# PHYS 485: Problem Set 6

Due: 4:30 pm, 23 March 2010

If the answer is shown, all the makers will be given for the derivation not for writing down the answer.

1. [8] Griffiths Problem 8.1
2. [6] Griffiths Problem 9.15.
3. [14] Griffiths Problem 9.23. You might not get quite the same answers as are quoted. Look up the branching ratios for all of the $Z^0$ decays in the PDG and comment on how well your calculations agree with experiment. Also comment on how well your lifetime agrees with the value in the PDG.
4. [8] Griffiths Problem 9.26.
5. [2] Griffiths Problem 9.27.
6. [4] Show that an arbitrary $n \times n$ unitary matrix has $n^2$ real parameters, and hence that

$$U = e^{-i\alpha} \begin{pmatrix} \cos\theta_c e^{i\beta} & \sin\theta_c e^{i\gamma} \\ -\sin\theta_c e^{-i\gamma} & \cos\theta_c e^{-i\beta} \end{pmatrix}$$

   is the most general form of a $2 \times 2$ unitary matrix.

   The most general form of $(d, s)$ mixing is

$$\begin{pmatrix} d' \\ s' \end{pmatrix} = \mathbf{U} \begin{pmatrix} d \\ s \end{pmatrix},$$

   where $\mathbf{U}$ is an arbitrary $2 \times 2$ unitary matrix, $\mathbf{U}^\dagger\mathbf{U} = 1$. Show that this can be reduced to the Cabibbo mixing matrix by adjusting the arbitrary phases of the quark states $s, s'$ and $d'$.