Generally:

$$(\Delta t)_{observed} = \gamma(v) \cdot (\Delta t)_{proper}$$

- $(\Delta t)_{observed}$: time elapsed in observer's frame
- v: relative velocity
- $(\Delta t)_{proper}$: time elapsed on moving clock (or any 2 events AT SAME PLACE in moving frame)

Experimental evidence:

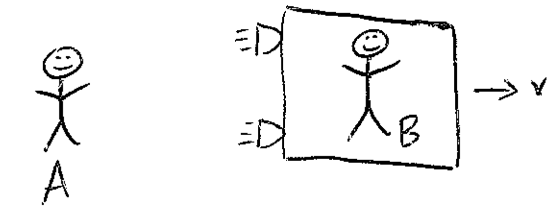
- accurate clocks on airplanes come back running behind.
- observed decay rate for unstable particles slower if they are moving close to speed of light.

★ Time dilation formula ~~NOT~~ ONLY VALID if two events are at same place in some frame of reference ★

★ Time dilation formula applies to time interval between events, not times for single events ★

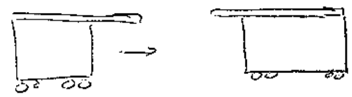
★ Both observers in relative motion observe others time to run slower ★

LAST TIME: assume Principle of Relativity.

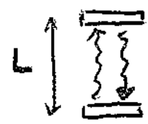


How are measurements in A's frame related to those in B's frame?

IMPORTANT FACT #1: observers agree on transverse distances (perpendicular to relative motion)



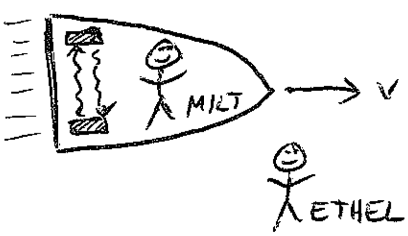
IMPORTANT FACT #2: moving clocks appear to run slow (TIME DILATION)



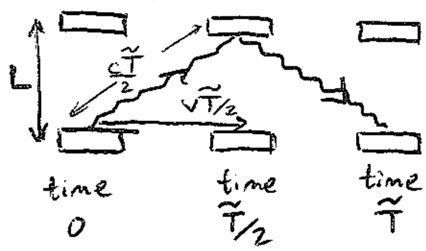
Light clock

T = time for light to go up & down in clock's frame

$= \frac{2L}{c}$



Ethel sees:



$\tilde{T}$ = time observed by Ethel for light to go up & down.

Pythagorus: $\left(\frac{c\tilde{T}}{2}\right)^2 = \left(\frac{v\tilde{T}}{2}\right)^2 + L^2$

$$\tilde{T} = \frac{2L}{\sqrt{c^2 - v^2}} = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}\, T$$

↖ bigger than 1

Define $\gamma(v) = \frac{1}{\sqrt{1 - v^2/c^2}} \geq 1$

↗ gamma