Interaction of particles with matter

IPM Tutorial 1

Give all numerical results with three significant digits

1 - Basic calculations

a) Compute the Lorentz factor, γ, the speed, β, and the momentum of neutral kaons (K^0) of kinetic energy E_{kin} = 600 MeV. Take the mass of the kaon, m (K^0) = 497.611 MeV/c^2.

b) The K_S and the K_L mesons have mean lifetime $\tau = 8.954 \cdot 10^{-11}$ s and $5.116 \cdot 10^{-8}$ s, respectively. Compute their decay lenght when the kinetic energy is E_{kin} = 600 MeV and E_{kin} = 10 GeV.

c) Convert the mass of the neutral K from MeV/c^2 to kg.

2 - Interactions of neutral particle on matter : neutrons

a) The mean free path of fast neutrons in lead is about 5 cm. Compute the corresponding total neutron cross section in lead in barn.

b) The mass of neutron is m = $1.675 \cdot 10^{-27}$ kg. Convert it to GeV/c^2.

3 - Interactions of neutral particle on matter : photons

a) Compute the wavelenght of the electromagnetic radiation corresponding to a photon of energy E = 50 KeV (h= $6.626 \cdot 10^{-34}$ m^2 kg/s).

b) Which is the most probable interaction mechanism of 50 KeV photons in lead (Z=82) ?

c) Compute the maximal kinetic energy that a photon with energy E$_\gamma$= 800 KeV can transfer to an electron of the matter in a Compton process. Which is the minimal energy of the final photon ? For which photon scattering angle this happens ?

d) Compute the maximum energy that a photon with energy E$_\gamma$= 800 KeV can transfer to the final photon and the minimal energy of the scattered electron. For which photon scattering angle this happens ?

e) If the scattering angle of the final photon is 30 degrees, compute the $\beta\gamma$ of the scattered electron.