

Physics 331 – Problem Set # 7

(due Wednesday, March 15)

1. Peskin and Schroeder, Problem 20.3.
2. Peskin and Schroeder, Problem 20.4.
3. Using explicit polarization vectors, compute the scattering amplitudes for $e_R^- e_L^+ \rightarrow W^- W^+$ and $e_L^- e_R^+ \rightarrow W^- W^+$ for the case of longitudinally polarized W bosons. Do the exact calculation, without making the approximations used by Peskin and Schroeder in Section 21.2. (You may ignore the electron mass.) Show that the individual diagrams are of the order of $e^2 s/m_W^2$ but that a power of s/m_W^2 cancels to produce the final answer. It is much easier to see the cancellation in the case of $e_R^- e_L^+$. Show that the final answer in each case is proportional to $e^2 \sin \theta$ at high energy. Show that these results reproduce the amplitudes for $e_R^- e_L^+ \rightarrow \phi^- \phi^+$, $e_L^- e_R^+ \rightarrow \phi^- \phi^+$, where ϕ^+ , ϕ^- are the Goldstone bosons in the Higgs multiplet.
4. Using the computer program `ppcollider` from Problem Set 6 and the result of Problem 20.3, compute the dimuon invariant mass distribution for the Drell-Yan process $p\bar{p} \rightarrow \mu^+ \mu^- + X$ in $p\bar{p}$ collisions at a center of mass energy of 2.0 TeV.