Phy 523
PARTICLE PHYSICS

12th January 2009

Due 19th January 2009

1.Consider a particle A (mass M_A) decaying to two particles B,C (masses M_B, M_C). Find the momentum of particle B in the (a) rest frame of A and (b) in a frame in which the momentum of A is $\vec{P_A} = (0, 0, P_A)$ and the momentum of B makes an angle θ with A.

2. Consider a particle A (mass M_A) decay to three particles B,C and D (masses M_B, M_C and M_D). Find the maximum and the minimum energy range for C in the rest frame of A.

3. Consider the scattering $A+B \rightarrow C+D$. Masses are (M_A, M_B, M_C, M_D) respectively with $M_C + M_D > M_A + M_D$. Find the minimum energy needed for the particle A in order this reaction occurs (a) in the rest frame of B (b) in the centre of mass frame.

4. Consider the decay $\pi^0 \rightarrow \gamma + \gamma$ (mass of pion is M_π). Assume that the decay is isotropic in the rest frame of π^0. Now consider a frame π^0 is moving with energy E. Show that the energy disribution of the photons in this frame is given by

$$\frac{dN(E_\gamma)}{dE_\gamma} = \text{constant}$$

where $N(E_\gamma)$ is the number of photons emitted as a funcion of the energy of the photon E_γ. Further show that $E(1-\beta) < E_\gamma < E(1+\beta)$ where $\beta = (E^2 - M_\pi^2)^{1/2}/E$

5.(a) The life time of a particle in natural units ($\hbar = c = 1$) is $1Mev^{-1}$. Find the lifetime in seconds.

(b) the cross section of scattering in a process is $1Mev^{-2}$. Find the cross section in cm^2.