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# Physics of the Interstellar and Intergalactic Medium

Errata in the fourth and fifth printings.

Updated 2017.03.08

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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
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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

### Errata in the fourth and fifth printings.

- §3.6, p. 28, Eq. 3.31, typo: factor of 2 error. Eq. (3.31) should read

$$\sigma_{rr,ul}(E) = \frac{1}{2} \frac{g(X_\ell)}{g(X_u^+)} \frac{(I_{X,\ell u} + E)^2}{Em_e c^2} \sigma_{pi,\ell u}(h\nu = I_{X,\ell u} + E) \quad , \quad (3.31)$$

noted 2015.06.01 by E. B. Jenkins

- §3.7, p. 28, Eq. (3.33), typo: sign error. Change  $e^{-I_n/kT} \rightarrow e^{I_n/kT}$ .  
noted 2017.02.09

- §13.1, p. 130, second paragraph, typo:  
...to  $3 \times 10^{-10} \text{ s}^{-1}$  for Si  $\rightarrow$  ...to  $3 \times 10^{-9} \text{ s}^{-1}$  for Si  
noted 2017.03.05

- §14.9, p. 159, typo: factor of 2 error. Eq. (14.41) should read

$$\sigma_{rr}(E) = \frac{g_\ell}{2g_u} \frac{(I + E)^2}{Em_e c^2} \sigma_{pi}(h\nu = I + E) \quad . \quad (14.41)$$

noted 2015.06.01 by E. B. Jenkins.

- §14.9, p. 160, typo: factor of 2 error. Eq. (14.43) should read

$$\frac{\langle \sigma v \rangle_{rr}}{\langle \sigma v \rangle_{ci}} \approx 2\pi\alpha^3 \frac{f_{pi}}{C} \frac{I}{kT} e^{I/kT} \quad , \quad (14.43)$$

noted 2015.06.01 by E. B. Jenkins.

- §14.9, p. 160, typo: factor of 2 error. Eq. (14.44) and following should read

$$\frac{I}{kT} e^{I/kT} = \frac{C}{2\pi f_{pi}} \frac{1}{\alpha^3} \quad . \quad (14.44)$$

If  $C \approx 1$  and  $f_{pi} \approx 1$ , this has solution  $I/kT \approx 10.6$ . ...

noted 2015.06.01 by E. B. Jenkins.

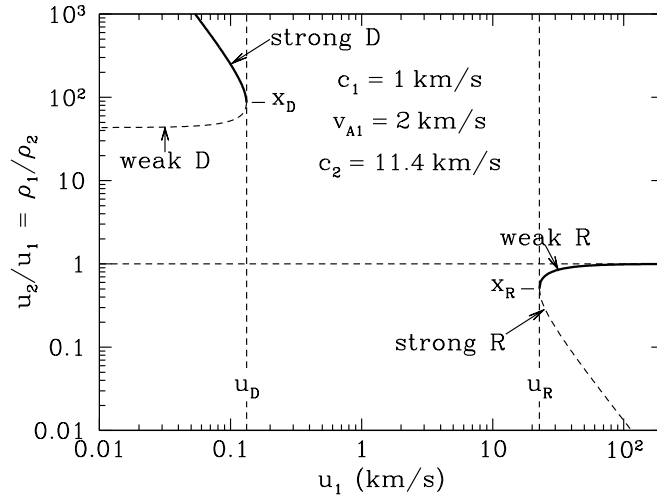
- §28.3, p. 328, 4th paragraph, typo: change distance from  $\Theta_1 \text{ Ori C}$  to the Orion Bar ionization front:  $\sim 7.8 \times 10^{18} \text{ cm} \rightarrow \sim 7.8 \times 10^{17} \text{ cm}$   
noted 2015.04.07

- §32.9, p. 368, just before eq. (32.11), typo: change  
 $A_V/N_H = 1.87 \times 10^{21} \text{ cm}^2 \rightarrow A_V/N_H = 5.3 \times 10^{-22} \text{ mag cm}^2$ .  
noted 2016.03.04 by Ilsang Yoon.
- §32.11, p. 372, prepenultimate paragraph: terminological correction. Change  
“core” to “clump” (three occurrences).  
noted 2015.04.16
- §36.2.3, p. 400, Eq. (36.10):  $v_x$  multiplying  $B_y B_x$  should be  $v_y$ , and  $v_x$   
multiplying  $B_z B_x$  should be  $v_z$ .  
noted 2015.12.17 by J. Miralda-Escudé.  
The equation should read

$$\left\{ \left[ \frac{\rho v^2}{2} + \frac{\gamma p}{(\gamma - 1)} \right] v_x + \frac{(B_y^2 + B_z^2)}{4\pi} v_x - \frac{(B_x B_y v_y + B_x B_z v_z)}{4\pi} - \kappa \frac{dT}{dx} \right\}_1 =$$

$$\left\{ \left[ \frac{\rho v^2}{2} + \frac{\gamma p}{(\gamma - 1)} \right] v_x + \frac{(B_y^2 + B_z^2)}{4\pi} v_x - \frac{(B_x B_y v_y + B_x B_z v_z)}{4\pi} - \kappa \frac{dT}{dx} \right\}_2. \quad (36.10)$$

- §37.1, p. 413, typo just above Eq. (37.3):  
 $Jh\nu/c = \rho_1 u_1 h\nu/\mu_i c \ll \rho_1 (u_1^2 + c_1^2 + B_1^2/8\pi)$ .  
 $\rightarrow$   
 $Jh\nu/c = \rho_1 u_1 h\nu/\mu_i c \ll \rho_1 (u_1^2 + c_1^2) + B_1^2/8\pi$ .  
noted 2016.12.08 by Ryohei Nakatani.
- §37.1 and §37.2, pp. 414-416: the mathematics is correct, but the “weak-type”, and “strong-type” terminology was unfortunately inverted: all occurrences of “weak-type” should be changed to “strong-type”, and vice-versa:
  - §37.1.1, p. 414, first paragraph:  
...are called **strong R-type**. Strong R-type solutions...  
 $\rightarrow$   
...are called **weak R-type**. Weak R-type solutions...
  - §37.1.1, p. 414, second paragraph:  
...referred to as **weak R-type**,...  $\rightarrow$  ...referred to as **strong R-type**,...
  - §37.1.1, p. 414, second paragraph:  
Hence, only strong R-type I-fronts are physically relevant.  
 $\rightarrow$   
Hence, only weak R-type I-fronts are physically relevant.
  - §37.1.2, p. 414, first paragraph:  
...is termed **weak D-type**.  $\rightarrow$  ...is termed **strong D-type**.
  - §37.1.2, p. 414, second paragraph:  
...is termed **strong D-type**.  $\rightarrow$  ...is termed **weak D-type**.
  - Fig. 37.1 and caption should be:



**Figure 37.1**  $u_2/u_1 = \rho_1/\rho_2$ , as a function of the velocity  $u_1$  of the I-front relative to the neutral gas just ahead of the I-front, for D-type and R-type ionization front solutions (see text) for an example with  $c_1 = 1 \text{ km s}^{-1}$ ,  $v_{A1} = 2 \text{ km s}^{-1}$ , and  $c_2 = 11.4 \text{ km s}^{-1}$ . The astrophysically relevant solutions are the strong D-type and weak R-type cases, shown as heavy curves. There are no solutions with  $u_1$  between  $u_D$  and  $u_R$ .

- §37.1, p. 416, first paragraph:  
...will be strong R-type, ... → ...will be weak R-type, ...
- §37.1, p. 417, fourth line:  
...will now be weak D-type, ... → ...will now be strong D-type, ...  
noted 2016.12.06 by Ryohei Nakatani.
- §37.2, p. 418, typos:  
...moving at a speed  $v_s$  that will be close to (just slightly larger than) the speed of the I-front:

$$v_s \approx V_i \quad . \quad (37.21)$$

→

...moving at a speed  $V_s$  that will be close to (just slightly larger than) the speed of the I-front:

$$V_s \approx V_i \quad . \quad (37.21)$$

noted 2016.12.08 by Ryohei Nakatani.

- §38.3, p. 428, last paragraph, typo:  
 $\dot{M}_w \approx 2 \times 10^{-5} \text{ km s}^{-1} \rightarrow \dot{M}_w \approx 2 \times 10^{-5} M_\odot \text{ yr}^{-1}$   
noted 2015.12.17 by J. Miralda-Escudé.

- §41.3, p. 456, typo: missing factor of  $G$ . Eq. (41.36) should read

$$E_{\text{grav}} = -\frac{G}{2} \int dV_1 \int dV_2 \frac{\rho(\mathbf{r}_1)\rho(\mathbf{r}_2)}{|\mathbf{r}_1 - \mathbf{r}_2|} \quad (41.36)$$

noted 2015.04.30 by J. Greco.

- Appendix D, p. 481: corrected typos:

F VI → VII:  $I = 147.163 \rightarrow 157.163$

Ne VI → VII:  $I = 154.214 \rightarrow 157.934$

Ti III → IV:  $I = 24.492 \rightarrow 27.492$

Ti V → VI:  $I = 123.7 \rightarrow 99.299$

Zn VI → VII:  $I = 133.903 \rightarrow 108.0$

noted 2015.07.10 by Guangtun Ben Zhu.

- Appendix F, Table F.2, p. 497, typo: the first transition listed for S III: change  $^3\text{P}_0 - ^1\text{P}_0 \rightarrow ^3\text{P}_0 - ^3\text{P}_1$

noted 2016.10.03 by C.D. Kreisch.

- Appendix F, Table F.6, p. 501: The table title should be

“Rate Coefficients for ... Deexcitation...” rather than “... Excitation...”.

noted 2015.07.03

- Appendix F, Table F.6, p. 501: the rates for entries 5 and 6 should be interchanged, so that entries 4-6 read

H	CI	$^3\text{P}_0 - ^3\text{P}_1$	$1.26 \times 10^{-10} T_2^{0.115+0.057 \ln T_2}$	<i>b</i>
H	CI	$^3\text{P}_0 - ^3\text{P}_2$	$8.90 \times 10^{-11} T_2^{0.228+0.046 \ln T_2}$	<i>b</i>
H	CI	$^3\text{P}_1 - ^3\text{P}_2$	$2.64 \times 10^{-10} T_2^{0.231+0.046 \ln T_2}$	<i>b</i>

noted 2015.07.03 by Munan Gong.

- Appendix F, Table F.6, p. 501: the rates for entries 23-28 should be changed to

H <sub>2</sub> (para)	OI	$^3\text{P}_2 - ^3\text{P}_1$	$1.49 \times 10^{-10} T_2^{0.369-0.026 \ln T_2}$	<i>h</i>
H <sub>2</sub> (ortho)	OI	$^3\text{P}_2 - ^3\text{P}_1$	$1.37 \times 10^{-10} T_2^{0.395-0.005 \ln T_2}$	<i>h</i>
H <sub>2</sub> (para)	OI	$^3\text{P}_2 - ^3\text{P}_0$	$2.37 \times 10^{-10} T_2^{0.255+0.016 \ln T_2}$	<i>h</i>
H <sub>2</sub> (ortho)	OI	$^3\text{P}_2 - ^3\text{P}_0$	$2.23 \times 10^{-10} T_2^{0.284+0.035 \ln T_2}$	<i>h</i>
H <sub>2</sub> (para)	OI	$^3\text{P}_1 - ^3\text{P}_0$	$2.10 \times 10^{-12} T_2^{1.117+0.070 \ln T_2}$	<i>h</i>
H <sub>2</sub> (ortho)	OI	$^3\text{P}_1 - ^3\text{P}_0$	$3.00 \times 10^{-12} T_2^{0.792+0.188 \ln T_2}$	<i>h</i>

noted 2015.08.24 by E.B. Jenkins.

- Appendix J, p. 510, Eq. (J.13), typo:

$$\Pi_0 \equiv \oint d\mathbf{S} \cdot \mathbf{r}p \quad \rightarrow \quad \Pi_0 \equiv \frac{1}{3} \oint d\mathbf{S} \cdot \mathbf{r}p$$

noted 2017.03.08.