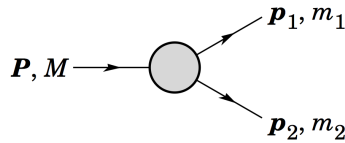# Experimental Particle Physics

ESIPAP 2019

Homework 1: Exercises

1 2-body decay

For a 2-body decay we proved in class that, in the CM framework of the decaying particle:

$$E_1 = \frac{M^2 - m_2^2 + m_1^2}{2M} \tag{1}$$

Compute what is $|p_1| = |p_2|$ in the CM framework of the decaying particle.

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_{col} of two colliding beams? Prove that:

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

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.

3 Accelerating electrons

How much energy did electrons and positrons of $E = 50$ GeV and 100 GeV loose in one round at LEP ($L = 27$ km)? Remember that:

$$\Delta E = \frac{4\pi}{3} \frac{1}{4\pi\varepsilon_0} \left(\frac{e^2 \beta^3 \gamma^4}{R} \right) \tag{3}$$

Hint: remember that $\frac{e^2}{4\pi\varepsilon_0 \hbar c} = \alpha$.