Simple kinematic calculations

(See page 10)

Example A – Inelastic Scattering

Electrons of energy 900 MeV scatter inelastically off protons. If an electron scattered through 30° has an energy of 234 MeV, what is the mass of the "excited proton" it creates?

Mass of electron = 0.5 MeV/c^2
Mass of proton = 938.3 MeV/c^2

Example B – Two-body Decay

a) Decay to massless particles
A π^0 (mass 135 MeV/c^2) at rest decays into 2 photons.

$$\pi^0 \rightarrow \gamma\,\gamma$$

What are their energies and momenta?

b) Particles with mass
A ρ^0 meson (mass 770 MeV/c^2) at rest decays into 2 charged pions (mass 140 MeV/c^2).

$$\rho^0 \rightarrow \pi^+\,\pi^-$$

What are their energies and momenta?

→ 4-vectors
Go to Fermions and Bosons slides

Example C – Two-body Collision

What energy pions must strike a proton at rest in order to produce a Δ baryon (mass 1232 MeV/c^2)?