04E61P

GAMMA10におけるプラズマパラメータ制御に向けたICRF加熱実験および3次元波動解析

ICRF experiment and three-dimensional wave analysis for controlling plasma-parameters on GAMMA10

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On GAMMA10, waves in ion cyclotron range of frequency (ICRF) are used for producing and heating plasmas, and keeping magneto-hydro dynamic (MHD) stability. On GAMMA10, there are five cells, which are a central cell, two minimum-B anchor cells connected to both sides of the central cell and supplying MHD stability, and plug/barrier cells. There are three types of ICRF antennas, which are Type-III antennas for producing plasmas and heating anchor plasmas, Double Half Turn (DHT) antennas for heating central plasmas, and Double Arc Type (DAT) antennas for heating anchor plasmas directly. In the west anchor cell, there are two DAT antennas. One is installed in the central side for the midplane of the anchor cell, and the other is installed in the plug/barrier side. The former antenna is called the West Anchor Inner DAT (WAI-DAT) antenna, and the latter called the West Anchor Outer DAT (WAO-DAT) antenna. Divertor simulation experiment progresses on GAMMA10, and requires high temperature and high density plasmas in the plug/barrier cell. It has been observed that there is a strong relationship between density in the central cell and ion-current to the end. In order to control plasma-parameters, the phase-control experiment has been introduced. The phase-control experiment is performed by applying rf current to Type-III antenna and WAO-DAT or WAI-DAT antennas with phase-difference. These experiments can change plasma-parameters in the anchor cell effectively. In order to evaluate these changes, the three-dimensional full wave code TASK/WF[1], in which parallel processing has been recently implemented, is used.

In this presentation, we discuss the dependence of the plasma-parameters on the phase-difference between both antennas with experiments and the numerical simulation. Figure 1 shows the relationship between phase-difference and the intensity of the secondary electron detector (SED) signal in the west anchor cell and the ratio of line-integrated density in the central cell without anchor heating to with anchor heating. It is confirmed that there are strong dependence of these parameters on phase-difference. It is observed that the intensity of SED signal and the ratio of line-integrated density have similar dependence on the phase-difference in the case of WAI-DAT antenna and different dependence in WAO-DAT case. In the numerical simulation with TASK/WF, wave electric field and antenna loading resistance in the case of the phase-control experiment are calculated.

This work is partially supported by the bidirectional collaborative research program of National Institute for Fusion Science, Japan (NIFS13KUGM077).

[1] A. Fukuyama et al., Proc. 20th Int. Conf. on Fusion Energy 2004 TH/P2-3.

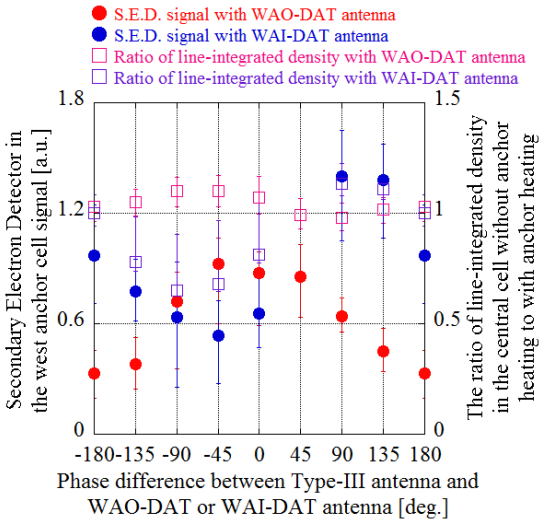

Fig.1 The relationship between phase-difference of two antennas and the SED signal in the west anchor cell and the ratio of line-integrated density in the central cell without anchor heating to with anchor heating in the phase-control experiment.