Analysis of Ion Temperature in High Intense Gas Puffing Experiment on Heliotron J

CY. Wang[1], S. Kobayashi[2], K. Nagasaki[2], DC. Qiu[1], MY. Luo[1], R. Fukushima[1], PF. Zhang[1], K.Y. Watanabe[3], R. Seki[3], R. Matoike[1], A. Miyashita, [1] Y. Kondo[1], K. Inoshita[1], T. Minami[2], S. Kado[2], S. Ohshima[2], S. Konoshima[2], T. Mizzuchi[2], H. Okada[2]

[1]*Graduate School of Energy Science, Kyoto University, 611-0011 Uji, Kyoto, Japan*

[2]*Institute of Advanced Energy, Kyoto University, 611-011 Uji, Kyoto, Japan*

[3]*National Institute for Fusion Science, 509-5292 Toki City, Gifu, Japan*

A fueling method named high intense gas puffing (HIGP) has been applied to obtain high-performance plasmas on the Heliotron J helical device. The fueling method puffs deuterium gas in a short period (~10-20ms) with high intensity. The electron density reached up to $6\times10^{19}m^{-3}$, depending on the HIGP intensity, with a steep density gradient at the peripheral region[1]. With a moderate HIGP, the improvement of core ion temperature T_i has been observed in NBI plasmas. Besides, the electron density profile is more peaked at the peak density of $2.5\text{-}3.5\times10^{19}m^{-3}$, and the electron temperature profile was also peaked. We studied the ion temperature profile measured with a charge exchange recombination spectrum (CXRS) system equipped on Heliotron J [2,3]. We compared the T_i profile to that obtained in a conventional gas puffing (GP) with a similar electron density. The plasma was initiated by electron cyclotron heating first and then heated by neutral beam injection (NBI).

Several differences in T_i between the HIGP and GP cases were observed. The T_i profile is improved after HIGP turn-off compared with GP case. After HIGP turn-off, T_i increased in a rather high rate while the increase was suppressed when HIGP was operating. We observed that the relation between T_i and n_e was also different. In the HIGP case, when n_e starts to decrease, T_i is kept increasing for about 10 ms. We also observed that shape of T_i profile and NBI absorption profile was related to the shape of n_e profile. A similar relationship was also observed between T_e and n_e profiles. These phenomena suggest that HIGP may improve the ion heat transport in the core plasma with a peaked n_e profile. In a further study, we will do the heat transport analysis.

Reference

[1] S. Kobayashi, et al., *Proc 26th IAEA Fusion Energy Conference*, EX/P8-17, (2016).

[2] HY. Lee, et al., *Plasma Phys. And Controlled Fusion* **55** 035012(2013).

[3] XX. Lu, et al., *Plasma and Fusion Research* **13** 1202077(2018).