

§8. Line Intensity Ratio of O V Multiplet Lines for $2s3s\ (^3S) - 2s3p\ (^3P_J)$

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The triplet lines $2s3p\ ^3P_{J=2,1,0} - 2s3s\ ^3S$ of Be-like O V ion is often measured for plasma diagnostics, since the line intensity is strong and the wavelengths are 2781.04, 2787.03, 2789.86. We have constructed a collision radiative model for O V with fine structure levels and studies the line intensity ratios. The 20 levels of $n = 2$ and 3 are included ($2s^2$, $2s2p$, $2p^2$, $2s3s$, $2s3p$, $2s3d$) in our model. Excitation by proton impact is included for the transitions among the $2s2p\ ^3P$ and $2p^2\ ^3P$ levels as well as the electron excitation.

Be like ions have the metastable state $2s2p\ ^3P_J = 0,1,2$. Since the radiative decay rate is zero for $2s2p\ ^3P_0$, the population density is not negligible even at low densities. Then the population of the excited states are affected by the metastable state even at low density plasmas. The contribution of the metastable state $2s2p\ ^3P_0$ is 50% for the population of $2s3p\ ^3P_0$ at low density limit. The reduced population densities $n(i)/n(1)/g(i)$ are shown in Fig. 1 where $n(i)$ and $g(i)$ are the population density and the statistical weight of the excited state i . The metastable state $2s2p\ ^3P$ reaches in statistical ratios for $n_e > 10^{10}\text{ cm}^{-3}$ as shown in Fig. 1. Then the line intensity ratios mentioned above do not follow the statistical weight. The calculated line intensity ratios are shown in Fig.2.

The O V multiplet lines were measured from EXTRAP T1 plasma in Royal Institute of Technology. The peak value of the electron temperature T_e is about 100 - 300 eV and the electron density n_e is about 10^{14} cm^{-3} . The observed mean ratio of $I(J = 3)/I(J = 0)$ and $I(J = 2)/I(J = 0)$ are 5.5 and 2.95, respectively. These

values are consistent if the O V lines are emitted in the plasma of $T_e = 100\text{ eV}$ and $n_e > 10^{14}\text{ cm}^{-3}$ as shown in Fig.2.

Furthermore we have to investigate the contribution of the recombination processes, since the Li-like ion is much abundant in plasma.

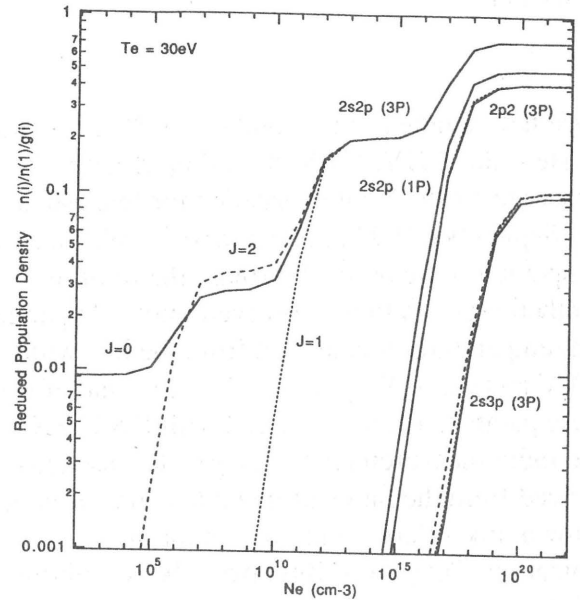


Fig. 1 Reduced population density of O V ions.

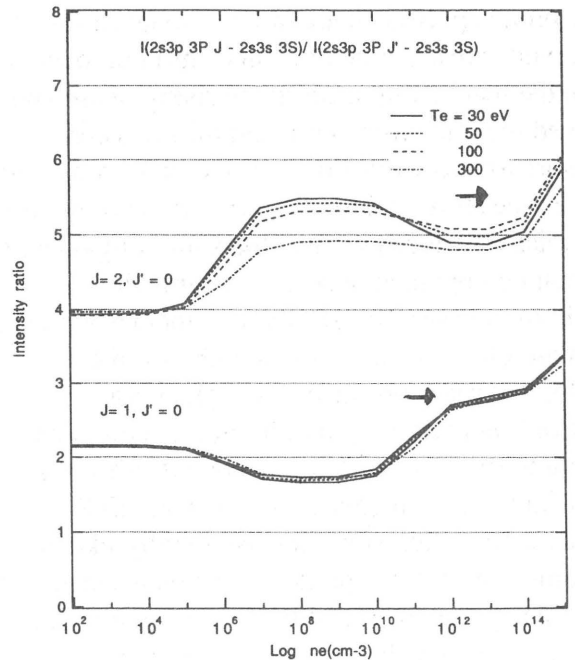


Fig. 2 The intensity ratios of $I_{2781}(J = 2)/I_{2789}(J = 0)$ and $I_{2787}(J = 1)/I_{2789}(J = 0)$. Observed values are shown by arrows.