

Physics 926: Homework #10

Due on April 7, 2020 at 5pm

Professor Ken Bloom

Robert Tabb

Problem 1

Show that:

$$\frac{\Gamma(K_L \rightarrow \pi^- e^+ \nu_e) - \Gamma(K_L \rightarrow \pi^+ e^- \bar{\nu}_e)}{\Gamma(K_L \rightarrow \pi^- e^+ \nu_e) + \Gamma(K_L \rightarrow \pi^+ e^- \bar{\nu}_e)} = 2\text{Re}(\epsilon)$$

to first order in ϵ . This asymmetry is evidence for indirect CP violation, and also allows us to unambiguously define electric charge - positive charge is assigned to the lepton that dominates in the K_L decay.

Solution

$$\begin{aligned} |K_L\rangle &= \frac{1}{\sqrt{1+|\epsilon|}} \left[\frac{1+\epsilon}{\sqrt{2}} |K^0\rangle - \frac{1-\epsilon}{\sqrt{2}} |\bar{K}^0\rangle \right] \\ |K_S\rangle &= \frac{1}{\sqrt{1+|\epsilon|}} \left[\frac{1+\epsilon}{\sqrt{2}} |K^0\rangle + \frac{1-\epsilon}{\sqrt{2}} |\bar{K}^0\rangle \right] \end{aligned}$$

Problem 2

Problem 3

Problem 4