Homework 1 for Physics 222/225b
Due Date: Tuesday, January 19th

1. Halzen & Martin 12.1 (20points)
2. Halzen & Martin 12.3 (20points)
3. Halzen & Marten 12.4 (20points)
4. Halzen & Marten 12.11 (20points)
5. Show that the energy spectrum in unpolarized muon decay is the same for V-A and V+A. In passing, show equation 12.35 in Halzen & Martin. (20points)

6. Extra Credit (40 points): Imagine you are trying to see WW production for the first time at CMS. W's decay to leptons and jets. (It's ok to use CDF or D0 papers as guidance, or CMS physics TDR as guidance. However, you must reference whatever you use! All CDF and D0 public results are available on the web via their web pages www-cdf.fnal.gov and www-d0.fnal.gov). You might want to consult the paper you read for last quarter's final.
    a. Develop an analysis strategy including:
        i. What final states are available in WW ?
        ii. What are their relative rates?
        iii. How would you trigger on each of the final states? Take the HLT trigger table E-12 from p.576 o vol.II of the CMS Physics Performance TDR as your guide.
        iv. Make a list of likely backgrounds for each final state.
    b. Use comphep to verify:
        i. What's the production cross section for your preferred final state at the LHC ? This should include WW production as well as branching fraction into your final state of choice.
        ii. What's the acceptance for your final state, given an |eta|<2.5 coverage of the detector, and the trigger strategy you chose.
        iii. How much luminosity do you think you need to make a 5sigma observation of WW given your analysis strategy ? A crude guess is ok here. However, state your assumptions clearly!