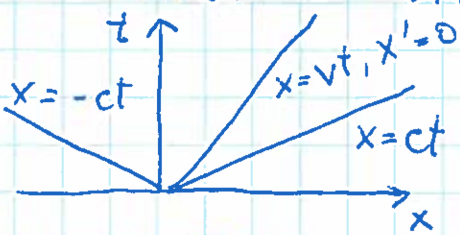
L 27

Postulates of SR

- inertial frame is any reference frame $(x,y,z,t) = S$ where all the laws of Physics hold in their usual form.
- Any ref. frame (x', y', z', t') that moves with constant velocity relative to S, is also inertial frame.
- Light in vacuum has the same speed c in every direction. in all inertial frames

Michelson - Morley experiment.

Problem with Galilean relativity.



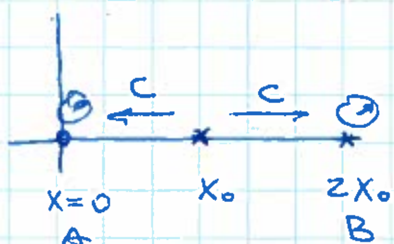
$x' = x - vt \qquad t' = t$

for light ray $\qquad x = ct$

$x' = (c-v)t' \qquad$ but $c \pm v \neq c$

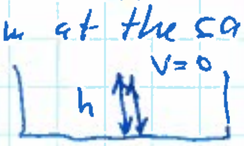
for light moving $-c \quad x' = -(c+v)t'$

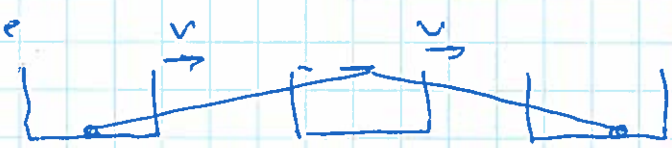
- simultaneous event in a single frame.



Chief observer can send a Light signal to other observers so they can sync their clocks knowing their distance x from origin.

light from event. right betwen obs A & B will reach them at the same time.





time dilation.

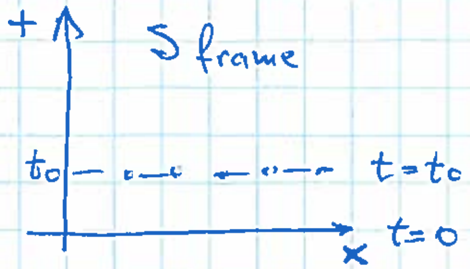
in S' $\quad \Delta t' = \frac{2h}{c}$

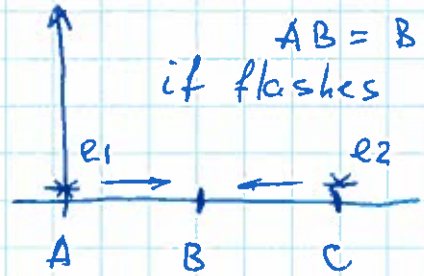
in S $\quad \left(c\,\Delta t/2\right)^2 = h^2 + \left(v\,\Delta t/2\right)^2 \qquad \Delta t = \frac{2h}{c}\frac{1}{\sqrt{1-v^2/c^2}}$

$$\Delta t = \Delta t' \cdot \frac{1}{\sqrt{1-v^2/c^2}}$$

L 27

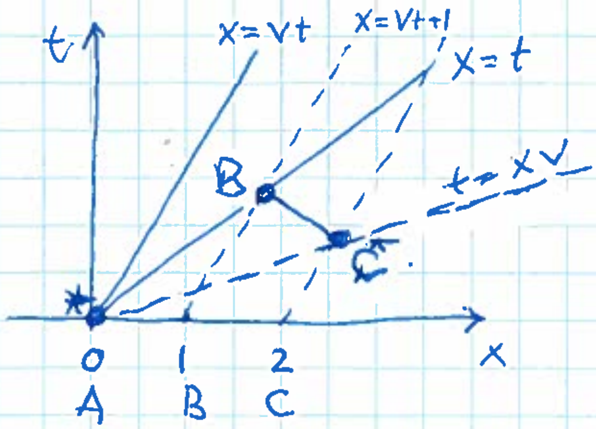
Simultaneous events in a moving frame.





AB = BC
if flashes come to B
at the same time
e1 and e2
are simultan.

moving frame S'



use $c = 1$

lets find the line of simultaneous events for observers in S'

events in A & C are simultaneous when observer B gets flashes at the same time.

flush from observer A: $\left.\begin{array}{l} x = t \\ x = vt+1 \end{array}\right\}$ $t = \frac{1}{1-v}$ $x = \frac{1}{1-v}$

flush from observer B:

$$\left.\begin{array}{l} x_B + t_B = \frac{2}{1-v} \\ x_B = vt_B + 2 \end{array}\right\} \quad t_B = \frac{2v}{1-v^2} \quad x_B = \frac{2}{1-v^2} \qquad t_B = v x_B .$$

$t = vx \rightarrow$ line of simultaneous events.

So $x' = (x - vt) f(v)$
$t' = (t - xv) g(v)$

using $x = t$ & $x' = t'$ for light ray obtain $f(v) = g(v)$
$x' = x(1-v) f$
$t' = t(1-v) g$ $f \neq g$.

but $x = (x' + vt') f(v)$
$t = (t' + vt') f(v)$

or $(x - vt) f^2 + v(t - vx) f^2 = x \rightarrow f = \frac{1}{\sqrt{1-v^2}}$

$x' = \frac{(x - vt)}{\sqrt{1-v^2}}$ $t' = \frac{(t - xv)}{\sqrt{1-v^2}}$ Lorents transformation