], Takashi Minami[2], Shinichiro Kado[2], Shigeru. Inagaki[2], Ryo Matsutani[1], Yusuke Toba[1], Chenyu Wang[1], Maoyuan Luo[1], Pengfei, Zhang[1], Naoki Kenmochi[3], Shinsuke Ohshima[2], Shinji Kobayashi[2], Hiroyuki Okada[2], Tohru Mizuuchi[2], Shigeru Konoshima[2], Ryo Yasuhara[3], Kazunobu Nagasaki[2]

[1]京都大学エネルギー科学研究科、[2]エネルギー理工学研究所、[3]核融合科学研究所

[1]Graduate School of Energy Science, Kyoto University, [2]Institute of Advanced Energy, Kyoto University,[3]National Institute for Fusion Science

qiu.dechuan.78n@st.kyoto-u.ac.jp

Thomson scattering diagnostic is one reliable method to determine the electron temperature (T_e) following the measurement of the scattered spectrum. The form of the scattered spectrum is dependent on the electron velocity distribution (EVD) function and EVD plays a key role in kinetic behavior of plasmas. Thus, anisotropic T_e measurement is helpful in achieving a more complete information of the EVD and further a better understanding on kinetic behavior of plasmas. By constructing a polarization-controlled MPTS system, beam of one laser shot can be confined in an optical path passing through plasma so that beam can be guided into plasma over one time from two opposite directions alternatively. As a result, the component of EVD parallel and perpendicular to the local magnetic field at measured position can be revealed by measuring T_e deduced from scattered spectrums corresponding to two incidences (going incidence and returning incidence) respectively.

An anisotropy T_e measurement was done in a plasma generated by Electron cyclotron heating (ECH) in Heliotron J. ECH power and the stored energy W_p in the ECH plasma. The plasma is initiated by ECH ($N_{\parallel} = 0.38$) from 170 ms and maintained only by electron cyclotron heating until 330 ms. The power of ECH is about 247 kW. Measured position is at core plasma (r/a~0.26). The angle between local magnetic field and $\Delta\overrightarrow{k_{going}}$ (defined as the difference between vector of going incident light wave number and scattering light wave number) and $\Delta\overrightarrow{k_{retruning}}$ (defined as the difference between vector of returning incident light wave number and scattering light wave number) are equal to 83.9º and 111.7º respectively.

Measured scattered light signals corresponding to going and returning incidence are shown in Fig. 1. Based on the waveform from 0 ns to the yellow vertical line, which is defined as the timing of appearance of returning incident signal, overlapping waveform of going incidence are fitted by exponential function as shown in dashed lines. As a result, T_e measured by going incidence can be deduced by fitted waveform of going incidence. Conversely, T_e measured by returning incidence can be deduced by using overlapping waveform minus the fitted waveform.

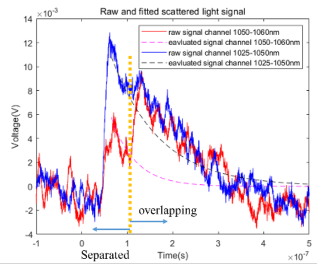

Figure 1. Raw and fitted scattered light signal measured by a double-pass mode of Thomson scattering system on Heliotron J.

T_e corresponding to going incidence (160º scattering) and returning incidence (20º scattering) measured at three timings are shown in Fig. 2: t = 280 ms, t = 300 ms, and t = 320 ms. The values of $< (T_{e\,160º} - T_{e\,20º})/T_{e\,160º} >$ at 300 ms and 320 ms are $6\% \pm 26\%$ and $14\% \pm 17\%$ respectively, which does not show obvious isotropic breaking in this experiment. No anisotropy was observed within the error bars in this initial experiment.

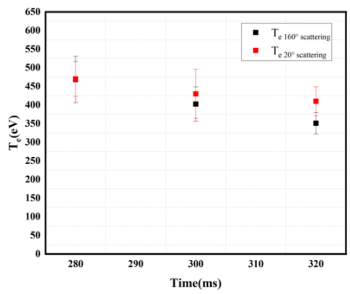

Figure 2. T_e anisotropy measurement at 280, 300, and 320 ms.