Homework Set No. 1, Physics 8808.02

Deadline − Tuesday, January 29, 2013

1. a. (15 pts) Calculate the differential cross section $d\sigma/dt$ for electron-positron annihilation into two photons, i.e., for

$$e^- + e^+ \to \gamma + \gamma.$$

You may assume that electron and positron are massless. Express your answer in terms of Mandelstam variables s, t and u, and electromagnetic coupling constant α_{EM}.

(Hint: you may want to use the replacement

$$\sum_{\lambda=\pm} \epsilon_\mu^{(\lambda)\,*}(k)\,\epsilon_\nu^{(\lambda)}(k) \;\to\; -g_{\mu\nu}$$

when summing over photon polarizations.)

b. (10 pts) Calculate the differential cross section $d\sigma/dt$ for the inverse process (again assuming that e^+ and e^- are massless):

$$\gamma + \gamma \to e^- + e^+.$$

Express your answer in terms of Mandelstam variables s, t and u, and α_{EM}. Compare the answer with the result of part **a**. Comment.

2. (25 pts) Problem 5.2 in Peskin and Schroeder. Clarification to their problem formulation: you are asked to find the differential cross section in the center-of-mass frame. Also write an expression for $d\sigma/dt$.