Flavour Physics: Week: I

Luismi Garcia

June 3, 2024

Problem 1. Following is a list of conservation laws (or symmetries) for interactions between particles. For each indicate by S,E,W those classes of interactions (strong, electromagnetic, weak) for which no violation of the symmetry or conservation law has been observed. For any one of these conservation laws, indicate a process which established a violation.

- I-spin conservation (look for Σ^0 decay)
- I_3 conservation (look for π^- decay)
- Strangeness conservation (Look for Λ decay)

Problem 2. A state containing only one strange quark:

(a) can decay into a state of zero strangeness

(b) can be created strongly from a state of zero strangeness.

(c) cannot exist

Problem 3. Consider the hadrons D^+, B^+, K^+, π^+ and Λ:

- Use the PDG to obtain their quark content and masses
- What would be their average distant traveled with assuming they have $\gamma = 4$.
- What is their associated momenta assuming a $\gamma = 4$
- Fraction of decays that happens in the first meter? What about 100m?

Problem 4. Consider the decays $B^0 \to J/\psi K^0_S$, $B^0 \to \pi^+\pi^-$, $B^0 \to K^+\pi^-$ and $B^0 \to \pi^+K^-$

- Check the PDG for the values of their branching ratios
- Why do they have such values (use their Feynman diagrams)?

Problem 5. Check the allowed (non-zero) terms for Lagrangian terms:

- $\overline{\psi_R}\psi_R$, $\overline{\psi_R}\psi_L$.
- $\overline{\psi_R}\gamma^5\psi_R$, $\overline{\psi_R}\gamma^5\psi_L$.
- $\overline{\psi_R}\gamma^\mu\psi_R$, $\overline{\psi_R}\gamma^\mu\psi_L$.
- $\overline{\psi_R}\gamma^5\gamma^\mu\psi_R$, $\overline{\psi_R}\gamma^5\gamma^\mu\psi_L$.