

## Week 2 (due Jan. 20)

1. Consider a beam of neutral kaons passing through a slab of material which acts on the  $K^0$  and  $\bar{K}^0$  components of the beam as follows:

$$|K^0\rangle \mapsto a|K^0\rangle, \quad |\bar{K}^0\rangle \mapsto b|\bar{K}^0\rangle.$$

Here  $a$  and  $b$  are complex numbers. Suppose the slab is placed some distance  $L = \tau$  from the kaon source, and that at the source the kaons are all  $K^0$ . Assume also that  $K_S$  and  $K_L$  are given by the difference and sum of  $K^0$  and  $\bar{K}^0$ , respectively. Find the fraction of  $K_S$  in the beam right after passing through the slab, as a function of  $\tau$ . Express the answer in terms of  $a, b, \Gamma_S, \Gamma_L$ , and the mass difference between  $K_S$  and  $K_L$ .

2. Compute the ratio of decay rates of the charged pion  $\pi^-$  into  $e^- \bar{\nu}_e$  and  $\mu^- \bar{\nu}_\mu$ . (Assuming the neutrino is massless). Compare with experimental data.