

pion has average life span of  $2.6 \times 10^{-8}$  s how long does the particle exist from perspective of the lab observer if pion moves past at  $.67c$ ?

$t = 2.6 \times 10^{-8}$  s – in pion-system

$v = 0.67 c$  – speed of pion

In the theory of relativity, time dilation is an actual difference of elapsed time between two events ( for example generation of pion and its decay ) as measured by observers either moving relative to each other. The formula for determining time dilation in special relativity is:

$$t' = \gamma t = \frac{t}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$t$  - life span in pion-system

$t'$  - life span in laboratory system

$c$  is the speed of light

$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$  is the Lorentz factor

Therefore:

$$t' = \frac{t}{\sqrt{1 - \frac{v^2}{c^2}}} = \frac{2.6 \times 10^{-8}}{\sqrt{1 - 0.67^2}} = 3.5 \times 10^{-8} \text{ s}$$

Answer:  $t' = 3.5 \times 10^{-8}$  s