PHYS 633: Elementary Particle Physics **Fall 2012**

Homework #5 **Due Date: 11/26/12**

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1. **Problem 7.3**

2. What is the expected ratio $K_L \to \pi^0\pi^0 / K_L \to \pi^+\pi^-$ if the pions are in (a) an $I = 0$ state ($\Delta I = \frac{1}{2}$ rule), or (b) an $I = 2$ state ($\Delta I = \frac{3}{2} \, or \, \frac{5}{2}$)?

3. **Problem 7.8**

4. The equation describing $K^0 - \bar{K}^0$ oscillations contains a term $\cos(\Delta m t)$ whereas $\nu_\mu - \nu_e$ oscillations go as
$$\sin^2\left(\frac{\Delta m^2 t}{4E}\right)$$
Account for the difference. Start with equation 7.57 of Perkins (for K^0 oscillations) and derive the form given in equation 9.16a from section 9.7 (for ν_μ oscillations).

5. Given $\Gamma(K_0 \to \pi^- e^+ \nu_e) = \Gamma(\bar{K}_0 \to \pi^+ e^- \bar{\nu}_e) = \Gamma_e$. Then if a K^0 is produced (e.g. in $\pi^- p \to \Lambda K^0$), show
$$\frac{BR(K_0 \to \pi^+ e^- \nu_e)}{BR(K_0 \to \pi^- e^+ \nu_e)} = \frac{4(\Delta m / \Gamma_+)^2 + (\Delta\Gamma / \Gamma_+)^2}{2 + 4(\Delta m / \Gamma_+)^2 - (\Delta\Gamma / \Gamma_+)^2}$$
where
$$\Delta\Gamma = \Gamma_1 - \Gamma_2$$
$$\Gamma_+ = \Gamma_1 + \Gamma_2$$
$$\Delta m = m_{K_1} - m_{K_2}$$
Start from equation 7.57 in Perkins. Find a numerical result for the ratio above, given that $\Delta m / \Gamma_1 = 0.477$.
