§15. Electron Heating and Plasma Production by Whistler waves in Low Toroidal Field

Shoji, T. (Dept. Energy Eng. and Sci. Nagoya Univ.), Suzuki, C., Takeuchi, M., Ikeda, R., Toi, K.

Introduction

Whistler wave discharges (WD) in MHz range of frequency studied in CHS ([1]-[3]) have the notable feature of producing plasmas in a low magnetic field strengths of kG range, which is important in the high beta and some Alfven wave related studies of helical systems. We measured the wave magnetic field to study WD in helical system.

Electron temperature and density profiles

Rf (9MHz, 10ms) and microwave (2.45GHz, 200ms) powers of 500kW and 30kW are used, respectively. The microwave heating is used to assists WD. In Fig. 1, dependences of electron density n_e and temperature and T_e measured by Languir probe on toroidal magnetic field (Bt) is shown. The probe position is at radius ρ=0.7 which is normalized by the radius of outmost closed flux surface. It is observed that n_e peaks around Bt~500G which is differ from the electron cyclotron resonance (Bt=875G) for 2.45GHz and Te is higher for lower Bt. This density exceeds more than 10 times larger than the density cut-off for the microwave.

The relation between n_e and Bt for toroidal eigen modes (mode number N) of Whistlaer waves is shown in Fig. 2. The n_e on Bt curve obtain in the experiment are also shown in the figure. It is conjectured that N=1 and >1 eigen modes corresponding to the density in Bt~800G and <800G are excited.

The dependence of wave magnetic fields measured by the magnetic probe located at #5 port (inside the torus) on Bt is shown in Fig. 3. The results indicate that the wave fields are lager at Bt~1000G and smaller at Bt~500G which are correspond to the eigen modes N=1 and 2-4, respectively. The comparison of Bt dependence on the density with the antena loading calculation is now under way.

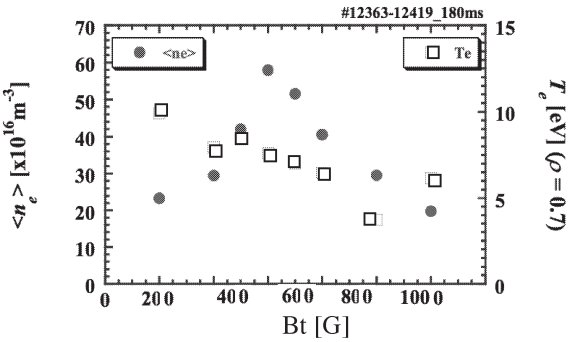

Fig.1 Averaged electron density and electron temperature versus troidal magnetic field strength Bt at ρ=0.7

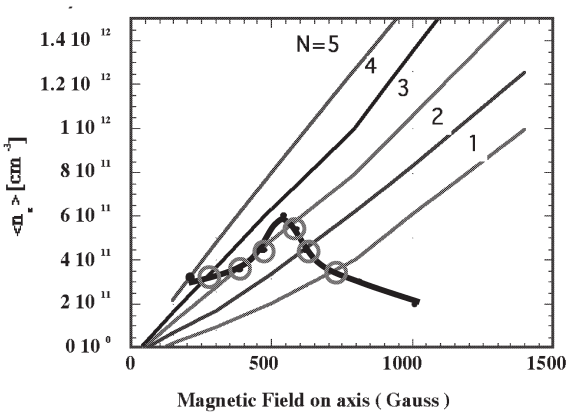

Fig. 2 Relation between plasma density and Bt for troidal eigen modes of Whistler wave. N is the troidal mode number of eigen modes.

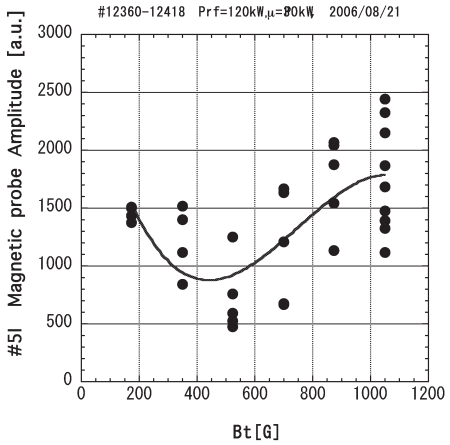

Fig.3 Wave magnetic fields measured by magnetic probe (#5I) versus Bt.

References

1) Shoji, T, Sakawa, Y, Suzuki. C., Matsunaga, G., Toi, K. Ann. Rev, NIFS, (2003) 283

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3) Shoji, T, Sakawa, Y, Suzuki. C., Takeuchi, M., Ikeda. R, Toi, K. Ann. Rev, NIFS, (2005) 296