



4-16-2013

Erratum: 'Improved He I emissivities in the Case B approximation'

R. L. Porter
University of Georgia

Gary J. Ferland
University of Kentucky, gary@uky.edu

P. J. Storey
University College London, UK

M. J. Detisch
University of Kentucky

[Click here to let us know how access to this document benefits you.](#)

Follow this and additional works at: https://uknowledge.uky.edu/physastron_facpub

 Part of the [Astrophysics and Astronomy Commons](#), and the [Physics Commons](#)

Repository Citation

Porter, R. L.; Ferland, Gary J.; Storey, P. J.; and Detisch, M. J., "Erratum: 'Improved He I emissivities in the Case B approximation'" (2013). *Physics and Astronomy Faculty Publications*. 241.
https://uknowledge.uky.edu/physastron_facpub/241

This Erratum is brought to you for free and open access by the Physics and Astronomy at UKnowledge. It has been accepted for inclusion in Physics and Astronomy Faculty Publications by an authorized administrator of UKnowledge. For more information, please contact UKnowledge@lsv.uky.edu.

Erratum: 'Improved He I emissivities in the Case B approximation'

Notes/Citation Information

Published in *Monthly Notices Letters of the Royal Astronomical Society*, v. 433, no. 1, p. L89-L90.

This article has been accepted for publication in *Monthly Notices Letters of the Royal Astronomical Society* ©: 2013 The Authors. Published by Oxford University Press on behalf of the Royal Astronomical Society. All rights reserved.

Digital Object Identifier (DOI)

<http://dx.doi.org/10.1093/mnrasl/slt049>



Erratum: ‘Improved He I emissivities in the Case B approximation’

by R. L. Porter,¹★ G. J. Ferland,² P. J. Storey³ and M. J. Detisch²

¹Department of Physics and Astronomy and Center for Simulational Physics, University of Georgia, Athens, GA 30602, USA

²Department of Physics & Astronomy, University of Kentucky, Lexington, KY 40506, USA

³Department of Physics & Astronomy, University College London, Gower Street, London WC1E 6BT, UK

Key words: errata, addenda – atomic data.

This is an erratum to the paper entitled ‘Improved He I emissivities in the Case B approximation’ published in MNRAS 425, L28 (2012). A setup error caused allowed resonance lines to escape via scattering from free electrons. Transitions to the ground state should not escape in the Case-B approximation. The escaping line photons resulted in decreased populations of $np\ ^1P$ levels, and indirectly decreased populations of other levels (via radiative decays and collisions). This most strongly affected low- L singlet transitions at densities $\lesssim 10^5\text{ cm}^{-3}$.

We have turned off the process and recalculated our results. Corrections to lines emitted from $np\ ^1P$ levels can be more than an order of magnitude, while lines from $ns\ ^1S$ levels are corrected by up to a factor of ~ 2 . This affected 11 of the 44 lines reported in the supplemental table. Most lines are affected by ~ 1 per cent or less. All line emissivities increase (or are negligibly affected) due to this change.

An additional error was the inadvertent disabling of some collisions with $\Delta n > 5$. This slowed approach to local thermodynamic equilibrium with increasing temperature or density, but the effects are generally comparable to or less than the uncertainties due to collisional rates. This omission has also been corrected here. Line emissivities can both increase and decrease as a result of this change. The behaviour is a function of temperature and density.

Fig. 1 pertained only to fundamental data and not the results of simulations. It is unaffected by the error. Figs 2 and 4 are only weakly affected. The identified trends are unchanged, and reproducing those figures is unnecessary.

Of the six emissivity ratios in Fig. 3, which are re-plotted here, four of them are only weakly affected. The results for $\lambda\lambda 5876$ and 6678 have increased as a result of the changes described here, the latter because its upper level, $3d\ ^1D$, is strongly populated by radiative decays from higher $np\ ^1P$ levels, the former because $3d\ ^1D$ and $3d\ ^3D$ are strongly mixed collisionally. These changes are in the same direction but smaller than the ones reported in the original paper.

We also compared our new emissivities to the full set of Benjamin, Skillman & Smits (1999; hereafter BSS99) results at 10 000 K and $n_e = 100\text{ cm}^{-3}$. The largest difference (~ 6 per cent) is for $\lambda 17003$ and seems to be directly attributable to different absorption oscillator strengths published by Kono & Hattori (1984) and Drake (1996). Only 12 of the remaining 32 emissivities differ by more than 1 per cent – the largest by ~ 3 per cent. The differences are strongly correlated with differences in recombination coefficients. Much larger differences continue to exist at higher densities and temperatures.

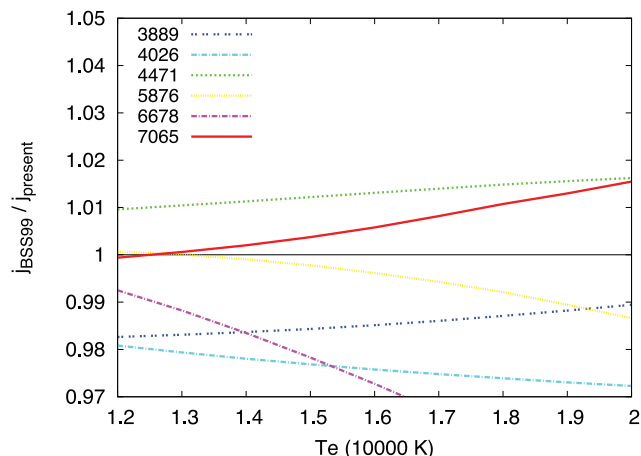


Figure 3. Ratio of BSS99 and present emissivities for several strong lines as a function of temperature with $n_e = 100\text{ cm}^{-3}$.

Table 1 contained a line list and associated level designations and does not require corrections. Table 2 and the supplemental table have been updated.

ACKNOWLEDGEMENTS

The authors thank Yuri Izotov and Manuel Peimbert for separately contacting us about the erroneous results.

REFERENCES

- Benjamin R. A., Skillman E. D., Smits D. P., 1999, ApJ, 514, 307 (BSS99)
 Drake G. W. F., 1996, in Drake G. W., ed., Atomic, Molecular, and Optical Physics Handbook. Am. Inst. Phys., Woodbury
 Kono A., Hattori S., 1984, Phys. Rev. A, 29, 2981

SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article:

Emissivities of He I lines for $5000 \leq T_e \leq 10000\text{ K}$ and $10^1 \leq n_e \leq 10^{14}\text{ cm}^{-3}$. Details contained within supplemental data file (<http://mnrasl.oxfordjournals.org/lookup/suppl/doi:10.1093/mnrasl/slt049/-/DC1>).

Please note: Oxford University Press are not responsible for the content or functionality of any supporting materials supplied by the authors. Any queries (other than missing material) should be directed to the corresponding author for the article.

★E-mail: ryanlporter@gmail.com

Table 2. Emissivities of several He I lines at conditions important for primordial abundance analyses. This table is a small subset of the full results. Values are $4\pi j/n_e n_{\text{He}^+}$ in units of 10^{-25} erg cm³ s⁻¹.

T_e (K)	n_e (cm ⁻³)	3889 Å	4026 Å	4471 Å	5876 Å	6678 Å	7065 Å
10 000	10	1.3897	0.2905	0.6105	1.6838	0.4788	0.2876
11 000	10	1.2987	0.2655	0.5556	1.5162	0.4306	0.2729
12 000	10	1.2201	0.2442	0.5092	1.3767	0.3904	0.2601
13 000	10	1.1513	0.2259	0.4695	1.2589	0.3566	0.2488
14 000	10	1.0906	0.2100	0.4352	1.1582	0.3277	0.2389
15 000	10	1.0365	0.1960	0.4052	1.0712	0.3028	0.2299
16 000	10	0.9880	0.1837	0.3788	0.9954	0.2810	0.2219
17 000	10	0.9442	0.1727	0.3554	0.9287	0.2620	0.2146
18 000	10	0.9044	0.1629	0.3345	0.8697	0.2451	0.2079
19 000	10	0.8680	0.1540	0.3157	0.8172	0.2301	0.2017
20 000	10	0.8347	0.1460	0.2988	0.7701	0.2166	0.1961
10 000	100	1.4005	0.2910	0.6116	1.6872	0.4796	0.2978
11 000	100	1.3115	0.2661	0.5571	1.5240	0.4326	0.2850
12 000	100	1.2349	0.2449	0.5113	1.3889	0.3938	0.2741
13 000	100	1.1681	0.2268	0.4722	1.2755	0.3614	0.2644
14 000	100	1.1092	0.2111	0.4385	1.1792	0.3338	0.2559
15 000	100	1.0568	0.1973	0.4091	1.0964	0.3102	0.2482
16 000	100	1.0098	0.1851	0.3833	1.0245	0.2898	0.2411
17 000	100	0.9673	0.1743	0.3604	0.9616	0.2720	0.2347
18 000	100	0.9286	0.1647	0.3401	0.9061	0.2563	0.2287
19 000	100	0.8933	0.1560	0.3218	0.8571	0.2424	0.2233
20 000	100	0.8609	0.1481	0.3054	0.8133	0.2300	0.2183
10 000	1000	1.4732	0.2939	0.6206	1.7530	0.4969	0.3759
11 000	1000	1.4004	0.2700	0.5698	1.6164	0.4576	0.3775
12 000	1000	1.3393	0.2501	0.5279	1.5090	0.4269	0.3793
13 000	1000	1.2868	0.2333	0.4930	1.4233	0.4027	0.3808
14 000	1000	1.2408	0.2189	0.4635	1.3540	0.3835	0.3815
15 000	1000	1.1998	0.2064	0.4382	1.2970	0.3680	0.3814
16 000	1000	1.1627	0.1955	0.4164	1.2493	0.3554	0.3804
17 000	1000	1.1285	0.1859	0.3973	1.2086	0.3448	0.3785
18 000	1000	1.0969	0.1775	0.3805	1.1740	0.3359	0.3762
19 000	1000	1.0678	0.1700	0.3659	1.1457	0.3284	0.3745
20 000	1000	1.0405	0.1632	0.3528	1.1206	0.3217	0.3721

This paper has been typeset from a \LaTeX file prepared by the author.