§ 8. Influence of Beam Direction on the Electron Transport in Low Density LHD Discharges

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In the low density (n $<1.5\times10^{19}m^{-3}$) ctr-beam heated inward shifted (Rax=3.5m) discharges, core flattening of the electron temperature profile occurs (Fig.1), deviating significantly from the normal profile in LHD, parabolic profile. Flattening is localized in the core region within the $\iota/2\pi$ = 1/2 surface. With increasing ECH power, a small bump starts to appear in the center as shown in Fig.1. With ECH power above a threshold, a narrow ITB (with high ∇T for ρ < 0.2) grows rapidly. The power threshold for ITB increases with n.

Core heat transport in the low density co-beam heated discharges is quite different from that of ctr-beam case. Core flattening does not occur. With added ECH power, a mild jump in ∇T appears at $\rho\sim0.5$. With higher co beam power, core profile flattening occurs ($0<\rho<0.3$). But temperature in the whole region increases and the mild jump disappears (Fig. 2).

The present LHD data show that the profile shape ($\nabla T/T$) in the core region ($0< \rho < 0.4$) varies, exhibiting core flattening and ITB. However, we have not observed any significant change in the profile shape in the outer region ($0.5 < \rho < 1$), an important region in determining the global energy confinement. In Fig. 3, Te(ρ = 0.5) and Te(ρ = 0.8) are plotted as a function of input power for co beam heating dominated discharges. In this scan, the line average densities are almost fixed around $n\sim1.0\times10^{19}m^{-3}$. The ratios of these temperatures are nearly constant (~2), independent of the power and beam direction. Temperatures increase reasonably well with input power and are a factor of 1.5-2 times higher than those in the ctr case, where a fairly severe saturation of Te with input power. This distinct difference is not due to iota change, caused by the beam driven plasma current since the electron temperature profile is insensitive to variation in plasma current. The observed burst of the magnetic fluctuations, shown in Fig. 4 may be responsible for it. The frequency of the modes is around 50 kHz and the mode numbers are m=1,2 and n=1. For high ctr power, amplitude of magnetic fluctuations and frequency of the burst are high, accompanying drops of the electron temperature. They are also substantially lower for co-beam heating case.

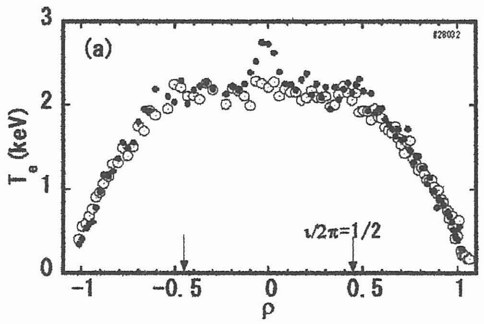

Fig. 1 Electron temperature profiles (n = $1.35 \times 10^{19}m^{-3}$) (o) with core flattening (P_{ECH}=0.0MW, $P_{NBI(ctr)}$= 3.6MW),(•)with bump(P_{ECH}=0.3MW,$P_{NBI(ctr)}$=3.6MW),

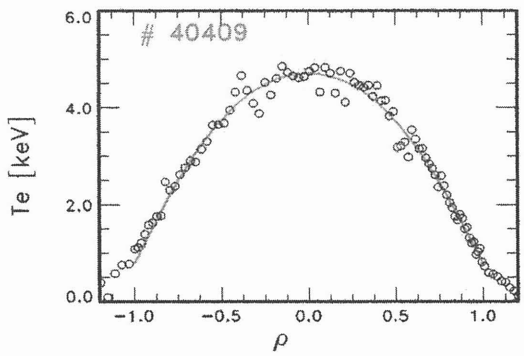

Fig. 2 Temperature profile in the co-beam heated Discharge(6MW).

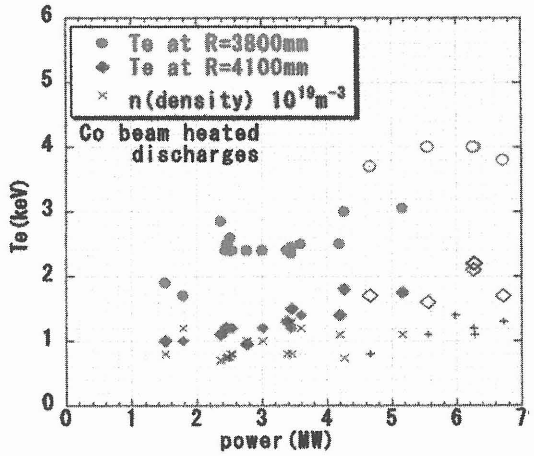

Fig.3 Electron temperatures at R = 3800mm (ρ=0.5) and at R = 4100mm (ρ=0.8) are plotted as a function of input power for Co beam heated heated discharges (Rax=3.5m configuration). Neon doped discharges are indicated by (o ◊).

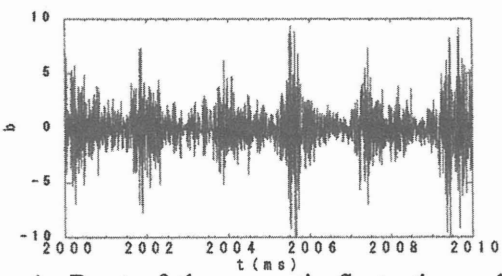

Fig. 4 Burst of the magnetic fluctuations which appear during the ctr beam heated discharges.