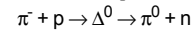


Chapter 5: Hadron quantum numbers

In a fixed target experiment a π^- -beam is used on a proton target and the process



can occur.

a) Draw a quark diagram for this process and estimate the mean distance travelled by Δ^0 before it decays, assuming it was produced with $\gamma = E/m \approx 10$.

Using 4-vectors (and perhaps Mandelstam variables):

b) Compute the π^- -beam energy required to produce the above process at the Δ^0 resonance, $m(\Delta^0) = 1230$ MeV.

c) Show that, if the π^0 and n are produced with an angle $\theta = \pi/2$ between them, they can only obtain the energies

$$E(n) (E(\pi^0)) = E(\pi^-),$$

and

$$E(\pi^0) (E(n)) = m(p),$$

assuming that $m(\pi^-) = m(\pi^0)$ and $m(n) = m(p)$.

Chapter 6: Quark states and colours

Resonance Δ^{++} has a baryon number $B=1$, electric charge $Q=2$, and $S = C = \tilde{B} = T = 0$.

Explain why such particle can not exist unless colour charge is introduced.

Could a baryon with three down-quarks exist?