4th Asia-Pacific Conference on Plasma Physics, 26-31Oct, 2020, Remote e-conference

# Study of electron thermal transport using ECH modulation in Heliotron J

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The study of electron heat transport is a major topic in the research of fusion plasmas to understand and improve the confinement performance. One of our purposes of study in the helical-axis heliotron device, Heliotron J, is to understand the physical mechanism of the magnetic configuration effect on the heat transport. For this purpose, we have developed multichannel radiometer systems to measure the electron temperature and fluctuations to analyze electron heat transport. Recently, we have acquired first result of $T_e$ fluctuation measurement in Heliotron J [1].

In this paper, we report electron temperature response measured from core to edge by 2nd harmonic X-mode electron cyclotron emission (ECE) with the multi-channel radiometer system in Heliotron J. The experiment is conducted with modulated electron cyclotron heating (MECH) power for estimating the incremental heat transport coefficient $\chi_e^{HP}$. Plasma current is controlled by scanning the ECH injection angle to study the effect of rotational transform on $\chi_e^{HP}$, which is possibly related to the formation of magnetic island [2].

The phase delay and perturbation amplitude can be obtained from the ECE signals. The phase delay is calculated by the cross spectrum of two ECE signals [3]. Figure 1 shows the profile of phase delay with reference to the core ECE channel. By scanning the injection angle from 0 to 0.38, the EC current are controlled, resulting in the increase in plasma current from 0 to 0.5 kA, which decreases the rotational transform. In the 0.5 kA case, the phase delay increases very slowly around rho ~ 0.4, which indicates fast heat propagation in this region. This phenomenon may be related to the formation of magnetic island due to the change of rotational transform. Figure 2 shows the perturbation amplitude obtained from the first harmonic Fourier component of ECE signals. Several models are used to calculate $\chi_e^{HP}$ from the phase and amplitude of the heat pulse [4-5]. The results calculated by different models show large differences among them, and also differ from the power balance calculation result, $\chi_e^{PB}$ around 7 $m^2/s$. One possible reason for these differences may be the effect of perturbed source profile which are not considered in these models. The cylindrical geometry may also affect the validity of some models. The validity of these models needs to be discussed, thus numerical calculation will be performed for more accurate estimation of $\chi_e^{HP}$ in Heliotron J.

References

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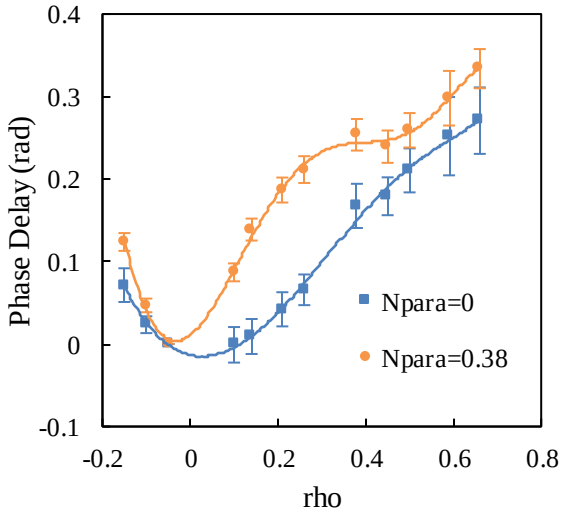


**Fig. 1 Phase delay profile measured by ECE under different ECH injection angles**

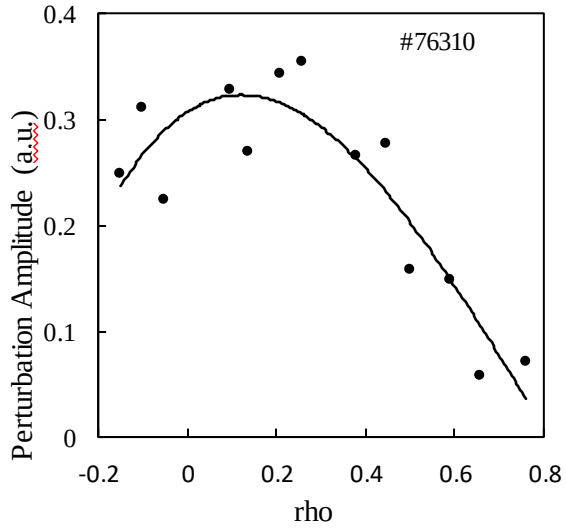


**Fig. 2 Electron temperature perturbation amplitude profile measured by ECE**