

Particle Physics 1: Exercise 12

Exercise 1

By considering the isospin states, show that the rates for the following strong interaction decays occur in the ratios

$$\begin{aligned} &\Gamma(\Delta^- \rightarrow \pi^- n) : \Gamma(\Delta^0 \rightarrow \pi^- p) : \Gamma(\Delta^0 \rightarrow \pi^0 n) : \\ &\Gamma(\Delta^+ \rightarrow \pi^+ n) : \Gamma(\Delta^+ \rightarrow \pi^0 p) : \Gamma(\Delta^{++} \rightarrow \pi^+ p) = 3 : 1 : 2 : 1 : 2 : 3. \end{aligned}$$

Exercise 2

The neutral vector mesons can decay leptonically through a virtual photon, for example by $V(q\bar{q}) \rightarrow \gamma \rightarrow e^+e^-$. The matrix element for this decay is proportional to $\langle \psi | \hat{Q}_q | \psi \rangle$, where ψ is the meson flavour wavefunction and $\hat{Q}_q$ is an operator that is proportional to the quark charge. Neglecting the relatively small differences in phase space, show that

$$\Gamma(\rho^0 \rightarrow e^+e^-) : \Gamma(\omega \rightarrow e^+e^-) : \Gamma(\phi \rightarrow e^+e^-) \approx 9 : 1 : 2.$$