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GAMMA 10における極小磁場部高周波加熱に関する研究
Study of ICRF heating in the minimum-B anchor configuration on GAMMA 10

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Ion Cyclotron Range of Frequency (ICRF) heating is the main method for ion-heating, producing plasmas, and keeping Magneto Hydrodynamic (MHD) stability on the GAMMA 10 tamdem mirror device. Two minimum-B anchor cells connected to both sides of the central cell supply the MHD stability [1]. In the standard discharge, the power of radio-frequency waves excited from the Type-Ⅲ antennas at the both ends of the central cell heat plasmas at the resonance layer in the minimum-B anchor cells. High pressure plasmas in the central cell are sustained with the help of MHD stability. In order to enhance the ion-heating, the direct anchor heating has been introduced experimentally and theoretically with a three-dimensional full wave code, which is developed by one of authors (A. Fukuyama) [2].

In the previous experiment, it has been confirmed that the antenna loading of the double arc type (DAT) antenna increases significantly than that of the straight bar-type antenna [3]. Figure 1 shows the dependence of the antenna loading resistance on applied frequency. In the simulation, the bar-type antenna is drawn as a straight line, the single arc type (SAT) antenna is an elliptical arc, and the DAT antenna is an elliptical arc with two fragments. The current through the antenna is set 5.0 A/m in each antenna, so current of 2.5 A/m is set in each fragments on the case of DAT antenna. And these antennas are set as current strap with same width. Results are shown with following markers. Circles are in the case of the bar-type antenna, triangles are those of the SAT antenna, and squares are those of DAT antenna. Open points indicate the results in the case of 1.0×10^{18} m^{-3} and the solid points in the case of 2.0×10^{18} m^{-3} at the core. Then, it is confirmed that density dependence is small. And it is confirmed that the antenna loading resistance increase twice or more by changing shape from the straight bar-type antenna to the elliptical DAT antenna. By using the DAT antenna, more effective ion-heating in the east (9.9 MHz) and west (10.3 MHz) anchor cells have been observed in the experiment. We evaluate the wave excitation in the complex magnetic field configuration with three-dimensional numeral simulation code.

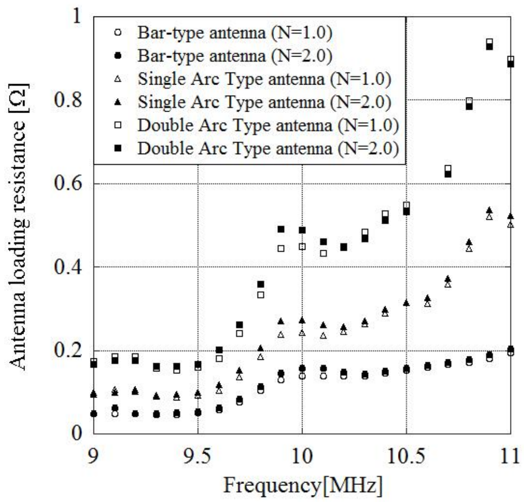

Fig. 1. The dependence of the antenna loading resistance on density and applied frequencies are calculated with the three-dimensional numeral simulation. The open and solid symbols correspond to the case where background core density is 1.0×10^{18} m^{-3} and 2.0×10^{18} m^{-3}, respectively. The circle, triangle and square symbols correspond to the bar-type, SAT, and DAT antennas respectively.

Reference

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