The Lorentz transformation - a conversation on proof

Hans Lugtigheid
Amsterdam
hanslugtigheid.nl
hans@hanslugtigheid.nl
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November 9, 2024

Abstract

In this article I present a discussion on the v in the Lorentz transformation. Alice observes that this v is the velocity of a point without dimensions. And that from that v we cannot conclude a maximum speed or anything for physical objects. Bob counters by bringing up the theory of relativity. The conversation leads to Bob to conclude to a necessary condition for the theory of relativity - the v is the velocity of a physical object - which he cannot prove. However, other parts of the theory of relativity still hold - e.g. the formulas used in GPS still bring us home. This conclusion is a starting point for further research about what exactly the various parts of the theory really tell us.

Introduction

We have a conversation between two people. Alice starts with an observations on the v in the Lorentz transformation. Bob holds on to the theory of relativity. This will cast doubt on some current opinions.

A conversation on proof

Alice: "The v in the Lorentz transformation is the velocity of the origin of the second frame of reference. It is the point from where we measure. And as such it only exists in our mind. Hence, this is a point with no dimensions. From the velocity of this point we can not deduce a maximum velocity, or anything, for physical objects."

Bob: "This is not correct. In the theory of relativity we prove with this velocity v in the gamma that the speed of light is the maximum speed for physical objects."

Alice: "So you say that for the theory of relativity it is a necessary condition that the v in the Lorentz transformation is the velocity of a physical object. Can yo prove this necessary condition? I mean, can you prove that, because of the nature of the equation of the Lorentz transformation, the v is the velocity of a physical object."

Bob: "Ho-ho. If you have a problem with the theory of relativity then you have to prove it wrong."

Alice: "Can I respond to that?"

Bob: "Please do"

Alice: "Okay. First thing. I was talking about the Lorentz transformations. Those are equations. I didn't mention the theory of relativity. The Lorentz transformations are part of the theory of relativity but the theory of relativity is much more than the Lorentz transformations. Correct?"

Bob: "Correct."

Alice: "I made a remark on the Lorentz transformation. I didn't mention the theory of relativity. Agreed?"

Bob: "Mmm. Okay..."

Alice: "I said that the v in the Lorentz transformation is the velocity of the origin of the second reference frame. This exists only in our mind. OK?"

Bob: "OK."

Alice: "From that you 'jumped' to the theory of relativity. And you said that you use the v in the gamma to prove that physical objects can not go faster than the speed of light. OK?"

Bob: "OK."

Alice: "We also have other aspects of the theory of relativity. Especially a lot of measurements which are often used as a proof of the theory of relativity."

Bob: "Correct. Although we know that observations don't constitute proof of a theory. They support the idea of validity of the theory."

Alice: "Exactly. So for this conversation I state that the measurements are in accordance with the appropriate equations from the theory of relativity. Agreed?"

Bob: "Yes."

Alice: "And the fact that these measurements are in accordance with the theory of relativity do not prove that the speed of light is the maximum speed in the universe. Nor does this fact prove that the v in the gamma in the Lorentz transformation is the velocity of a physical object. OK?"

Bob: "I see what you are getting at. One part of the theory of relativity is OK. But that has no relation with the other part of the theory that we are talking about."

Alice: "Exactly. That's why I am not saying that *the* theory of relativity is wrong. I have questions about one part of it. But I don't question the whole theory."

Bob: "OK. Point taken."

Alice: "Back to the v in the gamma. I said that the v is the velocity of a point that only exists in our mind. and as such has no dimensions. Therefore we cannot conclude a maximum speed, or anything, for physical objects from the v in the gamma. Then you argued that this is not possible because the theory of relativity requires the v to be the velocity of a physical object. Am I correct?"

Bob: "Yes."

Alice: "And with that you deduced a necessary condition for the theory of relativity."

Bob: "Correct."

Alice: "So you have a necessary condition for your version of the theory of relativity. And if you want to stick to your theory of relativity then at least you have to prove that necessary condition. Agreed?"

Bob: "Agreed."

Alice: "So, can you prove that, by nature of the equations, the v in the gamma in the Lorentz transformation is the velocity of a physical object?"

Bob: "Mmm. We always use the point mass in our equations. And a point has no dimensions."

Alice: "The point mass is a simplification of reality. And it has a mass and, when it moves, energy and impulse. So it has physical dimensions."

Bob: "Darn, you're right. However for the theory of relativity I have to say [....gives an eloquent monologue about particle physics, Maxwell equations, electromagnetism, spacetime, Minkowski spaces, cosmological constant, Big Bang theory, inflation etc ....] . See?"

Alice: "Impressive. And how does this prove that the v in the theory of relativity is, by nature of the Lorentz equations, the velocity of a physical object?"

Bob: "Well..."

Alice: "Exactly. So when someone start with criticism on some part of the theory of relativiy then usualy other people say they have to disprove the theory of relativity. And then they ignore the one with critisism. But in the end it is up to the one who adheres to the theory of relativity to prove that there are no flaws in the theory. And with what we discussed I think the physics community has something to talk about."

Bob: "I second that. And I need a drink!"

Analysis/Conclusion

In the above conversation person Bob reaches, by his own reasoning, a conclusion which he did not expect. He cannot prove the necessary condition for what he thinks to be the theory of relativity. This is food for thought and bring up questions. What can we really conclude from the v in the Lorentz transformation? And can we prove that the speed of light is the maximum in the universe without using that v? Is this related to uses of the theory of relativity and how?

To be clear: I don't claim that the whole theory of relativity is wrong. I also don't claim that I can prove that we can or cannot go faster than the speed of light.

Also this conversation shows that when one looks at measurements and relativity one can get many measurements and thus so-called 'confirmations' of the theory of relativity but at the same time can have a problem with with the v in the Lorentz transformation. So there is a risk of getting a false sense of having a theory proven because there are many confirmations of one aspect, while overlooking the fact that another aspect might be wrong.

Also the above shows that it is important that we always ask the question: Who needs to prove what and why?

The reader is invited to investigate these questions further.

Literature

Lugtigheid, H. (2019). *On the v and c in the Lorentz transformation and the absence of movement* Zenodo. *https://doi.org/10.5281/zenodo.8421046*