Physics 135b
Problem set number 8
Due Wednesday, March 3, 2004

Reading: Read chapter 10 in the text, on weak interactions.

39. Problem 9.13 in text. Make sure you carefully consider the singlet state wave function, and show explicitly how the factor of three comes about that the hint describes. Use your result to make an approximate prediction for the $\eta_c \to \gamma\gamma$ branching ratio and compare with experiment.

40. Problem 9.16 in text. Using the experimental result, $\alpha_s(m_Z^2) = 0.1172 \pm 0.0020$, determine the value (with uncertainty) of the QCD scale parameter Λ according to Eqn. 9.71. Be sure to justify your choice for f (should it be 6?). Compare your answer with the value quoted in Eqn. 9.72.

41. Problem 10.1 in text.

42. Problem 10.2 in text.

43. In class we stated that the gluon energy term in the QCD Lagrangian was:

$$\tfrac{1}{4} G^a_{\mu\nu} G^{\mu\nu}_a, \tag{2}$$

where the gluon field strength tensor is given by:

$$G^a_{\mu\nu} = \partial_\mu G^a_\nu - \partial \nu G^a_\mu - g f_{abc} G^b_\mu G^c_\nu. \tag{3}$$

Show that this term is gauge invariant.