AKT II – Übung

7. 1. 2019

Bsp 1+2

6.1 Using the properties of the γ-matrices of (4.33) and (4.34), and the definition of $\gamma^5 \equiv i\gamma^0\gamma^1\gamma^2\gamma^3$, show that

$$(\gamma^5)^2 = 1\,, \quad \gamma^{5\dagger} = \gamma^5 \quad \text{and} \quad \gamma^5\gamma^\mu = -\gamma^\mu\gamma^5\,.$$

6.2 Show that the chiral projection operators

$$P_R = \tfrac{1}{2}(1+\gamma^5) \quad \text{and} \quad P_L = \tfrac{1}{2}(1-\gamma^5),$$

satisfy

$$P_R + P_L = 1\,, \quad P_R P_R = P_R\,, \quad P_L P_L = P_L \quad \text{and} \quad P_L P_R = 0\,.$$

Bsp 3+4

6.3 Show that

$$\Lambda^+ = \frac{m + \gamma^\mu p_\mu}{2m} \quad \text{and} \quad \Lambda^- = \frac{m - \gamma^\mu p_\mu}{2m},$$

are also projection operators, and show that they respectively project out particle and antiparticle states, *i.e.*

$$\Lambda^+ u = u, \quad \Lambda^- v = v \quad \text{and} \quad \Lambda^+ v = \Lambda^- u = 0.$$

7.3 In an $e^- p$ scattering experiment, the incident electron has energy $E_1 = 529.5\,\text{MeV}$ and the scattered electrons are detected at an angle of $\theta = 75°$ relative to the incoming beam.

a) At this angle, almost all of the scattered electrons are measured to have an energy of $E_3 \approx 373\,\text{MeV}$. What can be concluded from this observation?

b) Find the corresponding value of Q^2.