Study on non-inductive EBW heating experiment using direct XB mode conversion in VEST

H. Y. Lee[1], J. G. Jo[1], J. I. Wang[1], S. H. Kim[2], Y.S. Hwang[1]

[1] *Seoul National University, 151-744, Seoul, Korea*
[2] *Korea Atomic Energy Research Institute, 305-353, Daejeon, Korea*

Lead-author e-mail: yhwang@snu.ac.kr

The Electron Bernstein Wave (EBW) can be effective heating method in Spherical Torus (ST) due to density limit according to low toroidal field. Since the direct XB mode conversion requires only a simple Low Field Side (LFS) waveguide for perpendicular injection compared to OXB mode conversion, the experiments of plasma generation and heating by using the direct XB mode conversion have been conducted in a small linear device with axial magnetic field bent and VEST (Versatile Experiment Spherical Torus). In the linear device, it is observed that over dense plasmas above X-mode cutoff density is generated by LFS X mode injection and the electron temperature peaks near Electron Cyclotron Resonance (ECR), indicating the presence of direct XB mode conversion and EBW collisional heating due to the short density scale length near edge Upper Hybrid Resonance (UHR) layer. In addition, the experimental results in the linear device for the effect of MicroWave (MW) multi-reflection using polarized slits reflecting X or O mode only show that the multi-reflected X wave can affect the direct XB mode conversion. The similar experimental result of XB mode conversion and EBW collisional heating are observed in VEST pre-ionization plasma that the pattern of density profile, the position and density scale length of mode conversion layer depend on the toroidal magnetic field and MW power. It is expected that those dependency on input MW power can be used for non-inductive EBW heating experiment in startup phase has been conducted for efficient XB mode conversion by controlling magnetic scale length (L_B) and density scale length (L_n). The feasibility of non-inductive EBW heating and current drive using direct XB mode conversion will be also investigated using 1D full wave mode conversion efficiency calculation code [1] and GENRAY ray tracing code.

[1] S. H. Kim, H. Y. Lee, J. G. Jo and Y.S. Hwang, "One dimensional full wave simulation on XB mode conversion in electron cyclotron heating", Physics of Plasmas **21**(6) (2014)