**PHYS 633: Elementary Particle Physics Fall 2012**

**Homework #3 Due Date: 10/04/12**

1. a) Find the quark wave-function (flavor only) for the mixed-antisymmetric baryon octet representations (the mixed-symmetric wave-functions were all given in your handout). Show that the two Σ0 and the two Λ0 states (one MS and one MA each) are all orthogonal to each other.

b) From the quark wave-function for the Λ0, show that



 so that the Λ0 has I=0 and is also a part of the baryon octet (JP=1/2+).$ $

1. Use Young Tableaus to find the quantities A, B, and C in
	1. $4⊗4⊗4=A⨁B⨁B⨁C$
	2. $8⊗8⊗8=A⨁B⨁B⨁C$
	3. $4⊗4=A⨁B$
	4. $4⊗\overbar{4}=A⨁B$
2. In addition to the u,d,s quarks, there is a fourth quark c which makes the upper member of a (c,s) doublet (but note that I=0 for both c and s). Find all of the ground state baryons containing one and only one c quark and their quark wave-functions, with
	1. $J^{P}=\frac{3}{2}^{+}$
	2. $J^{P}=\frac{1}{2}^{+}$(use only the MS octet representation)

Give the quantum numbers I, I3, S, and Q for each of these states.

1. From the quark wave-function for the mesons, prove that
	1. $I^{+}|\left.η^{8}\right〉=0 and V^{+}|\left.η^{8}\right〉=|\left.K^{+}\right〉$

so that the η8 has I=0 and belongs to the meson octet, and

* 1. $I^{+}|\left.η^{1}\right〉=0 and V^{+}|\left.η^{1}\right〉=0$

so that the η1 has I=0 and does not belongs to the meson octet.

1. Find all of the ground state mesons containing one and only one c quark and their quark wave-functions, with
	1. $J^{P}=0^{-}$
	2. $J^{P}=1^{-}$

Start from the properly symmetrized wave-functions

 $|\left.π^{+}\right〉=\frac{1}{\sqrt{2}}(u\overbar{d}+\overbar{d}u) and |\left.ρ^{+}\right〉=\frac{1}{\sqrt{2}}(u\overbar{d}-\overbar{d}u)$.

Give the quantum numbers I, I3, S, and Q for each of these states.

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