Special Relativity is Wrong

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Abstract:
The theory of special relativity is the result of compounded errors. In his paper, Einstein first made a reasoning error regarding the property of light, then he applied this wrong idea inconsistently. As a result, the conclusion of Special Relativity is not only against the principle of relativity, but also contradicts its own mathematical base. As a measure of demystification, using the concept of average speed, the critical formulas of Special Relativity are re-introduced and their meaning are re-explained.

Keywords: Special Relativity

1. Introduction

A lot of people have heard about the theory of Special Relativity, but few of us can understand it. Interestingly, behind this difficult theory, are two very simple postulates.

The two postulates are stated this way in "***On the Electrodynamics of Moving Bodies***"[1]:

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.*

Here in this paper, we will start from these postulates, and then continue onto the conclusion of Special Relativity. In the end, we will follow a more direct path to get the critical formulas of Special Relativity, and give these formulas some new meaning.

2. The First Postulate

The first postulate is the principle of relativity. It says that any physical law is not affected by the selection of reference frames, as far as the reference frames are all in uniform motion.

All reference frames mentioned hereafter are in uniform motion, unless otherwise specified.

In the field of mechanical motion, the principle of relativity is represented in this form: Newton's second law of motion, $\mathrm{F} = ma$, works exactly the same in all reference frames. A short mathematical proof, or verification, is given below.

Suppose in a reference frame C, an experiment about Newton's second law of motion is undergoing. Here we have to prove, given any two reference frames A and B, the observations will lead us to the exact same formula: $\mathrm{F} = ma$.

As both A and B are virtual, they should have no effect on the *F* and *m* of the real experiment, so the same acceleration should be obtained from both reference frames.

In reference frame A, the acceleration is:

$$a_A = \frac{dv_A}{dt}$$

In reference frame B, the acceleration is:

$$a_B = \frac{dv_{\mathrm{B}}}{dt} = \frac{d\left(v_A + v_{AB}\right)}{dt} = \frac{dv_A}{dt} + \frac{dv_{AB}}{dt} = \frac{dv_A}{dt} + 0 = \frac{dv_A}{dt}$$

Where v_{AB} is the relative velocity of reference frame A to reference frame B, which does not change with time, thus $dv_{AB} / dt = 0$.

We can see both reference frames give the same acceleration. Or in another word, Newton's second law of motion is exactly the same in both reference frames.

Since the reference frames A and B are arbitrarily chosen, one of them might be taken as the reference frame C itself. Thus we can go a little farther: the reference frame, where the experiment event is happening, has no effect on the experiment itself, whether it is "at rest" or in uniform motion.

In this way, the validity of the principle of relativity, in the field of mechanical motion, is established.

In the proof above, the critical part is the Galilean velocity combination rule: $v_B = v_A + v_{AB}$.

Based on the Galilean concept that all motions are relative, we can see a hidden condition behind the principle of relativity: all objects follow the rule of relative motion.

For clarity, we can describe the first postulate like this:

- **All reference frames of uniform motion are equivalent. Any one physical law behaves exactly the same in all of them. Or in another word, the mathematical form of a physical law is unique.**

- **All physical objects follow the rule of relative motion.**

3. The Second Postulate

Comparing with the first postulate, the second postulate is not so easy to understand.

The difficulty is not in the constant speed of light, as this fact is common knowledge to all of us. The source irrelevant part is also easy to understand. As light is a kind of wave, it should behave like any other wave, whose propagation speed is not affected by the source.

But what does the "stationary" mean? Which reference frame is stationary? This reference frame cannot be the Earth, as the Earth is orbiting the sun, and is also rotating on its own axis. It cannot be the "Ether" either, because Einstein specifically rejected it in his paper.

As I cannot think of any such stationary reference frame, let's see how Einstein explained it in "***Relativity: The Special and General Theory***" [2].

In Part I, Section 07, "The Apparent Incompatibility of the Law of Propagation of Light with the Principle of Relativity", Einstein explained this incompatibility like this:

Suppose one beam of light is sent out from the railway embankment, in the same direction where the train is moving. To an observer on the embankment, the speed of this beam is c. To an observer on the train, the speed of this beam is c-v, where v is the speed of the train. But according to the principle of relativity, the speed of light should be the same, whether the reference frame is the train or the embankment. Thus we get an incompatibility issue.

From here we can see that Einstein used the two postulates this way: The second postulate leads to the constant speed of light in a "stationary" reference frame, and **the first postulate leads to the same constant speed of light in all reference frames.**

Did Einstein really mean that?

Yes. Just look at the velocity combination rule under Special Relativity, and it will be clear.

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

Let v be the speed of a reference frame, and w be the speed of light c relative to that reference frame, the resulting V, which is the combined speed relative to us, will always be c!

Here Einstein's reasoning is wrong.

As shown in Section 2 of this paper, the principle of relativity implies that all objects follow the rule of relative motion. So the observed speed c-v is the direct result of the principle of relativity, while the same light speed in all reference frames is against the principle of relativity.

To make this point clear, let's use a falling apple as an example.

In an orchard where a train is passing through, an apple is falling from a tree. To a person standing beside the tree, the apple is falling vertically. To a person on the train, the apple is falling along a path of parabola. Both observations are objective, but they seem to contradict each other. Does this mean the principle of relativity is wrong?

Certainly not. The two observations are both related to the physical law, but they are not the physical law itself. The goal of any physical law, if achievable, is to represent the relationship between cause and effect. In this example, the falling of the apple is caused by the gravity. If we calculate the acceleration from both observations, the results will be exactly the same number - the acceleration due to gravity.

As shown in our proof of the principle of relativity, the difference in observation results is a necessity for the uniqueness of a physical law. The principle of relativity means two things at the same time: a physical law is unique, and all observation results are relative.

Einstein’s error here is that he took the observation results as the physical law itself.

From the above analysis, we can see that Einstein's reasoning for “**the same constant speed of light in all reference frames**” is wrong, and Special Relativity becomes groundless.

4. Self-Contradictions in Special Relativity

In his paper [1], Einstein started with this first step:

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

and got the formulas below:

$$\tau = t\sqrt{1-v^2/c^2} \quad \text{(time dilation equation)}$$

$$V=\frac{v+w}{1+vw/c^2} \quad \text{or} \quad v_{\mathrm{B}}=\frac{v_{\mathrm{A}}+v_{\mathrm{AB}}}{1+v_{\mathrm{A}}v_{\mathrm{AB}}/c^2} \quad \text{(velocity combination rule)}$$

There are two self-contradictions here, and this is the first one:

Special relativity is based on the principle of relativity, but its velocity combination rule breaks the principle of relativity, since

$$\frac{dv_A}{dt} \neq \frac{dv_B}{dt} \quad (a_A \neq a_B)$$

Only under a linear velocity combination rule, like the Galilean one, the influence of a reference frame can be completely removed by the derivation of velocity with respect to time, if the reference frame is in uniform motion.

If the principle of relativity works so well in this universe, which is introduced by Einstein himself, as can be seen from Part I, Section 05 of [2], why do we have to break it?

And here is the second self-contradiction:

The time dilation equation effectively puts a limit to the speed in the universe, but either the *c+v* or the *c-v* in the first step will exceed that limit.

How did this self-contradiction arise?

The following paragraph comes from the middle part of Section 03, Part I, paper [1]:

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

$$\xi = ct \quad or \quad \xi = \alpha c\left(t - \frac{v}{c^2 - v^2} x' \right)$$

This was the first time when the idea of "the same speed of light in all reference frames" got really utilized. But the idea had appeared from the very beginning, as can be seen from the two postulates raised in section 02 of paper [1].

To use the idea consistently, both the $c+v$ and $c-v$ in the first step should be replaced by c.

Or, after having obtained the velocity combination rule under special relativity, the new rule has to be put into use in the first step, to replace the $c+v$ and $c-v$, which all come from the Galilean velocity combination rule.

How did Einstein forget to put the same idea to the first step, we may never know.

Whatever the reason, out of this inconsistency, the theory of special relativity was born.

5. Special Relativity Demystified

In a smooth running river, a gentleman is swimming. As this is his first time of swimming in a river, to make it safe, he is swimming along one bank of the river. He has started from a downstream point A, and intends to reach an upstream point B, and then returns to point A.

Here is the question: What is his average speed during this round trip, if his swimming speed in still water is c, and the river is running downstream at a speed of v?

It is easy to get the average speed, as can be seen from the following:

Let s be the distance between A and B, then

Time from A to B: $t_{AB} = \dfrac{s}{c - v}$

Time from B to A: $t_{BA} = \dfrac{s}{c + v}$

Total time: $t_{sum} = t_{AB} + t_{BA} = \dfrac{s}{c - v} + \dfrac{s}{c + v} = 2s\left(\dfrac{c}{c^2 - v^2}\right)$

Average speed: $c_{avg} = \dfrac{2s}{t_{sum}} = \dfrac{c^2 - v^2}{c} = c\left(1 - \dfrac{v^2}{c^2}\right)$

We can see that the average speed is lower than the swimmer's speed in still water.

But unfortunately, this gentleman is no other person than your boss. He is so confident with his swimming skills, if you are to tell him that his speed is less than *c*, you will certainly get yourself into trouble. So you have to tell him that something is wrong with the clock or the ruler, and ask him to try again after you have fixed it.

How should you fix it?

Mathematically, there are numerous solutions available; but physically, you have only three options: using a slower clock, using a shorter ruler, or changing both the clock and the ruler.

Solution 1: A Slower Clock

$$t_{fix} = 1/\left(1 - v^2/c^2\right)$$

Solution 2: A Shorter Ruler

$$l_{fix} = \left(1 - v^2/c^2\right)$$

Solution 3: A Slower Clock and a Shorter Ruler

$$t_{fix} = 1/\sqrt{\left(1 - v^2/c^2\right)}$$

$$l_{fix} = \sqrt{\left(1 - v^2/c^2\right)}$$

With all these solutions, there are some common problems.

Problem 1: The solution will get broken if $v \geq c$.

Anyway, the boss will know by his own experience that going upstream is not possible, so the fix is not needed any more.

Problem 2: The solution only works for round trips along the bank.

For one way trip when the direction of *c* and *v* are along the same line, v^2 and c^2 will not appear.

Problem 3: The solution is direction related.

Our example is only a special case, as Galilean velocity addition is actually vector addition. When the path is in an angle of θ (a value between 0 and 90°) with the bank, the average speed can be calculated this way:

$$v_{avg} = c\frac{1-\gamma^2}{\sqrt{1-\sin\theta\cdot\gamma^2}}, \quad \text{where} \quad \gamma = v/c,$$

Let θ=0, we have $v_{avg} = c(1-\gamma^2)$, this is our case.

Let θ=90°, we have $v_{avg} = c\sqrt{1-\gamma^2}$, this is the case when the path is perpendicular to the bank.

Any other angle between 0 and 90° will result in an average speed between these two values.

Replace the boss with a water wave with re-bouncing capability, the results will not be affected in any way.

Does solution 3 look familiar? The formulas are the same as those of Special Relativity, except that they are in the simplest form.

How are the formulas obtained?

First, we assumed that the swimmer's motion is relative, and the swimmer has a round trip along one bank, that is where the *c+v* and *c-v* comes from. Then, we assumed that the swimmer's speed in moving water is the same as in still water, in another word, the swimmer's motion is an absolute motion.

That is exactly the path taken by Einstein in his paper.

In our example here, the broken formula does not mean that the river can not run faster than the swimmer. It only represents the fact that in the case of $v \geq c$, the swimmer will never have a chance to reach upstream. Because an average speed can not be obtained, any effort trying to adjust this average speed to *c* is certain to fail.

Due to the same reason, Special Relativity does not imply that the speed of light is the speed limit in the universe, even if Special Relativity is correct.

6. Conclusion

In essence, Einstein's work in his paper is trying to build a bridge between relative motion and absolute motion.

Any result from this effort, if obtainable at all, is certain to destroy the principle of relativity, as the principle of relativity is established on the basis of relative motion.

There are two fatal errors in Special Relativity. The first one, the violation of the principle of relativity, is a conceptual error and is very subtle; while the second one, the internal inconsistency, is a technical error and is quite evident.

To kill Special Relativity, either of the two errors will do.

But to understand what Special Relativity is really about, one has to know some basic concepts, like relative motion, average speed, and the principle of relativity. Not that these concepts are difficult, but buried in complicated mathematical formulas, they can easily get forgotten.

References:

[1]. Albert Einstein, Annalen der Physik, (1905), page 891, **On the Electrodynamics of Moving Bodies**. English translation by George Barker Jeffery. Article from Fourmilab Switzerland.

[2]. Albert Einstein, **Relativity: The Special and General Theory** (Methuen & Co Ltd, 1924, Edition 10). English translation by Robert W. Lawson. Article from Project Gutenberg.