Errata for Fundamentals of Stellar Astrophysics
Circa 3/23/91

Page numbers referred to here are those of the book

- Page 28: The exponent on h in the last term should be 2

$$P = \frac{1}{3}\int_0^{p_0} \frac{p^2}{m} n(p)dp = \frac{1}{3}\int_0^{p_0}\left(\frac{8\pi p^2}{h^3}\right)dp = \frac{8\pi p_0^5}{15mh_3} = \frac{h^2}{20m}\left(\frac{3}{\pi}\right)^{2/3} n^{5/3} \tag{1.3.8}$$

- Page 37: The exponent of <ρ > in the last term was left off

$$\frac{G}{4\pi}\left(\frac{4\pi}{3}\right)^{\nu/3} \rho_c^{\nu/3} \frac{M(r)^{\sigma+1-\nu/3}}{\sigma+1-\nu/3} \geq I_{\sigma,\nu}(r) \geq \frac{G}{4\pi}\left(\frac{4\pi}{3}\right)^{\nu/3} \langle\rho\rangle^{\nu/3}(r) \frac{M(r)^{\sigma+1-\nu/3}}{\sigma+1-\nu/3} \tag{2.2.5}$$

- Page 47: The exponent of the last term was omitted.

$$GM^{(n-1)/n}R^{(3-n)/n} = -K(n+1)(4\pi)^{-1/n}\left(\xi_1^{(1+n)/(n-1)} \left.\frac{d\theta}{d\xi}\right|_{\xi_1}\right)^{(n-1)/n} \tag{2.4.20}$$

- Page 48: Sign error in the middle two terms

$$u \equiv \frac{d\ln[M(r)]}{d\ln r} = \frac{3\rho(r)}{\langle\rho(r)\rangle} = \frac{-\xi\theta^n}{d\theta/d\xi}$$

$$(n+1)v \equiv \frac{-d\ln[P(r)]}{d\ln r} = +\frac{3}{2}\frac{GM(r)/r}{\frac{3}{2}kT/\mu m_h} = -(n+1)\xi\frac{d\theta/d\xi}{\theta} \tag{2.4.22}$$

- Page 61: Sign changes should be made in equations (3.2.1-2) for consistency

$$\frac{d^2I}{dt^2} \approx \Omega \tag{3.2.1}$$

$$\frac{d^2I}{dt^2} \approx \frac{-I}{\tau_d^2} \tag{3.2.2}$$

- Page 71: Sign error in the second term of the exponential

$$r = N_1N_2\left(\frac{m_1}{2\pi kT}\right)^{3/2}\left(\frac{m_2}{2\pi kT}\right)^{3/2}\int_0^\infty\int_0^\infty \exp\left[\frac{(m_1+m_2)v_0^2+\tilde{m}v^2}{2kT}\right] \cdot v\sigma(v)4\pi v_0^2(4\pi v^2)\,dv_0\,dv \tag{3.3.10}$$

- Page 76: **Bahcall**, J. N., Huebner, W. F., Lubia,S. H., Parker,P. D., and Ulrich, R. K., Rev. Mod. Phy. 54, 1982, p. 767.
- Page 82: Equation (4.1.16) should read

$$\alpha_\nu^{\text{f-f}}(i,p)\,dp = \frac{4\pi Z_i^2 e^6 S_{fi}^2}{3\sqrt{3}hcm_e^2 v(p)} g_\nu^{\text{f-f}}\left(\frac{1}{\nu^3}\right)dn_e(p) \tag{4.1.16}$$

• Page 101: The last two of equations 4.6.1 should read

$$
\begin{aligned}
&(a)\ \frac{dM(r)}{dr} = 4\pi r^2 \rho(r) && \text{conservation of mass, eq. (2.1.8)} \\
&(b)\ \frac{dL(r)}{dr} = 4\pi r^2 \rho(r)\epsilon(r) && \text{conservation of energy, eq. (4.2.16)} \\
&(c)\ \frac{dP(r)}{dr} = -\frac{GM(r)\rho(r)}{r^2} && \text{conservation of momentum, eq. (2.1.6) (hydrostatic equilibrium)} \\
&\frac{dT(r)}{dr} = -\frac{3\bar{\kappa}(r)\rho(r)L(r)}{16\pi ac T^3(r) r^2} && \text{radiative transport, eq. (4.2.4)} \\
&(d)\ \left(\frac{dT}{dr}\right)_{ad} = -\frac{\mu m_h GM(r)}{(n+1)kr^2} && \text{convective transport, eq. (4.3.19)} \\
&(\Delta\nabla T) = \left[\frac{L^2(r)T(r)}{C_p^2\rho^2(r)GM(r)\pi^2 l^4 r^2}\right]^{1/3} && \text{eq. (4.3.18)}
\end{aligned}
\tag{4.6.1}
$$

• Page 103: Equation 4.7.3 (d) should read

$$
\begin{aligned}
&x = \frac{r}{R_*} \\
&q = \frac{M(r)}{M_*} \qquad p = P\left(\frac{GM_*^2}{4\pi R_*^4}\right)^{-1} \\
&f = \frac{L(r)}{L_*} \qquad t = T\left(\frac{m_h \mu G M_*}{kR_*}\right)^{-1}
\end{aligned}
\tag{4.7.3}
$$

• Page 107: Quantity left out of (b) and an improvement made to (d)

$$
\begin{aligned}
&\frac{P_{i+1} - P_i}{M_{i+1} - M_i} = \frac{GM_{i+1/2}}{4\pi r_{i+1/2}^4} \\
&\frac{r_{i+1} - r_i}{M_{i+1} - M_i} = (4\pi r_{i+1/2}^2)^{-1} \\
&\frac{L_{i+1} - L_i}{M_{i+1} - M_i} = \epsilon_{i+1/2} - T_{i+1/2} \left.\frac{\partial S}{\partial t}\right|_{i+1/2} \\
&\frac{T_{i+1} - T_i}{P_{i+1} - P_i} = \frac{T_{i+1/2}}{P_{i+1/2}} f(P_{i+1/2}, T_{i+1/2}, \rho_{i+1/2})
\end{aligned}
\tag{4.7.10}
$$

• Page 108: Runge-Kutta is mispelled in line 10 of ¶2.

- Page 131: Lead coefficient is wrong, should be

$$P_m(r_c) = \frac{1}{3\pi}\left[\frac{9(\gamma-1)}{4}\right]^4\left(\frac{kT}{\mu_i m_h}\right)^4 G^{-3}M_c^{-2} \qquad (5.4.5)$$

- Pages 140-143: Equations (5.4.9) - (5.4.14) should be renumbered to agree with the new section 5.5 that was introduced

- Page 142: (Equation 5.5.1 needs an integral of ε over volume to get the entire contribution of energy to the star to match the losses through *L*.)

- Page 142: Last paragraph line two, replace potential energy with internal energy.

$$E = \langle\Omega\rangle + \langle U\rangle - \int_0^t L\,dt + \int_V \int_0^t \epsilon\,dt\,dV \qquad \mathbf{(5.5.1)}$$

- Page 145: problem 5 should read
  5. Choose a representative set of models from the evolutionary calculations in Problem 4, (a) Calculate the moment of inertia, gravitational and internal energies of the core and envelope, and the total energy of the star (b) Determine the extent to which the conditions in Section **5.5a** are met during the evolution of the star.

- The discussion of Neutron Star Structure on pp 158-160 should be expanded to include the work by Keith Olive (1991 Sci. 251, pp.1197-1198) on the Quark-Hadron phase transition. Nothing here is wrong; it could just be made more complete.

- Page 163: The ε on the right hand side was left out.

$$\lim_{\gamma\to 4/3+\epsilon}[3(\gamma-1)U + \Omega] = (1+3\epsilon)(U_0 + \delta U) + \Omega_0 + \delta\Omega = -3\Omega_0\epsilon \qquad (6.4.8)$$

- Page 168: **Capriotti**[14] has evaluated the luminosity integral and gets

- Page 168: last paragraph

c Limiting Masses for Supermassive Stars

Let us **add equations (6.4.19) and (6.4.20)** and, taking care to express the relativistic integrals as dimensionless integrals by making use of the homology relations for pressure and density, **get for the total energy**:

$$E = -\frac{1}{2}\bar{\beta}\Omega + \frac{2G^2M^3}{R^2c^2}\int_0^1 \left[\frac{M(r)}{M}\frac{R}{r}\right]^2 \frac{P}{P_c}\frac{\rho_c}{\rho}\frac{dM(r)}{M} - \frac{9G^2M^3}{2R^2c^2}\int_0^1 \left[\frac{M(r)}{M}\frac{R}{r}\right]^2 \frac{dM(r)}{M} \tag{6.5.5}$$

- Page 169: The exponent on $M_\odot$ in the last term should be 3

$$E = -\frac{27GM_\odot^2}{4R_\odot}\left(\frac{M}{M_\odot}\right)^{3/2}\frac{R_\odot}{R} + 5.07\frac{G^2M_\odot^3}{R_\odot^2c^2}\left[\left(\frac{M}{M_\odot}\right)^{3/2}\frac{R_\odot}{R}\right]^2 \tag{6.5.6}$$

- Page 170: last paragraph - However, the only energy transportable by convection is the kinetic energy of the gas, which is an insignificant fraction of the **internal** energy. Therefore, unlike normal main sequence stars, although it is present, convection will be a very inefficient vehicle for the transport of energy. This is

- Page 173: Capriotti is spelled wrong
- Page 179: Sign should be changed for consistency

$$\vec{D} = -\nabla\Lambda \tag{7.1.9}$$

- Page 180: We may remove the unit vector from the s-component

$$D_z = D_\phi = 0\,,\quad D_s = \omega^2 s \tag{7.1.12}$$

- Page 183: sign error in second term of first eq.

$$D_r = (4\pi\rho c)^{-1}\left[\frac{\psi^2(r)}{r} + \psi(r)\frac{\partial\psi}{\partial r}\right]\mathrm{Sin}^2\theta = \tilde{A}(r) + \tilde{B}(r)P_2(\mathrm{Cos}\theta)$$

(7.1.31)

$$D_\theta = ((4\pi\rho c)^{-1}\frac{\psi^2(r)}{r}\frac{\partial P_2(\mathrm{Cos}\theta)}{\partial\theta} = \tilde{C}(r)\frac{\partial P_2(\mathrm{Cos}\theta)}{\partial\theta}$$

- Page 186: The last term should have a (1/r) in it

$$\begin{aligned}\frac{\partial P_0(r)}{\partial r} &= -\rho_0\frac{\partial\Omega_0(r)}{\partial r} + \rho_0(r)A(r)\\ \frac{\partial P_2(r)}{\partial r} &= -\rho_0(r)\frac{\partial\Omega_2(r)}{\partial r} + \rho_2(r)\frac{\partial\Omega_0(r)}{\partial r} + \rho_0(r)B(r)\\ P_2(r) &= -\rho_0(r)\Omega_2(r) + \rho_0(r)C(r)/r\end{aligned} \tag{7.2.5}$$

- Page 191: last two lines - In the equilibrium model, there are no mass motions, the velocity in equation (7.2.6) is already a **first**-order term and so to estimate its value we need only .....

- Page 204: eq 8.1.7 should read

$$d[M(r)] = 0 = \int_0^r 8\pi r_0 \rho \delta r dr + \int_0^r 4\pi r_0^2 \delta\rho_0 dr + \int_0^r 4\pi r_0^2 \rho_0 d(\delta r) \qquad (8.1.7)$$

- Page 206: The I_0 got left out

$$\sigma^2 = - [<3\gamma-4>(\Omega_0 + M_0) - <5-3\gamma>\omega_0\square_0]/\mathbf{I_0} \qquad (8.1.16)$$

- Page 211: Sign error on the third term

$$\frac{dW}{dt} = \int_0^M \left(g - \frac{1}{\rho}\frac{\partial P}{\partial r}\right)\frac{dr}{dt}\, dM(r) = \frac{d}{dt}\left(\int_0^M \frac{GM(r)\, dM(r)}{r}\right) - \int_0^M 4\pi r^2 \frac{\partial P}{\partial M(r)}\, \dot{r}\, dM(r) \qquad (8.2.5)$$

- Page 234: $dV = cdA\mathbf{\cos\theta}dt$ (9.2.4)

- Page 237: eq 9.2.18 in the book v's are occasionally υ's see $[h^4\upsilon^3/c^2...]$ and $(\upsilon/\upsilon')^3$. Should be

$$dn = dn_{gt} + dn_{gs} + dn_l = \frac{c^2}{h^4 \nu^3}\left[\frac{h^4\nu^3}{c^2}\frac{\varepsilon}{4\pi} + \frac{\sigma' h}{4\pi c}\int_0^\infty \oint (\nu/\nu')^3 R(\nu,\nu',\Omega,\Omega')d\nu' d\Omega' - \alpha I_\nu(\Omega)\right] dV dV_p \qquad (9.2.18)$$

- Page 238: equation (9.2.20) should be

$$\frac{h^4\nu^3}{c^3} S = \rho j_\nu + \frac{\rho\sigma_\nu}{4\pi}\int_0^\infty \oint_{4\pi} R(\nu, \nu', \Omega, \Omega') I_{\nu'}(\Omega')\, d\Omega'\, d\nu' - (\kappa_\nu + \sigma_\nu)\rho I_\nu(\Omega) \qquad (9.2.20)$$

- Page 246: equation (9.3.9) should be

$$K_\nu = \frac{1}{4\pi}\int_0^\pi \int_0^{2\pi} \begin{bmatrix} \hat{i}\hat{i}\sin^2\theta\cos^2\phi & \hat{i}\hat{j}\sin^2\theta\cos\phi\sin\phi & \hat{i}\hat{k}\sin\theta\cos\theta\cos\phi \\ \hat{j}\hat{i}\sin^2\theta\sin\phi\cos\phi & \hat{j}\hat{j}\sin^2\theta\sin\ \phi & \hat{j}\hat{k}\sin\theta\cos\theta\sin\phi \\ \hat{k}\hat{i}\sin\theta\cos\theta\cos\phi & \hat{k}\hat{j}\sin\theta\cos\theta\sin\phi & \hat{k}\hat{k}\cos^2\theta \end{bmatrix} \times I_\nu(\tau_\nu)\sin\theta\, d\theta\, d\phi \qquad (9.3.9)$$

- Page 251: The last three words of problem 1 should be "space **is** constant."

• Page 257: sign of first term r.h.s of 2nd equation should be negative

$$J_\nu(\tau_\nu) = \frac{1}{2}\int_0^1 I(+\mu', \tau_\nu)\, d\mu' + \frac{1}{2}\int_0^1 I(-\mu', \tau_\nu)\, d(-\mu')$$

$$J_\nu(\tau_\nu) = \frac{-1}{2}\int_0^1 \left[\int_\infty^{\tau_\nu} S(t)e^{+(\tau_\nu - t)/\mu'}\frac{dt}{\mu'}\right] d\mu' + \frac{1}{2}\int_0^1 \left[\int_0^{\tau_\nu} S(t)e^{-(\tau_\nu - t)/\mu'}\frac{dt}{\mu'}\right] d\mu' \quad (10.1.9)$$

• Page 266: summation should run from i=1, not i=0 as:

$$B(\tau) = \frac{\sum_{i=1}^{n} [B(t_i) - B(\tau)]E_1|t_i - \tau|W_i}{E_2(\tau)} \quad (10.2.10)$$

• Page 277: ν-subscript missing on the τ, should be

$$v = \mu\frac{dB_\nu(\tau_\nu)}{d\tau_\nu} = \mu\frac{du}{d\tau_\nu} \qquad \tau_\nu \gg 1 \quad (10.3.10)$$

• Page 278: The μ on the right hand side should be u.

$$\mu^2\frac{u_{k-1}(\mu)}{\Delta\tau_k\Delta\tau_{k-1/2}} - \frac{\mu^2}{\Delta\tau_k}\left(\frac{1}{\Delta\tau_{k-1/2}} + \frac{1}{\Delta\tau_{k+1/2}}\right)u_k(\mu) + \frac{\mu^2 u_{k+1}(\mu)}{\Delta\tau_k\Delta\tau_{k+1/2}} = u_k(\mu) - S_k \quad (10.3.13)$$

• Page 280: line 10 should read "for which it **is** suited."
• Page 304: Table 11.1 non-gray equation (1) should have S_ν not J_ν so that.

Table 11.1 Equations of Radiative Transfer for a Plane-Parallel Atmosphere

	Gray Atmosphere	Non-gray Atmosphere
(1)	$\mu\frac{dI}{d\tau} = I - J$	$\mu\frac{dI_\nu}{d\tau_\nu} = I_\nu - S_\nu$
(2)	$\frac{dF}{d\tau} = 0$	$\frac{dF_\nu}{d\tau_\nu} = 4(J_\nu - S_\nu)$
(3)	$\frac{dK}{d\tau} = \frac{F}{4}$	$\frac{dK_\nu}{d\tau_\nu} = \frac{F_\nu}{4}$

• Page 306: subscript ν on B in the denominator is a subscript, should be

$$\langle \kappa_\nu \rangle_P \equiv \frac{\int_0^\infty \kappa_\nu B_\nu(T)\, d\nu}{\int_0^\infty B_\nu(T)\, d\nu} \tag{11.4.10}$$

- Page 309: problem 6 should read

  6 Use a Model Atmosphere Code to find how the state of ionization **of hydrogen** varies with physical depth in a star with T_e = 10000#K and Log g = 4.0. Repeat the calculation for a star with T_e= 7000#K and Log g = **1.5**. Compare the two cases.
- Page 315: term in braces should be to the -1 power so that.

$$P(\tau_i) = \int_0^{\tau_i} g\{\kappa_0[T(\tau), P_e(\tau)] + \sigma_0[T(\tau), P_e(\tau)]\}^{-1} d\tau \equiv P[T(\tau_i), P_e(\tau_i)] \tag{12.2.7}$$

- Page 321: In the book $k_\nu(\tau_0)$ is given as $\kappa_\nu(\tau_0)$ in the first two terms of eq 12.2.6.

$$k_\nu(\tau_0) = k_\nu^{(0)}(t) + \lambda\tau^{(1)}(t)\frac{dk_\nu(t)}{dt}$$

$$B_\nu[T(\tau_0)] = B_\nu[T^{(0)}(t)] + \lambda T^{(1)}(t)\frac{dB_\nu[T^{(0)}(t)]}{dT} \tag{12.4.6}$$

- Page 322: - superscript on K' L.H.S. is wrong. should be

$$F'^{(1)} = k_\nu^{(0)}(J_\nu^{(1)} + T^{(1)}\dot{B}_\nu^{(0)}) + (\tau'^{(1)}k_\nu^{(0)} + \tau^{(1)}k_\nu'^{(0)})(J_\nu^{(0)} - B_\nu^{(0)})$$

$$K_\nu'^{(1)} = \frac{J_\nu'^{(1)}}{3} = k_\nu^{(0)}F_\nu^{(1)} + (\tau'^{(1)}k_\nu^{(0)} + \tau^{(1)}k_\nu'^{(0)})F_\nu'^{(0)} \tag{12.4.12}$$

- Page 338: the 1 in τ_0>>**1** got lost. The equation should read

$$f_\nu(\mu) \approx \begin{cases} 1 - \tau_0 \dfrac{3F_c}{4I_c(\mu, 0)} & \tau_0 \ll 1 \text{ (weak lines)} \\ \dfrac{\{\sqrt{3}F_c/[2I_c(\mu, 0)]\}(\mu + 1/\sqrt{3})}{\tau_0} & \tau_0 \gg 1 \text{ (strong lines)} \end{cases} \tag{13.2.12}$$

- Page 350: - equation 14.1.4 should read (see equation 14.5.2)

$$S_\nu = \frac{S_\omega}{2\pi} = \kappa_\nu \rho / n_i \tag{14.1.4}$$

- Page 351:- Equation(14.2.1) the average symbol should extend over the 2

$$\frac{d\bar{W}}{dt} = -\frac{2e^2}{3c^3}\overline{\left(\frac{d^2x}{dt^2}\right)^2} \qquad (14.2.1)$$

- Page 353: - paragraph 1: the i in $i\omega_0 t$ got lost. It should read

If we assume that the photon encounters the atom at t=0 so that E(t)=0 for t<0, and that it has a sinusoidal behavior $E(t)=E_0e^{-i\omega_0 t}$ for t ≥ 0, ….

- Page 367: - Equation 14.3.32 should read

$$\frac{F_c - F_\nu(\text{line})}{F_c} = 1 - r_\nu \propto [1-\mu^2]^{1/2} = 1 - \left(\frac{\Delta\nu\, c}{\nu_0 v_m}\right)^2 \qquad (14.3.32)$$

- Page 371: - The "*e*" got left out of Equation (14.4.4), it should read

$$E(\omega) = \frac{1}{\sqrt{2\pi}}\int_{-\infty}^{+\infty} E(t)\ e^{i\omega t}\,dt = \frac{E_0}{\sqrt{2\pi}}\int_{-T/2}^{+T/2} e^{i(\omega-\omega_0)t}\,dt \qquad (14.4.4)$$

- Page 386: - The fraction in the center term of equation (14.5.4) should read

$$r_\nu = \left(1 + \frac{\sqrt{3}\tau_0}{2}\right)^{-1} = \left[1 + \frac{\sqrt{3}S_0H(a,u)N_i}{2}\right]^{-1} \qquad (14.5.4)$$

- Page 388: c should be removed from the denominator of equation (14.5.16) and equation (14.5.17) so they read

$$d\nu = \Delta\nu_d\, du \qquad (14.5.16)$$

$$W_\nu = 2\Delta\nu_d\int_0^\infty \frac{du}{1 + 2H(a,0)/[\sqrt{3}\chi_0 H(a,u)]} \qquad (14.5.17)$$

note the subscript change on W_ν.

- Page 389: - The "2" in equation (14.5.9) should be $\sqrt{2}$, so that

$$W_\nu \approx \left(\frac{\sqrt{2}\,\Delta\nu_d}{c}\right)(3^{1/4}\pi^{3/4}\sqrt{\chi_0 a}) \qquad (14.5.19)$$

- Page 391: - The sign on Log (ν_0/N) should be changed on equations (14.5.21-14.5.23) so that

$$\text{Log } X_i = \text{Log } x_0 + \text{Log}(\nu_0/N) \qquad (14.5.21)$$

$$\text{Log } X_i = \text{Log } x_0 + \text{Log}(\nu_0/N) - \text{Log}[g_i e^{-e_i/kT}/U(T)] \qquad (14.5.22)$$

$$\aleph_i = \text{Log } X_i - [\text{Log } x_0 + \text{Log}(\nu_0/N)] + \text{Log}[g_i e^{-e_i/kT}/U(T)] \qquad (14.5.23)$$

- Page 408: equation 15.2.25, the equation for B* should read

$$S_\ell = \frac{\int \phi_\nu J_\nu \, d\nu + \tilde{\epsilon} B_\nu(T) + \eta B^*}{1 + \tilde{\epsilon} + \eta}$$

$$\tilde{\epsilon} = \frac{N_e \Omega_{21}}{A_{21}} (1 - e^{-h\nu/(kT)})$$

$$\eta = \frac{1}{A_{21}} \frac{(R_{2k} + N_e\Omega_{2k}) N_1^*(R_{k1} + N_e\Omega_{1k}) - (g_1/g_2)(R_{1k} + N_e\Omega_{1k}) N_2^*(R_{2k} + N_e\Omega_{2k})}{N_1^*(R_{k1} + N_e\Omega_{1k}) + N_2^*(R_{k2} + N_e\Omega_{2k})}$$

$$B^* = \frac{2h\nu^3}{c^2} \left[\frac{N_1^* g_2 (R_{2k} + N_e\Omega_{2k})(R_{k1} + N_e\Omega_{1k})}{N_2^* g_1 (R_{1k} + N_e\Omega_{1k})(R_{k2} + N_e\Omega_{2k})} - 1 \right]^{-1} \quad (15.2.25)$$

- Page 409: no subscript on B^*, third line should read: If $\tilde{\varepsilon} B_\nu(T) > \eta B^*$ but $\eta > \tilde{\varepsilon}$ (or vice versa), the line is said to be mixed.

- Page 411: equation (15.2.27) should read:

$$l_{\text{th}} = \ell\sqrt{n} = \ell\sqrt{\mathscr{L}/\ell} = \sqrt{\mathscr{L}\ell} \quad (15.2.27)$$

- Page 413: equation 15.3.5 should read:

$$S_\ell(t_x) = \epsilon B_\nu(T) + \tfrac{1}{2}(1 - \epsilon) \int_{-\infty}^{+\infty} S_\ell(t) K(\tau_x, t) \, dt \quad (15.3.5)$$

- Page 414: line 9 should read: For isotropic scattering, $g(\hat{n}', \hat{n}) = 1$, while in the case of Rayleigh Scattering $g(\hat{n}', \hat{n}) = 3[1 + (\hat{n}' \bullet \hat{n})^2]/4$.

- Page 415: - there should be no ' on ξ' in the second of equations 15.3.10 on the right hand side. It should read

$$f(\xi') = \frac{\gamma_u/\pi}{(\xi' - \nu_0)^2 + \gamma_u^2} \qquad \text{Hummer's case III}$$

$$p(\xi', \xi) = \frac{\gamma_u/\pi}{(\xi - \nu_0)^2 + \gamma_u^2} \quad (15.3.10)$$

- Page 416: - Denominator of first fraction should end with γ_l^2 not η_l^2; the numerator of the fourth fraction should be γ_l^2 and one of the ξ's in the denominator should not have a prime, so that equation (15.3.12) should read

$$f(\xi')p(\xi',\xi) = \frac{\gamma_u(2\gamma_l+\gamma_u)\gamma_l/\pi^2}{\{(\xi'-\nu_0)^2+[(\gamma_l+\gamma_u)/2]^2\}\{(\xi-\nu_0)^2+[(\gamma_l+\gamma_u)/2]^2\}[(\xi'-\xi)^2+\gamma_l^2]}$$
$$+\frac{\gamma_l\gamma_u}{\{(\xi'-\nu_0)^2+[(\gamma_u+\gamma_l)/2]^2\}[(\xi'-\xi)^2+\gamma_l^2]}$$
$$+\frac{\gamma_l\gamma_u}{\{(\xi-\nu_0)^2+[(\gamma_l+\gamma_u)/2]^2\}[(\xi'-\xi)^2+\gamma_l^2]}$$
$$+\frac{\gamma_l^2}{\{(\xi-\nu_0)^2+[(\gamma_u+\gamma_l)/2]^2\}\{(\xi'-\nu_0)^2+[(\gamma_u+\gamma_l)/2]^2\}} \tag{15.3.12}$$

- Page 418: - the last of equations (15.3.18) should use v_{th} rather than v_d so that it is consistent with the first of those equations. Thus it should read

$$\vec{u} \equiv \sqrt{\frac{m}{2kT}}\,\vec{v} = \frac{\vec{v}}{v_{\mathrm{th}}}$$
$$\alpha \equiv \cos\frac{\psi}{2} \qquad \tilde{\alpha} \equiv \cos\psi$$
$$\beta \equiv \sin\frac{\psi}{2} \qquad \tilde{\beta} \equiv \sin\psi$$
$$w \equiv \frac{\nu_0 v_{\mathrm{th}}}{c} = \frac{\nu_0}{c}\sqrt{\frac{2kT}{m}} \tag{15.3.18}$$

- Page 421: - equation (15.3.33) should have a 1/4π in the last term

$$\mu\frac{dI_\nu}{d\tau_\nu} = I_\nu - \mathscr{L}_\nu B_\nu - \frac{(1-\mathscr{L}_\nu)}{4\pi}\int_0^\infty \int_{4\pi} I_{\nu'}(\mu')R(\nu',\nu,\mu',\mu)\,d\omega'\,d\nu' \tag{15.3.33}$$

- Page 429: problem 7 should read
  7. Show how equation (15.3.25) is implied by equation (15.3.15).

- Page 430: **Peytremann** is misspelled in Ref.16.

• Page 442: - The equations (16.2.1) should read

$$
\begin{aligned}
I &\equiv I_l + I_r = E_l^2 + E_r^2 \\
Q &\equiv I_l - I_r = E_l^2 - E_r^2 \\
U &\equiv (I_l - I_r)\,\mathrm{Tan}\,2\chi = 2\,E_l E_r \cos\epsilon \\
V &\equiv (I_l - I_r)\,\mathrm{Sec}\,2\chi\,\mathrm{Tan}\,2\beta = 2\,E_l E_r \sin\epsilon
\end{aligned}
\tag{16.2.1}
$$

• Page 457: equation 16.2.39 last equation LHS should be averaged to read

$$
\begin{aligned}
&\overline{g_{11}^2} = \sin^2\theta - \sin^2\theta\cos^2\theta' + \tfrac{1}{2}\cos^2\theta\cos^2\theta' \\
&\overline{g_{12}^2} = \tfrac{1}{2}\cos\theta \qquad \overline{g_{21}^2} = \tfrac{1}{2}\cos\theta' \qquad \overline{g_{22}^2} = \tfrac{1}{2} \\
&\overline{g_{12}g_{21}} = -\tfrac{1}{2}\cos\theta\cos\theta' \\
&\overline{g_{11}g_{22}} = +\tfrac{1}{2}\cos\theta\cos\theta' \\
&\overline{g_{12}g_{22}} = \overline{g_{21}g_{22}} = \overline{g_{11}g_{12}} = \overline{g_{11}g_{21}} = 0
\end{aligned}
\tag{16.2.39}
$$

• Page 464: second para., line 7 delete the "when" so that the sentence reads:... polarization approaching or exceeding the gray value in the vicinity of the Lyman Jump.

• Page 482: three lines from the bottom of the page: should be: ... the conservation laws of **physics**, the fundamental ...

• Page 484: **Capriotti**, E.R. 168, 178