Collective Thomson Scattering Study using Gyrotron in LHD

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The measurement of the ion velocity distribution is especially important in reactor relevant plasmas. The collective Thomson scattering (CTS) is one of the most promising methods for evaluating the ion velocity distribution function. In spite of its potential, this method had long been suffered from the absence of adequate power sources. Recent development in the higher power, and higher frequency range of the gyrotron and the transmission technique enabled to realize the measurement of not only the bulk but also high energy component of the ion velocity distribution function[1].

One of the newly installed 77 GHz gyrotrons in LHD can generate more than 1MW over 5 s. This gyrotron is connected to one of the Gaussian mirror antenna set. This antenna set includes one another Gaussian beam mirror suitable for receiving the scattered power from definite scattering volume. For use of this gyrotron, operational magnetic field should be chosen near 2.2 Tesla on axis so as to exclude the fundamental and second harmonic resonances of 77 GHz on the line of sight inside the plasma confinement region, in order to reduce the ECE background that is considered to be the largest noise source. A receiver system will be installed on the upstream of the transmission line. A heterodyne receiver system of a fundamental mixer with fixed local oscillator is under construction. The receiver system of a harmonic mixer with dynamic local frequency tracking capability to the gyrotron frequency will also be installed in the system to improve the IF (intermediate frequency) stability. A notch filter with the 3 dB band width of 300 MHz will be used for the front end. The adjustment and trial of the CTS using above mentioned system will be done during the next experimental campaign of LHD that will be started from the end of September 2008.

CTS using the higher frequency for the higher plasma density region is also under study. Advantages of using higher frequency are the lower expected ECE background and the higher spatial resolution. The gyrotron of the frequency range of 400 GHz is under development for this purpose in university of Fukui. Optimum injection and receiving systems using this gyrotron for CTS in LHD are under design.

[1] H. Bindslev, S. K. Nielsen, L. Porte, J. A. Hoekzema, S. B. Korsholm, F. Meo, P. K. Michelsen, S. Michelsen, J. W. Oosterbeek, E. L. Tsakadze, E. Westerhof, and P. Woskov, Phys. Rev. Lett. **97** (2006) 205005 .