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Effect of heating and gas injection on divertor simulation plasma in GAMMA 10/PDX

GAMMA 10/PDXにおける加熱及びガス入射が
ダイバータ模擬プラズマへ及ぼす影響

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Effects of plasma heating at the core on the plasma parameters in the divertor simulation experimental module (D-module) have been studied. It is suggested that in the case of the standard ion cyclotron heating (ICH), additional ICH at the west anchor cell, additional electron cyclotron heating (ECH) at the east plug cell, electron density near the V-shaped target in the D-module varies linearly with electron line density at the west plug cell.

1. Introduction

In GAMMA 10/PDX, divertor simulation experiments have been carried out by using the divertor simulation experimental module (D-module) to understand characteristics of divertor plasma [1-5]. In order to understand divertor simulation plasma physics in various range of parameters such as electron density, temperature, and so on, it is important to control these parameters. To control the parameters, heating at the upstream plasmas is effective, and gas injection into the D-module is also useful. And, understanding of the effect of the heating and the gas injection is important to know characteristics of recombination plasma such as detachment and molecular activated recombination (MAR). In this study, effects of heating and gas injection on divertor simulation plasma parameters have been studied by using mainly Langmuir probe installed at the D-module.

2. Experimental setup

A schematic view of GAMMA 10/PDX and the D-module is shown in Fig.1. GAMMA 10/PDX is a tandem mirror device, which is composed of a central cell, anchor cells, barrier cells, plug cells and end regions. Microwave imaging interferometers are installed in each cell to measure electron line density. The length of the device is 27 m and the volume of the vacuum vessel is 150 m^3. The main plasma is produced and sustained by the standard ion cyclotron heating (ICH) at the central cell and the anchor cells. The core plasma is confined mainly in the central cell. The anchor cells have minimum-B configuration and keep the plasma stable. In the barrier cells, the thermal barrier is formed by electron cyclotron heating (ECH). And in the plug cells, electrostatic potential is formed by ECH. The end loss plasma finally flows into the end regions and the neutralized gas is pumped by the cryopump.

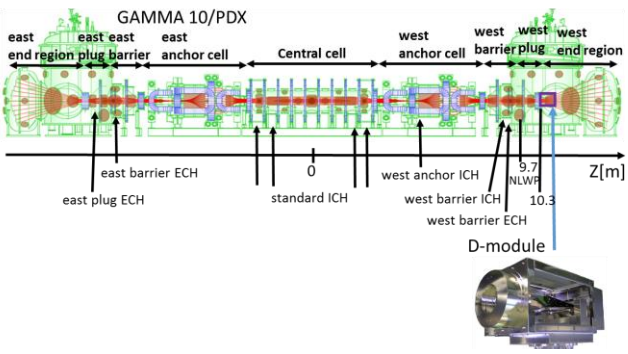

Fig .1 Schematic view of GAMMA10/PDX and the D-module

The D-module is installed in the west end region and it consists of a cuboid box made of stainless steel with an inlet hole and a V-shaped target. Figure 2 shows a view inside the D-module. The surface of the V-shaped target is covered with tungsten plates.

The open angle of the V-shaped target can be changed from 15 to 80 degrees. Thirteen Langmuir probes are installed on the upper target and two Langmuir probes are installed near the inlet of the D-module. In this study, two probes shown in Fig. 2 were used. Hydrogen gas injection pipes are installed near the inlet.

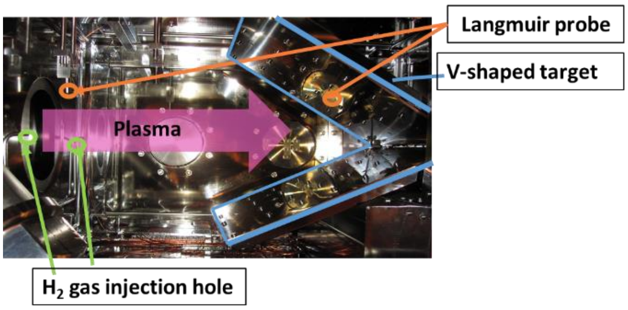

Fig. 2 View inside the D-module

3. Experimental results

Here, experimental results without gas injection into the D-module are shown. The characteristics of the electron density of the divertor simulation plasma near the V-shaped target with the standard ICH and the additional heating shown in Fig. 1 are studied. The open angle of the V-shaped target in the D-module was 45 degrees. In the case of the standard ICH, the additional ICH at the west anchor cell, and the additional ECH at the east plug cell, the electron density near the target varied almost linearly with the electron line density at the west plug cell (NLWP) as shown in Fig.3. On the other hand, in the case of the additional ECH at the east and west barrier cells and the additional ICH at the west barrier cell, the electron density of the divertor simulation plasma did not change well although the NLWP changed from the standard ICH.

More discussions about these heating effect and the effect of gas injection into the D-module will be done in the presentation.

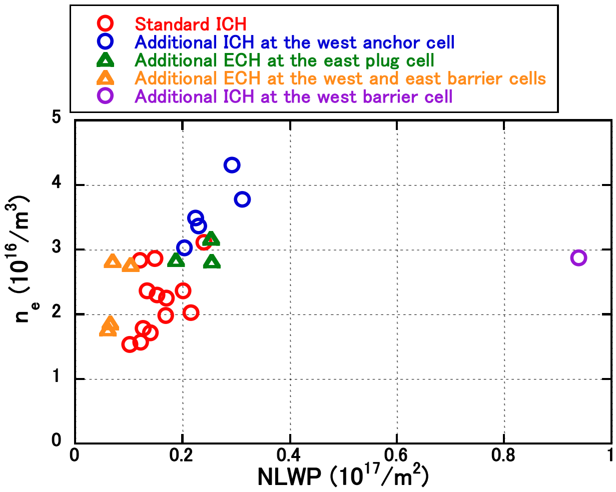

Fig.3 Electron density of the divertor simulation plasma near the target as a function of the NLWP.

Acknowledgments

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