Homework 4
Due date: 2019.04.22

Problem 1. In the computation of the Compton scattering $e^-(p_1)+\gamma(k_1) \to e^-(p_2)+\gamma(k_2)$, starting from the step

$$|\overline{\mathcal{M}}|^2 = \frac{e^4}{4}\mathrm{Tr}\Big[(\gamma\cdot p_2+m)\Big(\frac{2\gamma^\nu p_1^\mu+\gamma^\nu\gamma\cdot k_1\gamma^\mu}{2p_1\cdot k_1}-\frac{2\gamma^\mu p_1^\nu-\gamma^\mu\gamma\cdot k_2\gamma^\nu}{2p_1\cdot k_2}\Big)\cdot (\gamma\cdot p_1+m)\Big(\frac{2\gamma_\nu p_{1\mu}+\gamma_\mu\gamma\cdot k_1\gamma_\nu}{2p_1\cdot k_1}-\frac{2\gamma_\mu p_{1\nu}-\gamma_\nu\gamma\cdot k_2\gamma_\mu}{2p_1\cdot k_2}\Big)\Big],$$

where m is the electron mass, show that [15 points]

$$|\overline{\mathcal{M}}|^2 = 2e^4\Big[\frac{p_1\cdot k_1}{p_1\cdot k_2}+\frac{p_1\cdot k_2}{p_1\cdot k_1}+2m^2\Big(\frac{1}{p_1\cdot k_1}-\frac{1}{p_1\cdot k_2}\Big)+m^4\Big(\frac{1}{p_1\cdot k_1}-\frac{1}{p_1\cdot k_2}\Big)^2\Big].$$

Note: Please show all steps in your computation. You can use all the properties of the γ-matrices in the problems 1&2 of homework 3 of the QFT1 course (please look it up in github), and you don't have to re-do the proofs here.