§7. Optimization of EC Heating Location for N-ITB Formation of EC Heated NBI Plasma

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The N-ITB formation dependence on the location of the EC heating resonance zone has been investigated. The CHS is equipped with two neutral beam heating (NBI) systems (maximum power of each NBI is $\sim 1MW$) and two gyrotrons (53GHz, 106GHz). The electron and ion temperature were measured with multipoint YAG laser Thomson scattering system and charge exchange spectroscopy (CXS), respectively. The data of the CXS measurement are averaged during 20 ms.

The target plasma that is produced by short first pulse of 53 GHz gyrotron ($P_{inj} \sim 135kW$) is sustained by NBI heating ($P_{inj} \sim 620kW$). The magnetic axis is located at 92.1 cm. When second pulse of the same 53 GHz gyrotron injects into the NBI plasma (resonance zone is exactly located at the plasma center), the steep electron and ion temperature gradient are created, which indicate the formation of the N-ITB. On the temperature gradient region, the electron and ion thermal diffusivities are dropped by the $E \times B$ shear. The detailed characteristics of the N-ITB are discussed in the references [1]. The shift of the resonance zone is caused by the change of the magnetic field strength and the location of the focus of EC heating.

Figure 1 shows the achieved central electron and ion temperatures for the various resonance location. For the comparison, the results without the second ECH pulse are also plotted. The electron densities of the whole data ($2 - 4 \times 10^{12} cm^{-3}$) remain below the threshold density of the N-ITB formation [1]. The remarkable increases of the electron and ion temperatures have been observed when the plasma is heated around the magnetic axis ($-2cm < R_{resonance} < 2cm$), then the steep

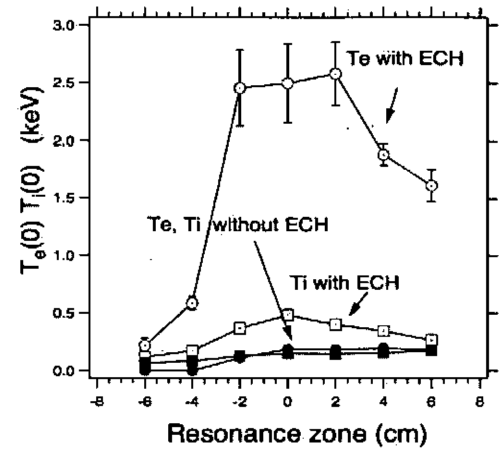

Fig. 1: **Achieved central electron and ion temperatures as a function of location of the resonance zone. Open circles and squares denote the electron and ion temperature with ECH, respectively. Closed circles and squares denote the electron and ion temperature without ECH, respectively.**

temperature gradient is also created at $\rho \sim 0.4$. The area is narrower than the region of the N-ITB ($-10cm < R_{N-ITB} < 10cm$). When the plasma is heated at the outer region than the above region ($2cm < R_{resonance}$), the increase of the temperature is small and the formation of the electron temperature gradient is unclear. This is because the shape of the electron temperature profile is broad compared to that in the central heating. Both electron and ion temperatures almost remain same level for the variation of the resonance zone without second EC heating. These results suggest that the transition from the ion to the electron root does not occur due to the low electron temperature. The temperatures are very low and the temperature gradient is unclear when the resonance zone located in the inner region ($R_{resonance} < -2cm$), because the plasma is heavily contaminated by sputtering from the inner wall due to the high energy electrons, because the resonance zone is close to the wall.

References

[1] T.Minami, et.al. .Nuclear Fusion, volume 44, issue 2, p. 342 - 349.