§16. Study of Impurity Ion Line Radiation Intensity in GAMMA 10

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Time and space resolved spectroscopic measurements of impurity ion radiation spectrum give us a lot of important information, such as time and space variations of plasma density, electron and ion temperatures, etc. After comparing the collisional-radiative (CR) model[1] calculation results for impurity ion line radiation intensities and those measured by spectroscopic method, we can obtain the impurity ion densities, electron density and electron temperature. The aim of this study is to construct the database for plasma spectroscopic diagnostics in the fusion plasmas.

CR-model calculation codes for carbon and oxygen ions developed at NIFS were used in this study.[1] These codes include the efficiencies for electron impact ionization, excitation, recombination and de-excitation. In this year, we used CR-model calculation code for CII ion in order to obtain the time dependent CII ion density distribution. Fig. 1 shows the CII line effective emission rate coefficient.

GAMMA 10 is a 27.1 m long tandem mirror machine consisting of a 5.6 m long axisymmetric central cell, two anchor cells and two axisymmetric end mirror cells. The GAMMA 10 plasma is produced and heated by ICRF with hydrogen gas puffing, and during the 200 ms of plasma duration ECRH is superimposed to make plug potentials in both end mirror cells. In the GAMMA 10 plasma, absolute CII ion line radiation intensities were measured by using absolutely calibrated time- and space-resolving vacuum ultraviolet spectrograph.[2] CII ion density is about 5×10^7 cm^{-3} at the center of the plasma. (Fig. 2) This result is the same as that obtained by using Coronal model calculation. This shows that the Coronal model calculation can be used in the GAMMA 10 plasma for CII ion. The peak of CII ion density profile is radius of about 8 cm. The CII ion density near the plasma center increases about five times as much as those without plug potential formed by ECRH. The CII density increases at the plasma center seem to come from the improvement of axial plasma confinement.

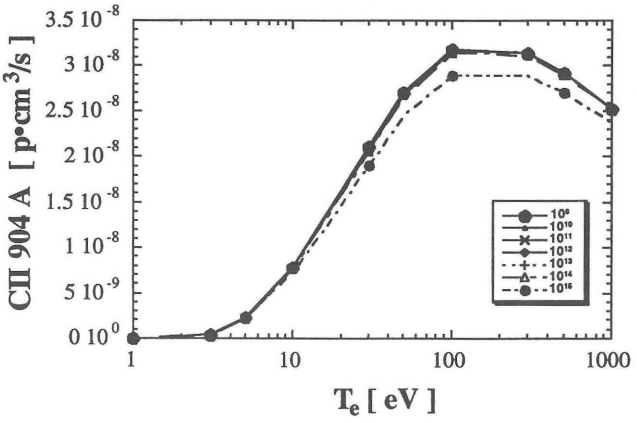

Fig. 1 CII ($2s^2\ 3d(^2D)$ - $2s^2\ 2p(^2P)$) effective emission rate coefficient.

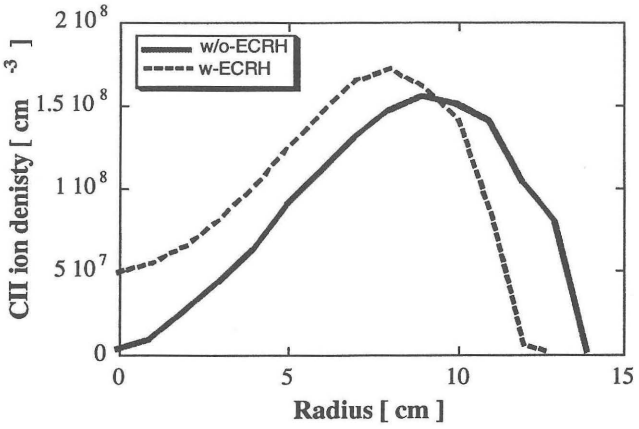

Fig. 2 CII ion density radial distribution.

We plan to construct CR-models for higher charged impurity ions measured in the GAMMA 10 plasma and to make a database for plasma spectroscopic diagnostics in order to obtain impurity ion densities, electron density and electron temperature.

Reference

1) Kato, T., et al.: Fusion Eng. Des., **34-35** (1997) 789.
2) Okamoto, Y., et al.: Jpn. J. Appl. Phys., **39** (1999) 2137.