SOLUTIONS

Group 9 Collaboration

Problem # 22

$$P + \gamma \rightarrow \Delta$$

momenta p_1 p_2 k

- 4-momenta conservation $p_1 + p_2 = k$
- Square both sides $p_1^2 + p_2^2 + 2p_1 \cdot p_2 = k^2$

$$m_P^2 + 2E_\gamma |p_1|(1 - \cos\theta) = m_\Delta^2$$

- Threshold condition: $\cos\theta = -1$ $p \longrightarrow \longleftarrow \gamma$ → $|p_1| = \dfrac{m_\Delta^2 - m_P^2}{4E_\gamma}$
- High energy approx: $E_P \sqrt{1 - \dfrac{m_P^2}{E_P^2}} = \dfrac{m_\Delta^2 - m_P^2}{4E_\gamma}$

$$E_P = \frac{m_\Delta^2 - m_P^2}{4E_\gamma}$$

Problem # 6

CPT $\longrightarrow$ $P(\nu_\alpha \to \nu_\beta) = P(\bar{\nu}_\beta \to \bar{\nu}_\alpha)$

if $\alpha = \beta$: CPT $\longrightarrow$ $P(\nu_\alpha \to \nu_\alpha) = P(\bar{\nu}_\alpha \to \bar{\nu}_\alpha)$

if we want to measure CP violation, we should measure

$$\Delta_{\alpha\beta} = P(\nu_\alpha \to \nu_\beta) - P(\bar{\nu}_\alpha \to \bar{\nu}_\beta)$$

but, if $\alpha = \beta$

by CPT

$$\Delta_{\alpha\alpha} = P(\nu_\alpha \to \nu_\alpha) - P(\bar{\nu}_\alpha \to \bar{\nu}_\alpha) = 0$$