

Electron impact excitation of O III

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Synopsis The B-spline Breit-Pauli R-matrix method has been used to calculate electron excitation collision strengths for a wide range of transitions between the first 220 fine-structure levels of O III. The calculation includes levels of the $2s^22p^2$, $2s2p^3$, $2s^22p3l$, $2s^22p4l$ and $2s2p^23l$ configurations. The present work considerably improves the existing calculations for oscillator strengths and collision strengths of O III.

Accurate transition rates and electron collision excitation rates of O III are important for the analysis and diagnostics of a wide range of astrophysical spectra. Electron scattering from O III has been performed by using highly accurate target wave functions and by including fine-structure effects in the close-coupling expansions directly. The present calculations have been carried out using the B-spline Breit-Pauli R-matrix (BSR) method [1]. The multi-configuration Hartree-Fock method in combination with B-spline expansions is employed for accurate representation of the target wave functions. This allows us to optimize the atomic wave functions for different states independently, resulting in a more accurate target description than those used in previous collision calculations.

Figure 1 shows collision strengths of the fine-structure $2s^22p^2$ (3P_0 - 3P_1 , 3P_1 - 3P_2) transitions in O III. High resolution at near-threshold energies is necessary for accuracy in rate coefficients at low energies. We will present detail comparison with available calculations. Generally, all recent R-matrix calculations [2-4] agree to within 10% for the thermally averaged collision strengths for the forbidden transitions among the five lowest levels of the ground $2s^22p^2$ configuration. An exception is for the transitions from the lowest three 3P_J levels to the 1S_0 level. Here our results support the most recent calculation by Storey *et al* [4]. Note also that the calculations Palay *et al* [3] show intensive resonance structure at electron energies above 3 Ry not supported by the present calculations.

For higher lying states the agreement is more diverse. The comparison of effective collision strengths for a set of temperatures is presented in figure 2 where the ratios of our results with other calculations [2] are shown. About 80% of transitions to excited states are within 30%, though for some weak transitions the rate coefficients differ by several factors. The present calculations are the direct Breit-Pauli calculations whereas the results in the works of Aggarwal and Keenan [2] and Storey *et al* [4] obtained from nonrelativistic LS calculation using the intermediate coupling frame transformation.

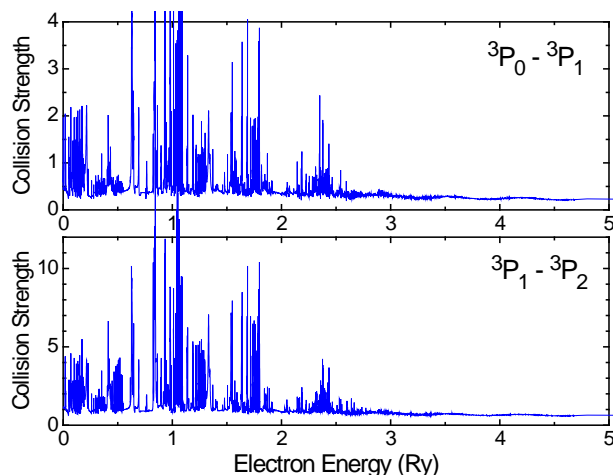


Figure 1. Collision strengths for the $2s^22p^2$ 3P_0 - 3P_1 and 3P_1 - 3P_2 fine-structure transitions in O III.

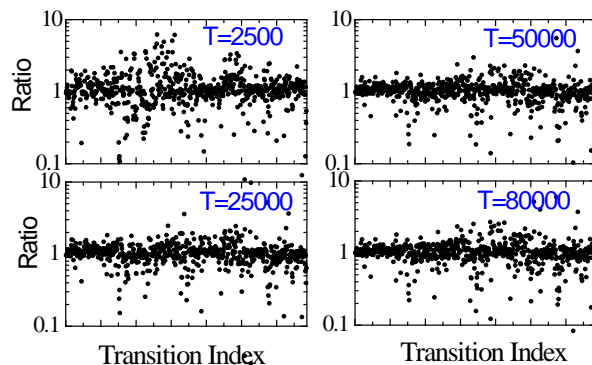


Figure 2. Comparison of effective collision strengths in O III with other calculations. The ratios between the R-matrix calculation [2] and the present results are shown.

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References

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