Physics 457 Problem Set 9

Due in Class, April 6, 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.

1. (Held over from last week). Estimate the α–decay lifetime of ^{239}Pu.

2. Use the electric dipole operator to show that an electric dipole transition can only lead to decays between states of OPPOSITE parity with Δ J = 1.

3. (Also Frauenfelder and Henley 10.13) Estimate the mean life (or half life) of electric dipole transitions

a.) in an atom (e.g. the $2p_{1/2}$ to $1s_{1/2}$ transition in hyrodrgen)

b.) in a nucleus, (e.g. the 3 MeV $1/2^+$ to $1/2^-$ ground state transition in ^{13}C.

4. Estimate the average matrix element

$$[\ |< f|H^w_{int}|i >|^2\ ]^{1/2}$$

for the electron capture reaction

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(Use two body phase space and the lifetime given in the Nuclear Wallet Card.)

5. 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).