Study 1: Feynman Graph Calculations and Deep Inelastic Scattering

This series of 6 problems will give you practice in calculating using Feynman graphs (1-2) and introduce the concepts used in analyzing deep inelastic scattering (3-6). Please feel encouraged to use any and all reference materials, talk with friends, or whatever, to get the job done – just as you would with a research project. Also, as with a research project, write up your results as if they were going to be presented to the whole wide world, not just your professor. Set out the logic and the results fully, but include only enough algebra to make it clear how it goes. Put it all in TeX, or its moral equivalent. Take pride in what you do! Problems 1-2 are due on Monday, October 21, and 3-6 on Friday, October 25.

Electron-Positron Annihilation Through Photons

Calculate the differential cross-section for e^+e^- annihilation through photons into muons or into quarks, to lowest non-trivial order, as a function of energy and angle. Assume unpolarized beams and that that the final spins are not observed. Discuss how to set up the calculation for e^+e^- final states, and set up the amplitude calculation, with special attention to signs, but don't feel compelled to work it out to the bitter end.

Electron-Positron Annihilation Through Massive Vector Particles

Re-do the calculation for annihilation through a massive vector boson, allowing for both vector and axial vector couplings at both ends. Use the propagator allowing for a finite width vector boson. In this calculation, take the masses of the electron and positron to be zero. (Non-zero masses introduce interesting theoretical complications, associated with the Higgs mechanism, which we'll take up later.) Discuss how parity violation is manifested.