B.Sc – I

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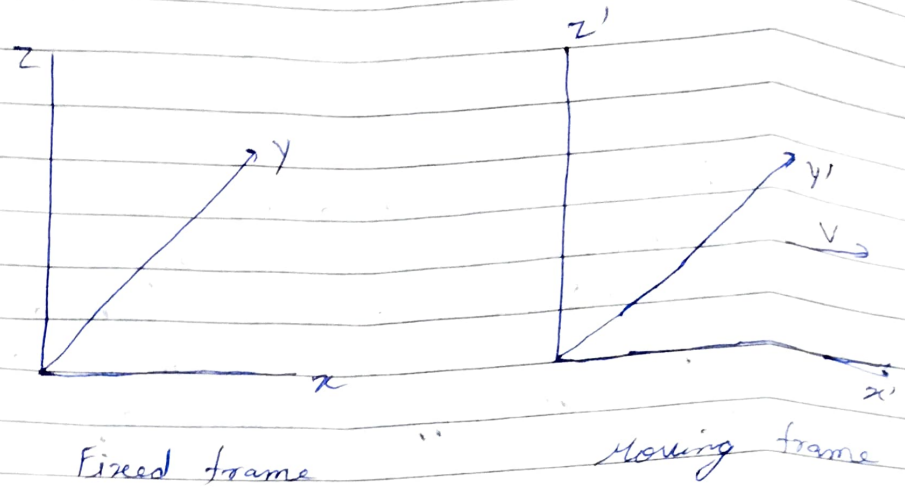
Time Dilation



Fixed frame Moving frame

A clock in a moving frame will be seen to be running slow or dilated according to the Lorentz transformation the Time will always be shortest as measured in its rest frame. The time measured in the frame in which the clock is at rest is called the proper time.

If the time interval $T_0 = t_2' - t_1'$

is measured in the moving reference frame Then

$T = t_2 - t_1$ can be calculated using the Lorentz transformation

The time measurements made in the moving frame are made at the same location, so the expression reduces to:

$$T = t_2 - t_1$$

$$= \frac{t_2 + \frac{Vx_2'}{c^2} - t_1' + \frac{Vx_1'}{c^2}}{\sqrt{1 - V^2/c^2}}$$

$$T = \frac{T_0}{\sqrt{1 - \frac{v^2}{c^2}}} = T_0 \gamma$$

For small velocities at which the relativity factor is very close to 1, then the time dilation can be expanded in a binomial expansion to get the approximate expression

$$T = T_0 \left[1 + \frac{v^2}{2c^2} \right]$$

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