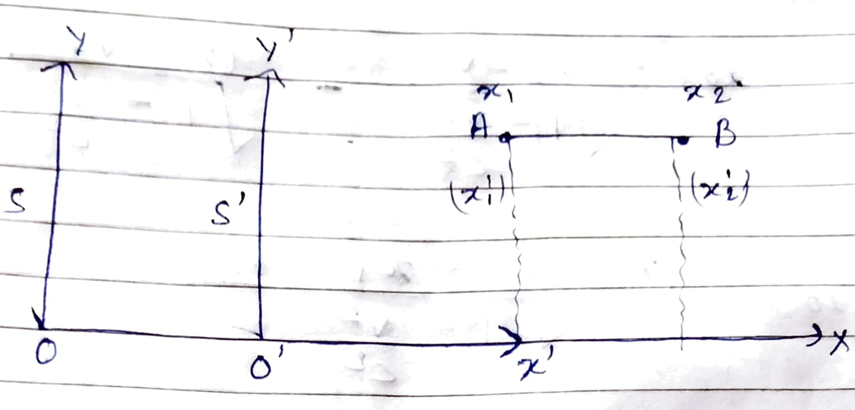
LORENTZ FITZGERALD CONTRACTION



Let us consider frame S is static and frame S' is dynamic along +ve x-axis with constant velocity v. Let a rod A to B is stablished parallel to x-axis when length of rod is considered in dynamic frame then its length remains static because this rod is situated in dynamic frame.

Proper length of rod (l_0)

$$l_0 = x_2' - x_1' \quad \text{---(i)}$$

When this length of rod is measured w.r.t static frame then improper length of rod (l)

$$l = x_2 - x_1 \quad \text{---(ii)}$$

According to the Lorentz contraction-

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

Putting the value of x_1' & x_2' in eqn (i)

$$l_0 = \frac{x_2 - vt}{\sqrt{1-\frac{v^2}{c^2}}} - \frac{(x_1 - vt)}{\sqrt{1-\frac{v^2}{c^2}}}$$

$$l_0 = \frac{x_2 - vt - x_1 + vt}{\sqrt{1-\frac{v^2}{c^2}}}$$

$$l_0 = \frac{x_2 - x_1}{\sqrt{1-\frac{v^2}{c^2}}} \qquad \text{From eq}^n \text{ (ii)}$$

$$l_0 = \frac{l}{\sqrt{1-\frac{v^2}{c^2}}}$$

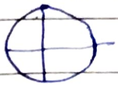
$$l = l_0 \sqrt{1 - v^2/c^2} \qquad \because \sqrt{1-v^2/c^2} < 1$$

$$\frac{l}{l_0} < 1$$

$$\boxed{l < l_0}$$

According to the above explanation it is clear that when any rod is dynamic along its length then its length vertically contracted but when direction of velocity is perpendicular to its length then there is no effect of contraction.

For Exam. $\xrightarrow{}$ v dynamic



circle

ellipse

$\xrightarrow{}$ v

Rectangle