

177.

Problem 2.28 (R)

A π^+ meson is created in a high-energy collision of a primary cosmic-ray particle in the earth's atmosphere 200 km above sea level. It descends vertically at a speed of $0.99c$ and disintegrates, in its proper frame 2.5×10^{-8} s after its creation. We have to find the altitude above the seal level observed from earth when it disintegrates.



Solution:

In its rest frame the life of π^+ meson is 2.5×10^{-8} s.

Its speed as observed from earth is $0.99 c$. Its life as observed from earth will be

$$t = \frac{2.5 \times 10^{-8}}{\sqrt{1 - 0.99^2}} \text{ s} = 1.77 \times 10^{-7} \text{ s}.$$

Distance travelled by the π^+ meson as observed from earth from the instant it is created to its disintegration will be

$$l = vt = 0.99 \times (3 \times 10^8) \times 17.7 \times 10^8 \text{ m} = 52.6 \text{ m}.$$

As the π^+ meson was produced at 200,000 m above the sea level, the altitude at which it disintegrates as

observed from earth will be

$$(200,000 - 52.6) \text{ m} = 199,947 \text{ m}.$$

