Refutation of Twin Clocks Paradox

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From *Google* [1]:

"In his famous paper on special relativity in 1905, Albert Einstein deduced that for two stationary and synchronous clocks that are placed at points ***A*** and ***B***, if the clock at ***A*** is moved along the line ***AB*** and stops at ***B***, the clock that moved from A would lag the clock at ***B***. He stated that this result would also apply if the path from ***A*** to ***B*** was polygonal or circular. Einstein considered this to be a natural consequence of special relativity, not a paradox as some suggested ..."

The whole situation could be demonstrated with a simple diagram:

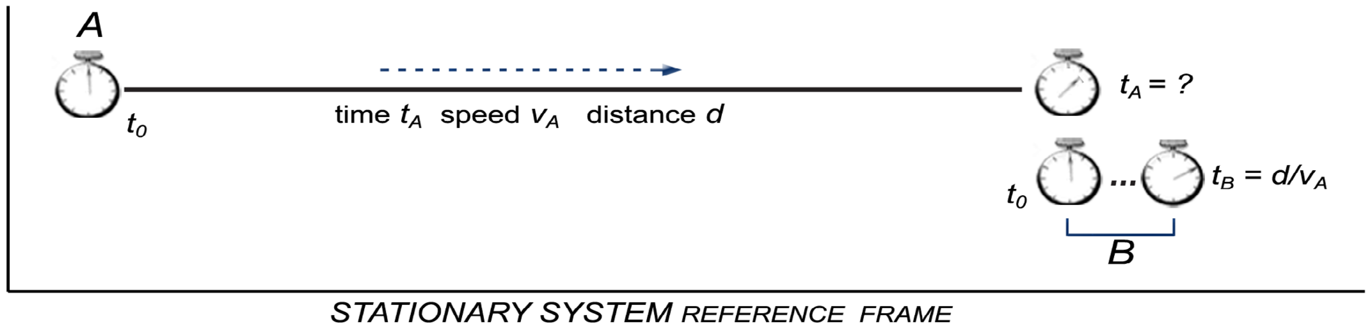

Figure 1. Twin Clock Paradox

Clocks ***A*** and ***B*** exist in the stationary system and are synchronized to initial time t_0. Clock ***A*** moves to position ***B*** with velocity v_A, and arrives at ***B*** at time t_A. At the same time, clock ***B*** displays elapsed time $t_B = d / v_A$. It is generally believed that clock ***A*** will display time $t_A < t_B$, i.e. , being behind clock ***B***.

When we apply the principle of relativity to this scenario, we could say that if the clock ***B*** is moving and ***A*** is stationary, then clock ***B*** will be displaying a different time from the clock ***A***. We can do this, since there is no criterion for deciding which of two relatively bodies is moving.

Analysing this situation, there is no obvious logical reason why the time on clock ***A*** should be behind the time on clock ***B***. That is why this is by many called a paradox.

Yet, Einstein did not consider that as a paradox and he had his reasons for it: According to him this was a consequence of special relativity. In his special relativity theory.[2] Einstein believed that moving body will experience slowing down of time flow, caused by the body's speed. He used Lorentz equations and Lorentz factor γ to calculate the resulting and highly controversial time dilation.

Because of that, a new version of this paradox emerged, called "modified clock paradox" In this version, the general belief is that on arrival clock ***A*** will still display slower time than clock ***B.*** This situation differs from the previous by the addition of the **observer*,*** stationed at clock ***A.***

This can be demonstrated by the following figure:

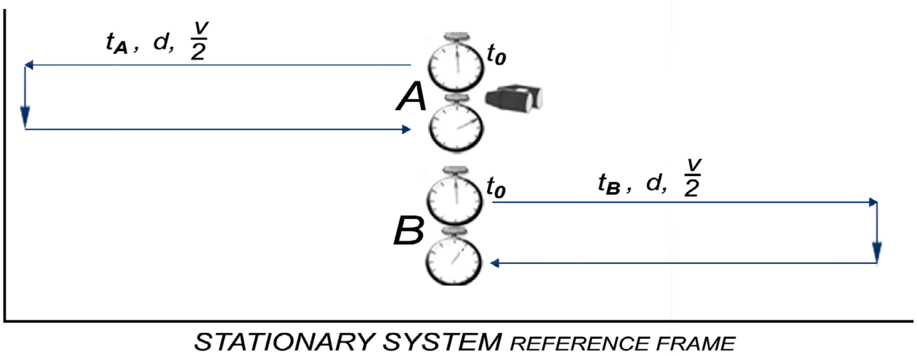

Figure 2. Modified Clock Paradox*.*

Clock ***A*** travels total distance ***d*** at the speed ***v / 2.*** Clock ***B*** travels the equal distance ***d*** at the same speed ***v / 2*** .

Since now everything is happening relative to the observer, clock ***B*** travels in opposite direction relative to clock ***A*** but not at speed ***v / 2,*** as it would in the stationary system reference frame without the observer but at speed ***v***.

In the following figure 3, the clock ***A*** is set as a reference frame and clock ***B*** then moves relatively to clock ***A***.

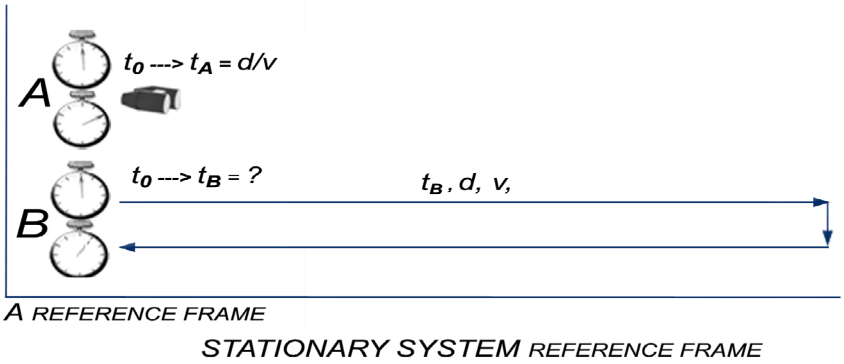

Figure 3. Modified Clock Paradox
*The reference frame is set to clock **A**.*

Situation is the same as in figure 2 but after adding the observer and setting the relative reference frame to clock ***A***, clock ***A*** becomes stationary and initially displays time t_0. Clock ***B*** is synchronised to t_0 and relative to the observer at clock ***A***, clock ***B*** travels away and returns at speed ***v*** **-** not ***v / 2***, as is the case in figure 2! After clock ***B*** returns to starting position, time on the ***A*** clock becomes $t_A = d / v$.

The addition of the observer supposes to justify the change in the rate of time flow on clock ***A***,. This change is defined in the formula of Lorentz factor. which expresses the ratio of hypothetical dilated time of travelling body to the time of stationary body.

The Lorentz factor γ can be then expressed as: $\gamma = t_B / t_A$

The time on both clocks can be also expressed differently in terms of the distance and speed and the formula then becomes: $\gamma = (d / v_B) / (d / v_A)$

Clock ***A*** in its reference frame does not move, therefore $v_A = 0$.

(d / v_A) then becomes undefined and renders the formula of the Lorentz factor incorrect. From this we can conclude that Lorentz factor γ cannot be involved in calculating the hypothetical time dilation of moving object. This also agrees with conclusions drawn in appendix dealing with Lorentz calculations.

Using Lorentz equations creates the formula for the Lorentz factor:

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

v is the speed of moving observer
c is the maximum speed of light in the vacuum

Although this formula is obviously flawed, as is also explained in the appendix, we will still test it in the modified clock paradox.

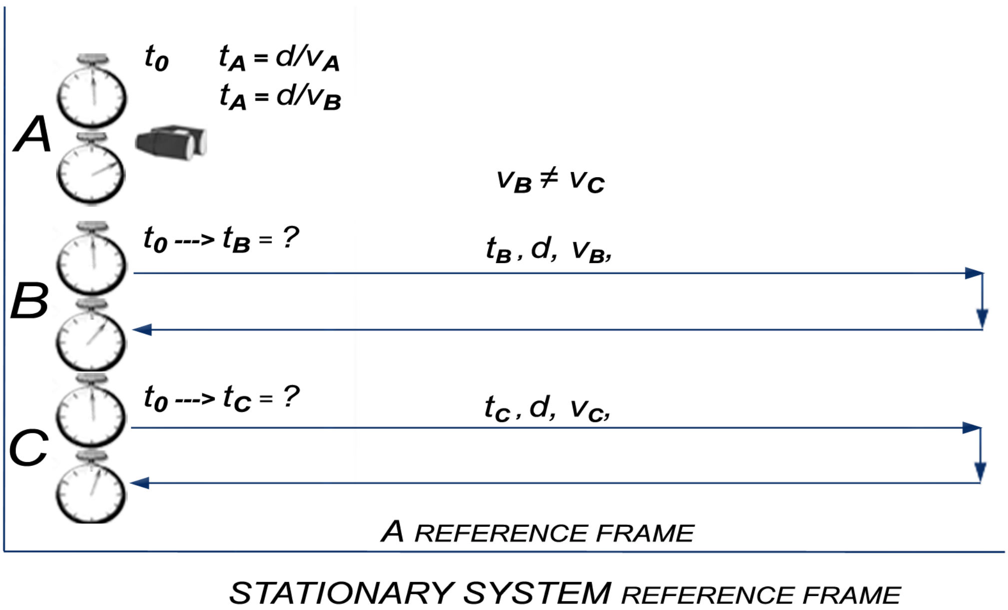

Figure 4. Modified Clock Paradox
*The reference frame is set to clock **A**.*
Clock B and C are moving independently at different speeds v_B and v_C .

1.) Observed light is specific to individual reference frames. A moving observer in its reference frame has its own sources of observed light. Should these sources move independently to each other, the observed light from these sources will have its own observed speed, frequency and wavelength, depending on observer's and light source direction and speed within the stationary system reference frame. At any time, a meaningful dilation would be therefore valid only in individual observer's reference frame, located within the stationary system.

That implies each observer could have its own dilated time. For example, two aircraft heading to the airport at two different speeds. In the figure 4 they are symbolised by clock ***B*** and ***C***. Because of the difference in their speed, both will have differently dilated time. Compared to the maximum speed of light, their speeds are negligible and the hypothetical dilation of their time will be unnoticeable.

Different situation arises when we are dealing with space craft, satellites and associated global positioning system. Although the ratio of their relative speed to the maximum speed of light is very small, it could still effect the final results in evaluating the exact position of the moving body. I believe this was already experienced and using Lorentz factor in global positioning system is avoided.

2.) The maximum speed of light was measured in a medium surrounding our planet. This medium limits the maximum speed of light to the measured value of approx. $3x10^8$ m/sec.

We consider the maximum speed of the light ***c*** in vacuum as a constant, set-in stone and yet, this might not be true. We know that a stationary body in the water or glass experiences the maximum speed of light of $2.25x10^8$ m/sec and $2x10^8$ m/sec respectively. Then, according to the Lorentz factor, a moving body in the water will experience different time dilation then body moving in the vacuum.

The universe is also not a homogenous media, in some places is filled with some cosmic dust, with ice flakes, light-modifying gasses, etc. Treating speed of light in vacuum as an unchanging constant is incorrect and so is its inclusion in the Lorentz factor.

3.) The last argument against the concept of time dilation is basic and yet, the most relevant:

The hypothetical dilation of time is based on the Lorentz factor, which represent only a time delay,
and not the change in the rate of time flow.
(Described in the appendix.)

Using Lorentz Factor for calculations will only calculate the time delay, i.e., how much longer it will take a beam of light from a stationary source to reach a moving body, than to reach a stationary body. Einstein, and the overwhelming scientific community were, and even now still are mistaking a simple time delay for non-existing time dilation.

This fact alone will classify any speculations about different rate of aging during interplanetary voyages as a pure fantasy. It also supports the concept of universal time, called also Newtonian time, set by Newton some centuries ago, which is the unchanging time reigning our universe. It progresses from the past in the direction of expected future. It consists only of our past and it jumps over the present time, since the present time and our future exist only in the infinity, which is not part of our world. This inevitably means that we live only in the past time, which has already happened and therefore cannot be changed. Any speculations about manipulation of the time are futile.

Any intelligent fool can make things
bigger, more complex, and more violent ...
(Albert Einstein)

Addendum

Fortunately, besides universal time there is another incarnation of time, I call it "subjective time". It could be known under other names too, since is with us right from the creation of living beings. It is experienced by each individual and both times, universal and subjective time, are independent of each other. The rate of flow of universal time is constant throughout the whole universe and the rate of flow of subjective time is subject to many factors affecting the individual mind, such as their surroundings, frequency of experiences, mental health, etc.

The subjective time is specific to each living individual object, it exists in the object's mind, it is infinite and therefore it is not a part of our three-dimensional world. It could be only represented here by actions of individual living beings. We can go back in our mind, what is generally called remembering the past, and we can go to the future, what is called fantasising.

The existence of subjective time can be demonstrated on an example of patients on operating table. Under narcosis they have their senses 'switched off' and the flow of their subjective time stops. Operation could take hours and yet, when patients wake up, it seems to them that the operation did not take any time at all. Falling unconscious and waking up from anaesthesia seems to them to be instantaneous. It is obvious that during the operation, patients' subjective time stopped, while the universal time kept going at its normal rate.

When you are courting a nice girl, an hour seems like a second.
When you sit on a red-hot cinder a second seems like an hour ...
(Albert Einstein)

Appendix - Lorentz's Transformation

Well before Albert Einstein defined his special theory of relativity[2], Dutch physicist H. A. Lorentz was already attracted by the relationship between the light and time. He conducted an abstract experiment, in which he used the light, propagating relatively to a universal reference frame with constant speed ***c***, to calculate a delay in time caused by the *observer's* movement.

In the first part of his abstract experiment, in the universal reference frame, i.e. relatively to the stationary medium in which the light propagates, a stationary *observer* sends a beam of light over distance $\underline{\boldsymbol{S}}_0$ to a distant mirror, and measures the time $\underline{\boldsymbol{t}}_0$ it takes for the beam to return.

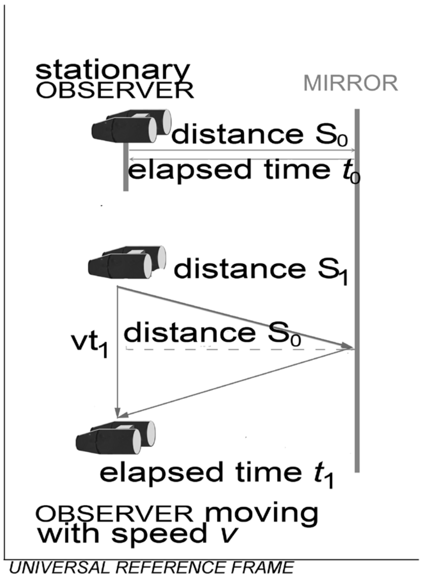

Figure A1. *Lorentz hypothetical experiment*

In the second part of this experiment, an *observer* moves on a straight line with speed ***v***, sends a beam of light to the mirror and measures the time $\underline{\boldsymbol{t}}_1$ it takes for the light to return. The light travels the distance $\underline{\boldsymbol{S}}_1$ which is greater than $\underline{\boldsymbol{S}}_0$.

The resulting *Lorentz factor* ***Y*** then describes how much longer it takes for the light to reach a moving *observer*, instead of a stationary *observer.*

$$t_0 = \frac{s_0}{c} \quad t_1 = \frac{s_1}{c} \quad \text{and} \quad S_0^2 + v^2 \cdot t_1^2 = S_1^2 \quad \text{therefore} \quad S_1 = \sqrt{s_0^2 + v^2 t_1^2}$$

$$t_1 = \frac{\sqrt{s_0^2 + v^2 t_1^2}}{c}$$

$$t_1^2 = \frac{s_0^2 + v^2 t_1^2}{c^2}$$

$$t_1^2 \cdot c^2 = s_0^2 + v^2 t_1^2$$

$$t_1^2 \cdot c^2 - v^2 t_1^2 = s_0^2$$

$$t_1^2 (c^2 - v^2) = s_0^2$$

$$t_1^2 = \frac{s_0^2}{(c^2 - v^2)} = \frac{t_0^2 c^2}{c^2 \left(1 - \frac{v^2}{c^2}\right)} = \frac{t_0^2}{1 - \frac{v^2}{c^2}}$$

$$\frac{t_1}{t_0} = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$$

Figure A2. *Calculation of Lorentz Factor*

v/c	Lorentz Factor γ	v/c	Lorentz Factor γ
0.5	1.15	0.99999	223
0.8	1.7	0.9999999	2236
0.95	3.2	0.99999999	7071
0.98	5.02	0.999999999	22360
0.99	7.08	1.0	? (infinity)

Figure A3. *Some selected values of Lorentz factor*

Lorentz in his calculations assumed that relative to the universal reference frame, the speed of light is constant. He also assumed that the *observer's* clock, measuring the time delay, is not affected by the *observer's* speed. (This possibility was firstly and mistakenly introduced in the special theory of relativity.)

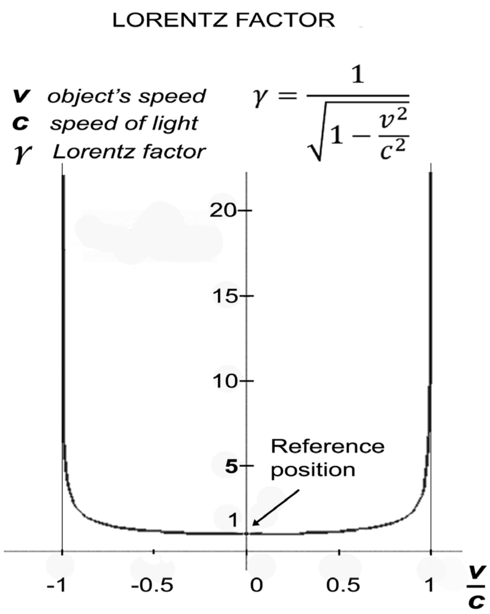

Figure A4 *Graph of Lorentz factor. It uses observers' speed* ***v*** *and constant speed of light* ***c****.*

It is important to note that all what Lorentz achieved with his calculations, was to calculate the time delay. For the light wave, progressing with constant speed, he calculated the time difference between reaching a moving *observer* instead of a stationary *observer*.

It is important to note that in this experiment the flow of time does not change. During travel the same clock with the same rate of time flow is used, as during the stationary part of this experiment. Should the time flow on this clock change, *Lorentz's* calculations would be meaningless.

If the same clock used for measuring the elapsed time will go slower, there will be no time delay.

In the following years, the first incorrect assumption made by many physicists was to mistake this delay in time for a change in the rate of time flow. They believed that the rate of time flow, measured by the *observer* observing a beam of light, would change due to the *observer's* movement.

The second incorrect assumption was to consider the *Lorentz factor* in only one special case: The *observer* is moving along a straight line, perpendicular to the line connecting the *observer* and the light source from the position closest to the light source. (Illustrated in figure A1.)

That excludes any other movements, but in reality, the *observer* could move in whatever direction, and from whatever position.

The simplest case to investigate is the *observer's* movement along the line, connecting the *observer* with the light source. The movement could be in both directions, toward and away from the light source. This option traveling on a collision line, directly toward or away from the light source, was missing entirely from *Lorentz's* experiment. This situation is illustrated in figure A5.

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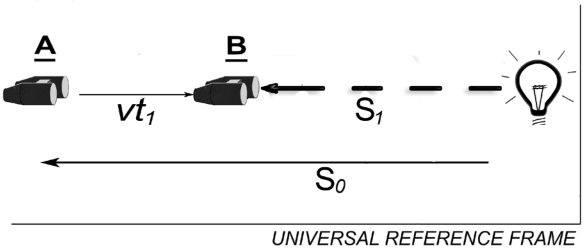

Figure A5 *Observer moves from* ***A*** *to* ***B*** *in time* t_1*.*
The light travels distance S_1*, and the observer* vt_1*.*

The light emitted by the bulb will reach the stationary *observer* in time t_0 and cover distance S_0. To reach moving *observer*, the light would have to cover distance S_1 in time t_1, while *observer* would travel the distance vt_1

1. Stationary *observer*:
The light will reach the *observer* at position ***A*** in time t_0
Distance travelled by light will be $S_0 = ct_0$

2. Moving *observer*: Moving with speed v from position ***A*** to ***B***.
At ***B*** the light will reach *observer* in time t_1
Distance travelled by the light $S_1 = ct_1 = S_0 - vt_1$
In time t_1 the *observer* will move $AB = vt_1$

Again, the similar calculations could be used as used by Lorentz:

$$t_0 = \frac{S_0}{c} \qquad t_1 = \frac{S_1}{c} = \frac{S_0 - vt_1}{c}$$

$$t_1 c = S_0 - vt_1$$

$$t_1 c + vt_1 = S_0$$

$$t_1 = \frac{S_0}{c+v}$$

$$\frac{t_1}{t_0} = \frac{\frac{S_0}{c+v}}{\frac{S_0}{c}} = \frac{c}{c+v} = \frac{1}{1+\frac{v}{c}}$$

Figure A6

The figure A6 illustrates two graphs, depicting the values of the *Lorentz factor*, and values of its different, modified formula.

Original *Lorentz factor*: $\gamma = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}}$ ***Extended*** *Lorentz factor*: $\gamma' = \frac{1}{1+\frac{v}{c}}$

Full line represents the original formula for calculating the *Lorentz factor*. Dotted line represents the extended formula of *Lorentz factor* ***Y'***.

The right side of the dotted line represents a situation where the *observer* moves on a collision course with the light source. In this scenario the *Lorentz factor* ***Y'*** will infinitely decrease. That means the light will reach the *observer* in a shorter period of time than in a situation where the *observer* is not moving directly toward the light source.

This dotted right-hand part of the graph is vastly different from other parts and yet, all that makes such a difference is only a very slight change in direction the *observer* travels. The second formula includes not only delay, but also reduction in time interval, needed for the light to reach a moving *observer*.

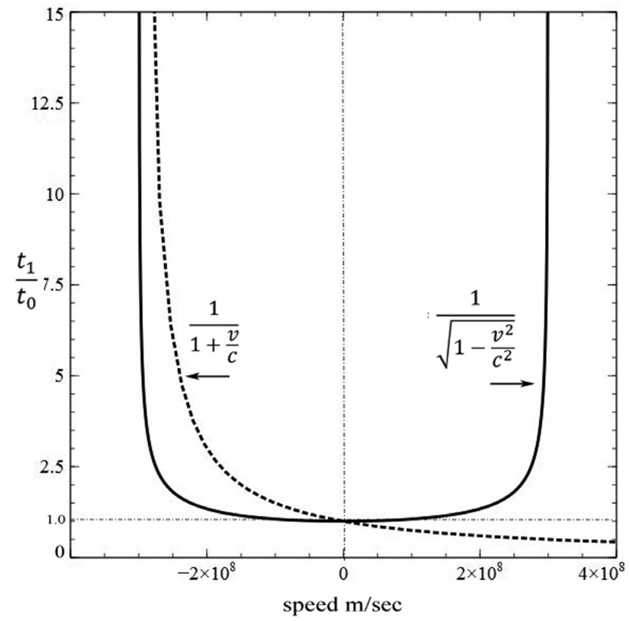

Figure A7 *Graphs of two versions of Lorentz factor.*

Should we use this extended factor to calculate the rate of time flow, then the time will speed up, which is contrary to what was deduced in the special theory of relativity. This factor is valid only for *observers* moving towards the mirror on a direct line, connecting both the *observer* and the light source.

It is also easy to prove that the *Lorentz factor* will change with the starting position, as illustrated in figure A7.

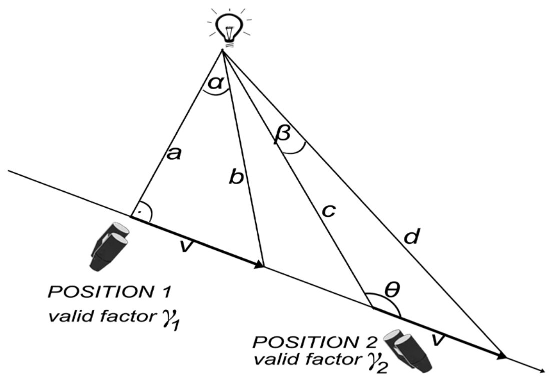

Figure A8 *Observer moves with speed v in the same direction.*
Separate measurements are taken for position 1 and 2.

Starting from position 1, and comparing ***b*** and ***a*** will produce the value of originally defined *Lorentz factor* ***Y***. Should the *Lorentz factor* describe movement initiated at any other position on that line, for example position 2, then the ratio of ***d*** and ***c*** should be the same as ***b*** and ***a***.

Using some properties of a triangle and some trigonometric functions, we could compare these two ratios.

$$\frac{v}{\sin\alpha} = \frac{b}{\sin 90} = b \qquad \frac{v}{\sin\beta} = \frac{d}{\sin\theta}$$

$$\sin(180-\theta) = \frac{a}{c} = \sin\theta$$

For both factors to be equal: $\frac{b}{a} = \frac{d}{c}$

$$\frac{\frac{v}{\sin\alpha}}{a} = \frac{\frac{v\sin\theta}{\sin\beta}}{c}$$

$$\frac{1}{a\cdot\sin\alpha} = \frac{\sin\theta}{c\cdot\sin\beta}$$

$$\frac{1}{a\frac{v}{b}} = \frac{\sin\theta}{c\cdot\sin\beta}$$

$$\frac{b}{av} = \frac{\frac{a}{c}}{c\cdot\sin\beta} = \frac{a}{c^2\sin\beta}$$

$$\frac{b}{a} \neq \frac{av}{c^2\sin\beta}$$

Figure A9

We can choose any position and evidently the angle ***β*** and resulting distance ***c*** could have any value, provided ***α*** > ***β***. As a consequence of that, the value of ***a***/***b***, which proportionally represents *Lorentz factor* ***Y***, could vary with the position and can have an infinite number of values. The correct formula for the *Lorentz factor* ***Y*** would be also different and would have to include the angles ***β*** and ***θ***.

The following example in figure A8 illustrates the general case, when the *observer* could move in any direction, not just on the line perpendicular to the line, connecting the *observer* and the light source.

To reach the *observer*, the light has to travel a different distance, and therefore it will reach the *observer* with different delays.

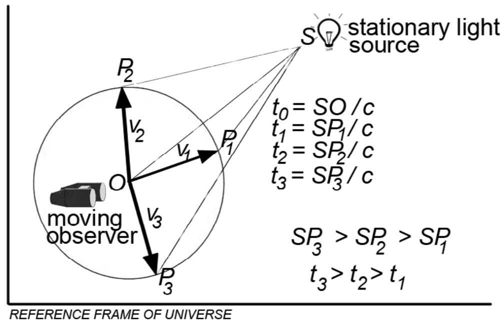

Figure A10 *The observer could move with the same speed* ***v*** *to any of the positions* P_1, P_2 *and* P_3.

The observer starts from position *O* and could move to positions *P1, P2* and *P3.*

The possible distance travelled: $OP_1 = OP_2 = OP_3$

When the *observer* is stationary, the light will travel the distance ***SO***, in time $t_0 = SO/c$

Similarly: $t_1 = SP_1 /c$ $t_2 = SP_2 /c$ $t_3 = SP_3 /c$

Since $SP_1 < SP_2 < SP_3$, the light will travel a shorter time interval, therefore: $t_1 < t_2 < t_3$

The *Lorentz factor* is defined as a ratio of time taken by the light to reach a moving *observer* to time taken to reach a stationary *observer*.

Then, for different directions of travel, and the same *observer's* speed, we would have different values of ***Lorentz factor:***

$$\gamma_1 = (t_1 / t_0) \qquad \gamma_2 = (t_2 / t_0) \qquad \gamma_3 = (t_3 / t_0)$$

resulting in $\gamma_1 < \gamma_2 < \gamma_3$

These differences are not due to the different *observer's* speed, since $v_1 = v_2 = v_3$, therefore, they would have to be calculated using a different formula for *Lorentz factor* ***Y***.

We have already calculated one such factor ***Y'***, for a simplified situation and obviously, the difference is substantial.

It is obvious that the values of the *Lorentz factor* depend not just on the *observer's* speed ***v***, but also on the position and direction the *observer* is heading. The starting position and direction of movement plays a vital role, and if the *Lorentz factor* should be used in any calculations it has to be included in the formula.

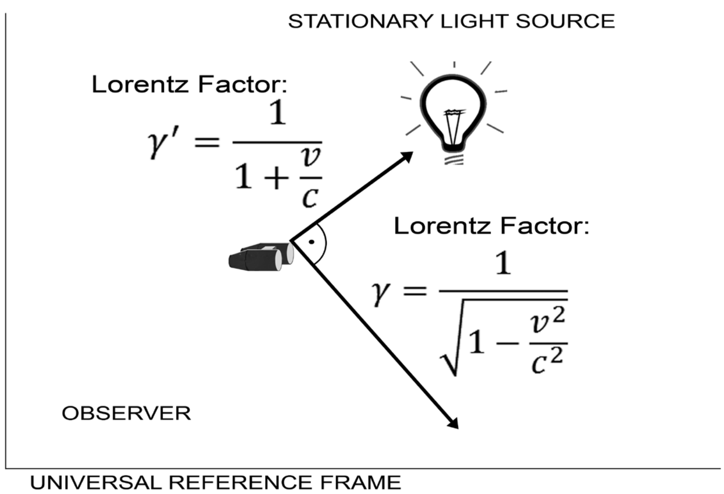

Figure A11 *Simplified diagram of Lorentz experiment. Observer travels in two different directions and for each situation, different versions of the Lorentz factor exist.*

We can conclude:

- *The Lorentz factor does not represent any changes in the rate of time flow, i.e., changes to the time dilation. Furthermore, it is incomplete and using Lorentz factor to define the invented dilation of time or the relativistic mass is erroneous.*

References

[1] Wikipedia - Twin paradox:
https://en.wikipedia.org/wiki/Twin_paradox#

Google search

https://www.google.com/search?q=%22in+his+famous+paper+on+special%22&lr=&sca_esv=662da3b4bba4bd88&hl=en&as_qdr=all&ei=aRHgZbWQNIKZvr0PhMud4AU&ved=0ahUKEwj16NWN5M-EAxWCjK8BHYRlB1wQ4dUDCBA&uact=5&oq=%22in+his+famous+paper+on+special%22&gs_lp=Egxnd3Mtd2l6LXNlcnAiICJpbiBoaXMgZmFtb3VzIHBhcGVyIG9uIHNwZWNpYWwiMgUQIRigATIFECEYoAFIn2pQjy5Y30lwAXgAkAEAmAGNAqABuBKqAQUwLjMuOLgBA8gBAP-gBAZgCCaACkRDCAgkQIRgKGKABGArCAgYQIRgKGAqYAwCIBgGSBwMyLTk&sclient=gws-wiz-serp

[2] Book 'RELATIVITY THE SPECIAL AND GENERAL THEORY' by *Albert Einstein*, 1920, Ph.D., translated by *Robert W. Lawson*, M.Sc. University of Sheffield