§27. Measurement of Helium Line Intensity Distributions in the Edge Plasma of the JIPP T-IIU Tokamak

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Spectral lines of He I and He II were measured to study charge-transfer processes in the edge plasma. Helium was chosen so that we can compare its spectra with the CR model that employs reliable atomic data. Helium was introduced into the vacuum vessel before the start up of the deuterium plasma. Relative line intensities were measured in the flat-top phase of the ohmic plasma; Ip=115kA, Bt=1.9T, T_e=1.1keV, $n_e=0.9\times10^{-13}cm^{-3}$ at the center, T_e=10～20eV, $n_e\sim1\times10^{11}cm^{-3}$ in the edge region. In Fig. 1, line intensities are shown which corresponds to the transition n=2 ← 3, 4, 5 in singlet and triplet. Each line intensity was divided by the effective rate coefficient that was calculated on the CR model by Sasaki, et al.[1]. Their ratios are normalized to that of the 5876Å line. Intensities of those lines were fitted to the calculation, except the lines of n=2 ← 3. Considering the error of both experiment and calculation, it seems that the discrepancy was caused by recombination processes which were not taken into account in the calculation. The density of He^+ ion was determined to be equal to that of He; we have compared 1s-4f excitation with spontaneous emission of 4f-3d transition (HeII 4686Å). Then the density of He^{2+} was evaluated to be about ten times of He from ionization balances and transport effects. The densities of H, H_2, D and D_2 were supposed to be several percent of n_e.

Radiative, dielectronic and three-body recombination can be negligible in the present case. Because these processes do not have large rate coefficients enough to affect on the spectra. It is concluded that the double charge-transfer reaction $He^{2+}+H_2 \rightarrow He^* + 2H^+$ is the most probable process that affect the spectrl intensity distribution. Because it has a large rate coefficient $4\times10^{-9}cm^3s^{-1}$ and the property of selective electron capture to n=3 states. [2,3] The contribution of this process was estimated to be of the same order of each electron impact excitation rate for He.

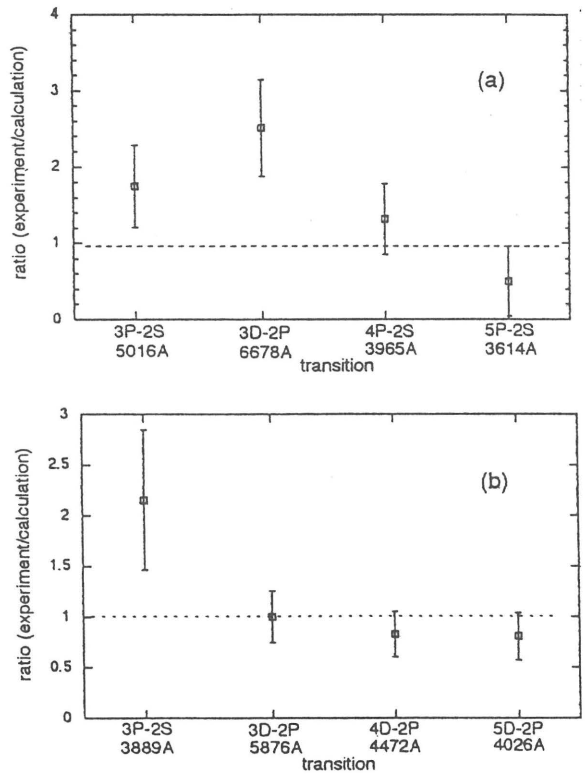

Fig.1. Intensity ratio of singlet(a) and triplet(b) lines

References

1) Sasaki, S. et.al, Reserch report, NIFS-346, (1995)
2) Okuno, K. et.al J. Phys. B: At. Mol. Opt. Phys. 25 (1991) L105,
3) Sato, K. et.al, J. Phys. B: At. Mol. Opt. Phys. 27 (1994) L651-4,