Homework Set No. 1, Physics 880.08

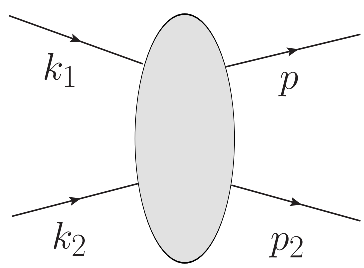
Deadline – Monday, January 23, 2012

1. (35 pts) Problem **4.1** in Peskin and Schroeder. (Hints: Reading pp. 32-33 in Peskin and Schroeder first may help understand the problem. Assume that $j(x)$ is real. Each item is worth the following amounts of points: (a) - 3, (b) - 5, (c) - 10, (d) - 8, (e) - 7, (f) - 2.)

2. (20 pts) Consider $2 \to 2$ scattering of identical particles of mass m. Suppose the production cross section of a particle with 4-momentum p is given by

$$\mathcal{E}_p \frac{d\sigma}{d^3p} = f(s,t,u)\, \delta(s' + t' + u' - 4\, m^2)$$

where f is some function of $s = (k_1 + k_2)^2$, $t = (k_1 - p)^2$, and $u = (k_1 - p_2)^2$, with $s' = (p + p_2)^2$, $t' = (k_2 - p_2)^2$, $u' = (k_1 - p_2)^2 = u$ (see figure below). Just like in class $k_1^\mu = (E_{k_1}, \vec{k}_1)$, $k_2^\mu = (E_{k_2}, \vec{k}_2)$, $p^\mu = (E_p, \vec{p})$, and $p_2^\mu = (E_{p_2}, \vec{k}_1 + \vec{k}_2 - \vec{p})$.



Show that

$$\frac{d\sigma}{dt} = \frac{\pi}{\sqrt{s\,(s - 4\,m^2)}}\, f(s,t,u)$$

where u is now defined by $u = 4\,m^2 - s - t$ and $s = (k_1 + k_2)^2$ still. (Hint: it is easier to prove this result by picking either the rest frame of one of the initial state particles or the CMS frame.)