§8. Observations and Modelling of Line Intensity Ratios of O V Multiplet Lines for 2s3s (^3S) - 2s3p (^3P_J)

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The triplet lines 2s3s (^3S) - 2s3p ($^3P_{0,1,2}$) of Be-like O V ions are frequently used in plasma diagnostics since the line intensities are strong and the wavelengths are in the UV - visible range (2781.04 A, 2787.03 A and 2789.86 A). The lines are often used for ion temperature measurements through measurements of the Doppler broadened line profiles. However, also the line intensity ratios are of diagnostic interest since they are temperature and density sensitive in regions of interest for plasma diagnostics. It has previously been observed that these line ratios do not agree with those predicted by the statistical weights of the J states in the multiplet. Furthermore, measurements of lifetimes have shown that the multiplet lines show different lifetimes due to a J-selective transition in the multiplet.

We have constructed a collisional radiative model for O V with fine structure levels and studied the line intensity ratios for density and temperature diagnostics. In this paper the calculated electron density and temperature dependencies of the line ratios of these multiplet lines are compared with measurements from the Extrap T1 and T2 RFP experiments in Rotal Institute of Technology.

Be-like ions have the metastable state 2s2p $^3P_{2,1,0}$. Since the radiative decay rate is zero for the level 2s2p $^3P_0$, the population density of the metastable state is not negligible even at low electron densities. Consequently, the population of the excited states are affected by the metastable state also at low plasma densities. The O V multiplet is an interesting example for testing atomic data in a collisional radiative model since several plasma laboratory experiments at different conditions and with different time scales have shown the line ratios to deviate from the values expected from Boltzmann distributions including transition rates and statistical weights. The existence of metastable states is of interest since these states are populated in the plasma and their influence on the line intensities is important when modelling the radiation processes from the plasma. Recently, experiments from a small tokamak have shown the same non-statistical multiplet line intensity ratios and these deviations were interpreted as caused by polarisation effects[1].

As shown in Fig. 1, the calculation and the observed intensity ratios do not agree within experimental error. We have considered the reasons of this discrepancies; i) Inner sub-shell ionisation process, ii) Electron recombination, iii) Proton collisions, iv) Cascade from 2s3d^{3}D, v) Non quasi steady state effect, vi) Atomic data of excitation and radiative transition rate.

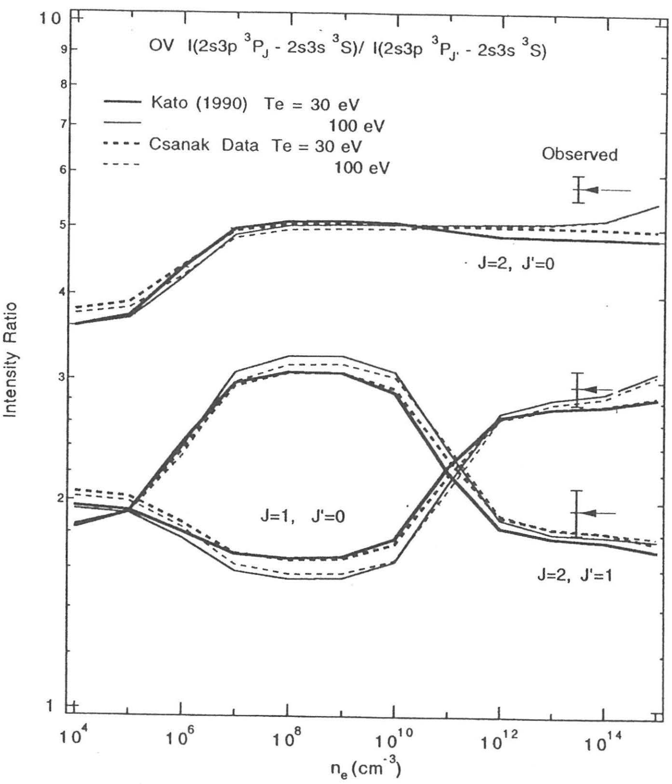

Fig. 1 The intensity ratios of I2781(J = 2)/I2789(J = 0) and I2787(J = 1)/I2789(J = 0). Observed values are shown by arrows.

Reference

1. Kallstenius T, 1994, MSc thesis, (KTH),TRITA-FYS-1034, ISSN 0280-316X