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GAMMA 10におけるECH二枚ミラーアンテナ系の改良
Development of ECH antenna system with two mirrors in GAMMA 10

中澤和寛，今井剛，南龍太郎，假家強，沼倉友晴，
中林英隆，江口濯，河原崎遼，南齋宏駿，浅野徳馬
K. Nakazawa, T. Imai, T. Kariya, R. Minami, T. Numakura,
H. Nakabayashi, T. Eguchi, R. Kawarasaki, H. Nanzai, T. Asano

筑波大学プラズマ研究センター
Plasma Research Center, University of Tsukuba

In the GAMMA 10, Electron Cyclotron Heating (ECH) is utilized for the formation of the plasma-confining potentials in plug/barrier cell. The central ECH (c-ECH) is another key to improve plasma performance of the GAMMA 10, since low electron temperature causes the strong electron drug of hot ions in the central cell. To increase the electron temperature of the plasma, it is necessary to inject the strong electron cyclotron waves into the core plasma in the central cell. The c-ECH antenna system has been improved in terms of the transmission efficiency, the control of wave polarization, and radial profile. The antenna system with one mirror (M4) used in the last time enabled to inject accurate X-mode wave, since it directly see the EC resonance layer to remove wave polarization deterioration due to plasma. The transmission efficiency of the antenna system is 80% in calculation. In the plasma experiment, when we increase the injection power of the gyrotron of the c-ECH from 50kW to 150kW, the diamagnetisms tend to decrease. This results would be caused by the increase of the stray RF field generated by rest of the microwave power that couldn’t be covered on the antenna. Therefore, it is necessary to design the new c-ECH antenna system in order to reduce the stray RF radiation.

The c-ECH antenna system was newly designed to improve the previous antenna system with two mirrors (M1&M2) in 2009. The new antenna system is composed of two mirrors “M1a” and “M2”. The M1a is set on the end of the waveguide, and the M2 is the same as previous. The previous M1&M2 antenna system had only about 70% transmission efficiency because the size of the M1mirror had been limited by the port size. Clearing this limit from the M1 by being separable, it becomes possible to enlarge the size of the M1a about two times, from $40.88\times50\text{mm}^2$ to $52.5\times100\text{mm}^2$ and to expand the diameter of the waveguide at the open end from 31.75mm to 45mm. The transmission efficiency of the new antenna system is improved up to about 95% in calculation and the radial profile is ideally round. This calculation values are obtained by use of the computing code which calculates the surface currents on the mirror derived from the radiation at the waveguide mouth, and then calculates the electromagnetic field excited by them. [1,2]

In order to check mirror performance, we performed the cold radiation tests by using 1 W oscillator. The heat map at the resonance layer measured by infrared camera is compared with the calculation. The experimental data are in good agreement with the calculation. The transmission efficiency of the new antenna M1a achieves about 83%, it is about 20% increase as compared with the previous M1 system.

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[1]Y.Tatematsu et al.,Jpn.Appl.phys.Tech45 (2006) 7911-7913
[2]Y.Tatematsu et al., Jpn.Appl.phys.Tech44 (2005)6791-6795