Problem Set #18
due Friday, Feb. 9.

PHYSICS 852, SPRING 2001

1. The $\Delta^{++,+0,-}$ baryons have isospin 3/2 while the $\pi^{+0,-}$ mesons form an isotriplet. Calculate the branching ratios of all four $\Delta$ decays into the corresponding $p\pi$ or $n\pi$ channels. (For instance, what fraction of the $\Delta^+$s decay into $p\pi^0$ vs the $n\pi^+$ channels.)

2. The $S(975)$ meson is an isoscalar, and decays into two pions. What fraction of the two-pion decays are expected to go into the neutral pion channel?

3. Write the Racah coefficient, $W(j_1, j_2, j_3, J; J_{12}, J_{23})$ which is defined by

$$
\langle (j_1, j_2), J_{12}, J, M | j_1, (j_2, j_3), J_{23}, J, M \rangle = \delta_{M, M'} \sqrt{(2J_{12} + 1)(2J_{23} + 1)} W(j_1, j_2, j_3, J; J_{12}, J_{23}),
$$

in terms of Clebsch Gordan coefficients.

4. For each operator, define a set of irreducible tensor operators $T^k_q$, then define the operator as a linear sum of the irreducible operators. (When defining a set, define $T^k_q$ for all possible $q$.)

(a) $z$
(b) $p_x$
(c) $x^2$
(d) $L_z L_y$

5. Write down the rotation matrix $u_m^{(j)}(\phi, \theta, \psi)$ for the case where $j = 1/2$, and $\phi$, $\theta$ and $\psi$ are Euler angles.