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# Heat transport Analysis Based on Ion Temperature Profile in High Intense Gas Puffing Experiment on Heliotron J

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The Heliotron J device achieves a peak density profile using a high-intensity gas puffing (HIGP) method. By controlling the pulse width and the intensity of HIGP, the peaked density profile was controlled from 2.0 to 3.5 $\times 10^{19}$m$^{-3}$ with different core densities.

In previous work [1], we compared the heat transport coefficient $\chi$ of the HIGP plasma with a peaked density profile, with that of a conventional gas puffing (GP) plasma with a flat density profile. The peaked density profile case found a low heat transport coefficient at the core region.

In this study, 4 sets of HIGP discharges with different densities were compared to investigate the density dependence of the heat transport: the core density of $3.5\times10^{19}$m$^{-3}$ (case A), $3.0\times10^{19}$m$^{-3}$ (case B), $2.5\times10^{19}$m$^{-3}$ (case C): and $2.0\times10^{19}$m$^{-3}$ (case D). The density profiles are shown in figure 1. As shown in figure 2, the electron and ion temperatures for the four cases are similar, and the maximum temperature difference at the same position is no more than 20eV.

The heat transport coefficient for the four cases was calculated based on the FIT3D code [2] and the TR-SNAP code [3]. The result of the analysis is shown in figure 3. The electron heat transport coefficient decreases as the density increases in the range of 2.5~$3.5\times10^{19}$m$^{-3}$. At the range of r/a = 0.0~0.6, the difference between case C and case D is not so obvious, which's core density is $2.5\times10^{19}$m$^{-3}$ and $2.0\times10^{19}$m$^{-3}$. The ion heat transport coefficient does not change much in the density range of 2.5~$3.5\times10^{19}$m$^{-3}$. However, when the core density is $2.0\times10^{19}$m$^{-3}$, the ion heat transport coefficient is higher than the three other cases at the region r/a = 0.15~0.66.

In conclusion, the electron heat transport coefficient will decrease while the density increases when the density varies from 2.5 to $3.5\times10^{19}$m$^{-3}$. On the other hand, the ion heat transport coefficient is not so sensitive to the variation of density, although we observed some small decreases while the density increased.

## Reference

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[3] R Seki et al. *Plasma and Fusion Research* 62402081 (2011)

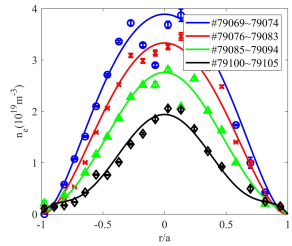


**Figure 1.** Density profiles of the 4 cases.

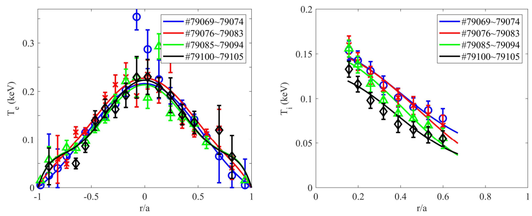


**Figure 2.** Left: electron temperature of the 4 cases; Right: ion temperature of the 4 cases.

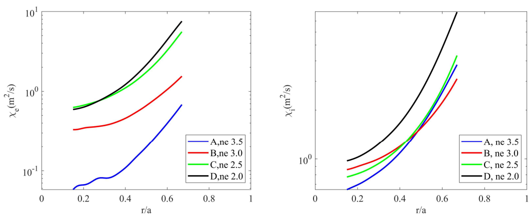


**Figure 3.** Left: electron heat transport coefficient; Right: ion temperature heat transport coefficient.