

PHY 5667 : Quantum Field Theory A, Fall 2002

November 19th, 2002

Assignment # 6

(due Thursday December 5th, 2002)

1. Calculate the $\mathcal{O}(\alpha)$ radiative vertex correction to $e^- \rightarrow e^-$ scattering off a potential. In particular:
 - show that the electron vertex function is UV-divergent and use Pauli-Villars regularization to calculate the UV-divergent integrals;
 - subtract the UV-logarithms as explained in Sec. 6.3 and summarized in Eq. (6.55) of your book, and derive the form factors $F_1(q^2)$ and $F_2(q^2)$ as given in Eqs. (6.56) and (6.57);
 - show that the electron vertex function is also IR-divergent and that the IR-divergent integrals can be regularized by introducing a photon mass term (μ). Calculate explicitly the terms that diverge (logarithmically) as $\mu \rightarrow 0$ and show that they are cancelled by analogous terms in the soft part of the cross section for $e^- \rightarrow e^- \gamma$ (where by *soft part* we mean the part of the cross section for $e^- \rightarrow e^- \gamma$ when the energy of the emitted photon goes to zero).

It is not necessary that you work out all the integrals over the Feynman parameters till the end if this is not required by finding any of the results mentioned above. This means that you can just leave them just as formal integrals whenever they appear in terms that will only contribute to the finite part of the cross section.

You can follow the trace of Sec. 6.3-6.4 of your book, and the notes you have taken in class, but pay attention to show all the details of your calculation. The aim of this homework is to allow you to study the material of Sec. 6.3-6.4 with care and attention to the details, so that you can understand it in depth.