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Fundamentals of Neutrino Physics and Astrophysics
C. Giunti and C.W. Kim
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± Lines are calculated before (−) or after (+) the Anchor. If the Anchor is a page, t and b indicate, respectively, top and bottom.

Anchor	± Lines	Wrong	Corrected
page iii	$t + 5$	Universita	Università

Chapter 1			
Anchor	± Lines	Wrong	Corrected
page 4	$b - 9$	1967	1962

Chapter 2			
Anchor	± Lines	Wrong	Corrected
eqn (2.189)		$(\not{p}_{\mathrm{P}} - m)\,\gamma^0\,u^{(-h)}(p_{\mathrm{P}}) = 0$	$(\not{p} - m)\,\gamma^0\,u^{(-h)}(p_{\mathrm{P}}) = 0$
eqn (2.276)	+1	following eqn (2.276)	following eqn (2.278)
eqn (2.414)		$\left(V_\mu^{ab} - A_\mu^{ab}\right) W^{\mu\,\dagger}$	$\left(V_\mu^{ba} - A_\mu^{ba}\right) W^{\mu\,\dagger}$
eqn (2.414)		$\left(V_\mu^{ba} - A_\mu^{ba}\right) W^{\mu}$	$\left(V_\mu^{ab} - A_\mu^{ab}\right) W^{\mu}$

Chapter 2			
Anchor	± Lines	Wrong	Corrected
eqn (2.434)		$(S_{ab})^{\mathrm{T}} = -\xi_{\mathrm{T}}^{a*}\,\xi_{\mathrm{T}}^{b}\,\overline{\psi_b}\,\psi_a = -\xi_{\mathrm{T}}^{a*}\,\xi_{\mathrm{T}}^{b}\,S_{ba}$	$(S_{ab})^{\mathrm{T}} = \xi_{\mathrm{T}}^{a}\,\xi_{\mathrm{T}}^{b*}\,\overline{\psi_a}\,\psi_b = \xi_{\mathrm{T}}^{a}\,\xi_{\mathrm{T}}^{b*}\,S_{ab}$
eqn (2.435)		$(V_{ab}^{\mu})^{\mathrm{T}} = -\xi_{\mathrm{T}}^{a*}\,\xi_{\mathrm{T}}^{b}\,\overline{\psi_b}\,\gamma_\mu\,\psi_a = -\xi_{\mathrm{T}}^{a*}\,\xi_{\mathrm{T}}^{b}\,V_{\mu}^{ba}$	$(V_{ab}^{\mu})^{\mathrm{T}} = \xi_{\mathrm{T}}^{a}\,\xi_{\mathrm{T}}^{b*}\,\overline{\psi_a}\,\gamma_\mu\,\psi_b = \xi_{\mathrm{T}}^{a}\,\xi_{\mathrm{T}}^{b*}\,V_{\mu}^{ab}$
eqn (2.436)		$(T_{ab}^{\mu\nu})^{\mathrm{T}} = \xi_{\mathrm{T}}^{a*}\,\xi_{\mathrm{T}}^{b}\,\overline{\psi_b}\,\sigma_{\mu\nu}\,\psi_a = \xi_{\mathrm{T}}^{a*}\,\xi_{\mathrm{T}}^{b}\,T_{\mu\nu}^{ba}$	$(T_{ab}^{\mu\nu})^{\mathrm{T}} = -\xi_{\mathrm{T}}^{a}\,\xi_{\mathrm{T}}^{b*}\,\overline{\psi_a}\,\sigma_{\mu\nu}\,\psi_b = -\xi_{\mathrm{T}}^{a}\,\xi_{\mathrm{T}}^{b*}\,T_{\mu\nu}^{ab}$
eqn (2.437)		$(A_{ab}^{\mu})^{\mathrm{T}} = -\xi_{\mathrm{T}}^{a*}\,\xi_{\mathrm{T}}^{b}\,\overline{\psi_b}\,\gamma_\mu\,\gamma^5\,\psi_a = -\xi_{\mathrm{T}}^{a*}\,\xi_{\mathrm{T}}^{b}\,A_{\mu}^{ba}$	$(A_{ab}^{\mu})^{\mathrm{T}} = \xi_{\mathrm{T}}^{a}\,\xi_{\mathrm{T}}^{b*}\,\overline{\psi_a}\,\gamma_\mu\,\gamma^5\,\psi_b = \xi_{\mathrm{T}}^{a}\,\xi_{\mathrm{T}}^{b*}\,A_{\mu}^{ab}$
eqn (2.438)		$(P_{ab})^{\mathrm{T}} = \xi_{\mathrm{T}}^{a*}\,\xi_{\mathrm{T}}^{b}\,\overline{\psi_b}\,\gamma^5\,\psi_a = \xi_{\mathrm{T}}^{a*}\,\xi_{\mathrm{T}}^{b}\,P_{ba}$	$(P_{ab})^{\mathrm{T}} = \xi_{\mathrm{T}}^{a}\,\xi_{\mathrm{T}}^{b*}\,\overline{\psi_a}\,\gamma^5\,\psi_b = \xi_{\mathrm{T}}^{a}\,\xi_{\mathrm{T}}^{b*}\,P_{ab}$
eqn (2.439)		$W_\mu \xrightarrow{\mathrm{T}} -\xi_{\mathrm{T}}^{W}\,W^{\mu\,\dagger}$	$W_\mu \xrightarrow{\mathrm{T}} \xi_{\mathrm{T}}^{W*}\,W^{\mu}$
eqn (2.440)		$\xi_{\mathrm{T}}^{a*}\,\xi_{\mathrm{T}}^{b}\,\xi_{\mathrm{T}}^{W}\left(V_{\mu}^{ab} - A_{\mu}^{ab}\right)W^{\mu\,\dagger} + \xi_{\mathrm{T}}^{a}\,{\xi_{\mathrm{T}}^{b}}^{*}\,{\xi_{\mathrm{T}}^{W}}^{*}\left(V_{\mu}^{ba} - A_{\mu}^{ba}\right)W^{\mu}$	$\xi_{\mathrm{T}}^{a}\,\xi_{\mathrm{T}}^{b*}\,\xi_{\mathrm{T}}^{W*}\left(V_{\mu}^{ab} - A_{\mu}^{ab}\right)W^{\mu} + \xi_{\mathrm{T}}^{a*}\,\xi_{\mathrm{T}}^{b}\,\xi_{\mathrm{T}}^{W}\left(V_{\mu}^{ba} - A_{\mu}^{ba}\right)W^{\mu\,\dagger}$

Chapter 2			
Anchor	± Lines	Wrong	Corrected
eqn (2.454)		$(S_{ab})^{\rm CPT} = -\xi^{a*}_{\rm CPT}\,\xi^{b}_{\rm CPT}\,\overline{\psi_a}\,\psi_b = -\xi^{a*}_{\rm CPT}\,\xi^{b}_{\rm CPT}\,S_{ab}$	$(S_{ab})^{\rm CPT} = \xi^{a}_{\rm CPT}\,\xi^{b*}_{\rm CPT}\,\overline{\psi_b}\,\psi_a = \xi^{a}_{\rm CPT}\,\xi^{b*}_{\rm CPT}\,S_{ba}$
eqn (2.455)		$(V^{\mu}_{ab})^{\rm CPT} = \xi^{a*}_{\rm CPT}\,\xi^{b}_{\rm CPT}\,\overline{\psi_a}\,\gamma_\mu\,\psi_b = \xi^{a*}_{\rm CPT}\,\xi^{b}_{\rm CPT}\,V^{\mu}_{ab}$	$(V^{\mu}_{ab})^{\rm CPT} = -\xi^{a}_{\rm CPT}\,\xi^{b*}_{\rm CPT}\,\overline{\psi_b}\,\gamma^\mu\,\psi_a = -\xi^{a}_{\rm CPT}\,\xi^{b*}_{\rm CPT}\,V^{\mu}_{ba}$
eqn (2.456)		$(T^{\mu\nu}_{ab})^{\rm CPT} = -\xi^{a*}_{\rm CPT}\,\xi^{b}_{\rm CPT}\,\overline{\psi_a}\,\sigma_{\mu\nu}\,\psi_b = -\xi^{a*}_{\rm CPT}\,\xi^{b}_{\rm CPT}\,T^{\mu\nu}_{ab}$	$(T^{\mu\nu}_{ab})^{\rm CPT} = \xi^{a}_{\rm CPT}\,\xi^{b*}_{\rm CPT}\,\overline{\psi_b}\,\sigma^{\mu\nu}\,\psi_a = \xi^{a}_{\rm CPT}\,\xi^{b*}_{\rm CPT}\,T^{\mu\nu}_{ba}$
eqn (2.457)		$(A^{\mu}_{ab})^{\rm CPT} = \xi^{a*}_{\rm CPT}\,\xi^{b}_{\rm CPT}\,\overline{\psi_a}\,\gamma_\mu\,\gamma^5\,\psi_b = \xi^{a*}_{\rm CPT}\,\xi^{b}_{\rm CPT}\,A^{\mu}_{ab}$	$(A^{\mu}_{ab})^{\rm CPT} = -\xi^{a}_{\rm CPT}\,\xi^{b*}_{\rm CPT}\,\overline{\psi_b}\,\gamma^\mu\,\gamma^5\,\psi_a = -\xi^{a}_{\rm CPT}\,\xi^{b*}_{\rm CPT}\,A^{\mu}_{ba}$
eqn (2.458)		$(P_{ab})^{\rm CPT} = -\xi^{a*}_{\rm CPT}\,\xi^{b}_{\rm CPT}\,\overline{\psi_a}\,\gamma^5\,\psi_b = -\xi^{a*}_{\rm CPT}\,\xi^{b}_{\rm CPT}\,P_{ab}$	$(P_{ab})^{\rm CPT} = -\xi^{a}_{\rm CPT}\,\xi^{b*}_{\rm CPT}\,\overline{\psi_b}\,\gamma^5\,\psi_a = -\xi^{a}_{\rm CPT}\,\xi^{b*}_{\rm CPT}\,P_{ba}$
eqn (2.458)	+1	Since all the covariant bilinears are left invariant by a CPT transformation, apart for a possible irrelevant phase (which is the same for the vector and axial currents), any possible interaction Lagrangian is invariant under CPT, in agreement with the CPT theorem, which says that CPT is a symmetry of any relativistic local field theory.	Choosing $\xi^{a}_{\rm CPT} = \xi^{b}_{\rm CPT}$, CPT transforms each covariant bilinear into its Hermitian conjugate, with a minus sign for V^{μ}_{ab} and A^{μ}_{ab}. Since an interaction Lagrangian containing a covariant bilinear must contain also its Hermitian conjugate (the Lagrangian is Hermitian), it is invariant under CPT. The minus sign in the transformation of V^{μ}_{ab} and A^{μ}_{ab} is compensated by a corresponding minus sign in the transformation of the vector or axial fields to which they are coupled. The invariance under CPT of any interaction Lagrangian containing a covariant bilinear is in agreement with the CPT theorem, which says that CPT is a symmetry of any relativistic local field theory.

Chapter 3

Anchor	± Lines	Wrong	Corrected
eqn (3.122)		$\frac{\sum_k \left[I^k\left(I^k+1\right)-\left(I_3^k\right)\right] v_k^2}{2\sum_k \left(I_3^k\right) v_k^2}$	$\frac{\sum_k \left[I^k\left(I^k+1\right)-\left(I_3^k\right)^2\right] v_k^2}{2\sum_k \left(I_3^k\right)^2 v_k^2}$

Chapter 4

Anchor	± Lines	Wrong	Corrected
eqn (4.22)		$\begin{pmatrix} \cos\vartheta\, e^{i\omega_1} & \sin\vartheta\, e^{i(\omega_2+\eta)} \\ -\sin\vartheta\, e^{i(\omega_1-\eta)} & \cos\vartheta\, e^{i\omega_2} \end{pmatrix}$	$\begin{pmatrix} \cos\vartheta\, e^{i\omega_1} & \sin\vartheta\, e^{i(\omega_1+\eta)} \\ -\sin\vartheta\, e^{i(\omega_2-\eta)} & \cos\vartheta\, e^{i\omega_2} \end{pmatrix}$
eqn (4.23)		$\begin{pmatrix} \omega_1 & 0 \\ 0 & \omega_2 \end{pmatrix}$	$\begin{pmatrix} e^{i\omega_1} & 0 \\ 0 & e^{\omega_2} \end{pmatrix}$
eqn (4.62)		$W^{13} = W^{13}(\vartheta_{13}, \eta_{13}) = D^1(\eta_{13}) R^{13} {D^1}^\dagger(\eta_{13})$	$W^{13} = W^{13}(\vartheta_{13}, \eta_{13} - \eta_{12} - \eta_{23})$
eqn (4.78)	-1	η_{13}	$\eta_{13} - \eta_{12} - \eta_{23}$
eqn (4.108)	$+1$	One can parameterize the mixing matrix as a product of the type in eqn (4.65) with $W^{ab}(\vartheta_{ab} = \pi/2, \eta_{ab})$ on the extreme left or the extreme right. Using	If $W^{ab}(\vartheta_{ab} = \pi/2, \eta_{ab})$ is on the extreme left or on the extreme right of the product in eqn (4.45) which parameterizes the mixing matrix, using
eqn (4.78)		$\delta_{13} = -\eta_{13}$	$\delta_{13} = -\eta_{13} + \eta_{12} + \eta_{23}$
eqn (4.117)	$+1$	eqn (4.115)	eqn (4.116)

Chapter 5

Anchor	± Lines	Wrong	Corrected
eqn (5.124)		$1 - \frac{Q^2}{6} \langle (r_i^N)^2 \rangle$	$G_i^N(0) - \frac{Q^2}{6} \langle (r_i^N)^2 \rangle$

Chapter 6			
Anchor	± Lines	Wrong	Corrected
eqn (6.1)		$\overline{L_{\alpha L}}$	$\overline{L'_{\alpha L}}$
page 208	t + 5	[532,79,79,408]	[532,79,N1,408] New Reference: [N1] P. Langacker, M.-X. Luo, Phys. Rev. D44, 817, 1991.
page 227	t + 11	[532,79,79,408]	[532,79,N1,408]
page 228	b − 2	[814]	[N2,N3] New References: [N2] G. Lazarides, Q. Shafi, C. Wetterich, Nucl. Phys. B181, 287, 1981. [N3] R.N. Mohapatra and G. Senjanovic, Phys. Rev. D23 165, 1981.
eqn (6.345)		$\overline{\boldsymbol{n}} \left(i \overleftrightarrow{\not{\partial}} - M \right) \boldsymbol{n}$	$\frac{1}{2} \overline{\boldsymbol{n}} \left(i \overleftrightarrow{\not{\partial}} - M \right) \boldsymbol{n}$
eqn (6.418)		$\overline{\ell_{\alpha L}} \gamma^{\rho} U_{\alpha k} \nu_{kL}$	$\overline{\ell_{\alpha L}} \gamma^{\rho} U_{\alpha k} \nu_{kL} W_{\rho}^{\dagger}$
eqn (6.418)		$\overline{\boldsymbol{\ell}_{L}} \gamma^{\rho} U \, \boldsymbol{n}_{L}$	$\overline{\boldsymbol{\ell}_{L}} \gamma^{\rho} U \, \boldsymbol{n}_{L} W_{\rho}^{\dagger}$

Chapter 8			
Anchor	± Lines	Wrong	Corrected
eqn (8.29)	−2	$\mathcal{M}_{\alpha k}^{\mathrm{P}}$ or $\mathcal{M}_{\alpha k}^{\mathrm{D}}$	$\mathcal{M}_{\alpha k}^{\mathrm{P}}$ and $\mathcal{M}_{\alpha k}^{\mathrm{D}}$
eqn (8.77)	+3	$\sigma_{t}^{\mathrm{I}} \gtrsim \sigma_{p}^{\mathrm{I}}$	$\sigma_{t}^{\mathrm{I}} \gtrsim \sigma_{x}^{\mathrm{I}}$

Chapter 10			
Anchor	± Lines	Wrong	Corrected
eqn (10.70)	−3	as an effectively incoherent sum	as effectively incoherent sums

Chapter 11

Anchor	± Lines	Wrong	Corrected
eqn (11.67)		$R_{\mu/e}^{\text{multi-GeV}}$	$R_{\mu/e}^{\text{sub-GeV}}$

Chapter 12

Anchor	± Lines	Wrong	Corrected
eqn (12.13)	−2	Neglecting the small recoil energy of the neutron, the	The

Chapter 17

Anchor	± Lines	Wrong	Corrected
eqn (17.49)	−9	^{2}He	^{2}H
eqn (17.70)	+6	an upper limit	a lower limit

Appendix A

Anchor	± Lines	Wrong	Corrected
eqn (A.19)		$\epsilon_{ijk}\,\epsilon_{\ell mn} = \begin{vmatrix} \delta_{i\ell} & \delta_{im} & \delta_{in} \\ \delta_{j\ell} & \delta_{jm} & \delta_{in} \\ \delta_{k\ell} & \delta_{km} & \delta_{kn} \end{vmatrix}$	$\epsilon_{ijk}\,\epsilon_{\ell mn} = \begin{vmatrix} \delta_{i\ell} & \delta_{im} & \delta_{in} \\ \delta_{j\ell} & \delta_{jm} & \delta_{jn} \\ \delta_{k\ell} & \delta_{km} & \delta_{kn} \end{vmatrix}$

Appendix B

Anchor	± Lines	Wrong	Corrected
eqn (B.17)		$g^{\alpha\rho}\,(\Lambda^T)_\rho{}^\mu\,g_{\mu\nu}\,\Lambda^\rho{}_\nu = \delta^\alpha_\nu$	$g^{\alpha\rho}\,(\Lambda^T)_\rho{}^\mu\,g_{\mu\nu}\,\Lambda^\nu{}_\sigma = \delta^\alpha_\sigma$

Appendix C

Anchor	± Lines	Wrong	Corrected
eqn (C.11)		$[\psi_r(t,\vec{x}\,,\,\pi_s(t,\vec{y}]_\pm = i\,\delta_{rs}\,\delta^3(\vec{x}-\vec{y})$	$[\psi_r(t,\vec{x})\,,\,\pi_s(t,\vec{y})]_\pm = i\,\delta_{rs}\,\delta^3(\vec{x}-\vec{y})$
eqn (C.12)		$[\psi_r(t,\vec{x}\,,\,\psi_s(t,\vec{y}]_\pm = [\pi_r(t,\vec{x}\,,\,\pi_s(t,\vec{y}]_\pm = 0$	$[\psi_r(t,\vec{x})\,,\,\psi_s(t,\vec{y})]_\pm = [\pi_r(t,\vec{x})\,,\,\pi_s(t,\vec{y})]_\pm = 0$

<table>
<tr><th colspan="4">Bibliography</th></tr>
<tr><th>Anchor</th><th>± Lines</th><th>Wrong</th><th>Corrected</th></tr>
<tr><td>Ref. [813]</td><td></td><td>J. Phys. Conf. Ser., 53, 44-82, 2006</td><td>Ann. Rev. Nucl. Part. Sci., 56, 569-628, 2006</td></tr>
<tr><td>page 693</td><td></td><td colspan="2">[731] and [732] are the same</td></tr>
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