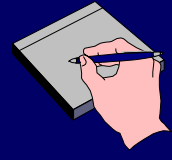

Time Dilation

A π^+ (pion) is an unstable elementary particle. It may decay into other particles in 10 nanoseconds.

Suppose a π^+ is created at Fermilab with a velocity v=0.99c. How long will it live before it decays?

$$\Delta t = \frac{\Delta t_0}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{10\ \text{ns}}{\sqrt{1-\frac{(0.99c)^2}{c^2}}} = \frac{10\ \text{ns}}{\sqrt{1-(0.99)^2}} = 71\ \text{ns}$$

- If you are moving with the pion, it lives 10 ns
- In lab frame where it has v=0.99c, it lives 7.1 times longer
- Both are right!
- This is not just "theory." It has been verified experimentally (many times!)