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GAMMA 10/PDXにおけるアンカー部ICRF加熱によるプラズマの高密度化
High-density plasma production with ICRF heating in the anchor cells on GAMMA 10/PDX

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High-density plasma production is one of the critical issues of tandem mirror devices and is required for extending operation regimes of a divertor simulation experiment which has been implemented on GAMMA 10/PDX. Ion Cyclotron Range of Frequency (ICRF) heating builds up plasmas in minimum-B anchor cells which keep the Magneto-Hydro-Dynamics (MHD) stability. Two Nagoya Type-III (Type-III) antennas in the central cell and two Double Arc Type (DAT) antennas in both anchor cells are used for effective heating of the anchor-cell plasmas. The line density in the east anchor cell increases more than tenfold typical one at the maximum (4.0×10^{14} cm^{-2}) by appropriate control of the phase difference between a Type-III antenna and a DAT antenna on east side with additional gas injections. Simultaneously controlling both east and west phase differences for effective heating of the both anchor-cells plasmas, we have succeeded in producing high-density plasmas in the both anchor cells. The line density in the anchor cell on a lower-density side has reached 1.4×10^{14} cm^{-2}. As the results, we have obtained the higher-density plasmas (4.4×10^{12} cm^{-3}) than typical one (2.0×10^{12} cm^{-3}) in the central cell. We have believed that one of possible mechanisms of the high-density plasma production in the central cell is a formation of positive potentials in the both anchor cells [1].

Figure 1 shows the potentials in the central cell Φ_C and in the anchor cells on the lower-density side Φ_A, and axial confinement potentials ϕ_c (=$\Phi_A-\Phi_C$) as a function of the anchor ICRF heating power with the DAT antenna in the anchor cell on the lower-density side. The Φ_C is measured with a gold neutral beam probe. We have assumed the potential measured with ion energy analyzers at the end regions indicates the anchor potential Φ_A, since the most of ions toward the end regions overcome the potential in the anchor cell. The ϕ_c becomes larger as the anchor ICRF power increases, and is estimated to be larger than axial potential differences from the Boltzmann relation. It is considered that one of possible mechanisms of the difference between the ϕ_c and the Boltzmann potential differences is electron pumping due to $\tilde{E}z$ of the ICRF waves [2]. We will analysis $\tilde{E}z$ profiles by using TASK/WF as a full wave code.

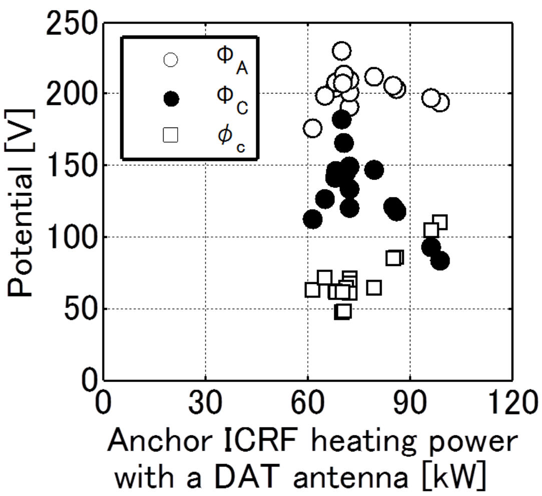

Fig. 1. Φ_A, Φ_C and ϕ_c as a function of the anchor ICRF heating power with a DAT antenna.

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