§8. A Study of Divertor Simulation Using Open Magnetic Field Configuration

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As a future research plan of Plasma Research Center, University of Tsukuba, making use of the advantage of open magnetic field configuration, we are planning to start a study of divertor simulation under the closely resemble to actual fusion plasma circumstances and to directly contribute the solution for realizing the divertor in ITER. In a large tandem mirror device GAMMA 10, a number of plasma production/heating systems with the same scale of present-day fusion devices, such as radio-frequency (RF) wave, microwave and neutral beam systems have been equipped and high-temperature plasmas have been produced. In this study, the investigation on the characteristics of plasma flow from the end-mirror exit of GAMMA 10 is performed to validate its applicability to the divertor simulation studies.

Figure 1 shows the schematic view of the vacuum vessel and the plasma in the west end-mirror region, together with the location of the diagnostic equipment. In order to perform a simultaneous measurement of heat and particle fluxes from the end-mirror exit, a set of calorimeter and Mach probe was manufactured and inserted from the bottom of the vacuum vessel up to the center axis of GAMMA 10. A high-speed camera was also installed to capture the detailed behavior of the visible emission from the plasma flow from the exit.

In typical hot-ion-mode plasmas (n_{e0} ~2×10^{18} m^{-3}, T_{i0} ~5 keV in the central-cell)[2], measurement of heat and particle fluxes from the end-mirror exit has been carried out. The radial profile of the heat-flux measured with the calorimeter is shown in Fig.2. In the experiment, ICRF wave heating of 0.2 s for plasma production/heating in the central-cell and ECH of 150~300 kW, 0.02~0.025 s in the end-mirror cell are applied to the initial plasma. In the case of only ICRF heating, as shown in the figure, the heat-flux density of 0.6 MW/m^2 was achieved on axis and overlaying of ECH attained the time-averaged heat-flux > 1 MW/m^2 over the diameter range of ~8 cm at the ECH power of 300 kW.

Figure 3 shows the angular dependence of ion-saturation current measured with the directional probe together with that of heat-flux by rotating the diagnostic unit in the case of only RF plasmas. Each result shows the similar dependence, which indicates that the heat source is dominated by ions flowing out of the end-mirror exit.

The above results give a clear prospect for achieving the objectives (20 MW/m^2) for divertor studies by building up heating systems to the end-mirror cell.

1. Y. Nakashima, *et al.*, Proc. 26th Annual Meeting of JSPF (December 1-4, 2009 Kyoto) (2009) 4pE21P.
2. Y. Nakashima, *et al.*, 2nd NIFS-CRC Int. Symp. on Plasma-Surface Interactions (Jan. 18-20, 2010, NIFS) paper No. 7-4.

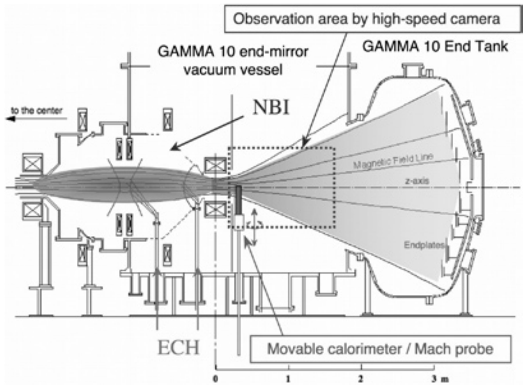

Fig. 1. Fig.1 Schematic view of west end-mirror vacuum vessel and the location of diagnostic equipment.

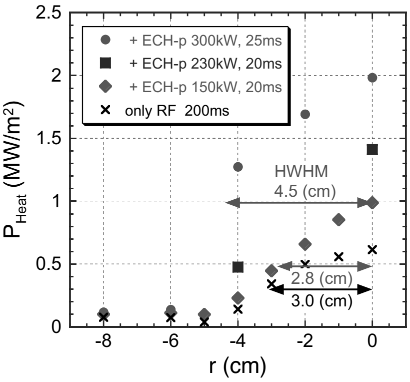

Fig. 2. The radial profile of the heat-flux density measured with the calorimeter obtained in typical hot-ion-mode plasma.

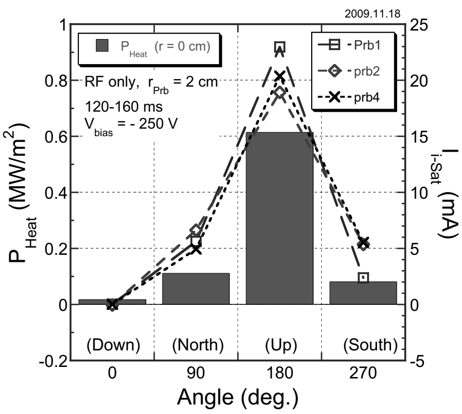

Fig. 3. Angular dependence of ion saturation current and that of heat flux by rotating the diagnostic unit.