Helicon wave experiments with steep magnetic field gradient devices Mini-RT and Mini-RT/L

Y. Ogawa[1], T. Takemoto[1], T. Sueyoshi[1], C. Kawai[1], J. Morikawa[1]

[1] *Graduate School of Frontier Sciences, the University of Tokyo, Kashiwa, 277-8568, Japan*

To explore high beta plasmas on the internal coil device Mini-RT ($B \sim 0.01$T) with the dipole magnetic configuration, the Electron Cyclotron Wave (f=2.45GHz) has been applied and the plasma density of 10^{17} m^{-3} (about two times higher than the cut-off density) has been achieved. In addition, the mode conversion to the Electron Bernstein Wave has been observed by direct measurement of wave propagation in plasmas[1]. Now we have conducted helicon wave experiments in the Mini-RT device, since helicon wave might be an attractive candidate to produce higher density plasmas in the low magnetic field devices. Compared with other linear and torus devices, the Mini-RT has slightly unique characteristics; i.e., the magnetic field by the dipole configuration has a steeper gradient, plasma radius is relatively large (a = 15 ~ 20 cm) and a filling pressure is limited at low level (0.01 ~ 0.05 Pa). In addition, only a saddle type antenna can be installed at the outer surface of the plasma column. The mode conversion condition to Trivelpiece-Gould wave from helicon one is calculated with the FDTD code. At present, preliminary experimental results show that the plasma density of less than 10^{16} m^{-3} has been achieved in the Mini-RT device.

Since the steep gradient configuration of the magnetic field in the Mini-RT device is quite different from other devices, a new linear device Mini-RT/L with a divergent magnetic field has been fabricated, in order to study excitation, propagation and absorption of the helicon wave in the steep magnetic field gradient configuration. In the Mini-RT/L experiments, as the helicon wave power is increased up to 3 kW, the plasma density of 4×10^{17} m^{-3} has been achieved. As the magnetic field has been raised, the plasma density has become the maximum value around 40 G. This characteristics seems to be similar to that observed by F.F. Chen[2]. Since the wave index is calculated to be 10 ~ 30 m^{-1}, the corresponding phase velocity is roughly equal to the thermal velocity of electron with the temperature of a few tens eV. This would suggest the possibility of Landau damping of the helicon wave.

[1] K. Uchijima, T. Takemoto, J. Morikawa and Y. Ogawa, Plasma Phys. Contr. Fusion, **57**, 065003 (12pp) (2015).

[2] F.F.Chen, et.al., Plasma Phys. Contr. Fusion, **39**, A411-A420 (1997).