§4. Development of High Performance Antennas for Electron Heating in GAMMA 10

Saito, T., Tatematsu, Y., Imai, T., Hojo, H. (Univ. Tsukuba, PRC),
Kubo, S., Shimozuma, T., Yoshimura, Y.,
Saigusa, M. (Faculty of Engineering, Ibaraki Univ.),
Notake, T. (Graduate School of Engineering, Nagoya Univ.),
Nagai, D., Nozaki, K., Machida, N. (Graduate School of Pure and Appl. Sci. Univ. Tsukuba)

I. Objectives

The role of electron cyclotron resonance heating (ECRH) in the GAMMA 10 tandem mirror is creating the plasma confining potential and heating of electrons in the central cell. The first objective of this subject is to confirm the performance of the antenna system designed and developed in the last year subject to increase the efficiency of power transmission to the resonance layer in the central cell. Second, this antenna is installed to heat electrons and improve the plasma quality. The third objective is the study of betterment of the antenna system for further high efficiency. For accurate evaluation of the antenna performance, a new apparatus for radiation measurement is started up.

II. Method and procedure

Second 500 kW gyrotron with higher power than the first gyrotron has been installed. Then, it is tried to generate high potential with strong electron heating at the East and West plugs. In the central cell, experiments of electron heating are carried out by installing the antenna fabricated last year. A test stand is constructed and the radiation pattern of the antenna is measured. A new antenna system with higher transmission efficiency is developed for central cell ECRH by changing the power transmission path.

III. Results

Experiments of high potential generation was done by using the new 28 GHz, 500 kW gyrotron and the plug antenna for an axisymmetric radiation profile on the resonance layer. An ion confining potential of 2.5 kV was obtained. This is a new record and 3.5 times as large as that of three years ago.

In the central cell, the microwave power in TE02 mode delivered from a 200 kW gyrotron was converted to TE11 mode and radiated onto the resonance layer. A clear increase in the diamagnetic signal and in the soft X-ray signal was observed during ECRH as plotted in Fig. 1. This shows that efficiency of ion heating is improved by reducing electron drag. This result is due to the optimization of radiation direction by using a new mirror attached just after the waveguide and suppression of stray heating in the edge region. The highest bulk electron temperature of 290 eV was attained.

Calibration measurement was carried out by using the newly constructed test stand. The measured power transmission rate well agreed with the design value.

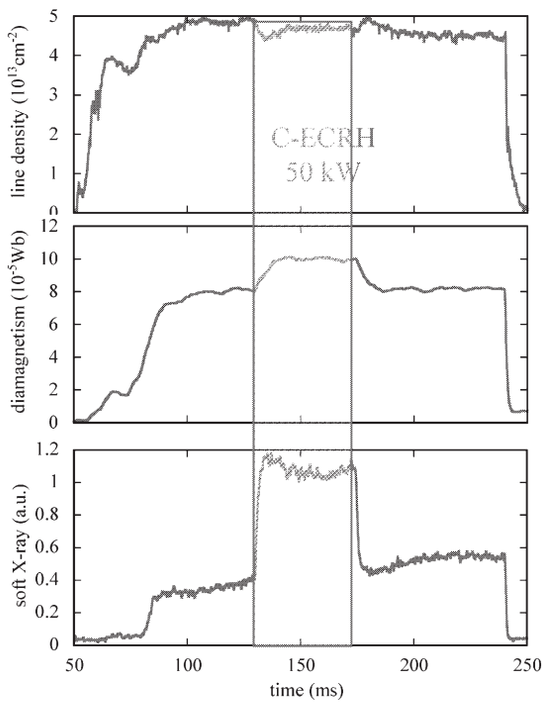

Fig. 1 Waveforms during central cell ECRH. The line density (upper trace), the diamagnetism (middle trace) and the soft X-ray signal (bottom trace).

References

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