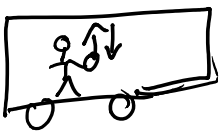
Special Relativity

May-10-16 9:58 AM

* 1. The laws of physics will be the same in all inertial frames.

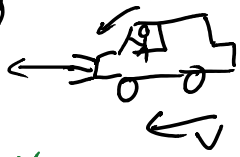
$V=0\,m/s$ is the same as



$\rightarrow V=50\,m/s$

* 2. The speed of light is the same regardless of which frame it is observed in.

according to traditional relativity light is travelling C+V



relative to the car light goes C. ← speed of light

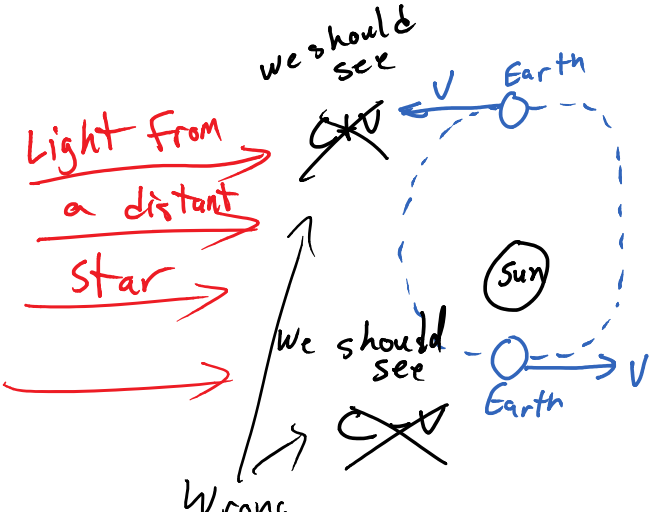
$C=3.0\times10^{8}\,m/s$

But it isn't, it is travelling at C.

Light seem weird it is always going $3\times10^{8}\,m/s$ regardless of any reference frame.

We need evidence: Michelson & Morley

→ measured the speed of light very accurately

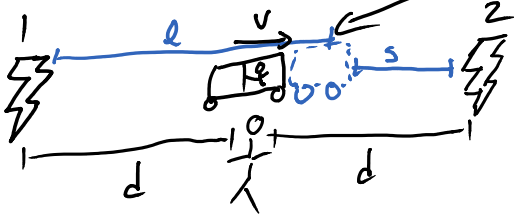


They found there was no difference in the speed of light.

Wrong.

Consequences from these postulates.

- Relative Simultaneity → There is no simultaneity

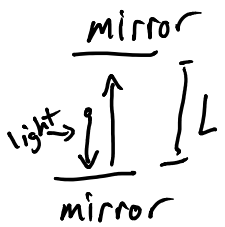


Sees lightning bolt 2 struck first.

Sees the lightning bolts happen simultaneously

Both viewpoints are valid.

Time Dilation: Light Clock



speed of light = c

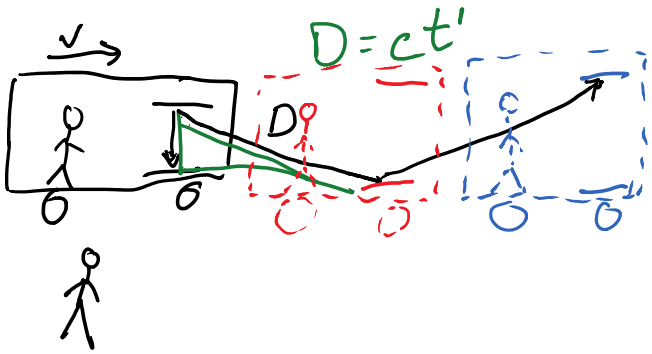
$t_0 = \frac{L}{c}$

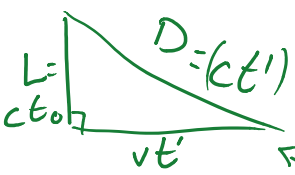
$d = vt$

$t = \frac{d}{v}$

$t_0 = \frac{L}{c}$ ← 1st Frame.

$\rightarrow L = ct_0$





← Pythagoras

$(ct')^2 = (vt')^2 + (ct_0)^2$

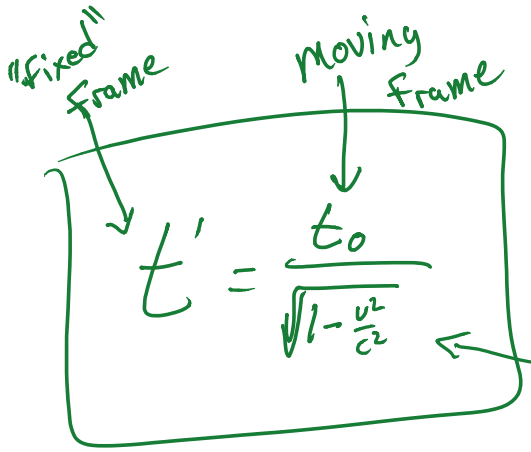
$c^2t'^2 = v^2t'^2 + c^2t_0^2$

$c^2t'^2 - v^2t'^2 = c^2t_0^2$

$$t'^2\left(\frac{c^2}{c^2}-\frac{v^2}{c^2}\right)=\frac{d^2}{d^2}t_0^2$$

$$\sqrt{t'^2\left(1-\frac{v^2}{c^2}\right)}=\sqrt{t_0^2}$$

$$\frac{t'\sqrt{\left(1-\frac{v^2}{c^2}\right)}}{\sqrt{\left(1-\frac{v^2}{c^2}\right)}}=\frac{t_0}{\sqrt{\left(1-\frac{v^2}{c^2}\right)}}$$



always $v < c$

smaller than one

$t' > t_0$

This means time goes slower for moving objects.

Example: Jason (16 yrs old → 16 yrs old) is going into space and Kiarash is waiting for him. Jason will travel at $\boxed{0.8c}$ for 5 years. How old will they be when Jason returns?

fixed

$t' =$

Jason $\Rightarrow t_0 = 5$ yrs

$v = 0.8c$

$16+5=21$

Jason is 21 yrs old.

$$t' = \frac{t_0}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{5}{\sqrt{1-\frac{(0.8c)^2}{c^2}}} = \frac{5}{\sqrt{1-0.64}} = \frac{5}{\sqrt{0.36}}$$

$$= \frac{5}{0.6} = 8.33 \text{ years}$$

Klarash = 16 + 8.33 = 24.3 years.

Why don't we see this normally

world record → 24791 miles/hour ≈ 40000 km/h ≈ 11000 m/s

$11. \times 10^3$

relativistic effect ⟶ $\sqrt{1 - \frac{v^2}{c^2}} = \sqrt{1 - \frac{11000^2}{(3\times10^8)^2}} = \sqrt{1 \frac{-1.21\times16^8}{9\times10^{16}}}$

$= \sqrt{1 - 0.00000000134} \simeq 1$

Fiction Based on this

Book: Forever War

Book: Old Man's War