

Problem Set 6

Physics 363
May 7, 2008

Spring Quarter 2008
Due in class Wed. May 14.

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Reading: Perkins Chapter 7, Sections 7.2-7.9; 7-11,7-12; Chapter 8, Sections 8.1-8.7. (this is a lot of reading on an elegant and important topic - more than a single sitting. Please give it several evenings.)

Problems:

1. Derive the couplings of the Z-boson to the charged and neutral leptons, and the up and down quarks.
2. Starting with Fermi's 4-fermion coupling model, derive the formula for the W-boson mass in terms of only numerical constants and the Weinberg angle.
3. Derive the relationship between the W mass and the Z mass in the Weinberg-Salam model.
4. Find the numerical values of e , g , and g' in the Weinberg-Salam model.
5. Show explicitly the dependence of neutrino-electron and antineutrino-electron differential cross-sections $d\sigma/dy$ on the Weinberg angle.
6. Derive the forward-backward asymmetry in $e^+e^- \rightarrow \mu^+\mu^-$ far above the Z-pole (i.e. $m_{\mu^+\mu^-} \gg M_Z$). (You may want to look up Jon Rosner's papers on this in Spires (at SLAC) or the Los Alamos server (xxx.lanl.gov)).