Physics of the Interstellar and Intergalactic Medium

Errata in the sixth, seventh, and eighth printings.

Updated 2024.12.08

Bruce T. Draine

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Which printing of the book you have can be determined from the last line on the copyright page:

First printing:	1 3 5 7 9 10 8 6 4 2
Second printing:	3 5 7 9 10 8 6 4 2
Third printing:	3 5 7 9 10 8 6 4
Fourth printing:	5 7 9 10 8 6 4
Fifth printing:	5 7 9 10 8 6
Sixth printing:	7 9 10 8 6
Seventh printing:	7 9 10 8
Eighth printing:	9 10 8
Ninth printing:	9 10

Errata in the sixth, seventh, and eighth printings.

- Plate 5 caption, typo:
  ...seen in Plate 6. $\rightarrow$ ...seen in Plate 4.
  noted 2018.04.07 by L. Bouma.

- §3.8, p. 31, Eq. (3.48), typo: change

  $$I_{n\alpha} \propto A_{n\alpha}h\nu_{n\alpha} \int n[\mathrm{H}(n)]ds \propto n^{-6}b_n \int n_e n(\mathrm{H^+})ds$$

  $$\rightarrow I_{n\alpha} \propto A_{n\alpha}h\nu_{n\alpha} \int n[\mathrm{H}(n+1)]ds \propto n^{-6}b_{n+1} \int n_e n(\mathrm{H^+})ds$$

  noted 2019.02.06

- §7.5, p. 69, Eq. (7.29), typo: missing a factor n_ℓ. Should read

  $$\kappa_\nu = n_\ell \sigma_{\ell \rightarrow u} \left(1 - \frac{n_u/g_u}{n_\ell/g_\ell}\right) < 0$$

  noted 2020.10.12 by Yan Liang.

- §9.8, p. 84, typo in line following Eq. (9.35): change
  $(v_{\mathrm{FWHM}}/2\,\mathrm{km\,s^{-1}})^2/3$ $\rightarrow$ $(v_{\mathrm{FWHM}}/2\,\mathrm{km\,s^{-1}})^{2/3}$.
  noted 2020.09.09 by Roohi Dalal.

- §10.2, sentence preceding Eq. (10.5): change
  ...the Gaunt factor from quantum-mechanical calculations is approximately
  $\rightarrow$
  ...the Gaunt factor is approximately (Scheuer 1960)
  noted 2018.11.18 by S. Weinberg.

- §10.5, p. 97, Eq. (10.25), typo (missing factor of 2): should read

  $$j_{\mathrm{fb},\nu} = \frac{g_\mathrm{b}}{g_e g_i} \frac{2\,h^4\nu^3}{(2\pi m_e kT)^{3/2}c^2}\, \mathrm{e}^{(I_\mathrm{b}-h\nu)/kT}\, \sigma_{\mathrm{b,pi}}(\nu)n_e n_i$$

  noted 2021.02.14 by Shigenobu Hirose.

- §11.4, p. 110, Eq. (11.34), typo (was off by factor 10^4): should read

$$= 6.53 \times 10^{-5} \, \text{arcsec} \left(\frac{D/\,\text{kpc}}{L/10^{14}\,\text{cm}} \right)^{1/2} \frac{(\Delta n_e)_{L,\text{rms}}}{10^{-3}\,\text{cm}^{-3}} \nu_9^{-2}$$

  noted 2021.10.25 by I. Wasserman.

- §14.2.4, p. 145, Eq. (14.13), typo (was off by factor of 10): should read

$$\tau_0(\text{Ly}\alpha) = 8.02 \times 10^3 \left(\frac{15\,\text{km s}^{-1}}{b} \right) \tau(\text{Ly cont})$$

  noted 2024.06.11 by D. Chernoff.

- §14.7.1, p. 156, Eq. (14.21), typo:
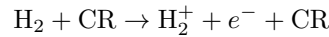 $$\text{H}(^1\text{S}_{1/2}) \;\rightarrow\; \text{H}(^2\text{S}_{1/2})$$
  noted 2022.07.06 by S. R. Kulkarni.

- §15.5, p. 174, sentence preceding Eq. (15.36), typo:
  $N(\text{He}^+)/N(\text{H}^+) < n_\text{H}/n_\text{He}$ $\rightarrow$ $N(\text{He}^+)/N(\text{H}^+) < n_\text{He}/n_\text{H}$
  noted 2020.09.29 by H. Jia

- §16.5, p. 188, Eq. (16.16), typo: should read

$$\text{H}_2 + \text{CR} \rightarrow \text{H}_2^+ + e^- + \text{CR}$$

  noted 2020.09.29 by R. Córdova

- §17.3, p. 195, footnote 3, typos:
  ...frequency $\sim 8 \times 10^{10}$ Hz... $\rightarrow$ ...frequency $\sim 1.1 \times 10^{10}$ Hz...
  ...$\sim 10^2$ precession periods. $\rightarrow$ ...~ 18 precession periods.
  noted 2020.10.02

- §20.1, p. 229, typo just below Eq. (20.2): replace
  ...unit time that level x will... $\rightarrow$ ...unit time the level u will...
  noted 2020.10.12 by Yan Liang

- §22.6, p. 256, footnote 6: the DDSCAT website has moved. Change
  http://code.google.com/p/ddscat $\rightarrow$ http://www.ddscat.org
  noted 2019.03.25

- §23.3.2, p. 268, typo: Si-O-Si bending mode $\rightarrow$ O-Si-O bending mode
  noted 2020.10.12

- §25.3, p. 299, typo following Eq. (25.11): change
  ...charge $Z_\text{gr} = Ua$ can... $\rightarrow$ ...charge $Z_\text{gr} = Ua/e$ can...
  noted 2021.06.25 by Yu Fung Wong.

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- §27.3.1, p 320, typos in coefficient of $\ln(T_4/Z^2)$ term: Eq. (27.19) and (27.20) should read

$$\gamma_A = -1.2130 - 0.0115 \ln(T_4/Z^2) \qquad (27.19)$$
$$\gamma_B = -1.3163 - 0.0208 \ln(T_4/Z^2) \qquad (27.20)$$

and (27.22) and (27.23) should read

$$\langle E_{\rm rr}\rangle_A = \left[0.787 - 0.0115 \ln(T_4/Z^2)\right] kT \qquad (27.21)$$
$$\langle E_{\rm rr}\rangle_B = \left[0.684 - 0.0208 \ln(T_4/Z^2)\right] kT \qquad (27.22)$$

noted 2023.01.29 by S. R. Kulkarni.

- §28.3, p. 328, 4th paragraph, typo: change distance from $\Theta_1 \mathrm{Ori\,C}$ to the Orion Bar ionization front: $\sim 7.8\times10^{18}\,\mathrm{cm}$ $\rightarrow$ $\sim 7.8\times10^{17}\,\mathrm{cm}$
noted 2020.10.26

- §34.4, p. 386, Eq. (34.10): sign mistake on RHS; change

$$-4\pi r^2 \kappa \frac{dT}{dr} \quad \rightarrow \quad 4\pi r^2 \kappa \frac{dT}{dr}$$

noted 2019.04.18 by G. Halevi.

- §37.1, p. 413, 2nd paragraph: Change
Cases of astrophysical interest will normally have..
$\rightarrow$
Many cases of astrophysical interest will have...
noted 2018.04.09.

- §37.1, Eq. (37.8): The correction terms for $u_{\rm R}$, $x_{\rm R}$, $u_{\rm D}$, and $x_{\rm D}$ can be improved by analyzing the full cubic equation (37.3): change

$$u_{\rm R} \approx 2c_2 \quad \rightarrow \quad u_{\rm R} \approx 2c_2 \left[1 - \frac{2c_1^2 - 3v_{A1}^2}{8c_2^2}\right]$$

$$x_{\rm R} \approx \frac{1}{2} + \frac{2c_1^2 + v_{A1}^2}{16c_2^2} \quad \rightarrow \quad x_{\rm R} \approx \frac{1}{2}$$

$$u_{\rm D} \approx \frac{2c_1^2 + v_{A1}^2}{4c_2} \quad \rightarrow \quad \frac{2c_1^2 + v_{A1}^2}{4c_2} \left[1 + \frac{2c_1^2 + v_{A1}^2}{8c_2^2}\right]$$

$$x_{\rm D} \approx \frac{4c_2^2}{2c_1^2 + v_{A1}^2} \quad \rightarrow \quad x_{\rm D} \approx \frac{4c_2^2}{2c_1^2 + v_{A1}^2} \left[1 - \frac{v_{A1}^2}{8c_2^2}\right]$$

noted 2018.02.19 by Woong-Tae Kim.

- §41.1, p. 453, typos: Eq. (41.17) should read

$$
M_{\mathrm{J}} \equiv \frac{4\pi}{3}\rho_0 \left(\frac{\lambda_{\mathrm{J}}}{2}\right)^3 = \frac{\pi}{6}\left(\frac{\pi k T}{G\mu}\right)^{3/2}\frac{1}{\rho_0^{1/2}}
$$
$$
= 1.34\,M_\odot \left(\frac{T}{10\,\mathrm{K}}\right)^{3/2}\left(\frac{m_{\mathrm{H}}}{\mu}\right)^{3/2}\left(\frac{10^6\,\mathrm{cm}^{-3}}{n_{\mathrm{H}}}\right)^{1/2} \quad . \tag{41.17}
$$

noted 2024.07.09 by Zhang Zhijun.

- Appendix B, p. 476: typo: incorrect units for Stefan-Boltzmann constant σ: $5.67040\times10^{-5}\,\mathrm{erg\,s^{-1}\,cm^{-3}\,K^{-4}}$ → $5.67040\times10^{-5}\,\mathrm{erg\,s^{-1}\,cm^{-2}\,K^{-4}}$ noted 2019.05.14 by Aaron Tran.

- Appendix E, p. 485: diagrams for N IV and O V: the levels shown as $^2P_1^o$ and $^2P_2^o$ should be $^3P_1^o$ and $^3P_2^o$, respectively. noted 2023.05.23

- Appendix E, p. 485, diagrams for C III, N IV, and O V: The weak (spin-forbidden magnetic dipole) $^1S_0$-$^3P_2$ transitions were inadvertently omitted. Very weak $^1S_0$-$^3P_0$ transitions occur only if hyperfine-induced by nucleus with nonzero spin (now noted in figure). Corrected figure:

noted 2024.12.06 by S.R. Kulkarni
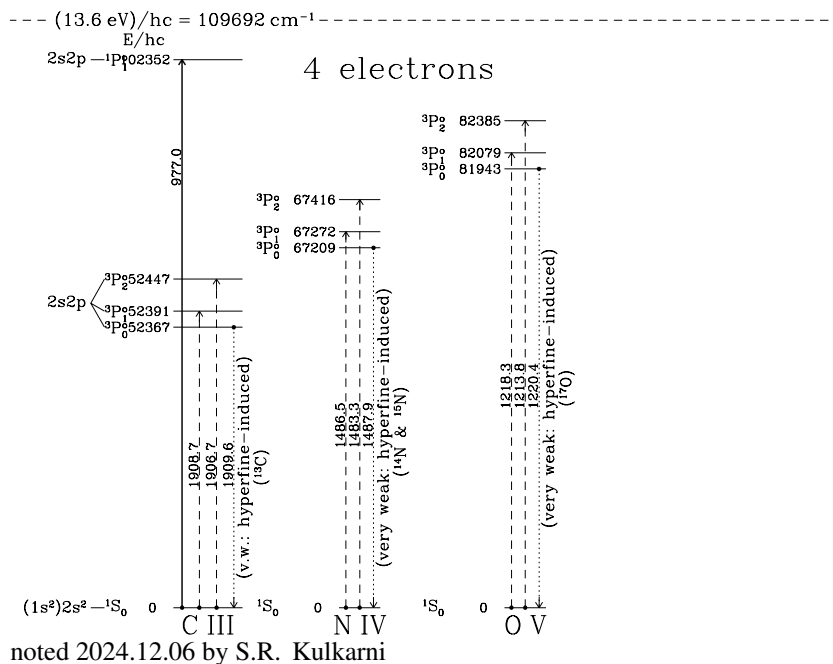
- Appendix E., p. 486: The weak (spin-forbidden magnetic dipole) $^1S_0$-$^3P_2$ transitions were inadvertently omitted. Very weak $^1S_0$-$^3P_0$ transitions can

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occur if hyperfine-induced by nuclei with nonzero spin (now noted in figure). Corrected figure:

noted 2024.12.08

- Appendix E, p. 488: inadvertent omission of $^2P^o_{1/2} \rightarrow {}^2D^o_{5/2}$ emission lines for N I, O II, and Ne IV. Corrected figure:

--- (13.6 eV)/hc = 109692 cm⁻¹ -----------------------------------

7 electrons

N I   O II   Ne IV

noted 2023.04.16 by S.R. Kulkarni.

- Appendix E, p. 494: inadvertent omission of $^1S_0 \rightarrow {}^1D_2$ emission lines for Si I and S III. Corrected figure:

14 electrons

------- (13.6 eV)/hc = 109692 cm⁻¹ ---------

Si I   S III   Ar V

noted 2023.04.16 by S.R. Kulkarni.

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- Appendix F, Table F.5, p. 500: Level u in the fourth line in the table should be $^2\mathrm{P}^o_{3/2}$ rather than $^2\mathrm{P}^o_{5/2}$.
  noted 2022.09.03 by S. R. Kulkarni

- Appendix G, p. 503, typo just before Eq. (G.7): change
  ...solution $x_0 = e^{-i\omega t}$ $\rightarrow$ ...solution $x = x_0 e^{-i\omega t}$.
  noted 2019.02.11

- Appendix I, p. 507, typo (15.78→31.56): Eq. (I.7) should read

$$\frac{Ze^2}{a_0 kT} = \frac{31.56Z}{T_4}$$

noted 2019.01.14.

- Appendix J, p. 510, Eq. (J.8): missing sign:

$$Y_3 = E_{\mathrm{grav}} = \frac{1}{2}\int dV_1 \int dV_2\, G\, \frac{\rho(\mathbf{r}_1)\rho(\mathbf{r}_2)}{|\mathbf{r}_1 - \mathbf{r}_2|}$$

$\rightarrow$

$$Y_3 = E_{\mathrm{grav}} = -\frac{1}{2}\int dV_1 \int dV_2\, G\, \frac{\rho(\mathbf{r}_1)\rho(\mathbf{r}_2)}{|\mathbf{r}_1 - \mathbf{r}_2|}$$

noted 2020.11.13