

Special Relativity:

◦ Who came up with? Michelson-Morley? Einstein?
- Theorist vs. Experimentalist

◦ Speed of Light 'c'

- $299792458 \text{ m/s} \approx 3 \times 10^8 \text{ m/s} \approx 1 \text{ ft/ns}$

- c has no error since the meter 'm' is defined by c

- $1 \text{ m} = \text{distance traveled by light (in vacuum)}$
in $c/299...8 \text{ s}$.

- since 'c' is fixed and 'm' is defined by 'c',
the only dependence is on 's'.

- $1 \text{ s} = \text{some number of transitions of cesium atom}$
- good/usable because quantized/countable

- $1 \text{ yr (light year)} \approx 9.5 \times 10^{15} \text{ m} \approx 10^{16} \text{ m}$

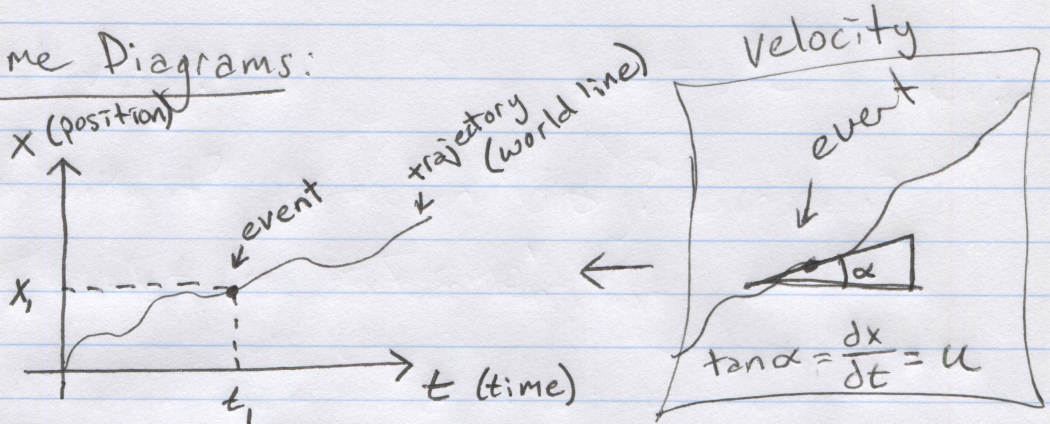
- $1 \text{ light-meter} = \frac{1}{3 \times 10^8} \text{ s} [t \rightarrow ct]$

side note:

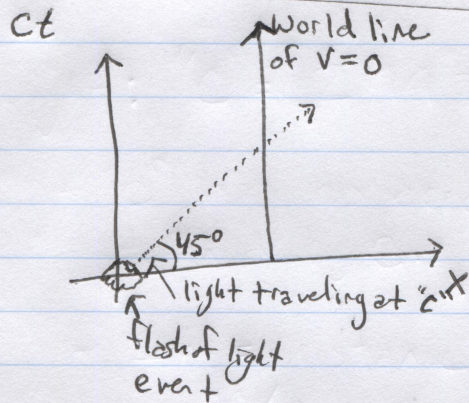
people thought that since light was a wave it must propagate through something (like a string). [Phase velocity (v_{phase}) on a string = $d \cdot f$
 $= \sqrt{T/\mu}$ ($T = \text{tension}$) ($\mu = \text{mass/unit length}$)] Such a material was called the 'Aether' and does not exist.

Space-Time Diagrams:

traditional diagram:



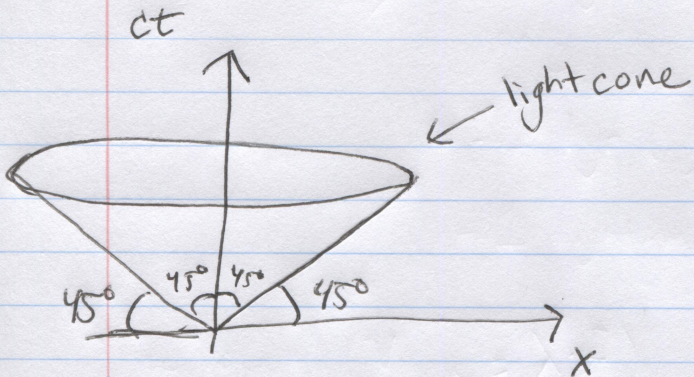
Space-time diagram:



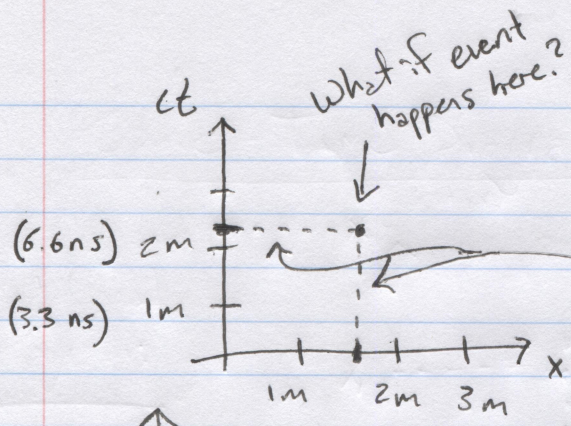
1 - Flip axis

2 - $t \rightarrow ct$ (very large number so must be used with very quickly traveling objects)

note: nothing with mass can travel equal to or faster than " c " but there may be tachyons that travel faster than " c " but can never travel slower than " c " and therefore cannot interact with us.



since light travels in all directions after flash (at " c ") it makes cone with 45° opening



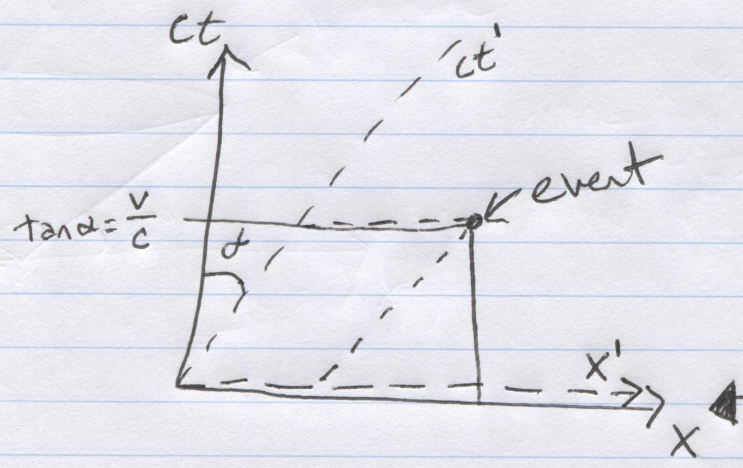
- since not at origin, we can't say it starts at (0,0). so we need a scale

- then draw lines to find (ct_e, x_e)

- all vertical lines share the same position value

- all horizontal lines share same time values

If we say the above is in inertial frame "S" how would we draw the inertial frame "S'" that is traveling at velocity (v not u) v compared to "S" [note: S and S' are synchronized [times are the same]]



these lines overlap. since S and S' are synchronized (share same time values - horizontal line)

$$ct_e' = ct_e \quad x_e' = x_e - ct_e \cdot \tan \alpha = x_e - v \cdot t_e$$

So: $w' = u - v$ $a' = a$ [v is constant] and $F = ma = ma'$