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Einstein's relativity has been misunderstood

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There are several different theories masquerading as Special Relativity. There is a difference between what was published as the theory in the original German and what was later translated into English. This has created a terrible mess, of there being a difference between what theory Special Relativity should be, and what many people believe the theory to be.

In the English translation of Einstein's paper of 1905 on Special Relativity (SR) "ON THE ELECTRODYNAMICS OF MOVING BODIES" [1] on p.2 it says:

"Let us take a system of co-ordinates in which the equations of Newtonian mechanics hold good.2"

The footnote 2 says "i.e. to the first approximation."

This footnote is not in the original German edition of his famous 1905 paper, and it is unclear whether Einstein approved it.

I contend that the original German version of the paper is a different theory (let us call THEORY#1) from the English version of the paper with this footnote (let us call THEORY #2).

i.e. it is two different theories!

This is not trivial; it is vitally important about this footnote, so as to make sense of the rest of his paper. It looks like the theory of SR was changed from one theory to another through translation of German into English.

The original Theory#1 is a totally different theory to Theory#2; in Theory #1 Newtonian physics is not an approximation.

Many people on reading Einstein's English SR paper seem to gloss over this issue of this mysterious footnote 2. But I contend it is vitally important to know whether Theory#1 is being discussed or Theory#2 because it leads to all the other problems later of trying to understand whether the maths of SR is correct, and in what context that maths is to be understood.

My position is that it is Theory#1, but many people are thinking of SR in terms of Theory#2, hence I am saying "Einstein's relativity has been misunderstood" by these people, as per the title of this paper.

Taking now the issue of Time dilation as example. (First I contend that it is better called clock dilation and not time dilation; as it is an effect on clocks not on time. But anyway, proceeding with it as called time dilation in the usual texts.)

The usual thing said by relativists such as Instructor Laurence G. Yaffe [2-3] is: "Newtonian dynamics is a good approximation when velocities are very small compared to c.."

In the case of Time dilation equation [4] : $\Delta t' = \Delta t \ /(1-(u/c)^2)^{1/2}$

When velocity u is small i.e. tends to zero then the time intervals Δt' and Δt tend to become equal (i.e. tend to Δt' = Δt) and this is then said to be tending to Newtonian physics.

i.e. this is Newtonian physics as approximation to SR at low speeds; which is Theory #2.

We now need to look at how this equation was derived.

Yaffe explains it as follows:

1.3 Clocks and rulers

A clock is some construct which produces regular "ticks" that may be counted to quantify the passing of time. An ideal clock is one whose period is perfectly regular and reproducible. Real clocks must be based on some physical phenomenon which is nearly periodic — as close to periodic as possible. Examples include pendula, vibrating crystals, and sundials. All of these have limitations. The period of a pendulum depends on its length and the acceleration of Earth's gravity. Changes in temperature will change the length of a pendulum. Moreover, the Earth is not totally rigid: tides, seismic noise, and even changes in weather produce (small) changes in the gravitational acceleration at a given point on the Earth's surface. The frequency (or period) of vibration of a crystal is affected by changes in temperature and changes in mass due to adsorption of impurities on its surface. In addition to practical problems (weather), the length of days as measured by a sundial changes with the season and, on much longer time scales, changes due to slowing of the Earth's rotation caused by tidal friction.

An idealized clock, which is particularly simple to analyze, is shown in Fig. 1.2. A short pulse of light repeatedly bounces back and forth (in a vacuum) between two parallel mirrors. Each time the light pulse reflects off one of the mirrors constitutes a "tick" of this clock.[2] If L is the distance between the mirrors, then the period (round-trip light travel time) of this clock is $\Delta t = 2L/c$.

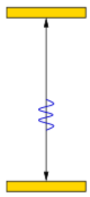

Figure 1.2: An idealized clock in which a pulse of light repeatedly bounces between two mirrors.

[1]This value is exact — because the meter is defined by this value for c and the international standard for time.
[2]To actually build such a clock, one would make one of the mirrors partially reflecting so that a tiny part of each light pulse is transmitted and measured by a photo-detector. These practical aspects are inessential for our purposes.

Now consider this same clock as seen by an observer moving to the left (perpendicular to the direction of the bouncing light) at velocity $-u$. In the observer's frame, the clock moves to the right at velocity u, as shown in Fig. 1.3. Let $\Delta t'$ be the period of the clock as viewed in this frame, so that the pulse of light travels from the lower mirror to the upper mirror and back to the lower mirror in time $\Delta t'$. The upper reflection takes place halfway through this interval, when the upper mirror has moved a distance $u\,\Delta t'/2$ to the right, and the light returns to the lower mirror after it has moved a distance $u\,\Delta t'$. Hence the light must follow the oblique path shown in the figure. The distance the light travels in one period is twice the hypotenuse, $D = 2\sqrt{L^2 + (u\,\Delta t'/2)^2} = \sqrt{4L^2 + (u\,\Delta t')^2}$. Now use the first postulate: the speed of light in this frame is c, exactly the same as in the original frame. This means that the distance D and the period $\Delta t'$ must be related via $D = c\,\Delta t'$. Combining these two expressions gives $c\,\Delta t' = \sqrt{4L^2 + (u\,\Delta t')^2}$ and solving for $\Delta t'$ yields $\Delta t' = 2L/\sqrt{c^2 - u^2}$. Inserting $2L = c\,\Delta t$ and simplifying produces

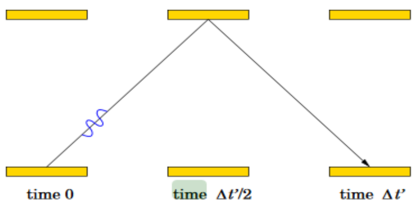

Figure 1.3: Three snapshots of the same clock viewed from a moving frame.

$$\Delta t' = \frac{\Delta t}{\sqrt{1-(u/c)^2}}\,. \tag{1.3.1}$$

This is a remarkable result. It shows that the period of a clock, when viewed in a frame in which the clock is moving, is different, and longer, than the period of the clock as viewed in its rest frame. This phenomena is known as *time dilation*. It is an inescapable consequence of the constancy of the speed of light. Although we have analyzed a particularly simple model of a clock to deduce the existence of time dilation, the result is equally valid for *any* good clock.[3] In other words, moving clocks run slower than when at rest, by a factor of

$$\gamma \equiv \frac{1}{\sqrt{1-(u/c)^2}}\,, \tag{1.3.2}$$

The equation he gives as D = c Δt' really misses out a few steps, as follows:

1. First should be written D = c' Δt' because we have the primed frame of time interval Δt' we should have primed lightspeed c'.

2. Then the assumption that c = c' changes D = c' Δt' into D = c Δt'.

It is this assumption that c=c' which presumably comes from Einstein's view of the second postulate. But in Newtonian physics as presented to us from Newton with universal time, we would not make that assumption. Thus we see the link from Newtonian physics to SR is merely to take c =c' to then have Δt' different to Δt; instead of Δt' = Δt with c and c' different. This is then Theory#1.

Thus, from Theory#1 we have the steps that give us the time dilation equation, but after that equation is derived it is often interpreted by relativists as Theory#2.

But Theory#1 and Theory#2 are different theories, so it is a mistake to merge them in the way that these relativists have done!

Thus, I contend Einstein's relativity has been misunderstood (by most relativists); what is taught is a mistaken merging of two different theories that are incompatible, and the correct understanding all along should have been as Theory#1, without the erroneous switch to Theory#2.

Based on the derivation of the time dilation equation (and other equations) Newtonian physics is not an approximation, it is merely been about imposing onto what would otherwise be Newtonian maths the condition c = c', and then making quantities like t and t' as no longer equal.

If given that we now know Einstein's relativity (SR) should really be Theory#1; we can discard all the wrong versions of relativity. Alternatively, if we don't do that and stay with the present mess of mixing Theory#1 and #2 then we can call that type of SR as wrong. i.e. I am talking about a revision to what we call SR; and the existing versions of SR are wrong.

There are of course other problems in the maths of SR, but now we know the context should really be Theory#1 we can work out what those other mistakes are. Einstein spent his days trying to work out the maths of a unified field theory, and so of course those changes of mind causes a great deal of obscurity in Einstein's writings and it is unclear how much of what is pointed out in this paper, that he realized. With the basis of his work as Theory#1 then the connection with Newtonian physics is greater than most relativists realize, and it is much easier then to deal with gravity as still within a Newtonian context.

References

[1] ON THE ELECTRODYNAMICS OF MOVING BODIES By A. EINSTEIN June 30, 1905 http://hermes.ffn.ub.es/luisnavarro/nuevo_maletin/Einstein_1905_relativity.pdf

[2] https://courses.washington.edu/partsym/15Spr/

[3] https://courses.washington.edu/partsym/15Spr/ch03.pdf

[4] https://courses.washington.edu/partsym/15Spr/ch01.pdf

Note: This article tries to gather together information I have presented previously, and trying to present it in a more easily understood way.