Study of SMBI fueling in GAMMA 10 based on experiment and Monte-Carlo simulation

M. M. ISLAM[1], Y. NAKASHIMA[1], S. KOBAYASHI[2], N. NISHINO[3], K. HOSOI[1], K. ICHIMURA[1], M. S. ISLAM[1], K. SHIMIZU[1], K. FUKUI[1], M. OHUCHI[1], A. TERAKADO[1], M. YOSHIKAWA[1], J. KOHAGURA[1], M. HIRATA[1], R. IKEZOE[1], X. WANG[1], M. ICHIMURA[1], M. SAKAMOTO[1] and T. IMAI[1]

[1]Plasma research center, University of Tsukuba Tsukuba, Ibaraki 305-8577, Japan

[2]Institute of Advanced Energy, Kyoto University, Gokasyo, Uji 611-0011, Japan

[3]Grauate school of Engineering, Hiroshima University, Hiroshima 739-8527, Japan

Email address: maidul@prc.tsukuba.ac.jp

Fueling is an important issues for future thermonuclear fusion reactors,. Fueling control enables the profile control of the core plasma density and reduction in neutral particles in the peripheral area. Supersonic molecular beam injection (SMBI) developed by L. Yao et al. [1], is suitable for future ITER-like tokamaks as well as small or medium device like GAMMA 10. SMBI is economical to develop and to maintain. SMBI gives high-speed and high-directive gas injection because of higher plenum pressure compared to the conventional gas puffing and it can inject neutral particles deeper into the core plasma.

GAMMA 10 is the world largest tandem mirror and is an open magnetic plasma-confining device. GAMMA 10 has many observation ports at the central-cell. Thus, the central-cell is suitable for analyzing the plasma behavior during SMBI. SMBI port is located at the bottom of the central-cell mid-plane. In the experiment, using laval nozzle SMBI pulses were injected into the typical plasmas heated by only ICRF. The results of SMBI experiment with plenum pressure from 0.3 MPa to 2.0 MPa were obtained. The distribution of the emission intensity during SMBI was investigated by the 2-dimensional image captured by the fast camera as an index of the neutral transport. The experimental results indicates that the effect of the laval nozzle reduces the dispersion of injected hydrogen molecules in the peripheral region. The FWHM value decreases with increasing the SMBI plenum pressure. However, the FWHM is saturated with plenum pressure in the range more than 1.0 MPa. It implies that the directivity of particle was suppressed by the collision between neutral particles in the case of higher plenum pressure.

Monte-Carlo code (DEGAS) has been used to numerically calculate the neutral density coupling with the measurement of Hα emission detector in GAMMA 10 [2, 3]. The simulation results have been roughly reproduced the experimental results. Detail will be presented in the workshop.

[1] L. Yao et al., Nucl. Fusion **47**, 1399 (2007).

[2] Y. Nakashima, et al. J. Nucl. Mater. **196-198**, 493 (1992).

[3] K. Hosoi, et al., J. Trans. Fusion Sci. Tech. **63**, 244(2013).