

If There Is No Relativistic Time Dilation Then There Is Light Speed Dilation

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Time dilation is one of the fundamental concepts of Special relativity (SR), depending upon the second postulate of this theory that the speed of light c ($\approx 3 \times 10^8 \text{ m sec}^{-1}$) is the same in all inertial frames of reference. It is the difference in the elapsed time of a particular event as measured by observers in different frames of reference.

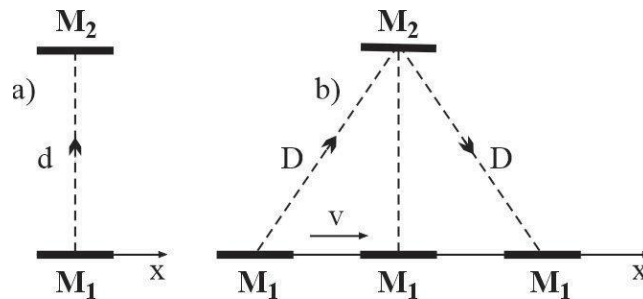


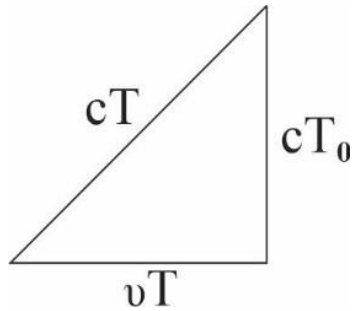
Fig. 1. The light clock is positioned perpendicular to the x-axis. (a): No relative motion. (b): light clock moving at speed v .

In elementary physics textbooks, this phenomenon is depicted using a device known as a light clock. This light clock consists of two plane parallel mirrors, M_1 and M_2 , that face each other and are separated by a distance d , Fig. 1a. For the sake of simplicity, we will first consider the time for the photon to travel from mirror M_1 to mirror M_2 . The light signal travels a distance d for the time interval $\Delta T_0 = d/c$. Now, allow the same light clock to be moving with a certain relative speed v horizontally in the direction of the positive x-axis, Fig. 1b. Clearly, a light signal travels the larger distance D and thus it will take a longer time $T = D/c$. T_0 and T are related by the relativistic time dilation equation

$$T = T_0 / \sqrt{1 - v^2/c^2} \quad \dots (1).^1$$

The observer in the rest frame who is watching the light clock can also design a diagram associated with a simple Pythagorean triangle, Fig. 2.

¹ $1/\sqrt{1 - v^2/c^2}$ is the Lorentz factor or time dilation factor.



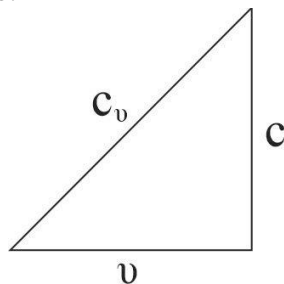
In the case of a classical light clock, a stationary observer cannot measure T but can only calculate it using eqn. (1). So, in this case, time dilation is not backed by experimental reasoning but only theoretically. In that case, we can consider the possibility that there is no relativistic time dilation or that $T_0 = T$.

Let us denote by c_v the speed of light of a moving light clock and by c its speed in a stationary reference frame. Since $T = D/c_v = T_0 = d/c$ then $c_v > c$. Thus, the speed of light of the reference frame of the moving light clock has to be higher than the speed of light c in the reference system of the stationary light clock. Of course, this is against the second postulate of SR.

The speeds in question will be related by eqn. (2)

$$c_v = \sqrt{(c^2 + v^2)} \quad \dots (2)$$

and their mutual relation can also be represented by the Pythagorean triangle, Fig. 3. This is in contrast to Newtonian kinematics, where we would have $c_v = c + v$ and it would be greater than the speed of light. This is contrary to relativistic kinematics, where the speed of light c is the universal speed limit, as we noted above.



In conclusion, only theoretically relativistic time dilation can be demonstrated with a classical light clock. Instead, light speed dilation is imposed.

Immediate consequences: no relativistic time dilation, mass reduction, length contraction and twin paradox. *Everything appears "normal"*.

