**PHYS 633: Elementary Particle Physics Spring 2012**

**Homework #4 Due Date: 10/30/12**



1. In the center-of-mass frame for the process , show that



And hence that the differential cross section is



1. Show that for very high-energy “spinless” electron-muon scattering,



Where *θ* is the scattering angle and *α=e2/4π*. Neglect the particle masses.

1. Show that in the reaction ,



1. Taking  to be the *s* channel process, verify that



Where *θ* is the center-of-mass scattering angle and , where  and are, respectively, the momenta of the incident and scattered electrons in the center-of-mass frame. Show that the process is physically allowed provided . The physical region is shown shaded in the figure drawn in class. Note that  correspond to forward (backward) scattering.

1. Show that the invariant amplitude for “spinless” electron-electron scattering,

,

can be written as

.

Comment on the symmetry of M under *s* ↔ *t*.

1. In  near threshold, one can obviously not neglect the mass

of the . Working from  and the exact spin-averaged amplitude



Show that the total cross-section for  production is given by

 where.

