§2. Transport Analysis of Hight Ion Temperature Mode in CHS

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The high ion temperature mode (HIT mode) for neutral beam heated plasma is observed in CHS. We analyze transport characteristics of this mode with the profile analysis code PROCTR-MOD.

There is a problem whether the increase in the ion temperature is due to the increase in the deposited power of the neutral beam or due to the improvement of the ion transport.

Fig.1 shows calculated deposited power as a function of the central density. In these experiments, the NBI power mainly deposits in the central region. The deposited power at ρ=0.1 represents the behavior of the total deposited power. As shown in Fig.1 (a), the deposited power to the ions in HIT mode is almost the same as that in L mode in the central region. The difference of the power deposition near the edge is negligible. In the case of this experiment, the beam power is mainly transferred to the electrons. The depositied power to the electrons in the HIT mode is larger than that in the L mode and increases as the density increases, as shown in Fig.1 (b), since the electron temperature in the HIT mode is lower than that in the L mode. However, because the differences of the temperature between the ion and the electron are small in the HIT mode, the energy transferred from the electrons to the ions is small in comparison with the deposited power. Therefore, it is difficult to explain the increase in the ion temperature of the HIT mode by the increase in the deposited power. Fig.2 (a) shows comparison of the calculated ion thermal diffusivities at ρ=0.5 for the L mode and the HIT mode as a function of the central density. The density dependence of the thermal diffusivity is similar in almost whole regon of the plasma. The diffusivity of the HIT mode is reduced in comparison with the L mode. The increase in the ion temperature in the HIT mode is mainly due to the improvement of the ion transport.

On the other hand, although the deposited power to the electrons increases, the electron temperature in the HIT mode is lower than that in the L mode. The calculated electron thermal diffusivity of the HIT mode is increased in comparison with the L mode as shown in Fig.2 (b). Therefore, the improvement of the energy confinement by the reduced ion thermal diffusivity was cancelled by the degradation of the electron confinement.

The code of the NBI deposition in the PROCTR-MOD is developed for the large density (>$2x10^{13}cm^{-3}$). There may be a little error of the calculation in the low density case (especially <$1x10^{13}cm^{-3}$). It is necessary to give careful consideration to the discussion about the density dependence. We have to further improve the accuracy of the calculation for the low density.

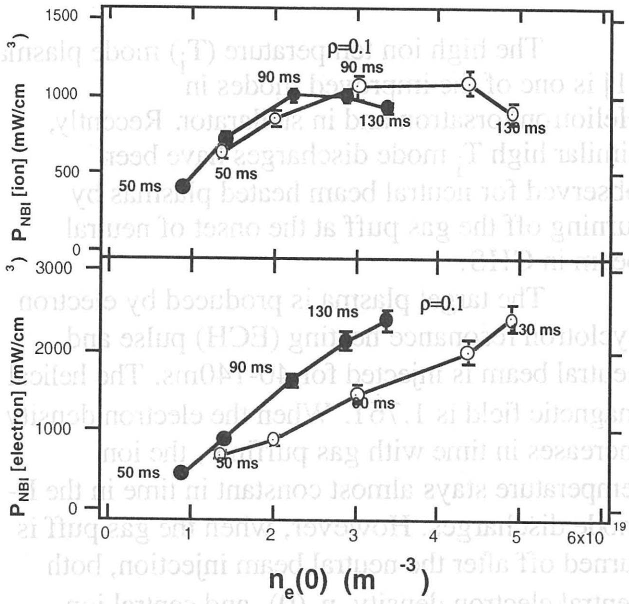

Fig. 1 (a) Power deposition of the neutral beam to ions as a function of the central electron density, (b) to electrons at ρ=0.1 The data are plotted every 20 ms.

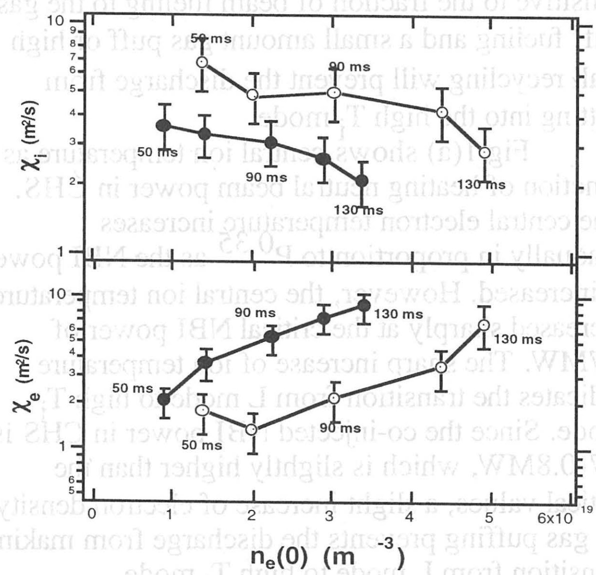

Fig. 2 (a) Ion thermal diffusivity as a function of the central electron density, (b) electron thermal diffusivity at ρ=0.5. The data are plotted every 20 ms.

Reference

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