Physics 56400 Assignment #2 – Due September 6th

1. A particle with mass M_A is moving with momentum p_A along the z-axis and decays into two particles with masses m_a and m_b. What is the minimum momentum p_A that will guarantee that both final state particles are also moving in the +z direction?

2. The PEP-II storage ring collided electrons with energy $E_{e^-} = 9.0\ GeV$ and positrons with energy $E_{e^+} = 3.1\ GeV$. Calculate the energy of the collisions in the center-of-mass frame. What is the velocity of the center-of-mass frame when observed from the stationary lab frame?

3. The SPEAR storage ring at SLAC collided electrons and positrons with a center-of-mass energy of 8 GeV and produced pairs of $D^{\pm}$ mesons. If the mass of a $D^{\pm}$ meson is 1.870 GeV, what is the maximum transverse momentum with which they can be produced? If the proper lifetime of a $D^{\pm}$ meson is $\tau_D = 1.04\ ps$, calculate their mean transverse decay length in the lab frame.

4. Fermilab experiment E687 produced $D^{\pm}$ mesons in fixed target collisions of a photon beam with a beryllium target. If the typical energy of $D^{\pm}$ mesons produced in this way was 200 GeV, calculate the mean decay length in the lab frame.