Physica Scripta. Vol. T28, 33–35, 1989.

Intermediate Coupling Dielectronic Recombination Rate Coefficients for the Ground and Metastable Levels of C and O Ions

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Received August 23, 1988; accepted November 10, 1988

Abstract

We present intermediate coupling dielectronic recombination rate coefficients for $\Delta n = 0$ core transitions from the ground and metastable levels of all C and O ions.

We present the results of calculations, using AUTOSTRUCTURE [1], of configuration-mixing intermediate coupling dielectronic recombination rate coefficients for $\Delta n = 0$ core transitions from the ground and metastable levels of all C and O ions. Except for the Li-like ions C^{3+} and O^{5+}, $1 \rightarrow n$ and $2 \rightarrow n$ core transitions can be neglected and so these can be regarded as total rate coefficients. Details of the calculational methods and discussion of most of the results presented here can be found in papers on Be-like ions [2, 3], B-like ions [4] and Oxygen ions [5].

In figures 1 to 8 we present intermediate coupling dielectronic recombination rate coefficients for the ground and metastable levels of C and O ion. In Tables I and II we present intermediate coupling dielectronic recombination rate coefficients for C and O ions statistically averaged over levels of the ground term. Rate coefficients at higher temperatures may be obtained by scaling in $T^{-3/2}$. Above $T = 10^6$ K the $1s \rightarrow 2l$ core transitions in C^{3+} and O^{5+} start to become important and could increase our results for these ions by up to a factor of two. In Table III we present low temperature intermediate coupling dielectronic recombination rate coefficients for the $^1S_0$ ground level of C^{2+} and O^{4+}. Low temperature LS-coupling dielectronic recombinaion rate coefficients for all ions of C and O involving a $\Delta n = 0$ core transition have been calculated by Nussbaumer and Storey [6].

Acknowledgements

This work was supported in part by the U.K. Science and Engineering Research Council under contract with the University of Cambridge and in part by the U.S. Department of Energy, Office of Fusion Energy under contract with Auburn University.

References

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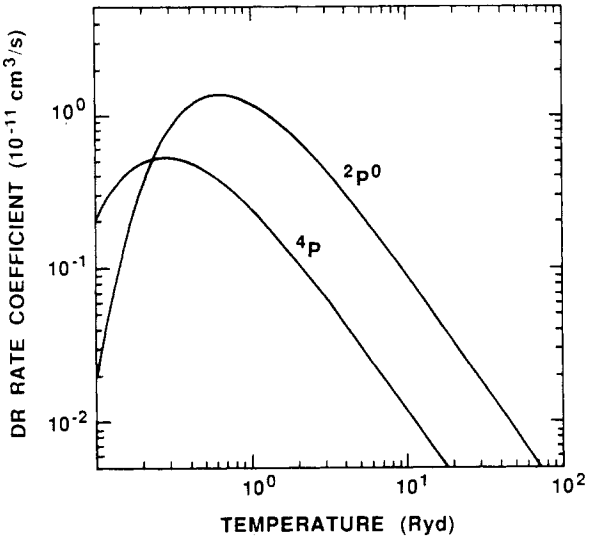

Fig. 1. Intermediate coupling dielectronic recombination rate coefficients for C^+ ($2s^2 2p\ ^2P^\circ$: $2s2p^2\ ^4P$).

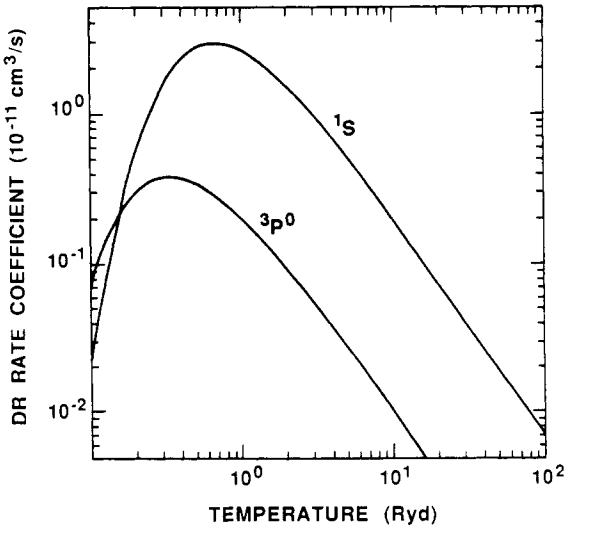

Fig. 2. Intermediate coupling dielectronic recombination rate coefficients for C^{2+} ($2s^2\ ^1S$: $2s2p\ ^3P^\circ$).

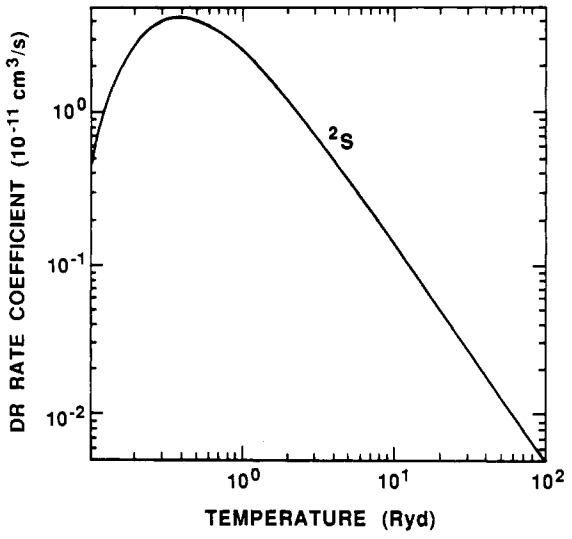

Fig. 3. Intermediate coupling dielectronic recombination rate coefficients for C^{3+} ($2s\ ^2S$).

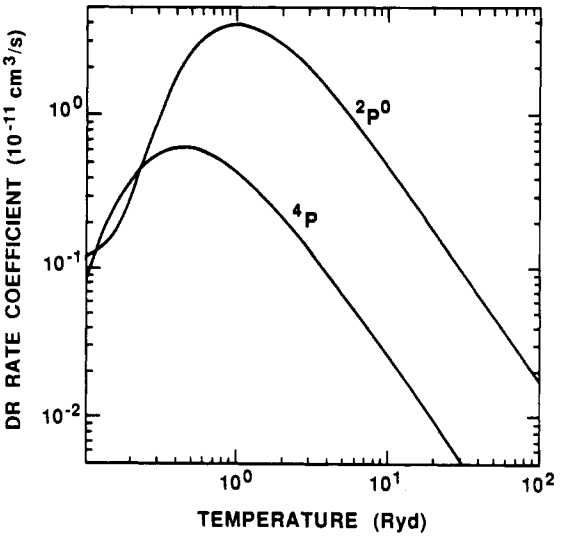

Fig. 6. Intermediate coupling dielectronic recombination rate coefficients for O^{3+} ($2s^2 2p\ ^2P^o$: $2s2p^2\ ^4P$).

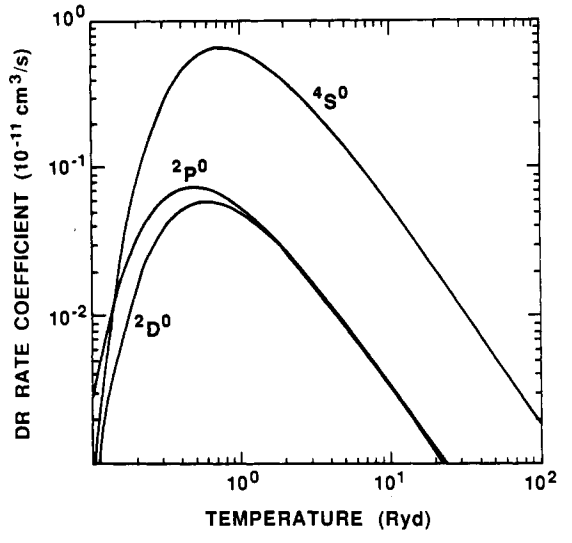

Fig. 4. Intermediate coupling dielectronic recombination rate coefficients for O^+ ($2s^2 2p^3\ ^4S^o$, $^2D^o$, $^2P^o$).

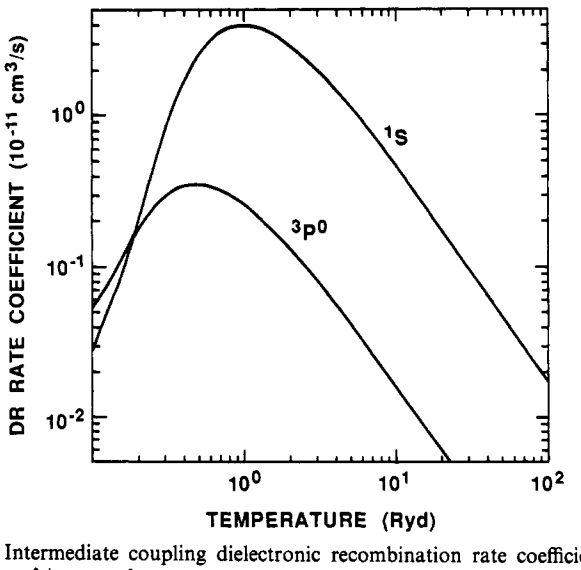

Fig. 7. Intermediate coupling dielectronic recombination rate coefficients for O^{4+} ($2s^2\ ^1S$: $2s2p\ ^3P^o$).

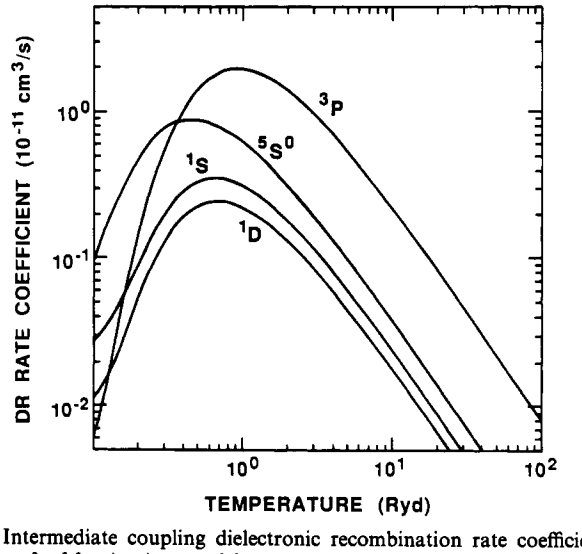

Fig. 5. Intermediate coupling dielectronic recombination rate coefficients for O^{2+} ($2s^2 2p^2\ ^2P$, ^4D, ^1S: $2s2p^3\ ^5S^o$).

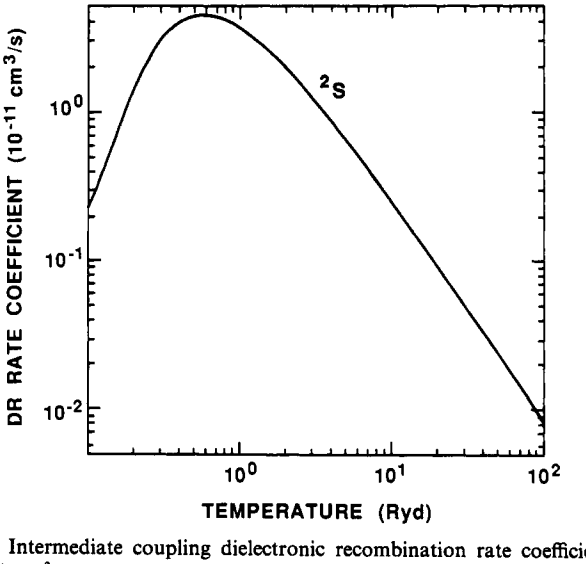

Fig. 8. Intermediate coupling dielectronic recombination rate coefficients for O^{5+} ($2s\ ^2S$).

Table I. *Dielectronic recombination rate coefficients ($cm^3\ s^{-1}$) for the ground term of C ions*

Log T(K)	C^+	C^{2+}	C^{3+}
4.4	1.72 (−12)†	7.15 (−12)	1.89 (−11)
4.6	6.25 (−12)	1.66 (−11)	3.64 (−11)
4.8	1.17 (−11)	2.82 (−11)	4.31 (−11)
5.0	1.38 (−11)	3.19 (−11)	3.72 (−11)
5.2	1.20 (−11)	2.69 (−11)	2.63 (−11)
5.4	8.54 (−12)	1.95 (−11)	1.63 (−11)
5.6	5.35 (−12)	1.23 (−11)	9.40 (−12)
5.8	3.09 (−12)	7.16 (−12)	5.13 (−12)
6.0	1.70 (−12)	3.94 (−12)	2.72 (−12)
6.2	8.99 (−13)	2.09 (−12)	1.41 (−12)
6.4	4.67 (−13)	1.09 (−12)	7.22 (−13)
6.6	2.39 (−13)	5.58 (−13)	3.67 (−13)

† 1.72 (−12) = 1.72×10^{-12}.

Table II. *Dielectronic recombination rate coefficients ($cm^3\ s^{-1}$) for the ground term of O ions*

Log T(K)	O^+	O^{2+}	O^{3+}	O^{4+}	O^{5+}
4.6	1.62 (−12)†	3.65 (−12)	5.61 (−12)	3.79 (−11)	2.35 (−11)
4.8	4.33 (−12)	1.08 (−11)	1.73 (−11)	4.36 (−11)	4.00 (−11)
5.0	6.26 (−12)	1.78 (−11)	3.20 (−11)	5.17 (−11)	4.43 (−11)
5.2	6.12 (−12)	1.96 (−11)	3.80 (−11)	5.05 (−11)	3.68 (−11)
5.4	4.68 (−12)	1.65 (−11)	3.33 (−11)	4.02 (−11)	2.54 (−11)
5.6	3.06 (−12)	1.15 (−11)	2.39 (−11)	2.74 (−11)	1.56 (−11)
5.8	1.82 (−12)	7.14 (−12)	1.50 (−11)	1.68 (−11)	8.87 (−12)
6.0	1.01 (−12)	4.10 (−12)	8.69 (−12)	9.61 (−12)	4.82 (−12)
6.2	5.42 (−13)	2.24 (−12)	4.77 (−12)	5.15 (−12)	2.54 (−12)
6.4	2.84 (−13)	1.19 (−12)	2.53 (−12)	2.68 (−12)	1.32 (−12)
6.6	1.46 (−13)	6.15 (−13)	1.32 (−12)	1.36 (−12)	6.73 (−13)
6.8	7.44 (−14)	3.15 (−13)	6.75 (−13)	6.85 (−13)	3.42 (−13)

† 1.62 (−12) = 1.62×10^{-12}.

Table III. *Low temperature dielectronic recombination rate coefficients ($cm^3\ s^{-1}$) for the ground level of C^{2+} and O^{4+}*

Log T(K)	C^{2+}	Log T(K)	O^{4+}	Log T(K)	O^{4+}
3.0	2.85 (−12)†	2.2	7.65 (−11)	3.4	1.07 (−10)
3.2	6.67 (−12)	2.4	1.95 (−10)	3.6	8.06 (−10)
3.4	9.65 (−12)	2.6	2.76 (−10)	3.8	6.65 (−10)
3.6	9.86 (−12)	2.8	2.70 (−10)	4.0	5.64 (−11)
3.8	8.07 (−12)	3.0	2.13 (−10)	4.2	4.79 (−11)
4.0	6.05 (−12)	3.2	1.52 (−10)	4.4	4.11 (−11)
4.2	4.96 (−12)				

† 2.85 (−12) = 2.85×10^{-12}.