5/12/16 Lecture 13 outline / summary

• Help with HW questions. Recall Clebsch Gordon coefficients, which can be found via $T_\pm|I,I_3\rangle = \sqrt{I(I+1)-I_3(I_3\mp 1)}|I,I_3\pm 1\rangle$. E.g. $|3/2,3/2\rangle = |1,1\rangle|1/2,1/2\rangle$. Lower both sides to get $|3/2,1/2\rangle = \sqrt{1/3}|3/2,1\rangle|1/2,-1/2\rangle + \sqrt{2/3}|1,0\rangle|1/2,1/2\rangle$, etc. compare with table of CG coefficients from the PDG. Physical observables involve squaring amplitudes, which will lead to ratios that differ by squares of the CG coefficients.

• $SU(3)$. Recall $|SU(N)| = N^2-1$, so $|SU(3)| = 8$. The fundamental representation is the $\mathbf{3}$ and the anti-fundamental rep is the $\overline{\mathbf{3}}$. These are the analogs of spin 1/2 for $SU(2)$; for general $SU(N)$ the $\mathbf{N}$ and $\overline{\mathbf{N}}$ differ, but for $SU(2)$ they happen to be equivalent. For general $SU(N)$ we can think of the fundamental as acting on v^c and the anti-fundamental on $\tilde{v}_c$, and $SU(N)$ preserves δ_c^d and $\epsilon_{c_1\ldots c_N}$ and $\epsilon^{c_1\cdots c_N}$. For $SU(2)$, we can relate $\tilde{v}_c = \epsilon_{cd}v^d$.

• The Gell-Mann matrices and the $\mathbf{3}$ vs the $\overline{\mathbf{3}}$.

• Application: approximate $SU(3)_F$ global symmetry for the (u,d,s) quarks. Mesons and baryons, spectrum and numbers.