- In the Special theory of relativity, the moving Clock is found to run slower than a clock at rest does. This effect is known as time dilation.

- A clock in Stationary frame measures longer time interval between two events occuring in a moving frame of reference then does a Clock in the moving frame or a

Clock moving with a Uniform Velocity V relative to an observer appears to him to go slow by a factor $\sqrt{1-\frac{v^2}{c^2}}$, than when at rest relative to him.

This effect is Called time dilation.

• To derive a relation for time dilation,

Let us Consider initially that the Observer O in frame S and O' in frame of reference S' are at rest with respect to each Other.

→ Let the Clock in S is situated at a position x and given out signal at two instant of time t_1 and t_2 as measured by an observer in S.

$$t_0 = t_2 - t_1 \qquad —①$$

→ Let the time measured by an observer O' in moving frame S' b/w the same two events be t_1' and t_2', then

$$t = t_2' - t_1' \qquad —②$$

From Lorentz transformation equation

$$t_1' = \frac{t_1 - xv/c^2}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$t_2' = \frac{t_2 - xv/c^2}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$t = t_2' - t_1' = \frac{t_2 - xv/c}{\sqrt{1 - \frac{v^2}{c^2}}} - \frac{t_1 - xv/c^2}{\sqrt{1 - \frac{v^2}{c^2}}}$$

Or $$t = \frac{t_2 - t_1}{\sqrt{1 - \frac{v^2}{c^2}}}$$

or $$t = \frac{t_0}{\sqrt{1 - \frac{v^2}{c^2}}}$$ or $$t_0 = t\sqrt{1 - \frac{v^2}{c^2}}$$

Hence $t > t_0$

Thus, the observer O' in frame S' measure a longer time travel between two events with his clock at rest with respect to him.

~~In other words, time interval appears to~~ be

Therefore a moving clock appears to go slow (i.e take more time to complete a rotation compared to a rest clock).

- if $v = c$, then $t = \infty$