LORENTZ TRANSFORMATIONS

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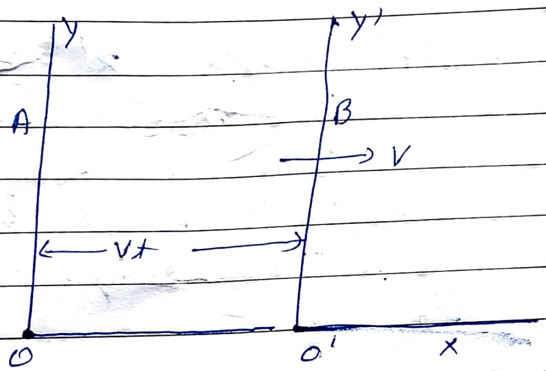
Consider two frame of reference A and B as shown in the fig. A is fixed and B is moving along the direction of the X-axis with a constant velocity V.

After time 't' the frame of reference B has moved a distance $OO' = Vt$

For the point P in space the co-ordinate are (x, y, z) with reference to the frame A and (x', y', z') with reference to the frame B.



According to Galilean transformation equation:

$$x' = x - Vt$$

$$y' = y$$

$$z' = z$$

$$t' = t \quad \text{--- (1)}$$

Differentiating the equation (1)

$$\frac{dx'}{dt'} = \frac{dx}{dt} - V$$

$$c' = c - V$$

This equation says if a person is moving in a spaceship the speed of the passing light will be $(c - v)$

But according to the postulates of the special theory of relativity the velocity of light remains constant in free space.

The suggests that the Galilean transformation are not in accordance with the special theory of relativity. So the need for the new transformations equation is there

However, the equation $x' = x - vt$ is in accordance with the ordinary laws of mechanics. So the new transformation for the x co-ordinates must be similar to this equations. The simplest possible form of this can be

$$x' = K(x - vt) \quad \text{--- (2)}$$

where K depends only of the value of v and doesnot depend upon the value of x and t. The above equation is linear and x' has only one value for given value of x.

According to the first postulate of the special theory of relativity observation made in the frame of reference B must be identical to those made in A expect for a change in the sign of v and having the same value for the constant of proportionality K.