

Physics 457 Problem Set 10

Due in Class, April 13, 2005

Note: The second take home exam will be due April 15, 2005. It will be handed out in class on Wednesday, April 13.

Reading: Frauenfelder and Henley Chapter 17, 10, 11

1. (Held over from last week). Estimate the average matrix element

$$[| \langle f | H_{int}^w | i \rangle |^2]^{1/2}$$

for the electron capture reaction $^{40}\text{K} + e^- \rightarrow ^{40}\text{Ar} + \nu$ (Use two body phase space and the lifetime given in the Nuclear Wallet Card.)

2. (also from last week) What is the $ft_{1/2}$ value for the β decay of ^{239}Np ? (use the data handed out with Problem set to determine the Q-value).

3. Identify the decay interaction (strong, electromagnetic or weak) and justify

you answer for each of the following:

a.) $\pi^+ \rightarrow \mu^+ \nu_\mu$

b.) $\pi^0 \rightarrow \gamma\gamma$

c.) $\Lambda^0(s = -1) \rightarrow p + \pi^-$

d.) $\Delta^{++} \rightarrow p + \pi^+$

4. Estimate the branching ratios for the following decays:

a.)

$$\frac{R(K_S^0 \rightarrow \pi^+ \pi^-)}{R(K_S^0 \rightarrow \pi^0 + \pi^0)} = ?$$

b.)

$$\frac{R(\Lambda \rightarrow p^+ \pi^-)}{R(\Lambda \rightarrow n + \pi^0)} = ?$$

c.)

$$\frac{R(\Sigma^+ \rightarrow p^+ \pi^0)}{R(\Sigma^+ \rightarrow n + \pi^+)} = ?$$

Note: K_S^0 has $I = 1/2, J^P = 0^-$; Λ has $I = 0, J^P = \frac{1}{2}^-$; Σ^+ has $I = 1, J^P = \frac{1}{2}^+$.