

5/5/16 Lecture 11 outline / summary

- $SU(2)_I$  with  $u$  and  $d$  quarks forming the  $I = 1/2$  representation. Also  $SU(2)_{spin}$ . Find  $SU(2)_I$  representations of mesons and baryons. Mesons:  $\mathbf{2} \times \mathbf{2} = \mathbf{1} + \mathbf{3}$ , and pions. Baryons:  $\mathbf{2} \times \mathbf{2} \times \mathbf{2} = \mathbf{2} + \mathbf{2} + \mathbf{4}_S$ . Now  $SU(2)_{spin} \times SU(2)_{isospin}$ .

- Including the strange quark,  $SU(2)_I$  enhances to an approximate  $SU(3)_F$  symmetry. Gell-Mann matrices. Isospin and hypercharge assignments of quarks and anti-quarks. Now form light mesons.

- Approximate formula for meson masses:

$$m(q_1 q_2) \approx m_1 + m_2 + \frac{A}{m_1 m_2} \langle \vec{S}_1 \cdot \vec{S}_2 \rangle.$$

$m_u \approx m_d \approx 0.307 GeV$ ,  $m_s \approx 0.4900 GeV$ ,  $A \approx 0.06 GeV^3$ . Note  $m_{\eta', naive} \approx 355 MeV$  vs  $m_{\eta', actual} \approx 958 MeV$ . Recall discussion from last time.

- $j = 0$  baryons and symmetry.
- Approximate formula for baryon masses:

$$m(q_1 q_2 q_3) \approx m_1 + m_2 + m_3 + A' \left( \frac{\langle \vec{S}_1 \cdot \vec{S}_2 \rangle}{m_1 m_2} + 2 - perms \right).$$

$m_u \approx m_d \approx 0.365 GeV$ ,  $m_s \approx 0.540 GeV$ ,  $A' \approx 0.026 GeV^3$ . Comments.

- quark model predictions for magnetic moments:  $\mu_p \approx \frac{4}{3}\mu_u - \frac{1}{3}\mu_d$ ,  $\mu_n \approx \frac{4}{3}\mu_d - \frac{1}{3}\mu_u$ , and  $\mu_u \approx -2\mu_d$ .