§23. Study on Neutral Particle Transport in Non-Axisymmetric Helical Plasmas

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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 schematic view of the plasma cross-section and the carbon-target. The material of the target is CFC and an electrostatic probe is installed on the top of the target. In a 70 GHz second-harmonic electron cyclotron heating (ECH) plasma, a number of measurements such as two-dimensional image measurement with a camera and high time-resolving Dα line-emission profile detector and spectroscopic measurements were carried out under the condition of changing the insertion length of the carbon-target. In this experiment, the target was inserted from 15 mm outside of the outer-most magnetic surface (-15 mm) to 10 mm inside of the surface (+10 mm).

Figure 2(a) shows the 2-D image of the target obtained with the camera in the case of the insertion length of +10 mm. A strong light emission area is observed in the left side of the target except for its top. In this viewing angle, the magnetic surface is raised up from the left to the right of this figure. Therefore the contact between the carbon-target and the plasma is concentrated on the left side. Such localization of light emission shown in Fig.2(a) is thought to be ascribed to the above geometrical reason.

Figure 3 shows the preliminary mesh model for the DEGAS simulation of the carbon-target experiment. At present improvement of the mesh is in progress.

Reference

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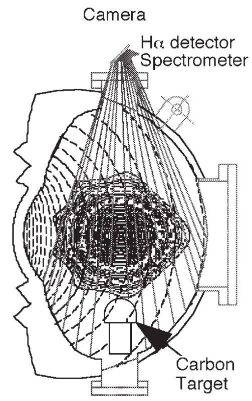

Fig. 1 Schematic view of Heliotron-J cross-section and the carbon target

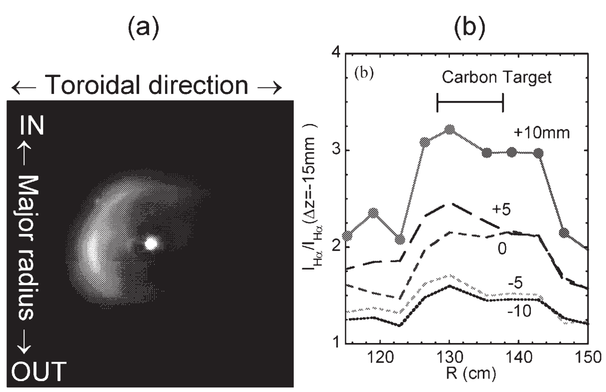

Fig.2 (a) 2-dimensional image of Hα, Dα line-emission, (b) profile of the intensity ratio in different insertion length of the carbon limiter.

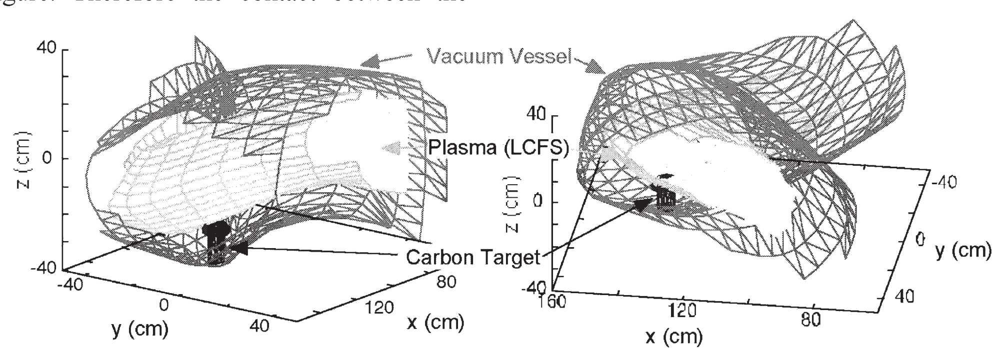

Fig.3 Plasma mesh model simulating the carbon-target experiment used in DEGAS Monte-Carlo simulation.