Reminders 4-29-08:
-Watch Your Books for the Next Two Weeks
-Robert Barchfeld 3PM Wednesday S-105
-Exam 4 Average 72%
-Read Chapter 26

Objectives:
-Introduction to Relativity
-Time Dilation, Length Contraction
-Simultaneity and Synchronization
-Relativistic Dynamics

Start with 10^8 muons at 9000 m $\tau = 2\mu s$

If $v = .998c$

$$t = \frac{9000\,m}{(.998)(3\times10^8)} = 30\mu s$$

$$N = 10^8 e^{-30\mu s/2\mu s} = 10^8 e^{-15} = 30$$

But if $\Delta t' = 2\mu s$ what is it in stationary frame?

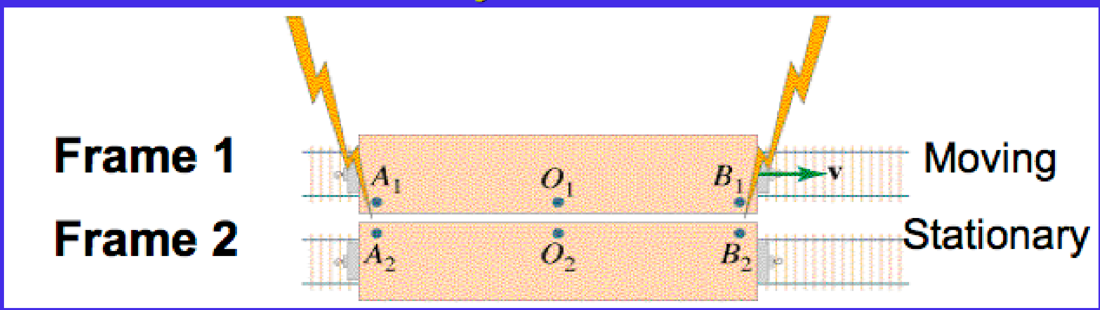
$$\Delta t = 2\mu s \frac{1}{\sqrt{1-\left(\frac{.998c}{c}\right)^2}} = 2\mu s(15)$$

I measure the half-life of muon to be $30\mu s$

$$N = 10^8 e^{-30\mu s/30\mu s} = 10^8 e^{-1} = 3.7\times10^8$$

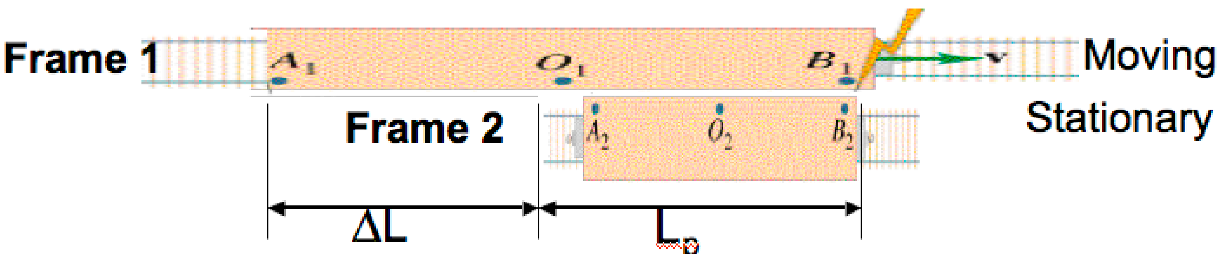
Relativity

Simultaneity-Assume O_2 observes lightning strikes on both the moving vehicle and the stationary vehicle.



In frame 2, lightning strikes occur at same time to O_2. But according to O_2, O_1 sees event at front of car first, because in the time it takes the light to reach O_2 the car has traveled $v\Delta t$. Thus O_2 concludes events are not simultaneous in O_1 frame.

According to Frame 1, the length of train is $L'_{T1}=\gamma L_o$ where L_o the is the distance between strikes observed by stationary (it also corresponds to length of train as seen by O_2. The length of the stationary vehicle as seen in Frame 1 is $L_P=L_o/\gamma$.



According to Frame 1, lightning strikes the back of the train when A_1 and A_2 coincide. This happens in a time $\Delta t_1=\Delta L/v= [\gamma L_o- L_o/\gamma]/v\approx v\gamma L_o/c^2$ after it strikes B_1. Frame 2 say this happens in a time $\Delta t_2= vL_o/c^2$.

- Astronauts in a spaceship traveling at v=0.6c past the Earth sign off from space control saying that they are going to take a nap for one hour and call back. How long does their nap last as measured on Earth? (*Ans: 1.25 hrs*)

- How fast must a meterstick travel to measure the same length as a yardstick? (*Ans: v=0.406c*)

$$\Delta t = \Delta t' \gamma = 1\text{hr}\,\frac{1}{\sqrt{1-\left(\frac{.6c}{c}\right)^2}} = 1.25$$

$$36\text{in} = \frac{39.3}{\gamma} \qquad \gamma = \frac{39.3}{36}$$

$$\frac{1}{\sqrt{1-\frac{v^2}{c^2}}} = \left(\frac{39.3}{36}\right)$$

$$\frac{1}{1-\frac{v^2}{c^2}} = \left(\frac{39.3}{36}\right)^2$$

$$1-\frac{v^2}{c^2} = \left(\frac{36}{39.3}\right)^2$$

$$1-\left(\frac{36}{39.3}\right)^2 = \frac{v^2}{c^2}$$

$$v = \sqrt{c^2\left(1-\left(\frac{36}{39.3}\right)^2\right)} = .406c$$

- In a typical nuclear fusion reaction, a tritium nucleus (^3_1H;m=2808.94MeV/c^2) and deuterium (^2_1H) fuse together to form a helium nucleus (^4He; m=3727.41MeV/c^2) plus a neutron. How much energy is released in a fusion reaction?

- A proton and an antiproton at rest annihilate according to the reaction $p^+ + \overline{p} \rightarrow \gamma + \gamma$

- Why must the energy of the emitted photons be equal? Calculate the energy of each photon.

- A electron and a positron at annihilate according to the reaction $e^{+} + e^{+} \rightarrow \gamma + \gamma$

- If the head-on collision produced two 2.0Mev photons, what are the kinetic energies of the two particles before the collision?