pp physics, RWTH, WS 2003/04, T.Hebbeker

2003-11-05

Exercises, part 4

Thursday 2003-11-06 - Thursday 2003-11-13 16:00

1. interactions of charged particles with matter 3 points

Review the interaction of charged particles (incl. electrons) with matter. Please, describe the processes in words, via Feynman diagrams and write down the formulae describing the energy loss. How does it depend on the properties of the material ?

a) interaction with atomic electrons.

b) interaction with nuclei.

2. interactions of photons with matter 3 points

Answer the same questions for photons:

a) photo effect

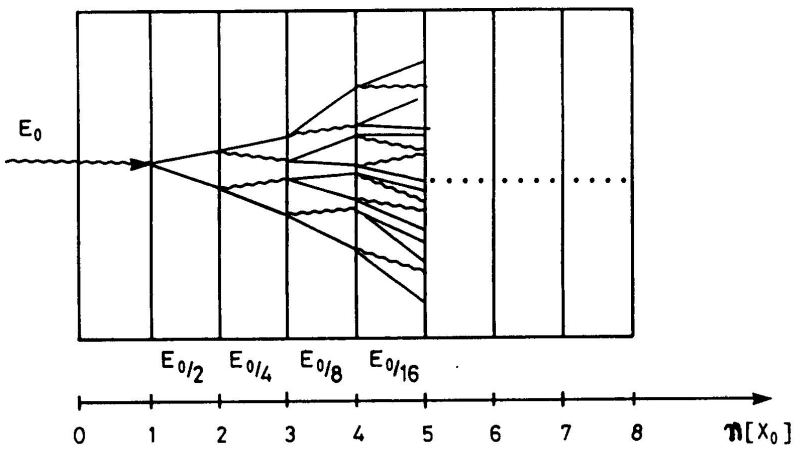
b) Compton effect

c) pair creation

3. electromagnetic showers 4 points

i) Which quantities characterize the longitudinal and transverse electromagnetic shower size ?

ii) Consider the following simple model of an electromagnetic shower, initiated by an electron, positron of photon of high energy E:



After exactly one radiation length an electron radiates and a photon splits into an electron positron pair; the energy of the primary particle is distributed equally to the two final state particles. The shower 'stops' when $E_\gamma < 2m_e$ or $E_e < E_c$ ('critical energy').

a) How many charged particles are created in total ? Which is the corresponding total path length ?

b) How many radiation lengths are necessary to absorb the shower completely ?

c) At which depth is the particle density at its maximum ? How does this depth depend on the primary energy E ?