Physics 325: Elementary Particle Physics  
Spring 2010  
Problem Set 9  

Due: Thu 15 April 2010  

Reading: Please finish reading Chapter 9 in Griffiths and begin to read Chapter 10.  

Problems:  

8.1. Filling in the steps in $e^+ + e^- \rightarrow q + q$.  

8.6. Form factors for a “Dirac proton” Here, the term “Dirac proton” refers to a fictional pointlike proton, for which $K^{\mu\nu}$ takes the same form as $L^{\mu\nu}$.  

9.2. Modified weak vertex I. Suppose that $\gamma^{\mu}(1 - \gamma^5)$ is replaced by $\gamma^{\mu}(c_V - c_A \gamma^5)$ in the definition of the weak vertex factor. Then, in any tree diagram in which particle 1 is transformed to particle 2 through the emission of a virtual $W^\pm$, we obtain the given trace as a factor in $\langle |M^2| \rangle$. This problem is relevant for the Partially Conserved Axial Current (PCAC) hypothesis, which describes the corrections to the fundamental weak vertex due to higher order diagrams involving the strong interactions. (See p. 320 and Example 9.5.)  

9.3(a) Modified weak vertex II. Suppose that $\gamma^{\mu}(1 - \gamma^5)$ is replaced by $\gamma^{\mu}(1 - \epsilon \gamma^5)$ in the definition of the weak vertex factor. This assumption is similar to that of the previous problem except we take $C_V = 1$ (following the experimental observations described on p. 320).  

9.5. Lifetime of the $\tau$.  