§2. Study of Divertor Simulation using Endregion of a Tandem Mirror - Mechanisms of Radiation Cooling Divertor and Plasma Detachment -

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In Plasma Research Center, making best use of open magnetic field configuration in the large tandem mirror device GAMMA 10/PDX, we have started a study of divertor simulation under the closely resemble to actual fusion plasma circumstances and we directly contribute the solution for realizing the divertor in toroidal devices.

The experimental module (D-module) was installed at the exit of west end-mirror of GAMMA 10/PDX and plasma is irradiated onto the V-shaped target in D-module. Experiments for realizing detached plasma state from the high-temperature plasmas have been performed using H_2 and noble gas injection in D-module. Here, the plasma with n_e ~2×10^{18} m^{-3} and $T_{i//}$ ~150 eV was produced at the upstream region (central-cell). (Fig.1)

Figure 2 shows the dependence of the heat flux (P_{heat}) and ion flux measured with the corner detector in D-module on the pressure of three kinds of injected gases (Ar, Ne and N_2). In the case of Ar and N_2, P_{heat} decreases with the pressure and reduces to 20 - 30% of the case without gas injection. In the case of Ne, however, weak dependence on P_{heat} is observed. This result indicates that Ne and Ar have stronger effect on heat and particle reduction than Ne.

Effects of additional plasma heating have been investigated in order to generate high particle flux in the end region. In Fig. 3, the time behavior of plasma parameters is shown. It is found that the particle flux at both ends are remarkably increased with the increase of the line density in the central and anchor cells and that are achieved up to 3.3×10^{23} /m^2 sec by applying the east ECH injection. This results showed the effectiveness of high particle flux generation using additional plasma heating.

The presentations and publications from this collaborative research are listed below:

1. Y. Nakashima, et al., 5th Int. Workshop on Plasma Material Interaction Facilities for Fusion Research (PMIF 2015) (Juelich, October 2015).

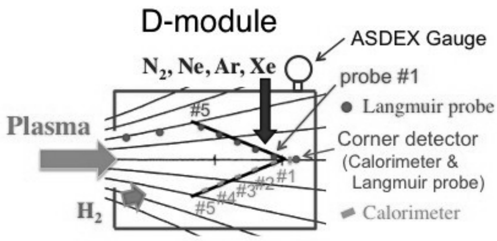

Fig. 1 Schematic view of D-module installed at the GAMMA 10/PDX west end-mirror vacuum and experimental arrangement.

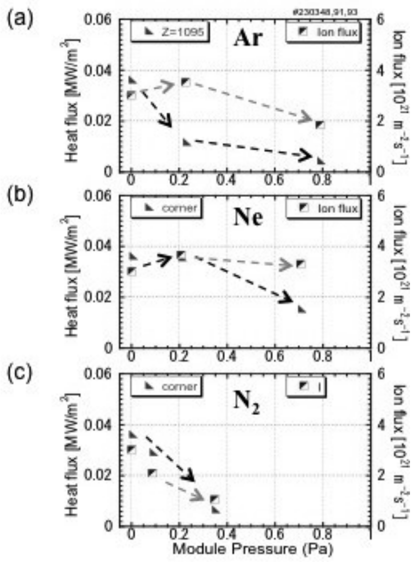

Fig. 2 Dependence of the plasma parameters on plenum pressure of impurity gases (a) Ar, (b) Ne and (c) N_2.

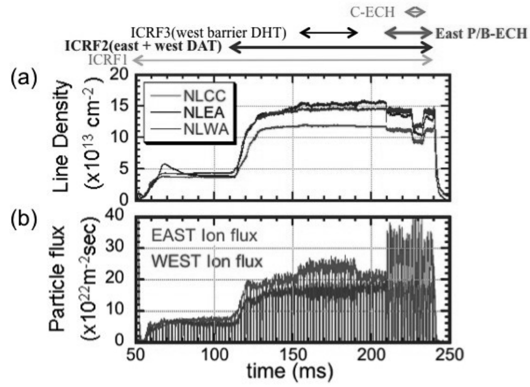

Fig. 3 Time behavior of plasma parameters in the high particle flux generation experiment using additional plasma heating systems. (a) Line density of plasmas in the central-cell (NLCC) and both east and west anchor-cells, (b) ion flux measured with ELIEA.

2. K. Ichimura, et al., ibid.
3. K. Ichimura, et. al., 25th International Toki Conference, (Toki, 2015) P2-16.
4. Y. Nakashima, et al., J. Nucl. Mater **463** (2015) 537-540.
5. Y. Nakashima, et al., Fusion Sci. Technol. **68** No.1, July (2015) 28-35.