Errata for Quantum Mechanics

by Ernest Abers

Serious Errata as of January 1, 2007 (1st and 2nd printings)

Chapter III

- Page 80, Equation (3.114): In the middle two expressions (but not in the other two) the subscript $l-1$ should be just l:

$$\begin{aligned} H|E_{l,l-1},l,l-1\rangle &= \frac{1}{\sqrt{2l}} HL_-|E_{l,l},l,l\rangle \\ &= \frac{1}{\sqrt{2l}} L_- H|E_{l,l},l,l\rangle = E_l|E_{l,l-1},l,l-1\rangle \end{aligned} \tag{3.114}$$

  [Thanks to J. May, 11/09/2004]

- Page 81, Equation (3.l22): Replace r in the exponent by ϕ:

$$\psi_{Elm}(\mathbf{r}) = F(r,\theta)e^{im\phi} = R_{Elm}(r)Y_l^m(\theta,\phi) \tag{3.122}$$

  [Thanks to J. deGrassie, 11/01/2004]

- Page 82, Equation (3.128): "$R_{El}(r)$" should be "$R_{El}(r)^2$":

$$\int_0^\infty R_{El}(r)^2 r^2 dr = 1 \tag{3.128}$$

  [Thanks to J. Wright, 11/14/2005]

- Page 84, Equation (3.137): The last term should be Ze^2/r:

$$H = \frac{\mathbf{p}^2}{2m} - \frac{Ze^2}{r} \tag{3.137}$$

  [Thanks to K. Lane, 10/23/2003]

- Page 90, Equation (3.172): Change m to M in the equation and in the next line:

$$n - l - 1 = M \tag{3.172}$$

  for some nonnegative integer M.

  [Thanks to K. Lane, 10/23/2003]

Chapter VI

- Page 175, Equation (6.29): L_z should be H_2:

$$H_1|N,k\rangle = (N+1)\omega|N,k\rangle \qquad \text{and} \qquad H_2|N,k\rangle = \frac{eB}{|eB|}\omega k|N,k\rangle \tag{6.29}$$

  [Thanks to Y. Guo, 3/16/2006]

- Page 181, just above Equation (6.68): Replace "traceless Hermitean matrix" with "Hermitean matrix with unit trace."

  Here the density matrix is a 2×2 Hermitean matrix with unit trace.
  [Thanks to T. Tao, 2/15/2005]

- Page 186, just above Equation (6.98): The sentence in parentheses should't be there. [It would be true if $\nu_\mu \to \nu_e + \gamma$ were possible, and the states ν_e and ν_μ would not need to be orthogonal if $\mathrm{e} \to \mu + \gamma$ were possible, but as written it is certainly false.]

  Let $|\nu_1\rangle$ and $|\nu_2\rangle$ be the neutrino states with definite energy, normalized and orthogonal. Then
  [Thanks to T. Bodiya, 2/06/2005]

- Page 187: At some point I changed the sign of ω in about half the places it occurs, so that the argument became incomprehensible. Section 6.3 really needs to be rewritten, but several changes in this and the next three pages should fix it up: Just below Equation (6.100) change "In this basis" to "In Equation". In Equation (6.102) the middle expression should be preceded by a minus sign. At the end of the following sentence, change "$\omega\sigma_3$" to "$-\omega\sigma_3$". Just below Equation (6.104) change "In this basis" to "In Equation". In Equation (6.105), in the third expression delete the minus sign in the exponent, and in the last expression change minus to plus. In the line below Equation (6.105) change "$n_x = \sin 2\theta$" to "$n_x = -\sin 2\theta$". And in Equation (6.107) interchange "1" and "2" in the first two expressions:

  In Equation (6.100)...

$$\omega = -\frac{1}{2}\mathrm{Tr}\ \big(\sigma_3 H\big) = \frac{E_2 - E_1}{2} \tag{6.102}$$

  E_o is an overall constant energy that has no observable consequences, so redefine the Hamiltonian to be a traceless matrix $H = -\omega\sigma_3$.....

  In Equation (6.104)...

$$\psi(t) = \begin{pmatrix}\psi_{\nu_\mu}(t)\\ \psi_{\nu_\tau}(t)\end{pmatrix} = e^{-iHt}\psi(0) = e^{i\omega\hat{\boldsymbol{n}}\cdot\boldsymbol{\sigma}t}\psi(0) = \big[\cos\omega t + i\sin\omega t\,\hat{\boldsymbol{n}}\cdot\boldsymbol{\sigma}\big]\,\psi(0) \tag{6.105}$$

  where $n_x = -\sin 2\theta$, $n_y = 0$, and $n_z = \cos 2\theta$...

$$E_2 - E_1 = \sqrt{p^2 + m_2^2} - \sqrt{p^2 + m_1^2} = \frac{\Delta m^2}{2p} + \cdots \tag{6.107}$$

  [1/27/2005]

- Page 189, Equation (6.104′): The last expression should be preceded by a minus sign:

$$H = -\omega \begin{pmatrix} \cos 2\theta & -\sin 2\theta \\ -\sin 2\theta & -\cos 2\theta \end{pmatrix} = -\omega \left[\cos 2\theta \sigma_3 - \sin 2\theta \sigma_1 \right] \tag{6.104′}$$

[Thanks to D. Matlock, 1/27/2005]

- Page 190: Change the last word on page 189 to "switch". The sentence fragment at the top of page 190 should read "identitles (and momentum) by exchanging a W^- boson." In the second line,"electroweak" is one word. The section referred to in the paragraph above Equation (6.119) should be "6.3.2". In that Equation (6.119) replace "H_m" by $(H_m)_{diag}$ and insert a minus sign before "ω_m".

...The ν_e and the electron can switch identities (and momentum) by exchanging a W^- boson. The amplitude for this term can be computed exactly from electroweak theory, and...

The computation is identical to the one in Section (6.3.2)...

$$(H_m)_{diag} = -\omega_m \sigma_3 \tag{6.119}$$

[1/27/2005]

- Page 190, in the sentence below Equation (6.122) replace $\pi/2$ with $\pi/4$:

The formula for the mixing angle in matter has a maximum ($\theta_m = \pi/4$) when the denominator
[Thanks to Y. Guo, 3/16/2006]

Chapter VII

- Page 204, Equation (7.18): $|\psi_m^o\rangle$ should be $|\psi_m\rangle$.

$$\langle \psi_n^o | \, \psi_m \rangle = \delta_{mn} \tag{7.18}$$

[2/01/2006]

- Page 215, Equation (7.77): On the left, replace "V^2" by "$1/r^2$" and on the right, the numerator should be 1. In Equation (7.78), in the denominator, replace "α" by "a":

$$\left\langle \Phi_{jm}^{nl} \middle| \frac{1}{r^2} \middle| \Phi_{jm}^{nl} \right\rangle = \frac{1}{a^2 n^3 (l + \frac{1}{2})} \tag{7.77}$$

the expectation value of V^2 is

$$\left\langle \Phi_{jm}^{nl} \right| V^2 \left| \Phi_{jm}^{nl} \right\rangle = \frac{\alpha^2}{a^2 n^3 \left(l + \frac{1}{2}\right)} \tag{7.78}$$

[2/02/2005]

- Page 227, second line below Equation (7.139): replace "is positive" with "is greater than the ground-state energy of a He^+ ion."

  the expectation value of the Hamiltonian is greater than the ground-state energy of a He^+ ion;
  [Thanks to Y. Guo, 3/15/2006]

- Page 238, in the paragraph between Equations (7.205) and (7.206): Change $S'(x)/S(x)$ to $S''(x)/S'(x)^2$:

  the fractional change in wavelength over one wavelength should be small: $\left|S''(x)/S'(x)^2\right| \ll 1$.
  [1/15/2006]

- Page 238, first paragraph of subsection 7.7.1, replace "$V(x) < a$" and "$V(x) > a$" respectively by "$V(x) < E$" and "$V(x) > E$":

  Let a be a "turning point" of the classical motion, a point where $V(a) = E$, and suppose that $V(x)$ has a negative slope at $x = a$, so that $V(x) < E$ for $x > a$ and $V(x) > E$ for $x < a$.

  [Thanks to Y. Guo, 2/27/2006]

- Page 242, below Equation (7.239), replace "large positive x" with " $x \gg a$" and below Equation (7.240) replace "large negative x" with "$x \ll a$". In Equations (7.240) and (7.241), replace $(2m\beta)^{-1/6}$ by $(2m\beta)^{1/6}$. And in Equation (7.241) the lower and upper limits on the integrals should be x a respectively, and the minus sign belongs in the C_A term:[1]

  For $x \gg a$, this is

$$\psi(x) \underset{x\to+\infty}{\longrightarrow} \frac{1}{\sqrt{\pi}}(2m\beta)^{\frac{1}{6}}\frac{1}{\sqrt{k(x)}} \times \left[C_A \cos\left(\int_a^x k(x')dx' - \frac{\pi}{4}\right) - C_B \sin\left(\int_a^x k(x')dx' - \frac{\pi}{4}\right)\right] \tag{7.240}$$

  while for $x \ll a$, it is

$$\psi(x) \underset{x\to-\infty}{\longrightarrow} \frac{1}{\sqrt{\pi}}(2m\beta)^{\frac{1}{6}}\frac{1}{\sqrt{\kappa(x)}} \times \left[\frac{1}{2}C_A \exp\left(-\int_x^a \kappa(x')dx'\right) + C_B \exp\left(\int_x^a \kappa(x')dx'\right)\right] \tag{7.241}$$

  [Thanks to Y. Guo, 2/27/2006]

[1] The form is not unique, but this choice makes all the integrals positive.

- Page 243, Equations (7.243) and (7.244) replace $(2m\beta)^{-1/6}$ by $(2m\beta)^{1/6}$

$$C' = \frac{1}{\sqrt{\pi}}(2m\beta)^{\frac{1}{6}}C_A \qquad \text{and} \qquad D' = -\frac{1}{\sqrt{\pi}}(2m\beta)^{\frac{1}{6}}C_B \tag{7.243}$$

$$A = \frac{1}{\sqrt{\pi}}(2m\beta)^{\frac{1}{6}}C_B \qquad \text{and} \qquad B = \frac{1}{2}\frac{1}{\sqrt{\pi}}(2m\beta)^{\frac{1}{6}}C_A \tag{7.244}$$

  [Thanks to Y. Guo, 2/27/2006]

- Page 249, Problem 7.4: "$\delta(x)$" is missing on the right-hand side of the equation:

$$H' = \beta E_o a \delta(x)$$

  [Thanks to A. Young, 2/08/2005]

- Page 252, Problem (7.8) part (d), just below the equation, replace "$V(\mathbf{r})/r_i^2$" with "$\partial^2 V(0)/\partial r_i^2$":

  and express a and b in terms of the constant c and $\partial^2 V(0)/\partial r_i^2$. What are the eigenvalues and...
  [Thanks to L. Fredrickson and E. Hemsing, 2/14/2005]

- Page 255, Problem 7.12, last line part (b): change "$m' = m = 1$" to "$m' = m = 0$"

  and choose $m' = m = 0$ and $i = j = 3$.
  [Thanks to Y. Wang, 3/20/2006]

Chapter VIII

- Page 272, seventh line in the first paragraph: Replace "destructively" with "constructively":

  That is the point where all the "wavelets" interfere constructively.
  [Thanks to K. Lane, 2/14/2005]

- Page 273, Equation (8.56): In the second line, second term inside the large parentheses, move the asterisk from χ to ϕ. In the fourth line, first expression, second term inside the parentheses, change plus to minus:

$$\begin{aligned}
\frac{k\sigma_{tot}}{(2\pi)^3} &= -\mathrm{Im}\int\left(\phi^*(\frac{\partial\chi}{\partial r}) + \chi^*(\frac{\partial\phi}{\partial r})\right) r^2 d\Omega \\
&= -\mathrm{Im}\int\left(\phi^*(\frac{\partial\chi}{\partial r}) - \chi(\frac{\partial\phi^*}{\partial r})\right) r^2 d\Omega \\
&= -\mathrm{Im}\int\left(\phi^*(\frac{\partial\psi}{\partial r}) - \psi(\frac{\partial\phi^*}{\partial r})\right) r^2 d\Omega \\
&= -\mathrm{Im}\int (\phi^*\boldsymbol{\nabla}\psi - \psi\boldsymbol{\nabla}\phi^*)\cdot\hat{\boldsymbol{n}}dS = -\mathrm{Im}\int\left(\phi^*\boldsymbol{\nabla}^2\psi - \psi\boldsymbol{\nabla}^2\phi^*\right)d^3r \\
&= -\mathrm{Im}\int \phi^*(r)U(r)\psi(r)d^3r = \frac{1}{2\pi^2}\mathrm{Im}\, f(0)
\end{aligned} \tag{8.56}$$

  [Thanks to M. Gutperle, 5/05/2004]

- Page 280, Equation (8.97): Change the last r to r', and move the asterisk to after the second Y_l^m factor. In Equation (8.98), change the arguments of the first Y_l^m to (θ', ϕ'). In Equation (8.99) second line, change $\hat{\boldsymbol{n}}$ to θ', ϕ', and change $\hat{\boldsymbol{n}}_z$ to $0, \phi$:

$$\phi_{\mathbf{k}'}(\mathbf{r}') = \frac{4\pi}{(2\pi)^{\frac{3}{2}}} \sum_{l,m} i^l Y_l^m(\theta, \phi) Y_l^m(\theta', \phi')^* j_l(kr') \tag{8.97}$$

and

$$\psi_{\mathbf{k}}(\mathbf{r}') = \frac{4\pi}{(2\pi)^{\frac{3}{2}}} \sum_{l,m} i^l Y_l^m(\theta', \phi')^* Y_l^m(0, \phi) R_l(r') \tag{8.98}$$

Therefore the scattering amplitude is

$$\begin{aligned} f(\theta, \phi) = -4\pi \int & \left(\sum_{l,m} (-i)^l Y_l^m(\theta, \phi)^* Y_l^m(\theta', \phi') j_l(kr') \right) \\ & \times U(r') \left(\sum_{l'} i^{l'} Y_{l'}^o(\theta', \phi') R_{l'}(r') Y_{l'}^o(0, \phi) \right) r'^2 dr' d\Omega' \qquad (8.99) \\ & = -\int_0^\infty \left[\sum_l (2l+1) j_l(kr') U(r') R_l(r') P_l(\cos\theta) \right] r'^2 dr' \end{aligned}$$

[Thanks to M. Gutperle, 5/05/2004]

- Page 280, Equation (8.100): On the left, k should be the denominator of all the rest, not just δ_l:

$$\frac{e^{i\delta_l} \sin\delta_l}{k} = -\int_0^\infty j_l(kr) U(r) R_l(r) r^2 dr \tag{8.100}$$

[Thanks to M. Gutperle, 5/05/2004]

- Page 287, Line 5: "23" should be just "3":

... the cross section at $k = 0$ would indeed be about $3 \times 10^{-24}\,\mathrm{cm}^2$.
[3/09/2005]

Chapter IX

- Page 289, Equation (9.10), second line: $4m^2$ in denominator should be just m^2.

$$\begin{aligned} P_b(t) &\approx |V_{ba}|^2 \left| \frac{e^{i(\omega_{ba}-\omega)t} - 1}{\omega_{ba} - \omega} \right|^2 \\ &= \frac{\alpha}{m^2} A_o^2 \left| \langle \psi_b | \, \mathbf{p} \cdot \hat{\boldsymbol{\varepsilon}} e^{-i\mathbf{k}\cdot\mathbf{r}} \, | \psi_a \rangle \right|^2 \left| \frac{\sin(|\omega_{ba}| - \omega)t/2}{|\omega_{ba}| - \omega} \right|^2 \end{aligned} \tag{9.10}$$

[5/11/2004]

- Page 290, Equation (9.14): Delete the "4" in the denominator.:

$$P(t) = \frac{\alpha}{m^2}\int_0^\infty \frac{8\pi}{\omega^2}\rho(\omega)\left|\left\langle\psi_b\right|\mathbf{p}\cdot\hat{\boldsymbol{\varepsilon}}e^{-i\mathbf{k}\cdot\mathbf{r}}\left|\psi_n\right\rangle\right|^2\left|\frac{\sin\left[(|\omega_{ba}|-\omega)t/2\right]}{|\omega_{ba}|-\omega}\right|^2 d\omega \tag{9.14}$$

  [Thanks to Y. Guo, 5/01/2006]

- Page 290, Equation (9.16): Replace $4m^2$ by m^2 and $8\pi^2$ by $4\pi^2$.

$$P(t) \underset{t\to\infty}{\longrightarrow} \frac{\alpha}{m^2}\frac{4\pi^2}{\omega_{ba}^2}\rho(\omega_{ba})\left|\left\langle\psi_b\right|\mathbf{p}\cdot\hat{\boldsymbol{\varepsilon}}e^{-i\mathbf{k}\cdot\mathbf{r}}\left|\psi_n\right\rangle\right|^2 t \tag{9.16}$$

  [5/11/2004]

- Page 291, Equation (9.18): Replace $e^{i\mathbf{k}\cdot\mathbf{r}}$ by $e^{-i\mathbf{k}\cdot\mathbf{r}}$:

$$\left\langle\psi_b\right|\hat{\boldsymbol{\varepsilon}}\cdot\mathbf{p}e^{-i\mathbf{k}\cdot\mathbf{r}}\left|\psi_a\right\rangle \approx -im\hat{\boldsymbol{\varepsilon}}\cdot\langle\psi_b|\left[\mathbf{r},H_o\right]|\psi_a\rangle \tag{9.18}$$

  [5/11/2004]

- Page 291, Equation (9.17): Replace $4m^2$ by m^2 and $8\pi^2$ by $4\pi^2$.

$$\boxed{\Gamma_b = \frac{\alpha}{m^2}\frac{4\pi^2}{\omega_{ba}^2}\rho(\omega_{ba})\left|\left\langle\psi_b\right|\mathbf{p}\cdot\hat{\boldsymbol{\varepsilon}}e^{-i\mathbf{k}\cdot\mathbf{r}}\left|\psi_n\right\rangle\right|^2} \tag{9.17}$$

  [5/11/2004]

- Page 291, in the line just above Equation (9.21): Change θ to $\cos^2\theta$. In Equation (9.21) change $\cos\theta$ to $\cos^2\theta$:

  where θ is the angle between the constant vector $\mathbf{r}$ and the polarization. If the radiation is unpolarized and isotropic, just replace $\cos^2\theta$ by its average value:

$$\cos^2\theta \to \frac{1}{4\pi}\int\cos^2\theta\, d\Omega = \frac{1}{3} \tag{9.21}$$

  [Thanks to K. Lane, 2/21/2004]

- Page 304, Equation (9.90): Change the left hand side to $\langle\phi_b|\,T\,|\phi_a\rangle$:

$$\langle\phi_b|\,T\,|\phi_a\rangle = \delta_3\left(\mathbf{K}'-\mathbf{K}\right)\left\langle\phi_b\right|\bar{T}\left|\phi_a\right\rangle \tag{9.90}$$

  [Thanks to K. Lane, 2/21/2004]

- Pages 304-305, In equations (9.90) through (9.95), and in the sentence below Equation (9.91), change T' to T everywhere.
  [Thanks to K. Lane, 3/01/2004]

- Page 306, Equation (9.103). In the first line exchange $\mathbf{r}_1$ and $\mathbf{r}_2$ in the exponent. In the second line change the sign of the exponent:

$$\begin{aligned} H'_{ba,2} &= \pm\frac{1}{2}\frac{1}{(2\pi)^6}\int V(|\mathbf{r}_1-\mathbf{r}_2|)e^{i(\mathbf{k}_2-\mathbf{k}'_1)\cdot\mathbf{r}_2}e^{i(\mathbf{k}_1-\mathbf{k}'_2)\cdot\mathbf{r}_1}\,d^3r_1\,d^3r_2 \\ &= \pm\frac{1}{2}\frac{1}{(2\pi)^3}\int V(r)e^{i(\mathbf{k}+\mathbf{k}')\cdot\mathbf{r}}\delta_3\left(\mathbf{K}-\mathbf{K}'\right)d^3r \end{aligned} \tag{9.103}$$

[Thanks to K. Lane, 3/01/2004]

- Page 307: In equation (9.104) delete the delta function $\delta_3\left(\mathbf{K}-\mathbf{K}'\right)$ in the first line. Change T to $\bar{T}$ everywhere in (9.104) and (9.105). And replace p by k in these and the next two equations:

$$\begin{aligned} \bar{T}_{\text{direct}}(\omega_a,\theta,\phi) &= \frac{1}{(2\pi)^3}\int V(r)e^{i(\mathbf{k}-\mathbf{k}')\cdot\mathbf{r}}d^3r \\ &= \frac{e^2}{2\pi^2q^2} = \frac{e^2}{4\pi^2k^2(1-\cos\theta)} = \frac{\alpha}{8\pi^2k^2\sin^2(\theta/2)} \end{aligned} \tag{9.104}$$

$$\begin{aligned} \bar{T}_{\text{exchange}}(\omega_a,\theta,\phi) &= \bar{T}_{\text{direct}}(\omega_a,\pi-\theta,\phi+2\pi) \\ &= \frac{e^2}{16\pi^2k^2\cos^2(\theta/2)} = \frac{\alpha}{8\pi^2k^2\cos^2(\theta/2)} \end{aligned} \tag{9.105}$$

$$\begin{aligned} \frac{d\sigma}{d\Omega} &= (2\pi)^4\mu^2\frac{\alpha^2}{64\pi^4k^4}\left|\frac{1}{\sin^2(\theta/2)}\pm\frac{1}{\cos^2(\theta/2)}\right|^2 = \frac{\alpha^2\mu^2}{4k^4}\left|\frac{1}{\sin^2(\theta/2)}\pm\frac{1}{\cos^2(\theta/2)}\right|^2 \\ &= \frac{\alpha^2\mu^2}{4k^4}\left(\frac{1}{\cos^4(\theta/2)}+\frac{1}{\sin^4(\theta/2)}\pm 2\frac{1}{\sin^2(\theta/2)}\frac{1}{\cos^2(\theta/2)}\right) \end{aligned} \tag{9.106}$$

$$\left(\frac{d\sigma}{d\Omega}\right)_{\text{unpolarized}} = \frac{\alpha^2\mu^2}{4k^4}\left(\frac{1}{\sin^4(\theta/2)}+\frac{1}{\cos^4(\theta/2)}-\frac{1}{\sin^2(\theta/2)}\frac{1}{\cos^2(\theta/2)}\right) \tag{9.107}$$

[3/20/2004]

- Page 312, Equation (9.132): On the left, change ω' to ω'_a. On the right, change the denominator to $\omega_b-\omega_a$. In Equation (9.133) replace ω by ω_b. In the text below Equation (9.134) delete "with $\omega'_a = \mathrm{Re}\,\omega'$ above":

$$\omega'_a = \omega_a + H'_{aa} + \mathrm{Re}\sum_{b\neq a}|H'_{ba}|^2\frac{1}{\omega_b-\omega_a}+\cdots \tag{9.132}$$

$$-\pi\sum_{b\neq a}|H'_{ba}|^2\delta\left(\omega_b-\omega_a\right) = -\Gamma/2 \tag{9.133}$$

$$G(\omega)_{aa} = \frac{1}{\omega-\omega'_a+i\Gamma/2} \tag{9.134}$$

Evidently $T(\omega)$ has a singularity in the lower half plane,
[3/20/2004]

- Page 313: The whole paragraph containing Equation (9.139) should be on the next page, at the end of Section 9.4.2.
  [3/14/2005]

- Page 323, Problem 9.10, Part (c): In the unnumbered equation, replace "$\alpha + \beta + \gamma$" with "$\alpha^2 + \beta^2 + \gamma^2$":

$$\alpha^2 + \beta^2 + \gamma^2 = 1$$

  [5/05/2005]

Chapter X

- Page 334, Equation (10.71): Replace dy with $\mathcal{D}y$, and insert 1/2 between the minus sign and the integral. And in Equation (10.74), in the exponent at the far right, replace $V''(0)T/2m$ with $\sqrt{V''(0)/m}T/2$:

$$K_E(q_b, T; q_a, 0) \approx \int \mathcal{D}y \exp\left[-\frac{1}{2}\int_0^T y(w)\left(-m\frac{d^2}{dw^2} + V''(0)\right)y(w)dw\right] \qquad (10.71)$$

.....

$$\lim_{T\to\infty} K_E(q_b, T; q_a, 0) \approx K_o \frac{1}{\sqrt{\sinh V''(0)T/m}} \sim e^{-\sqrt{(V''(0)T/m)}/2} \qquad (10.74)$$

  [Thanks to Y. Guo, 5/22/2006]

- Page 340, Figure 10.1. The arcs should form a circle, whose center is at the base of the arrow. [Some glitch is a graphics program printed some of the arcs in the wrong place.]
  [7/31/2003]

Chapter XI

- Page 377, Equation (11.119): Replace 2^5 by 2^6, and therefore replace 9.49×10^{-31} by 1.87×10^{-30} and replace 1.44×10^{-15} by 2.84×10^{-15}. The the next line needs to read "The lifetime is 3.53×10^{14} seconds, over 100,000 centuries....". Also, delete Equation (11.117e) – there is nothing there:

  The $J = 0$ state is

$$\frac{\left|\frac{1}{2}, -\frac{1}{2}\right\rangle - \left|-\frac{1}{2}, \frac{1}{2}\right\rangle}{\sqrt{2}} \qquad M = 0 \qquad (11.117d)$$

$$\Gamma = \frac{2^6}{3^4}\alpha^{13} g_p^3 (m/M)^3 m = 1.87 \times 10^{-30}\text{eV} = 2.84 \times 10^{-15}\,\text{sec}^{-1} \qquad (11.119)$$

  The lifetime is 3.53×10^{14} seconds, over 100,000 centuries. It should be clear
  [Thanks to K. Lane, 3/19/2004]

- Page 385, Equation (11.170): E_i should be E_o, and the exponent is $-7/2$:

$$\frac{d\sigma}{d\Omega_f} = 32\alpha \sin^2\theta a^2 \left(\frac{E_o}{\omega}\right)^{\frac{7}{2}} \tag{11.170}$$

  [Thanks to V. Teplitz, 4/20/2006]

Chapter XII

- Page 411, Equation (12.32): Insert an i before each summation symbol:

$$[X_i, X_j] = i\sum_k \epsilon_{ijk} X_k \qquad [Y_i, Y_j] = i\sum_k \epsilon_{ijk} Y_k \qquad [X_i, Y_j] = 0 \tag{12.32}$$

  [5/04/2005]

- Page 416, Equation (12.66), replace $\mathbf{L}^2$ with $\mathbf{L}^2/r^2$:

$$\boldsymbol{\nabla}^2 = \frac{1}{r^2}\frac{\partial}{\partial r}r^2\frac{\partial}{\partial r} - \frac{\mathbf{L}^2}{r^2} \tag{12.66}$$

  [Thanks to S. Lake, 5/03/2006]

- Page 429, Equation(12.157): Change the sign of the last term:

$$\left(\frac{1}{2mr^2}\frac{\partial}{\partial r}r^2\frac{\partial}{\partial r} - \frac{1}{2mr^2}M + \frac{E\alpha}{mr} + \frac{E^2 - m^2}{2m}\right)\psi(\mathbf{r}) = 0 \tag{12.157}$$

  [5/15/2006]

- Page 429, Equation (12.162): On the right-hand side, there should be a "$2m$" in the denominator, and no m in the numerator

$$\frac{E^2 - m^2}{2m} = -\frac{E^2\alpha^2 m}{2m(n' + l' + 1)^2} \tag{12.162}$$

  [5/16/2005]

Chapter XIII

- Page 447, Equation (13.73). In each of the last two terms there is an extra b_i.

$$|\psi_o\rangle = \prod_i b_i^\dagger \Theta\left(E_F - \epsilon_i\right)|\rangle = \prod_i b_i^\dagger \Theta\left(p_F - |\mathbf{p}_i|\right)|\rangle \tag{13.73}$$

  [Thanks to A. Tableman, 5/30/2006]

- Page 468: Problem 13.6 is garbled. The first full sentence after Equation (13.198) should be in part (b), and the next sentence should be omitted. Also, the first sentence after (13.199) should be omitted:

  (a) Compute the single particle correlation function

$$C_r(|\mathbf{r}-\mathbf{r}'|) = \left\langle N_o \right| \Psi_r^\dagger(\mathbf{r})\Psi_r(\mathbf{r}') \left| N_o \right\rangle$$

  as a function of ρ, p_F, and the distance $|\mathbf{r}-\mathbf{r}'|$.
  (b) For the same state, work out the pair correlation function

$$C_{rs}(|\mathbf{r}-\mathbf{r}'|) = \left\langle N_o \right| \Psi_r^\dagger(\mathbf{r})\Psi_s^\dagger(\mathbf{r}')\Psi_s(\mathbf{r}')\Psi_r(\mathbf{r}) \left| N_o \right\rangle$$

  Work out the cases $r = s$ and $r \neq s$ separately. Show that for equal spins, this correlation function vanishes as $\mathbf{r} \to \mathbf{r}'$. At what separation does the correlation function first reach a maximum?

  [5/28/2006]