Estimation of the Effective Collective Thomson Scattering Cross Section using the Gaussian Beam in LHD ECRH System

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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 for electron cyclotron resonance heating (ECRH) enabled to realize the measurement of not only the bulk but also high energy component of the ion velocity distribution function[1].
The trial of CTS measurement using 1 MW 77GHz gyrotron in LHD has been started. Two Gaussian beam antenna set is installed in one LHD port. One beam is used for the probing and 8-channel radiometer type receiver is set at the upstream of one the transmission line connected to the other antenna. Promising scattering signals are observed well separated from electron cyclotron emission (ECE) background radiation[2].The receiver system is now upgraded to have 32 channel and to be more sensitive at each channel.
One of the main advantages of using ECRH system for CTS is well defined Gaussian beams for both probing and receiving. The effective scattering cross section and its extent over effective minor radius are the key to determine the intensity and the spatial resolution of the scattering spectra. The steering capability of the probing and receiving beams enables the detailed comparison between experiments and calculation for the system calibrations and optimization of the scattering configurations. The methods of estimating effective scattering cross section are described and compared with the beam steering experimental results.

[1] H. Bindslev, *et al.*, Phys. Rev. Lett. **97** (2006) 205005.
[2] S. Kubo, it et al., to be published in PFR (2009).