Twin paradox and Einstein mistake

a mathematical approach

Based on the book: "Logic in the Universe"

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The Michelson-Morley experiment showed inadvertently that the speed of light is constant. Based on Maxwell equations, the contraction of the length of a moving bar was rapidly accepted by the theoretical physicist community (Voigt 1887). The approach of Poincaré and Einstein was that Galileo's relativity does not contradict the constancy of the speed of light and can be integrated into a new "Principle of Relativity", that includes electromagnetic phenomena. This principle is used by Einstein to develop the entire relativistic mechanics and dynamics that is the basis of all current relativity.

What we want to prove is that the relativistic time contraction does not accumulate, as Einstein suggests. Once stopped the movement, at any time and anywhere, the length and time contraction disappear. This accumulation of contraction is not used in the later development of the dynamic.

I understand that this proposition makes no contribution to this science. However, there are so many scientists that approve this error and so many professors that lecture about it that makes it necessary to make this correction. Hundreds of websites are devoted to explaining the paradox. Some scientists claim that they have showed its validity experimentally. More than a hundred years of acceptance makes my job much harder. Following the idea of Max Planck, if I do not convince anyone, young people may come to evaluate it.

We shall refer to Einstein's paper of 1905, "On the Electrodynamics of Moving Bodies". More exactly we will refer to the following document:

The citations are shaded to recognize them.

About this Document

This edition of Einstein's *On the Electrodynamics of Moving Bodies* is based on the English translation of his original 1905 German-language paper (published as *Zur Elektrodynamik bewegter Körper*, in *Annalen der Physik*. 17:891, 1905) which appeared in the book *The Principle of Relativity*, published in 1923 by Methuen and Company, Ltd. of London. Most of the papers in that collection are English translations from the German *Das Relativatsprinzip*, 4th ed., published by in 1922 by Tuebner. All of these sources are now in the public domain; this document, derived from them, remains in the public domain and may be reproduced in any manner or medium without permission, restriction, attribution, or compensation.

Numbered footnotes are as they appeared in the 1923 edition; editor's notes are marked by a dagger (†) and appear in sans serif type. The 1923 English translation modified the notation used in Einstein's 1905 paper to conform to that in use by the 1920's; for example, c denotes the speed of light, as opposed the V used by Einstein in 1905.

This edition was prepared by John Walker. The current version of this document is available in a variety of formats from the editor's Web site:

http://www.fourmilab.ch/

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§ 2. On the Relativity of Lengths and Times

The following reflexions are based on the principle of relativity and on the principle of the constancy of the velocity of light. These two principles we define as follows:—

1. The laws by which the states of physical systems undergo change are not affected, whether these changes of state be referred to the one or the other of two systems of co-ordinates in uniform translatory motion.

2. Any ray of light moves in the "stationary" system of co-ordinates with the determined velocity c, whether the ray be emitted by a stationary or by a moving body. Hence

$$\text{velocity} = \frac{\text{light path}}{\text{time interval}}$$

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*Let us take **l** as the length of a rigid bar at relative rest frame and **l'** as the length of that same bar in relative inertial motion. We have **l > l'**. Let us take **t** and **t'** as the time light takes in traversing the static and the relatively moving rod, respectively. Given the constancy of the speed of light, the following relations should hold:*

$$c = \frac{l}{t} = \frac{l'}{t'} \; \frac{\text{centimeters}}{\text{seconds}}$$

Einstein *tells us that the contraction factor is:*

$$1 : (1 - (v/c)^2)^{1/2}$$

A rigid body which, measured in a state of rest, has the form of a sphere, therefore has in a state of motion—viewed from the stationary system—the form of an ellipsoid of revolution with the axes

$$\mathrm{R}\sqrt{1 - v^2/c^2},\ \mathrm{R},\ \mathrm{R}.$$

Thus, whereas the Y and Z dimensions of the sphere (and therefore of every rigid body of no matter what form) do not appear modified by the motion, the X dimension appears shortened in the ratio $1 : \sqrt{1 - v^2/c^2}$, i.e. the greater the value of v, the greater the shortening. For $v = c$ all moving objects—viewed from the "stationary" system—shrivel up into plane figures.† For velocities greater than that of light our deliberations become meaningless; we shall, however, find in what follows, that the velocity of light in our theory plays the part, physically, of an infinitely great velocity.

For ease of exposition, let us call the contraction factor, Einstein's factor, then we obtain the following function

$$E(v) = (1 - (v/c)^2)^{1/2}$$

*This factor is dimensionless since **v** and **c** cancel their measurement units. **E(v)** depends solely on **v**, since **c** is constant. What is most important to us is that **E(v)** does not depend on the extent of the movement; it depends solely on the speed.*

Once the system stopped moving, regardless of how long the movement has lasted, we will have ***v = 0*** *and thus* ***E(v) = 1****.*

v = 0 and 1 : E(v) implies => 1 : 1

This means that for ***v = 0****, there is no contraction; no matter how long the movement has lasted. Given the constancy of the speed of light, the following relationships are evident.*

$$c = \frac{l'}{t'} = \frac{l * E(v)}{t * E(v)} = \frac{l}{t} \; \frac{\text{centimeters}}{\text{seconds}}$$

so ***t' = t * E(v) seconds*** *which agrees with the first two terms of the equation on page 10*

$$\tau = t\sqrt{1 - v^2/c^2} = t - (1 - \sqrt{1 - v^2/c^2})t$$

If we subtract the contracted value from the value at rest we will have how much the variable decreased. We have for the length

$$l_d = l - l' = l - l * E(v) = l\,(1 - E(v))$$

and for the time

$$t_d = t - t' = t - t * E(v) = t\,(1 - E(v))$$

Let us call ***(1 - E (v))*** *the decreasing factor. Like* ***E(v)****, this factor is dimensionless. When* ***v = 0****,* ***E(v) = 1*** *and* ***1 - E(v) = 0****, it means that for* ***v = 0****, there is no decrease in length or delay in time.*

Now the article on the next page tells us that:

> whence it follows that the time marked by the clock (viewed in the stationary system) is slow by $1 - \sqrt{1 - v^2/c^2}$ seconds per second, or—neglecting magnitudes of fourth and higher order—by $\frac{1}{2}v^2/c^2$.

There is no transformation that can change the units of measurement of a physical entity. Adding the units of measure proposed by Einstein to the formula of the constancy of the speed of light we have:

$$c = \frac{l'}{t'} = \frac{l * E(v)}{t * E(v)} \; \frac{\text{centimeters}}{\text{seconds per second}} = \frac{l}{t} \; \frac{\text{centimeters}}{\text{seconds}}$$

and

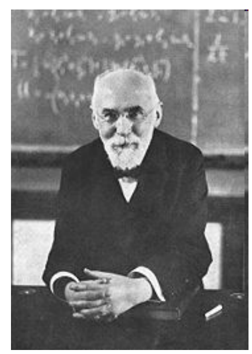
$$c = \frac{l_d}{t_d} = \frac{l * (1 - E(v))}{t * (1 - E(v))} \; \frac{\text{centimeters}}{\text{seconds per second}} = \frac{l}{t} \; \frac{\text{centimeters}}{\text{seconds}}$$

Einstein proposition contradicts the constancy of the speed of light and is totally unacceptable.

This change in units of measurement has enormous consequences.
A clock that is delayed $\boldsymbol{t_d}$ *seconds every second will be physically and permanently behind. With these units of measurement the clock will be behind in* $\boldsymbol{nt_d}$ *seconds after* ***n*** *seconds.*

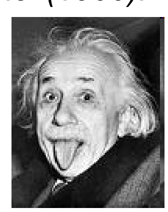
> From this there ensues the following peculiar consequence. If at the points A and B of K there are stationary clocks which, viewed in the stationary system, are synchronous; and if the clock at A is moved with the velocity v along the line AB to B, then on its arrival at B the two clocks no longer synchronize, but the clock moved from A to B lags behind the other which has remained at B by $\frac{1}{2}tv^2/c^2$ (up to magnitudes of fourth and higher order), t being the time occupied in the journey from A to B.
>
> It is at once apparent that this result still holds good if the clock moves from A to B in any polygonal line, and also when the points A and B coincide.
>
> If we assume that the result proved for a polygonal line is also valid for a continuously curved line, we arrive at this result: If one of two synchronous clocks at A is moved in a closed curve with constant velocity until it returns to A, the journey lasting t seconds, then by the clock which has remained at rest the travelled clock on its arrival at A will be $\frac{1}{2}tv^2/c^2$ second slow. Thence we conclude that a balance-clock[7] at the equator must go more slowly, by a very small amount, than a precisely similar clock situated at one of the poles under otherwise identical conditions.

If the delay is $\boldsymbol{t_d}$ *measured in seconds, the delay disappears when* ***v*** *becomes* ***0****. These are the implications of changing the units. The permanent physical delay is unacceptable because it is a consequence of incorrect measurement units and contradicts the constancy of the speed of light.*
I would like to tell to those who claim to have experimentally demonstrated permanent physical contraction, that they should revise their calculations, because what they have shown is that the speed of light is not constant, but decreases with the extent of the experiment.



A curious detail is that Einstein, throughout the article, did not use units of measure, except in the case mentioned. If he had not specified the seconds per second, every reader would have assumed that the contraction was given in seconds and therefore did not accumulate. Einstein did not want that. So he takes the time and effort to use the units of measurement, this one time only, to underline that time contraction accumulates and is physical and permanent.

This position of Einstein remembers what is known as Lorentz 'local time' (1900). But Lorentz's time is not relativistic. Larmor even speaks of how the atoms are physically deformed. Einstein was a romantic. This led him to devote his time and life to his idea of unifying all physical fields. He fall in love with the beauty of Lorentz's local time, but by doing so he forgot about logic and mathematics.



Or… is he laughing at us?

Moreover, the Lorentz's local time is against relativity.

In 1904, Henri Poincaré, gave a conference "Present and future of mathematical physics" in the Fair of St. Louis. Among other principles he explains:

“The principle of relativity, according to which the laws of physical phenomena should be the same, whether for an observer fixed, or for an observer carried along in a uniform movement of translation; so that we have not and could not have any means of discerning whether or not we are carried along in such a motion.”

Putting it another way: of two objects in relative inertial motion it can not be detected, which one is moving and which is not. And at the end of the movement, which one of them moved and which one stayed static. Anything that contradicts this statement contradicts the “Principle of Relativity".

Poincaré, Henri (1904), “L'état actuel et l'avenir de la physique mathématique”, Bulletin des sciences mathématiques 28 (2): 302-324
English translation: Poincaré, Henri (1905), “The Principles of Mathematical Physics”, in Rogers, Howard J., Congress of arts and science, universal exposition, St. Louis, 1904, vol. 1, Boston and New York: Houghton, Mifflin and Company, pp. 604-622

a logical approach

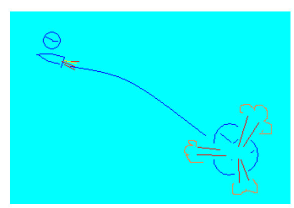
What we want to show is that time contraction is relative. Once the movement stops, at any time and anywhere, the contraction disappears.

Twin paradox was proposed by the French scientist Paul Langevin, based on Einstein's paper. The twins replace two synchronized clocks. This presentation has several shortcomings. He introduces gravity that does not appear in Einstein's paper. Clocks can measure seconds, which would not be noticed in a human being.

We abandon Langevin. We are not interested, neither in his relativity nor in his paradox. We could regain Langevin at the end of what we have to say. We return to Einstein. Consider two synchronized clocks at any point in space-time. Let one of the clocks move away and when he comes back he is behind. This is Einstein's paradox. In his paper, he proposed:

is slow by $1 - \sqrt{1 - v^2/c^2}$ seconds per second

This means that the delay is growing second by second. We can apply his formula at any second to know how much the delay has grown. Therefore, there is no need to wait for the moving clock to come back to the origin for measuring its delay. There is no jumping in the delay accumulation.



*Let us think of an experiment where the traveler's clock should be delayed on his return in **t** seconds. But when he was already late in **t/2** seconds, a disaster takes place at the source and the static clock completely disappears.*

The traveling clock doesn't known about the disaster and continues to move inertial as he was moving before the accident happened. Now you have to decide between the following options:

*- The physical delay of **t/2** is maintained, but not growing.*
- The physical delay continues to grow, but now relative to whom?
- The physical delay completely disappears at the time of the accident.

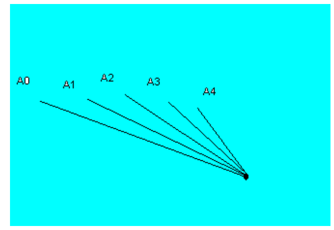
The delay is measured with respect to the static clock. Disappeared the static clock, it does not make sense any delay. But a permanent physical delay can not disappear by an accident that does not concern him.

Conclusion:

--- The permanent physical time delay never existed

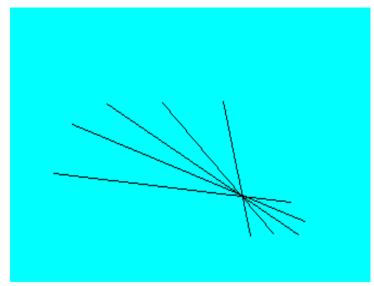
*We have shown that **time contraction is not a property of the moving clock**. How can another's property force a permanent physical change?*

Quintuplets counter paradox



Let us consider another experiment to show that when clocks stop there is no delay. Five quintuplets, A0 ... A4, synchronize their clocks at a point in space-time. Then separate at different speeds. A0 knows his speed relative to the other four brothers and choose to calculate his own age, according to the others. The contraction on its own clock is k0 = 0. Contraction with respect to other siblings is k1 ... k4.

A0 wonders for a moment and decides: I can not have five different ages. Then my age is the one marked by my watch.
The other ages, my brothers see on me, are not physical ages but relative to the motion. Therefore, these other ages are not permanent and should disappear when the relative motion stops.



It may be that someone is concerned about acceleration and its effects. In his article Einstein did not talk about acceleration. Let us take away the acceleration from the previous experiment.

Five people agree to go through a given point in space–time at the same time. Each traveler gets to the point moving inertial, but at different speeds. At the time of coincidence all synchronized their watches.

You can repeat the previous experiment, but now without the acceleration.

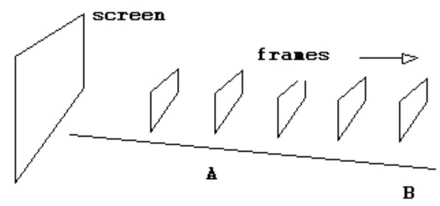
Positional correction

You probably have heard or read about the Clock Tower in the city of Berne that inspired Einstein in the formulation of Special Relativity. They say that withdrawing from the clock on a tram, he imagine he grabbed a ray of light and the clock stopped.

Let us change the tower with a giant screen of a drive-in cinema; that place where cars arrive, park and take a megaphone to have sound and image.

Let us take two points A and B, located at 150.000 and 300.000 km respectively from the screen. The frequency of the frames in the film is 30 frames per second. We have arrived in the middle of the show and the screen displays a clock, to tell the attendants when will begin the next session.

At any time an observer at A, will have seen 15 frames (half a second) that B has not seen. The time B can see is behind in half a second of what A can see.



If an observer moves from A to B, he will see fewer frames than anyone at A. When he reaches B he will be delayed in have second. The speed and the time taken are unimportant, only their product, i.e. the distance ***x = v t****. The delay is given by* ***x/c*** *seconds.*

This contraction is permanent provided that the observer remains at B. This may have confused Einstein. But if the observer returns from B to A, he will see more frames than those that are seen at B. When he reaches A he will be half a second ahead with respect to B.

I would like you to think about the next few lines. I used to send them as a heading in my letters, when I presented the absurd of the paradox.

Any given body, at any moment in time, is moving relative to millions of millions of other objects. How one of them, (family or not) can force a physical permanent (absolute) contraction by just observing it?

Now I am ready, if you want, to discuss about Langevin's Twin Paradox. But I believe you are not interested in it anymore.