

# Phenomenology of Particle Physics

## Errata (7/4/23)

1. **p. 4:** Eq. (1.2) The electron-volt is defined as the amount of energy gained by a single electron when it moves through an electric potential difference of one volt, hence one should read:

$$1 \text{ GeV} = 10^9 e (1 \text{ V}) = 1.602 176 634 \times 10^{-10} \text{ J} \quad (\text{exact}) \quad (1)$$

2. **p. 14:** Eq. (1.30), one should read:

$$m = 1 \text{ GeV}/c^2 = \frac{10^9 \text{ eV}}{c^2 \frac{\text{m}^2}{\text{s}^2}} = \dots \quad (2)$$

3. **p. 298:** Eq. (9.197), one should read:

$$\overbrace{a_3 a_4 a_{x_1}^\dagger a_{x_1} a_{x_2}^\dagger a_{x_2} a_1^\dagger a_2^\dagger} \rightsquigarrow -\overbrace{a_3 a_4 a_{x_1}^\dagger a_{x_1} a_{x_2}^\dagger a_{x_2} a_1^\dagger a_2^\dagger} \rightsquigarrow +\overbrace{a_3 a_4 a_{x_1}^\dagger a_{x_1} a_{x_2}^\dagger a_{x_2} a_1^\dagger a_2^\dagger} \quad (3)$$

4. **p. 301:** Ex. 9.2, point c, one should read:

$$(c) \pi^+ \pi^- \rightarrow \pi^0 \pi^0 \text{ and } \pi^0 \pi^0 \rightarrow \pi^+ \pi^-$$

5. **p. 389:** Eq. (11.295), one should read:

$$\frac{ie^2}{q^2} \bar{v}(p') \gamma_\mu (k_- - k_+)^{\mu} u(p) \quad (4)$$

where  $q^\mu = k_- + k_+$ .

6. **p. 436:** Ex 13.1, Eq. (13.44) should read:

$$\frac{1}{2} \sum_{\text{spins}} \mathcal{M} \mathcal{M}^* = \frac{1}{2} \left( \frac{e\lambda}{4m_{\ell^*}} \right)^2 q_\mu q_\alpha \epsilon_\nu^* \epsilon_\beta \text{Tr} [\not{p}_2 (\gamma^\mu \gamma^\nu - \gamma^\nu \gamma^\mu) (1 - \gamma^5) \not{p}_1 (1 + \gamma^5) (\gamma^\beta \gamma^\alpha - \gamma^\alpha \gamma^\beta)] \quad (5)$$

7. **p. 437:** Ex 13.1, Eq. (13.46) should read:

$$d\Gamma = \frac{1}{8m_{\ell^*}} \frac{1}{(2\pi)^2} \left( \frac{e\lambda}{4m_{\ell^*}} \right)^2 [32(m_{\ell^*}^3 E_2 - m_{\ell^*}^2 E_2^2)] \frac{p_2^2 dp_2 d\Omega d^3 \vec{k}}{\omega E_2} \delta(m_{\ell^*} - E_2 - \omega) \delta^3(-\vec{p}_2 - \vec{k}) \quad (6)$$

8. **p. 444:** In point 3, one should read “magnetron frequency” instead of “magneton frequency”.

9. **p. 463:** Eq. (14.123) should read  $\vec{E}(x, y, z) = -\frac{V_0}{r_0^2} (x, y, -2z)$  instead of  $\vec{E}(x, y, z) = \frac{V_0}{r_0^2} (x, y, -2z)$ .

10. **p. 463:** Accordingly, Eq. (14.124) should also have a minus sign in front of the first term:

$$\begin{pmatrix} \ddot{x} \\ \ddot{y} \\ \ddot{z} \end{pmatrix} = -\frac{eV_0}{mr_0^2} \begin{pmatrix} x \\ y \\ -2z \end{pmatrix} + \omega_0 \begin{pmatrix} \dot{y} \\ -\dot{x} \\ 0 \end{pmatrix} \quad (7)$$

11. **p. 502:** Eq. (16.28) should have absolute values.

$$\begin{aligned} |F_S(\vec{q}^2)| &= \left| \frac{3}{qa^3} \int_0^a dr r \sin(qr) \right| = \left| \frac{3}{qa^3} \left[ \frac{r \cos qr}{q} \Big|_0^a - \int_0^a \frac{\cos qr}{q} dr \right] \right| \\ &= \frac{3}{qa^3} \left| \frac{a \cos qa}{q} - \frac{\sin qa}{q^2} \right| = \left| \frac{3 \cos qa}{(qa)^3} [qa - \tan qa] \right| \end{aligned} \quad (8)$$

12. **p. 529:** Bottom of the page. “Such discrimination is not possible...”. The end of the sentence should read  $I_3 = Y = 0$  instead of  $I = Y = 0$ .

13. **p. 540:** Eq. (17.68) should read:

$$\Gamma(\pi^0 \rightarrow \gamma\gamma) = \left( \frac{\alpha}{3\pi} \right)^2 N_C^2 (Q_u^2 - Q_d^2) \frac{m_\pi^3}{8\pi f_\pi^2} \quad (9)$$

14. **p. 551:** Ex 17.3, point c, one should read  $\sin \theta = 1/\sqrt{3}$  instead of  $\theta = 1/\sqrt{3}$ .

15. **p. 814:** Eq. (26.91) should read  $\sigma(e^+e^- \rightarrow Z^0 \rightarrow \ell^+\ell^-) = \dots$  instead of  $\sigma(e^+e^+ \rightarrow Z^0 \rightarrow \ell^+\ell^-) = \dots$

16. **p. 814:** Eq. (26.93), same

17. **p. 814:** Eq. (26.94), same

18. **p. 994:** Appendix A.13, the first sentence should refer to “Gauss’s theorem” instead of “Stokes’s theorem”.