

Development of Electron Bernstein Emission Diagnostics System on Large Helical Device

R. Ikeda, H. Igami, S. Kubo, T. Shimosuma, Y. Yoshimura, H. Takahashi and T. Mutoh

National Institute for Fusion Science, 322-6 Oroshi-cho, Toki 509-5292, Japan

e-mail r.ikeda@nifs.ac.jp

Electron cyclotron wave heating (ECH) and current drive (ECCD) play an important role in magnetic confinement plasmas. However, the propagation of electron cyclotron wave (ECW) is restricted by cutoff layers. Therefore, conventional ECH and ECCD are not realized in over-dense plasmas which exceed cutoff density. In Large Helical Device (LHD), over-dense plasmas called as super dense core (SDC) plasmas are often produced [1]. Electron Bernstein wave (EBW) that is electrostatic wave is expected to resolve this problem. EBW has no cutoff density and is strongly absorbed near electron cyclotron resonance (ECR) layers. So far, attractive results of EBW heating (EBH) and current drive (EBCD) have been indicated in many confinement devices [2-5]. On the other hand, there is a difficulty in realizing EBH and EBCD. Because EBW cannot propagate vacuum region, the process such as O-mode – slow X-mode – EBW (O-X-B) mode conversion is required in plasmas. To realize high mode conversion efficiently, initial conditions such as injection position, angle and polarization have to satisfy optimal conditions determined by radial profiles of the electron density and the magnetic field strength in target plasmas. So, we aim to develop a method that determines initial injection conditions for EBH and EBCD with measurement of electromagnetic wave emitted by an inverse process of O-X-B, B-X-O. We transmit EBW emission (EBE) to ECRH transmission line on LHD to obtain the optimal condition for EBH and EBCD. EBE near the ECR layer couples to the slow X-mode at UHR layer and slow X-mode converts to O-mode at plasma cutoff layer. This O-mode propagates vacuum region as elliptically-polarized wave and is transferred from movable mirror to corrugate waveguide. And this electromagnetic wave is transferred to EBE diagnostic system. The intensity of emission from signals of intermediate frequency down-converted by mixer and local oscillator are detected in this system. In the conference, we will present details of design of EBE diagnostic system on LHD.

- [1] Ohyaabu *et al.*, Phys. Rev. Lett., 97, 055002 (2006).
- [2] H. P. Laqua *et al.*, Phys. Rev. Lett., 78, 3467 (1997).
- [3] A. Sykes *et al.*, Phys. Plasmas **8**, 2101 (2001).
- [4] V. Shevchenko *et al.*, Phys. Rev. Lett. **89**, 265005 (2002).
- [5] H. Igami *et al.*, Rev. Sci. Instrum. **77**, 10E931 (2006).