Physics 222. Quantum Field Theory 3. Professor Dine

Spring, 2011. Homework Set 3. Due Thurs, May 12.

1. Compute the renormalization of the coupling in QED with a single, massless four-component fermion using the background field method.

2. Read carefully the discussion in Peskin and Schroeder, pp. 232-236. (You don't need to hand anything in, but you should do this reading with paper and pencil and assign yourselves exercises). Then consider equation 7.55, but in the case of a fermion, i.e. with $\not{k} - \not{q} + m$ in the numerator. Rewrite in terms of (positive energy, in the case $d^0 > 0$) spinors, and explain, without doing calculations, why such factors will build up the appropriate fermion cross sections. Similarly for gauge bosons.

3. Work through the kinematics of lepton pair production, pp. 564-568, deriving, in particular, eqn. 17.48