- Special Theory of Relativity :-

* $v \geq 10^5$ m/sec

$v \approx c$ (TOR works)

→ Newtonian mechanics :-

space, mass, time

Event (where)

↳ (x, y, z, t)

Frame of reference

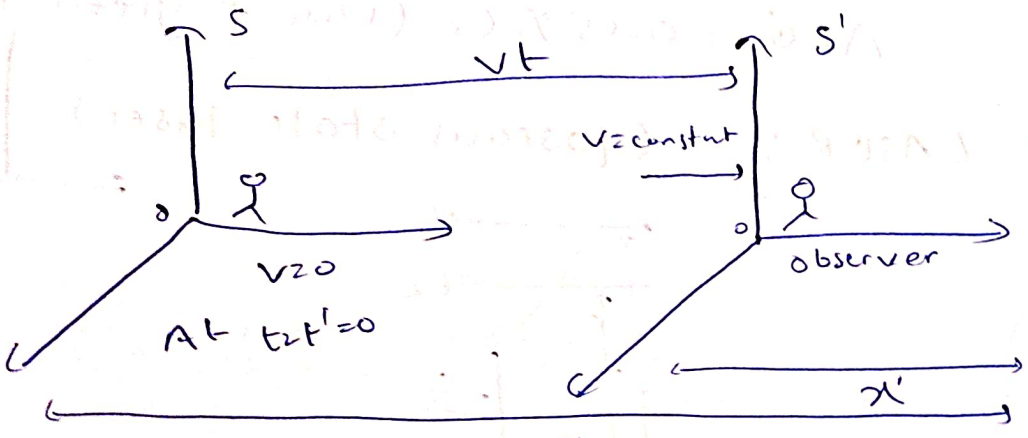
↙ Initial $v = 0$, $|\vec{v}| =$ constant

↘ Non-inertial $\vec{a} \neq 0$

← Galilion Tranformation Equation :-

* P (x, y, z, t)

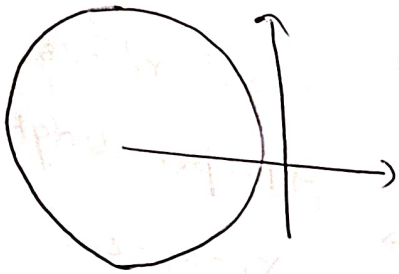
(x', y', z', t')



$x' = x - vt$, $y' = y$, $z' = z$, $t' = t$

-Concept of Aether:-

1. A material medium is required for transport of Electromagnetic waves.
2. A medium exists in outward space around earth, that medium is called aether.



velocity of earth is wrt to surrounding medium Aether

-Michelson-Morley Experiment:-

→ No Aether is there

- Postulates of Special theory of Relativity:-

1. C is the ultimate velocity.
2. Law of physics are same in all inertial frame of references.

- Lorentz transformation equations:-

$$x' = \frac{x - vt}{\sqrt{1 - \frac{v^2}{c^2}}}, \quad y' = y, \quad z' = z, \quad t' = \frac{t - xv/c^2}{\sqrt{1 - \frac{v^2}{c^2}}}$$

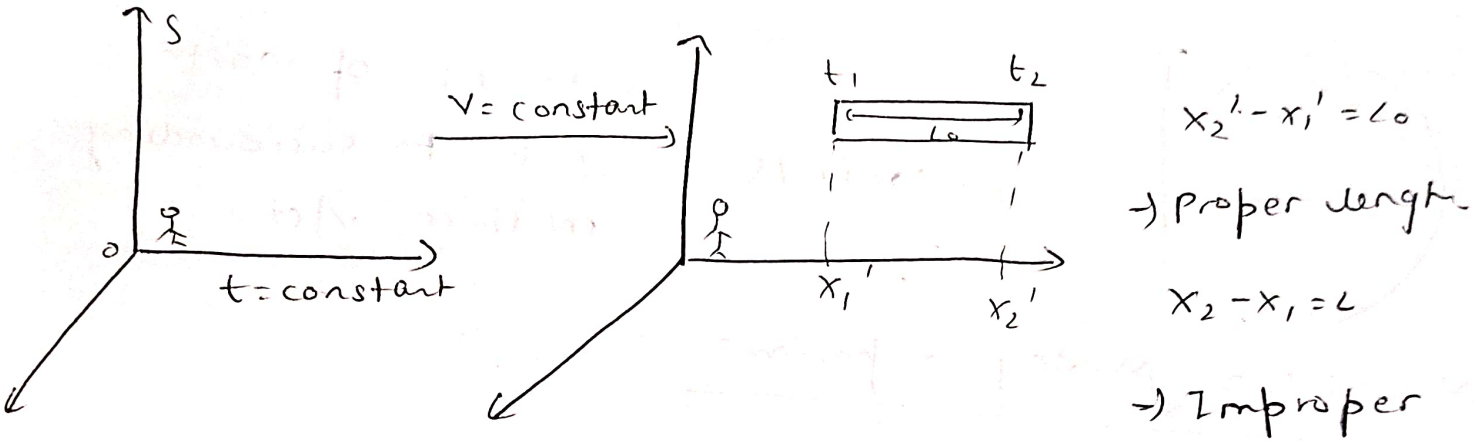
- Consequences of Lorentz transformation Equation:-

1. Length contraction:-

- Inverse Lorentz transformation Equation:-

1). Length contraction:-

$$x = \frac{x' + vt}{\sqrt{1 - v^2/c^2}} \quad , \quad y = y' \quad , \quad z = z' \quad , \quad t = \frac{t' + xv/c^2}{\sqrt{1 - \frac{v^2}{c^2}}}$$



$x_2' - x_1' = L_0$

→ Proper length.

$x_2 - x_1 = L$

→ Improper length

$$L_0 = x_2' - x_1'$$

$$t_1 = t_2 = t$$

$$x_1' = \frac{x_1 - vt_1}{\sqrt{1 - v^2/c^2}} \quad , \quad x_2' = \frac{x_2 - vt_2}{\sqrt{1 - \frac{v^2}{c^2}}} \quad ,$$

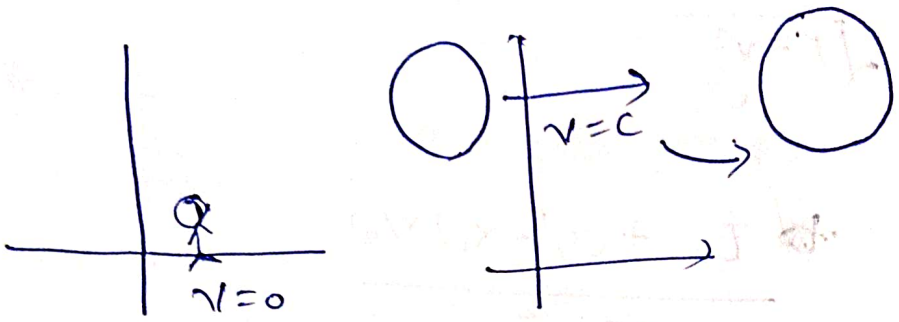
$$x_2' - x_1' = \frac{x_2 - x_1}{\sqrt{1 - \frac{v^2}{c^2}}}$$

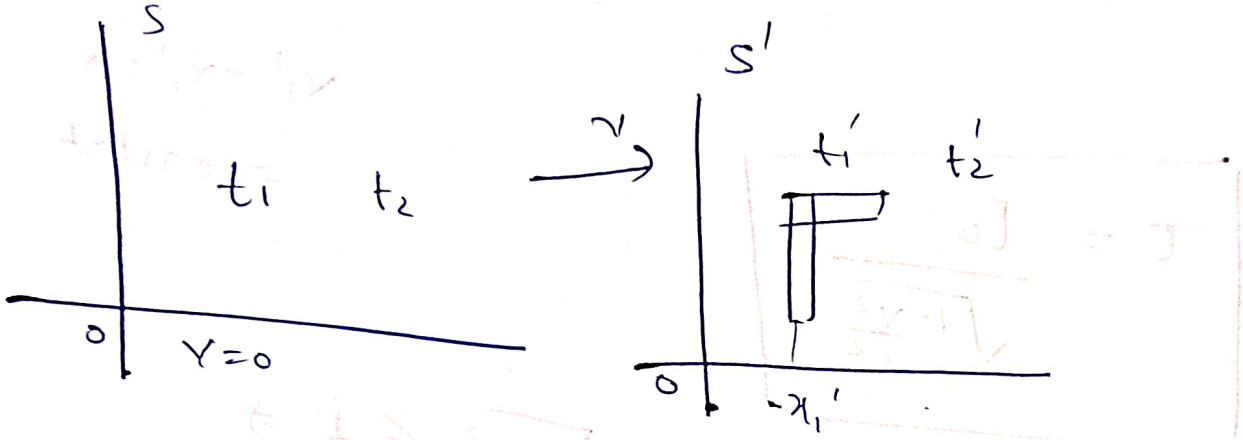
$$\boxed{L = \frac{L_0}{\sqrt{1 - v^2/c^2}}} \quad , \quad \sqrt{1 - v^2/c^2} < 1$$

$$\Rightarrow \boxed{L < L_0}$$

(length contraction)

- Time Dilation :-





$t_2 - t_1 = \tau$ [improper time interval]

$t_2' - t_1' = \tau_0$ [proper time interval]

"μ-decay"

Twin paradox

- Inverse Lorentz Tranformation Equation :-

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

$$t_1 = \frac{t_1' + x_1'v/c^2}{\sqrt{1 - \frac{v^2}{c^2}}}, \quad t_2 = \frac{t_2' + x_2'v/c^2}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$t_2 - t_1 = \frac{t_2' + x_2' v/c^2 - t_1' - x_1' v/c^2}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$= \frac{\tau_0 + (x_2' - x_1') v/c^2}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$x_2' = x_1' = x'$

$= \text{constat}$

$$\boxed{\tau = \frac{\tau_0}{\sqrt{1 - \frac{v^2}{c^2}}}}$$

$$\Rightarrow \sqrt{1 - \frac{v^2}{c^2}} < 1 \Rightarrow$$

$$\boxed{\tau > \tau_0}$$