

PARTICLE PHYSICS 2 : EXERCISE 6

1) Kaon decays

Draw the lowest-order Feynman diagrams for the decays

$$K^0 \rightarrow \pi^+\pi^-, \quad K^0 \rightarrow \pi^0\pi^0, \quad \bar{K}^0 \rightarrow \pi^+\pi^-, \quad \text{and} \quad \bar{K}^0 \rightarrow \pi^0\pi^0$$

and state how the corresponding matrix elements depend on the Cabibbo angle θ_C .

2) B^0 decays

Draw the lowest-order Feynman diagrams for the decays

$$B^0(d\bar{b}) \rightarrow D^-(d\bar{c})\pi^+(u\bar{d}), \quad B^0(d\bar{b}) \rightarrow \pi^+(u\bar{d})\pi^-(d\bar{u}) \quad \text{and} \quad B^0(d\bar{b}) \rightarrow J/\psi(c\bar{c})K^0(d\bar{s}),$$

and place them in order of decreasing decay rate.

3) D^0 decays

Draw the lowest-order Feynman diagrams for the decays

$$D^0(c\bar{u}) \rightarrow K^-(s\bar{u})\pi^+(u\bar{d}) \quad \text{and} \quad D^0(c\bar{u}) \rightarrow K^+(u\bar{s})\pi^-(d\bar{u})$$

and explain the observation that

$$\frac{\Gamma(D^0 \rightarrow K^+\pi^-)}{\Gamma(D^0 \rightarrow K^-\pi^+)} \approx 3 \times 10^{-3}.$$

4) T meson

A hypothetical $\bar{T}^0(t\bar{u})$ meson decays by the weak charged-current decay chain,

$$\bar{T}^0 \rightarrow W\pi \rightarrow (X\pi)\pi \rightarrow (Y\pi)\pi\pi \rightarrow (Z\pi)\pi\pi\pi.$$

Suggest the most likely identification of the W, X, Y and Z mesons and state why this decay chain would be preferred over the direct decay $\bar{T}^0 \rightarrow Z\pi$.