§19. Study of Dα Line-Emission Spectroscopy and Edge Neutral Transport in Non-Axisymmetric System

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In magnetically confining plasma devices, investigation of neutral transport is an important subject for understanding edge plasma behavior and for the estimation of particle confinement characteristics. In non-axisymmetric plasmas, such as helical devices, the analysis of neutral transport becomes complex due to the three-dimensional configuration of the system. The objective of this study is focused on the neutral transport in the above three-dimensional non-axisymmetric plasma and leads to the understanding of its edge plasma and the plasma-wall interactions with such plasmas. In this research, a fully three-dimensional Monte-Carlo simulation code DEGAS[1, 2] is applied to Heliotron-J device[3, 4], which utilizes a helical-axis heliotron configuration and examine the neutral particle behavior in a carbon-target experiment of Heliotron-J.

Figure 1 shows the mesh model of Heliotron-J vacuum vessel and the carbon-target for DEGAS Monte-Carlo simulation. The mesh is divided into 15 segments in radial direction and 28 segments in poloidal direction of plasma cross-section. In order to investigate the precise behavior of neutral particles near the carbon target, the toroidal divided number is doubled (256 to 512), which improves the spatial resolution of Dα image reproduced on the carbon target. By using the above mesh model, direct comparison between 2-D image from the high-speed camera and the simulation.

Three-dimensional simulation has been performed using the above mesh. Figure 2 shows the simulation results near the carbon target. In this simulation, the intensity profile of the particle source (normal) is modified as shown in Fig. 2(a) so as to reproduce the measured Dα emission image based on the measured Dα emission measured with the CCD camera.

Figure 2(b) shows the result of Dα emissivity calculated from the predicted atomic and molecular hydrogen density by using 3-D DEGAS simulation together with the given plasma parameters (n_e, T_e, T_i).

From the above results, a basis for the analysis of neutral particle behavior in non-axisymmetric system is established using 3-dimensional Monte-Carlo simulation.

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4) S. Kobayashi *et al.*, 11th IAEA Technical Meeting on H-mode and Transport Barriers, 26-28 September 2007, Tsukuba International Congress Center "EPOCAL", Tsukuba, Japan , P4-03.
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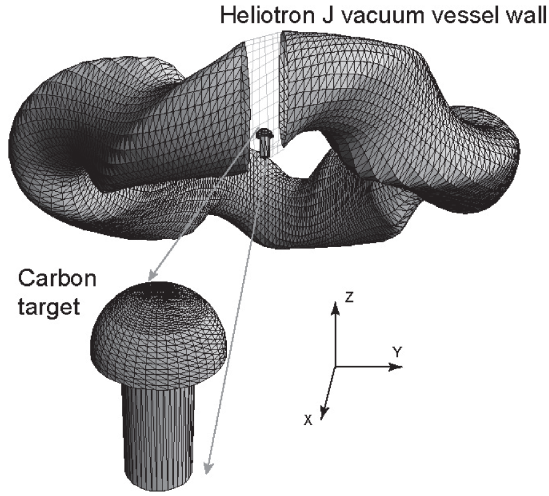

Fig. 1 Improved mesh model of Heliotron-J vacuum vessel and the carbon target

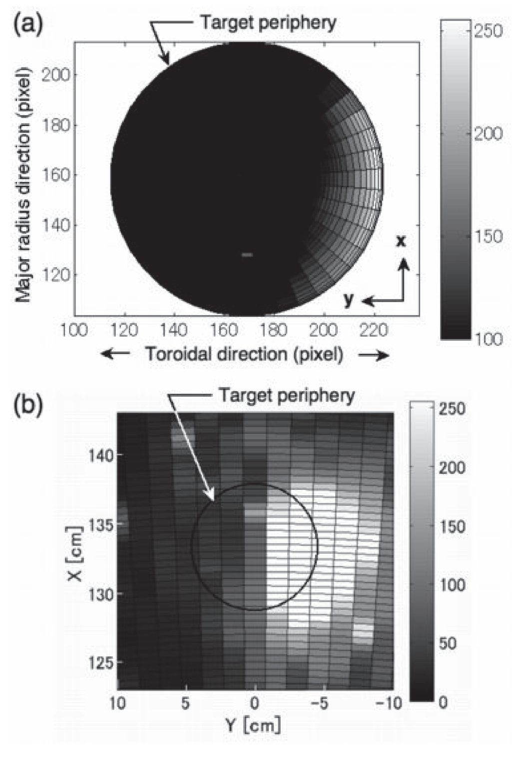

Fig.2 (a) 3-dimensional simulation results by using DEGAS code. (a) Particle source distribution. (b) 2-D image of predicted the Dα emissivity