§51. Neutral Particle Transport in Steady-state Torus Plasmas

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It is an important subject to investigate the behavior of neutral particles in order to evaluate the particle and energy confinement properties in the plasmas. Particularly in long duration and steady-state plasmas, the neutral behavior is though to contain much interesting feature, since the time constant of plasma-wall interactions has longer characteristic time than other time constants such as particle and energy confinement times [1]. In this study, a neutral transport simulation code is applied to TRIAM-1M tokamak, which produces long duration plasmas, in order to estimate the spatial profile of neutral density and neutral temperature in the plasma. The final goal of this study is a comprehensive understanding of the significant behavior of neutral particles in steady-state torus plasmas.

In TRIAM-1M, totally 14 Hα line-emission detectors are install and detailed spatial profiles of Hα line intensity has been measured and neutral particle behavior was investigated from the neutral transport simulation with the DEGAS Monte-Carlo code [2, 3]. In the previous research, the measured spatial profile of the Hα intensity was compared with the Monte-Carlo simulation. From the simulation results, the toroidal profile of Hα intensity is strongly affected by the geometrical structure of plasma and wall. Based on the above results, fully three-dimensional neutral transport simulation has been started.

Figure 1 shows the full 3-dimensional mesh model used in the DEGAS simulation. In this cylindrical geometry, a plasma column and scrape-off layer (SOL) region surrounding the plasma is defined in the same way as the previous mesh model. A neutral particle source is given near the midplane of the cylinder (z = 110 cm) and gas is injected in horizontal direction. In Fig. 2, the simulation results of atomic and molecular hydrogen density are shown along the toroidal direction (Z-axis) As shown in the upper figure, hydrogen molecules are strongly localized near the gas puff. On the other hand, atomic hydrogen is axially and azimuthally transported easily.

Figure 3 shows the cross-section view of the Hα emissivity calculated from DEGAS. It is found that a significant difference is clearly revealed between the core and edge regions Based on these results, more detailed and realistic simulation using DEGAS simulation will be performed in near future.

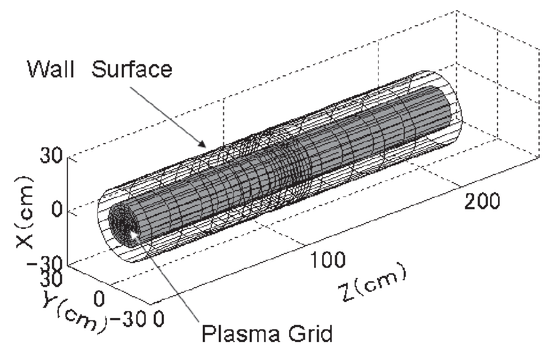

Fig. 1 Full 3-D cylindrical mesh model used in the simulation.

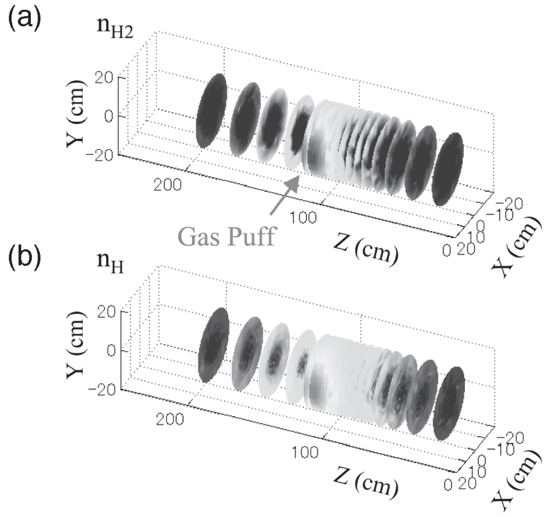

Fig. 2. Predicted atomic (a) and molecular (b) hydrogen density obtained by the DEGAS simulation.

Reference
1) Sakamoto, M. *et al.*, Nucl. Fusion. **44** (2004) 639.
2) Heifetz, D. *et al.*, J. Comput. Phys. **46** (1982) 309.
3) Nakashima, Y. *et al.* J. Nucl. Mater. **196-198** (1992) 493.
4) Zushi, H., Rajendraprasad, B., *et al.*, Proc. of 33rd EPS Conference (Rome)
5) Sakamoto, M., Ogawa, M., *et al.*, Proc. of 21st Fusion Energy Conference (Chengdu) EX/P4-25

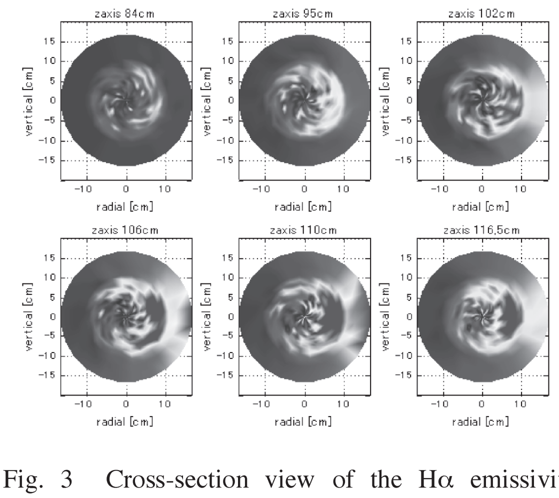

Fig. 3 Cross-section view of the Hα emissivity calculated from DEGAS.