§5. 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.

In typical hot-ion-mode plasmas (n_{e0} ~ 2×10^{18} m^{-3}, T_{i0} ~ 5 keV in the central-cell), measurements of heat and particle fluxes from the end-mirror exit have been carried out. In the experiment, ICRF wave heating of 150 kW, 190 ms for plasma production/heating are applied to the initial plasma injected from a plasma gun at east end. Figure 2 shows the angular dependence of ion-flux density measured with the directional probe at z_{EXIT} = 30 cm together with that of heat flux measured with the calorimeter by rotating the diagnostic instrument in the case of only RF plasmas. Each result shows the quite similar dependence, which indicate that the heat source is dominated by ions flowing out of the end-mirror exit.

Figure 3 shows the ECH power dependence on the net heat-flux density in the period of ECH. During 300 kW ECH injection, $P_{Heat}^{net\ ECH}$ is estimated to be 9 MW/m^2. This value almost comes up to the heat load of the divertor plate of ITER, which gives a clear prospect of generating the required heat density for divertor studies by building up heating systems to the end-mirror cell.

1) Y. Nakashima, et al., 19th Int. Conf. Plasma Surface Interactions, May 24-28, 2010, San Diego P1-87.
2) Y. Nakashima, et al., 8th Int. Conf. Open Magnetic Systems for Plasma Confinement, July 5-9, 2010, Novosibirsk.
3) Y. Nakashima, et al., 23rd IAEA Fusion Energy Conference, October 11-16, 2010, Daegeon, Korea FTP/P1-33.

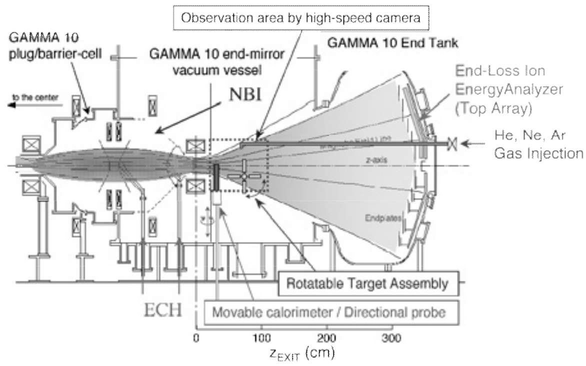

Fig. 1. Fig.1 Schematic view of west end-mirror vacuum vessel and the location of diagnostic equipment.

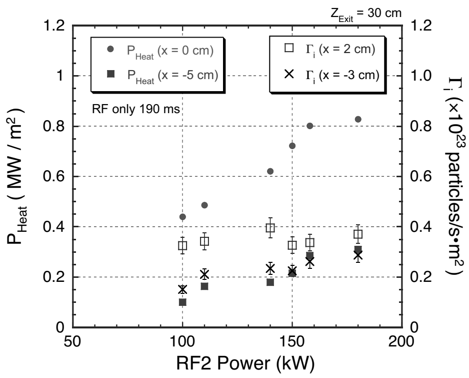

Fig. 2 ICRF power dependence of ion flux and that of heat flux.

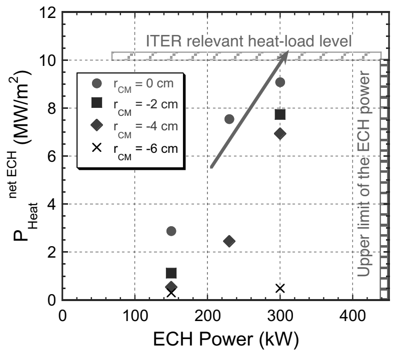

Fig. 3. ECH power dependence on the net heat-flux density during ECH.