§24. Plan of Comparison Studies of Over-dense Plasmas Produced by 2.45 GHz Microwaves in CHS and Heliotron J

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In the Compact Helical system (CHS), over-dense plasmas were routinely obtained by injection of 2.45GHz electron cyclotron waves at very low toroidal field B_t (from 120 % to 20 % of B_{res}(=875G)). The ECH power was launched with two different scenarios: one was perpendicular injection of X-mode for the toroidal field, and the other oblique injection of O-mode, as shown in Fig.1. In Fig.1, the location of the fundamental electron cyclotron resonance layer is shown with a thick (red) curve passes through the magnetic axis, where B_t=B_{res}. Each ECH system launched the power up to 20 kW with 2 s duration. Hydrogen, helium and neon were used as working gas. Dependence of obtained line averaged electron density $<n_e>$ on the toroidal field strength is shown in Fig.2. The value of $<n_e>$ clearly exceeds the O-mode cutoff density by a factor to 1 to 10 [1]. Radial profiles of electron density and electron temperature were measured with a movable triple Langmuir probe. Experimentally obtained deposition profiles of ECH power were concentrated in the core region beyond the O-mode cut-off layer. These over-dense plasmas are though to be produced by electron Bernstein waves (EBWs) converted from the launched electron cyclotron waves. Peak electron temperature was in the range from 10 eV to 35 eV. These plasmas provided an opportunity to study plasma transport and electrostatic fluctuations.

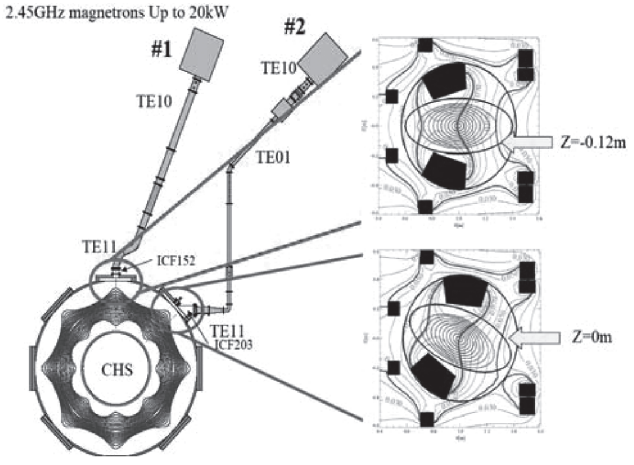

Fig. 1 Plan view of CHS where two ECH systems are installed. The fundamental electron cyclotron resonance layer is shown in the cross-section at two ECH launching ports.

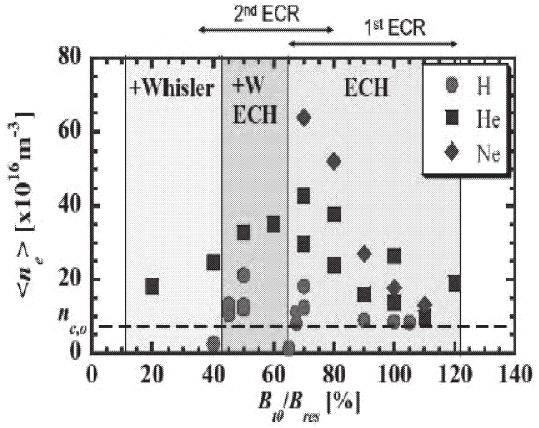

Fig. 2 Dependence of the line averaged-electron density on the toroidal field strength normalized by the resonance field of 2.45GHz ECH (=875G).

In order to extend these experimental researches on EBW and plasma turbulence to a different type of helical system, that is, Heliotron J (H-J), we have investigated the possibility from a point of view of vacuum port access and operation scenario of H-J device. Perpendicular launching of 2.45 GHz ECH power is thought to be possible from port availability. In the experiment using 2.45GHz ECH system, the toroidal magnetic field will be adjusted less than 1 kG. For the range of B_t from 500G to 1 kG, a flywheel generator is needed. On the other hand, experiment less than 500 G will be preferable to get sufficient machine time of H-J, because the toroidal field coils can be fed from a commercial power line. According to experiences in CHS, large ECH power more than 30 kW or another RF such as whistler waves is necessary to produce over-dense plasmas at thus low field less than 500G.

Reference

[1] R. Ikeda et al., J. Korean Phy. Soc. **49**(2006) S206-S210.