Physics 135b
Problem set number 2
Due Wednesday, January 21, 2004

Notes about course:

- Late policy: If you ask for an extension before the due date, with a reasonable excuse, it will most likely be granted. If you don't, and turn it in late, you are at the mercy of the TA's whim.
- URL: http://www.hep.caltech.edu/∼fcp/ph135/
- TA: Tristan McLoughlin, tristanm@its.caltech.edu; hours: Tuesdays 6-8 PM, location: 248 Lauritsen.

Reading: Read chapter 4 in the text, on symmetries.

6. Problem 2.5 in the text. Take this problem seriously, and you will already be doing some phenomenology of importance in the everyday life of the particle physicist. It really isn't difficult, if you have understood how to use Feynman graphs for simple arguments, and the discussion on the Cabibbo/Kobayashi-Maskawa mixing.

7. A particle with mass M decays to n particles with masses m_i, $i = 1, \ldots, n$. What is $p_{\max}$, the maximum momentum that any of the decay products can have in the frame of the decaying particle? If you use your intuition to figure out which kinematic regime gives the maximum momentum, give as convincing an argument for its validity as you can. Beware – it is possible to be misled by faulty intuition. However you arrive at your result, be sure it makes intuitive sense to you. Apply your result to the decay $J/\psi \to \Delta^{++}\bar{p}\pi^-$, giving your answer in MeV or GeV. For particle properties, such as masses, recall the URL: http://pdg.lbl.gov/2002/contents_tables.html

8. Problem 4.5 in the text. This is an exercise on matrix groups, which I am assigning just to make sure everybody has some feeling for what is going on in group theory, since we are using a fair amount of group theoretic language. If you already know something about group theory, then this problem will be trivial (I assume everybody is proficient with

matrices). Note that you can probably save some effort by noting that the sets of matrices in parts of the problems are subsets of other parts (the corresponding matrix groups – if they are indeed groups – will thus be "subgroups" of the other groups).

9. Problem 4.24 in the text. In addition, give the (I, I_3) assignments for the D^+, D^-, D^0, and $\bar{D}^0$.

10. Problem 4.32 in the text.

11. Problem 4.37 in the text. [Griffiths refers to the classification of the η as a "stable" particle. This is because the Particle Data Group, which publishes a *Review of Particle Properties*, used to label particles which did not decay strongly as "stable". If you look at the current edition of the *Review of Particle Properties* (Physical Review D **66** (2002) 010001, or URL in problem 6 above), however, you will find that the Particle Data Group no longer does this. It got to be less meaningful with particles such as the W, which decays weakly, having a shorter lifetime than many strongly decaying particles.]