

Einstein's 1905 Speed/velocity of Light errors

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Einstein made too many mistakes that it's difficult to deal with them all; this paper is just dealing with some of the errors he made with lightspeed in his 1905 paper on Special relativity.

Hans Ohanian [1] seems to be an Einstein apologist – he admits that Einstein made lots of mistakes, but tries to justify it as despite the mistakes in his derivations; Einstein still comes up with the correct answers. Ohanian might think that, but anyone else reading the numerous mistakes made by Einstein just find themselves swamped under a mountain of those mistakes, making the conclusions definitely ambiguous if not wrong. So Ohanian is trying to just excuse the inexcusable.

Anyway, Ohanian is an Einstein supporter and it is rare to have anyone admit from the Einstein supporter group that Einstein made mistakes. So, there might be progress in that group that all do not believe Einstein perfect, and some attempt might now be made to correct those mistakes.

If we look at the lightspeed issue in Einstein's 1905 paper on Special relativity: "On the Electrodynamics of moving bodies," a good thing to note is there has been a translation problem from Einstein's original German into English. The German language does not differentiate between the English words "speed" and "velocity". (Others have noticed this, so I cannot take credit for discovering it.

In Einstein's German original paper [2] he has the word "Geschwindigkeit" this can translate into English as "speed" or "velocity".

There is a difference between "speed" and "velocity". Velocity is magnitude and direction, while speed is just magnitude.

Thus when Einstein talks of velocity of light being constant does it mean that both magnitude and direction are constant (?) Upon reading many Einstein's relativity papers, it seems he must mean "speed" not "velocity", because he deals with light changing direction when he talks of light velocity as constant; so that is the first issue – when Einstein gets translated into English as "light velocity is constant" he must be meaning "lightspeed is constant". That does add to the confusion in dealing with Einstein, especially when he makes transition from Special relativity to General relativity. Einstein can be excused that this is a problem with the translation from German into English. But surely as he became aware of the English language more (after giving lectures to English speakers), he must have become aware of this

problem with the word “Geschwindigkeit”. He did not however seek to clarify that issue; he did not seek to clarify lots of areas where his writings are confused; he just left them as a mess; and that is inexcusable except to Einstein apologist who will seek to excuse Einstein of anything.

Collecting all the statements that Einstein makes regarding light velocity (bearing in mind he must mean speed) in the English version [3] of his 1905 paper:

statement 1: “We will raise this conjecture (the purport of which will hereafter be called the “Principle of Relativity”) to the status of a postulate, and also introduce another postulate, which is only apparently irreconcilable with the former, namely, that light is always propagated in empty space with a definite velocity c which is independent of the state of motion of the emitting body. These two postulates suffice for the attainment of a simple and consistent theory of the electrodynamics of moving bodies based on Maxwell's theory for stationary bodies.”

statement 2: “In agreement with experience we further assume the quantity

$$\frac{2AB}{t'_A - t_A} = c,$$

to be a universal constant--the velocity of light in empty space.”

statement 3: “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

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

where time interval is to be taken in the sense of the definition in § 1, “

me: Statements 1-3 since okay if we bear in mind that velocity should really mean speed, then Einstein is saying the speed of light is constant c in these 3 statements. Things start to go wrong with the next statement:

Statement 4: “We imagine further that with each clock there is a moving observer, and that these observers apply to both clocks the criterion established in § 1 for the

synchronization of two clocks. Let a ray of light depart from A at the time t_A , let it be reflected at B at the time t_B , and reach A again at the time t'_A . Taking into consideration the principle of the constancy of the velocity of light we find that

$$t_B - t_A = \frac{r_{AB}}{c - v} \text{ and } t'_A - t_B = \frac{r_{AB}}{c + v}$$

where r_{AB} denotes the length of the moving rod--measured in the stationary system. Observers moving with the moving rod would thus find that the two clocks were not synchronous, while observers in the stationary system would declare the clocks to be synchronous.

So we see that we cannot attach any *absolute* signification to the concept of simultaneity, but that two events which, viewed from a system of co-ordinates, are simultaneous, can no longer be looked upon as simultaneous events when envisaged from a system which is in motion relatively to that system."

me: Einstein is using $c-v$ and $c+v$ for the lightspeeds instead of c , something is going radically wrong in Einstein's paper, he can't stick with lightspeed as c , or something else is happening, so we have to read on:

The next statement is a long one, and we have to break it into parts:

statement 5 part1: "From the origin of system k let a ray be emitted at the time τ_0 along the X-axis to x' , and at the time τ_1 be reflected thence to the origin of the co-ordinates, arriving there at the time τ_2 ; we then must have $\frac{1}{2}(\tau_0 + \tau_2) = \tau_1$, or, by inserting the arguments of the function τ and applying the principle of the constancy of the velocity of light in the stationary system:--

$$\frac{1}{2} \left[\tau(0, 0, 0, t) + \tau \left(0, 0, 0, t + \frac{x'}{c - v} + \frac{x'}{c + v} \right) \right] = \tau \left(x', 0, 0, t + \frac{x'}{c - v} \right).$$

Hence, if x' be chosen infinitesimally small,

$$\frac{1}{2} \left(\frac{1}{c - v} + \frac{1}{c + v} \right) \frac{\partial \tau}{\partial t} = \frac{\partial \tau}{\partial x'} + \frac{1}{c - v} \frac{\partial \tau}{\partial t},$$

or

$$\frac{\partial \tau}{\partial x'} + \frac{v}{c^2 - v^2} \frac{\partial \tau}{\partial t} = 0.$$

me: Einstein is still using speeds $c-v$ and $c+v$ instead of c . Einstein continues:

Statement 5 part2: “It is to be noted that instead of the origin of the co-ordinates we might have chosen any other point for the point of origin of the ray, and the equation just obtained is therefore valid for all values of x', y, z .

An analogous consideration--applied to the axes of Y and Z--it being borne in mind that light is always propagated along these axes, when viewed from the stationary system, with the velocity $\sqrt{c^2 - v^2}$ gives us

$$\frac{\partial \tau}{\partial y} = 0, \frac{\partial \tau}{\partial z} = 0.$$

me: Something has gone very wrong, Einstein now says the speed of light is $\sqrt{c^2 - v^2}$. Einstein continues:

Statement 5 part 3: « Since τ is a *linear* function, it follows from these equations that

$$\tau = a \left(t - \frac{v}{c^2 - v^2} x' \right)$$

where a is a function $\phi(v)$ at present unknown, and where for brevity it is assumed that at the origin of k , $\tau = 0$, when $t=0$.

me: Einstein is still using $(c^2 - v^2)$. He continues:

Statement 5 part 4: “With the help of this result we easily determine the quantities ξ , η , ζ by expressing in equations that light (as required by the principle of the constancy of the velocity of light, in combination with the principle of relativity) is also propagated with velocity c when measured in the moving system. For a ray of light emitted at the time $\tau = 0$ in the direction of the increasing ξ

$$\xi = c\tau \text{ or } \xi = ac \left(t - \frac{v}{c^2 - v^2} x' \right).$$

me: Einstein has c for moving frame, but a different value of lightspeed in stationary frame; when he is supposedly claiming at the start of the paper that lightspeed is constant as c . He continues:

Statement 5 part 5: “But the ray moves relatively to the initial point of k , when measured in the stationary system, with the velocity $c-v$, so that

$$\frac{x'}{c-v} = t.$$

me: He is back with $c-v$, this means light travels distance x' in time interval t with speed $c-v$.

Statement 5 part 6: "If we insert this value of t in the equation for ξ , we obtain

$$\xi = a \frac{c^2}{c^2 - v^2} x'.$$

In an analogous manner we find, by considering rays moving along the two other axes, that

$$\eta = c\tau = ac \left(t - \frac{v}{c^2 - v^2} x' \right)$$

when

$$\frac{y}{\sqrt{c^2 - v^2}} = t, \quad x' = 0.$$

Thus

$$\eta = a \frac{c}{\sqrt{c^2 - v^2}} y \quad \text{and} \quad \zeta = a \frac{c}{\sqrt{c^2 - v^2}} z.$$

Substituting for x' its value, we obtain

$$\begin{aligned} \tau &= \phi(v) \beta (t - vx/c^2), \\ \xi &= \phi(v) \beta (x - vt), \\ \eta &= \phi(v) y, \\ \zeta &= \phi(v) z, \end{aligned}$$

where

$$\beta = \frac{1}{\sqrt{1 - v^2/c^2}},$$

and ϕ is an as yet unknown function of v . If no assumption whatever be made as to the initial position of the moving system and as to the zero point of τ , an additive constant is to be placed on the right side of each of these equations.

We now have to prove that any ray of light, measured in the moving system, is propagated with the velocity c , if, as we have assumed, this is the case in the

stationary system; for we have not as yet furnished the proof that the principle of the constancy of the velocity of light is compatible with the principle of relativity.”

me: This last paragraph above makes no sense, he is violating his assumption that light speed is constant all the way to this paragraph. He continues:

Statement 5 part 7: At the time $t = \tau = 0$, when the origin of the co-ordinates is common to the two systems, let a spherical wave be emitted therefrom, and be propagated with the velocity c in system K. If (x, y, z) be a point just attained by this wave, then

$$x^2 + y^2 + z^2 = c^2 t^2.$$

Transforming this equation with the aid of our equations of transformation we obtain after a simple calculation

$$\xi^2 + \eta^2 + \zeta^2 = c^2 \tau^2.$$

The wave under consideration is therefore no less a spherical wave with velocity of propagation c when viewed in the moving system. This shows that our two fundamental principles are compatible.

me: He makes a claim that he has shown the two principles compatible when he has done no such thing, all the way to this point he has been unable to stick to keeping light speed constant as c .

Now onto the next statements:

Statement 6: “It follows, further, that the velocity of light c cannot be altered by composition with a velocity less than that of light. For this case we obtain

$$V = \frac{c + w}{1 + w/c} = c.$$

We might also have obtained the formula for V , for the case when v and w have the same direction, by compounding two transformations in accordance with § 3. If in addition to the systems K and k figuring in § 3 we introduce still another system of co-ordinates k' moving parallel to k , its initial point moving on the axis of Ξ^{x5} with the velocity w , we obtain equations between the quantities x, y, z, t and the corresponding quantities of k' , which differ from the equations found in § 3 only in that the place of “ v ” is taken by the quantity

$$\frac{v + w}{1 + vw/c^2};$$

from which we see that such parallel transformations--necessarily--form a group.

We have now deduced the requisite laws of the theory of kinematics corresponding to our two principles, and we proceed to show their application to electrodynamics.”

statement 7: “Velocities greater than that of light have--as in our previous results--no possibility of existence.”

Somehow he has now obtained relativistic velocity addition in statement 6 as:

$$\frac{v + w}{1 + vw/c^2};$$

if we add velocities say v and w they now do not equal v+w but instead this equation

$$\frac{v + w}{1 + vw/c^2};$$

So when we have earlier Einstein writing things like c-v and c+v presumably they are now supposed to be added by this relativistic velocity addition.

Back now to when the problems first started in statement 4, we have:

$$t_B - t_A = \frac{r_{AB}}{c - v} \text{ and } t'_A - t_B = \frac{r_{AB}}{c + v}$$

by relativistic velocity addition c-v becomes $(c-v)/(1 - vc/c^2) = (c-v)/(1-v/c) = (c-v)/(c-v)/c = c$

and for c+v this becomes $(c+v)/(1 + vc/c^2) = (c+v)/(1+v/c) = (c+v)/(c+v)/c = c$

So the equations

$$t_B - t_A = \frac{r_{AB}}{c - v} \text{ and } t'_A - t_B = \frac{r_{AB}}{c + v}$$

become:

$$t_B - t_A = \tau_{AB}/c \quad \text{and} \quad t'_A - t_B = \tau_{AB}/c$$

If we proceed with this of replacing c-v and c+v by c in the statements that follow, the whole thing just degenerates, and everything is devoid of any real meaning.

So we summarise:

Summary

In his famous paper of 1905 Einstein makes many contradictions. For example-

After stating the constancy of velocity of light:

"The following reflexions are based on the principle of relativity and on the principle of the constancy of the velocity of light."

Einstein then later says light is some other value than c :

"An analogous consideration--applied to the axes of Y and Z--it being borne in mind that light is always propagated along these axes, when viewed from the stationary

system, with the velocity $\sqrt{c^2 - v^2}$..."

$\sqrt{c^2 - v^2}$
not c ?

but then $c-v$ probably means $c-v = c$, same as $c+v = c$, when we allow such mathematical nonsense we can write any rubbish; and Einstein proceeds to accept that nonsense.

So either Einstein is saying one thing and contradicting himself later by saying the opposite, or he has $c - v = c+v = c$ by relativistic velocity addition, and also giving us also $\sqrt{c^2 - v^2} = c$ as well (because $(c^2 - v^2) = (c-v)(c+v)$); but that's really degeneration into having everything equal to c . Whatever is supposed to be meant by Einstein it just makes no mathematical sense. Mainstream physics that has accepted this, has just tied experimental measurements to mathematical nonsense, which is devoid of any real sensible meaning in a type of Lewis Carroll "Through the Looking glass" mad world. Science cannot really be built on such mathematical nonsense. This famous paper by Einstein should have been taken as a joke as it surely was intended (?) and not taken seriously. Ohanian tries to excuse these mathematical mistakes of Einstein, but they are really inexcusable.

References

[1] Einstein's Mistakes, Hans C. Ohanian, WW Norton and Company, 2008 ISBN 978-0-393-06293-9

[2] See A. Einstein, Zur Elektrodynamik bewegter Körper. Kommentiert und erläutert at:
<http://www.rzuser.uni-heidelberg.de/~mplenert/einstein.pdf>

[3] On the Electrodynamics of moving bodies, by A. Einstein
June 30, 1905, <http://www.fourmilab.ch/etexts/einstein/specrel/www/>

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