

§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 thought 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 times¹⁾. 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 H α line-emission detectors are installed and detailed spatial profiles of H α 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 H α intensity was compared with the Monte-Carlo simulation. From the simulation results, the toroidal profile of H α 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

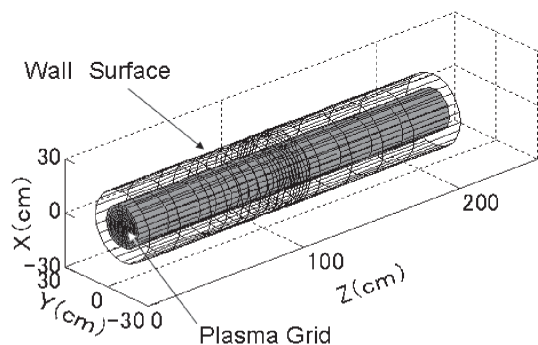


Fig. 1 Full 3-D cylindrical mesh model used in the simulation.

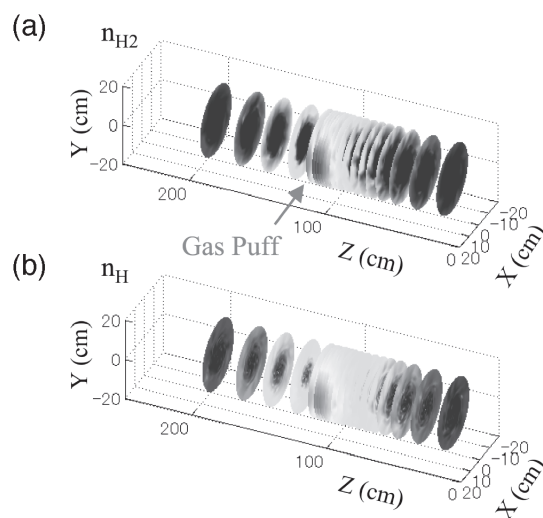


Fig. 2. Predicted atomic (a) and molecular (b) hydrogen density obtained by the DEGAS simulation.

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 H α 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.

Reference

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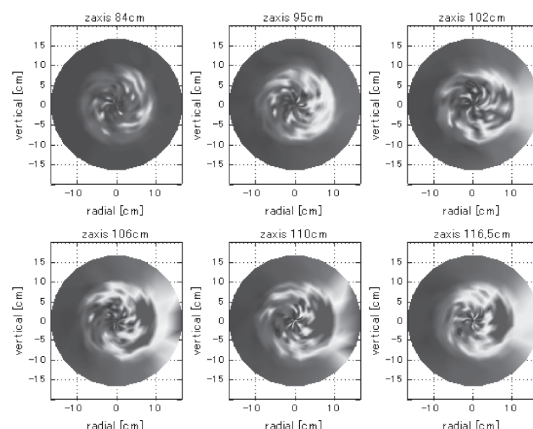


Fig. 3 Cross-section view of the H α emissivity calculated from DEGAS.