

Reading: Chapter 12

Problems:

1. Williams, Problem 12.3.
2. Williams, Problem 12.6.
3. Williams, Problem 12.8.

Hint: The muon lifetime can be calculated from the Fermi theory of β -decay. Neglecting the electron mass (a valid approximation since $m_e \ll m_\mu$) the result is

$$\frac{1}{\tau_\mu} = \frac{G_F^2 c^4}{192 \pi^3 \hbar^7} m_\mu^5$$

Draw Feynman diagrams for the β decay of μ^+ and for the weak decays (leptonic/hadronic) of D^+ . Use a formula analogous to the one above to estimate the D^+ lifetime. Your estimate should be somewhat smaller than the experimental value

$$\tau(D^+) = (10.57 \pm 0.15) \times 10^{-13} \text{ s}$$

The discrepancy is because the final state will include a kaon, whose mass cannot be really neglected. Get a better estimate for the lifetime by replacing m_D in the formula by $m_D - m_K$.

4. Williams, Problem 12.14.
5. Williams, Problem 12.16.

Reminder: The term paper is due on Wednesday, April 16.