§26. Construction of Neutral Transport Code for LHD Edge Plasmas

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We are constructing collisional-radiative models of atomic and molecular hydrogen and a neutral transport code for hydrogen species. Intensities and profiles of atomic hydrogen emission lines from LHD edge plasmas have been analyzed by the codes in order to study the particle balance and the energy balance of the plasmas.

In this study, to test the reliability of the codes, we have applied them to RF(13.56MHz) plasmas in Shinshu University. The plasmas are cylindrical about 5cm in diameter.

Intensities of the Balmer lines of atomic hydrogen were measured and they were compared with the results of the codes.

In calculating the intensities with the code, electron densities and temperatures are given as input parameters. In this study, in addition to the electric double probe, we have newly installed the electric single probe in order to evaluate the distribution of velocity of the electron. Figure 1 shows the electron densities and temperatures measured by the probes. The single probe data indicates that two plasma components exist in the center region of the plasma column.

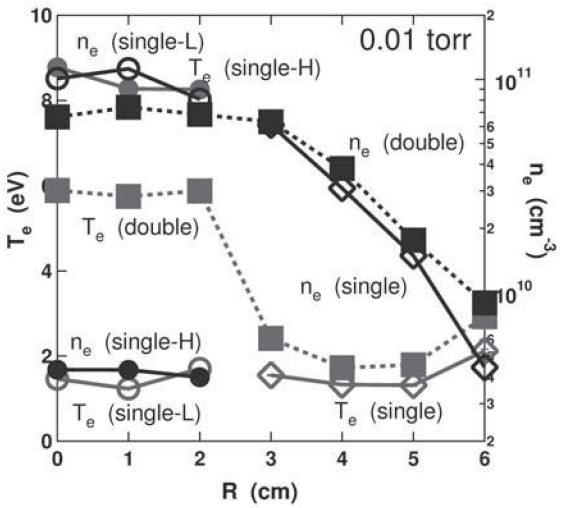

Fig.1. Electron temperatures and densities measure by the double probe and the single probe.

Previously, in the code, single Maxwell distribution was assumed in calculating the effective rate coefficients of various processes. We have rewritten the codes for the two plasma components.

Figure 2 shows the populations of the upper states of the Balmer-α line (principal quantum number $n = 3$). The results of the calculations with the double probe data and the single probe data are shown in Figs.2(a) and 2(b), respectively. The new code with the single probe data has well reproduced the experimental values.

In the calculation, the population of the excited state which originates from the radiation trapping is included by an iteration method [1]. In the outer region of the plasma, the calculation indicates that the excited state $n = 3$ is dominantly produced by the absorption of the Lyman β.

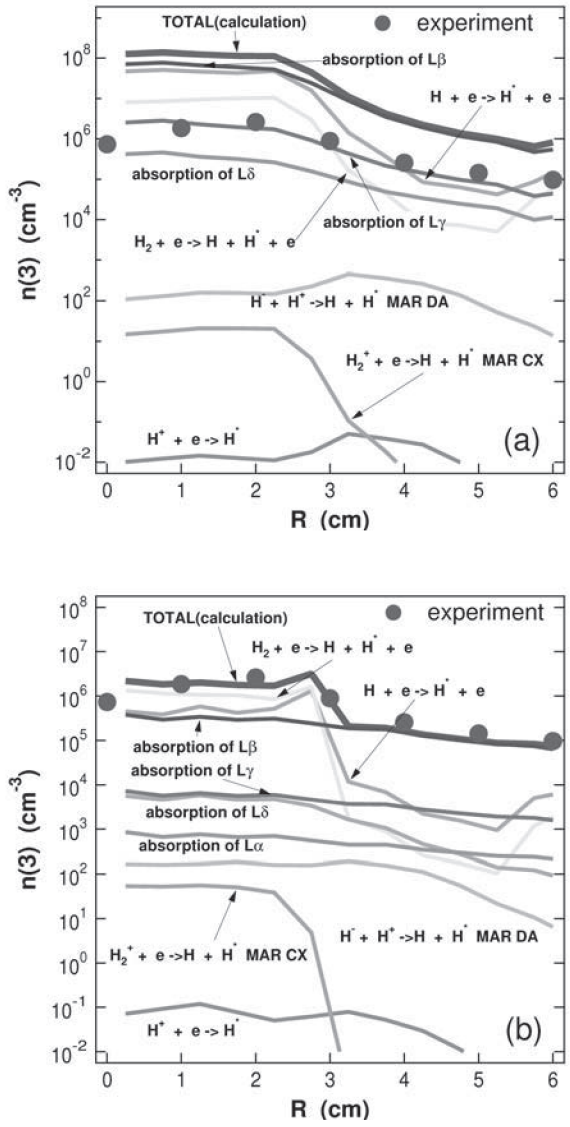

Fig.2. Population densities of excited state of atomic hydrogen with principal quantum number $n = 3$. As input parameter for the calculation, (a) double probe data and (b) single probe data are used, respectively.

1) Sawada, K., J. Plasma Physics, **72**, (2006) 1025 .