Experimental Particle Physics

ESIPAP 2021

Homework 1: Exercises

1 Reaction threshold

Compute the energy a pion beam impacting a metal target (assume the target is made of protons) should have for this reaction to happen:

$$\pi^- + p \to \pi^- + \pi^+ + \pi^- + p \tag{1}$$

Hint: remember that for a reaction to happen $\sqrt{s} \geq \sum_i m_i c^2$. Work in natural units to make calculation simpler.

2 Fixed target vs. collider experiments

How much energy E_{fix} should a fixed target experiment have to equal the center of mass energy E_{coll} of two colliding beams? Prove that:

$$E_{\text{fix}} = 2\frac{E_{\text{coll}}^2}{m} - m \tag{2}$$

assuming both the beam(s) and the target are composed by particles of mass $m = m_1 = m_2$.
Hint: define the center of mass energy in both cases, then equal them.