Elementary Particle Physics: Assignment # 3
Due Feb 15 10 am

1 Show that the "originally proposed" beta decay $n \rightarrow p + e^-$ also violated angular momentum. The proposal of Pauli was to introduce the neutrino so that the reaction would conserve both energy and angular momentum $n \rightarrow p + e^- + \bar{\nu}_e$. What could you know from this reaction about the spin of the neutrino?.

2 Suppose that you have a bound state made of two particles with spin 2 each in a state $m=0$. THey are bounded in the s-wave (i.e with relative orbital angular momentum $l = 0$).
What are the possible values you can measure for the total spin of state?
What is probability of each value? (check that they add up to 1) [hint: use the table of Clebsh-Gordan coefficients]

3 The η' is a meson for which you want to find out its spin, parity and charge conjugation quantun numbers.
You have observed the following electromagentic decay

$$\eta' \rightarrow \rho^0 \gamma$$

and have measured the $\rho^0 \gamma$ angular distribution and show that they are in a p-wave state (i.e with relative orbital angular momentum $l = 1$).
What can are the possible values of the s,P,C quantum numbers of the η'.?
hint: you need to use both conservation laws in the decay as well as the fact that the η' is a meson so its quantum numbers must follow consistently from the composition of the angular momentum of its quark-antiquark components.