Against the realistic interpretation of the Theory of Relativity (and any other theory)

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Table of Contents

Abstract

The Theory of Relativity has been portrayed as a theory that redefined the way we look at the cosmos, enabling us to unlock the reality we live in. Its proponents are constantly reminding us of how Einstein managed to reveal the true nature of the universe with his groundbreaking theory, which has been proved multiple times until now. Yet, philosophy of science teaches us that no theory has any privileged connection with what we call reality per se. The role of science is to formulate models of the cosmos we see and not to try to interpret or reveal reality. This paper tries to show how this holds true even for the famous relativity theory, by showing specific objections to the connection of the theory with the Holy Grail of philosophers. By analyzing various subjects related to the theory, from the twins' paradox to the GPS satellites, this paper illustrates that relativity is much less connected to reality than what we would like to think. At the end, what Einstein's theory provides is nothing more than a way to formalize the interactions of the world but without being able to make any claims whatsoever regarding the 'reality' of its conclusions.

Tags: science; science philosophy, axioms, postulates; reality

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Goal of the paper

The goal of this paper is to show that the realistic interpretation of the Theory of Relativity is something wrong, the result of false axioms and principles. By analyzing why Einstein's famous theory cannot and should not be seen as something "physically true", what Harmonia Philosophica has been postulating for many years now will become even more obvious: Scientific theories are nothing but useful tools to create scientific models of the cosmos, but not methods to reach what philosophers call "truth".

Related articles

- Science modelling: Can scientific models ever be "wrong"? A not-so-evident answer…
- Science describes. Nothing more.

Overview

The Theory of Relativity (ToR) consists of the Special Relativity (SR or STR) and the General Relativity (GR). A general overview of the Theory of Relativity can be found easily in various sources [(1) (4) (5) (9)] and such a description is not the goal of this paper. What is the goal of this article is to show that the results of the ToR – which are considered as true and verified – are not related to what philosophy calls 'reality' and that we should be very careful on taking them into account as a tool to understand the cosmos.

Einstein developed special and general relativity to accommodate the invariant speed of light, a consequence of Maxwell's equations, with the principle that only relative movement has physical consequences [(6)]. To formulate STR successfully, Einstein could not simply propose a new set of physical laws within the existing classical framework of ideas about space and time: he had to simultaneously reformulate the representation of space and time. He did this primarily by reformulating the rules for assigning coordinate systems for space and time. He gave a new system of rules suited to the new physical principles of STR, and reexamined the validity of the old rules of classical physics within this new system [(2)].

There are many asterisks though to that simplified description of the theory; asterisks which make the use of the SR and the GR highly questionable – from a philosophical but also a practical point of view – in the actual world. These limitations are mainly related to the axioms used to build the theory in the first place (Theory of Relativity postulates) and how we tend to forget that these axioms are by definition not provable.

1. Postulates and the infamous 'Speed limit'…

Two are the postulates of the Theory of Relativity [9]:

- The laws of physics are the same in all inertial frames of reference.
- As measured in any inertial frame of reference, light is always propagated in empty space with a definite velocity c that is independent of the state of motion of the emitting body.

According to the second postulate, the speed of light is invariant of the frame of reference. That statement has consequences [4].

The first consequence is that there are no "observer reference frames" that travel at this speed. An observer is always at rest with respect to himself. But if he were to travel at the invariant speed in some reference frames, he would travel at that speed in all reference frames… including his own. That's a contradiction; hence the assumption that such observers exist must be discarded [4].

The second consequence is that there is no continuous velocity transformation (Lorentz transformation) that takes a slower-than-the-invariant-speed reference frame to a faster-than-the-invariant-speed reference frame. Which means that it is not possible to achieve speeds faster than the vacuum speed of light; nor would an observer, traveling at those speeds, have a rest frame (i.e., no such observers exist) [4].

The above result in two very important conclusions:

- Length contraction and
- Time dilation

In simple words, this means that the faster someone/ something moves the smaller it looks and at the same time, time seems to pass over slower than someone who stands still.

1.1 The problem of scientism: Easily forgetting axioms…

The conclusions mentioned in the previous section (regarding length contraction and time dilation) have been extensively used in scientific literature to explain how the reality we experience is in essence relative, with the light playing a crucial role in how the perceived reality is transformed based on the speed of the reference systems.

As already mentioned in the beginning of this paper, these conclusions are highly debatable. The problem lies not with the theory per se, but with the tendency people today have to view theories as valid representations of reality – thus forgetting some of the major inherent limitations of scientific theories in general.

These limitations are related to the fact that every scientific theory has to start from somewhere. This is usually a set of axioms – propositions which are taken for granted as 'true'

and on which the theory is then built upon. The axioms (a.k.a. propositions, principles or postulates in the case of the Theory of Relativity) and by definition not proved.

This is not a problem on its own. To be fair (and scientific) they are absolutely necessary to start creating theories. Philosophically speaking there is no way to be 100% certain for anything (literally), so waiting to be certain for anything to start building theories would mean that we would never have theories at all.

The problem – as Harmonia Philosophica has stated many times in the past decade – lies with the tendency we have to forget that we even use axioms! And this is strongly related to the second problem in today's era: that we forget that axioms can be easily replaced by other – again not proved – axioms!

The two postulates (axioms) of the Theory of Relativity can be taken for granted and, thus, prove all the above-mentioned conclusions regarding time and length and reference systems. However, one can discard those axioms and result in a wholly different theory! That fact on its own provide a strong counter-argument against those who claim that we should take the ToR as an actual 'fact' (a known postulate of believers of scientism today is that science describes 'facts', which implies a deep misunderstanding on the true process of how scientific theories are created).

1.2 Method of research and goals

The next chapters focus of describing not only the main axioms but also other – usually 'hidden' from the main picture drawn – principles used by the theory of Einstein. These unproven principles (axioms, postulates) will be supplemented by paradoxes which will show to the reader that the Theory of Relativity is nothing more than a proven scientific theory. Nothing more. Nothing less. And most importantly: A theory which has nothing to do with reality per se.

This is something which is true for any scientific theory and it would not strike as a surprise to any of the loyal readers of Harmonia Philosophica. To be honest, anyone with a relatively basic grasp of the philosophy of science understands that scientific theories are nothing more than ways to create scientific models to describe what we see. The same thing could be described in an equally valid way with a different theory in the future.

This paper focuses on a more detailed description of the limitations of the SR and the GR, however what is mentioned here can easily be applied to any other sector of scientific thinking.

2. The light foundations: Maxwell's equations

Maxwell equations [6] [7] show that the speed of light is invariant of the speed of the observer.

However, there are many assumptions underlying the use of Maxwell's equation to prove the invariance of the speed of light in all frames of reference [11].

But how do you prove the invariance of the speed of light? Maxwell's equations suggest it is constant because you can write them as the wave equation, but how do you prove c is invariant under all frames of reference mathematically? The answer is that from Maxwell's equations, you cannot do such a thing. You cannot prove the invariance of the speed of light in all frames of reference [11].

This is because that these equations were first thought to be true only in the frame where the ether was at rest. In any other frame, there would be effects from the ether wind [12].

In summary, Maxwell's equations did not imply that the speed of light is invariant in any reference system. To have this postulate and use it, an experiment was needed…

2.1 The M-M experiment

The Michelson-Morley experiment (M-M experiment) showed the speed of light is constant [27]. Special relativity was developed to explain how that could be. The Theory of Relativity was essentially built on the results of that experiment and from that it was able to deduce all those astonishing conclusions we already mentioned.

That's an experiment though. And even though it is historically correct to say this this is how the upper bound of velocity was confirmed, a theoretical answer that incorporates the experiment as well is something that eludes science [12]. Again, with the fear of being boring and repetitive, we must note that the fact that something is used as an axiom (postulate) is a clear indication that it cannot be proved with the tools of the theory.

There are also many ways to interpret the experiment, even by still invoking the old and 'obsolete' idea of the ether[1]. This – regardless of the details – only reminds us of the things we forget and which were mentioned above: the axioms can be easily replaced by others and still have a self-consistent explanation of what we see. There are many who also note that the experiment did not show that there is an upper limit in velocities in the universe, but that the upper limit of the speed of light was postulated so that the null result of the experiment could be explained [12].

Similarly to a dog chasing its own tail, we are again in an everlasting vicious circle which cannot break unless we question what we take for granted. Is the upper limit of the speed of light explaining the M-M experiment? Is the experiment the basis for postulating the upper limit of

[1] It is also important to note that theories that interpret the cosmos based on the premise of ether (much like the one championed by Lorentz) cannot be proved wrong by the experiments conducted to verify the Theory of Relativity – all those theories adhere to the experimental data equally well [36].

the speed of light? (Are all laws similar in all reference systems? Is the universe isotropic? Questions which are highly interesting also in relation to other related areas of research also infested with axioms)

Let us see in more detail some of the problems between the 'actors' of the play we are watching…

Notes on M-M experiment

Some important notes on the M-M experiment are documented in this section. These must be viewed in conjunction with the notes mentioned above.

1. What is important here is not to prove or disprove the M-M experiment. There are many scientists who tried to do that and a lot of debate on the subject has been documented. The point which is important here is the way an experiment was used as the axiomatic basis of a theory and the limitations of that (and any other) theory regarding the interpretation of reality.

2. Just for completeness purposes we must note than not even Morley was not convinced of his own results. He subsequently performed more experiments which detected ether drag [(28)]. Other experiments did not detect such drag though. There are many scientists though who claim that the experiment would never be able to detect anything since ether is dragged along with Earth as it moves in space [(29)] [(30)]. Although there are claims that some other phenomena (aberration of star light, Fizeau exp, Sagnac effect etc) disproved the possibility of Ether drag, the truth is that there are ether-compatible explanations for all these phenomena [(31)] [(32)], at a point where ToR-proponents try to explicitly state that there are also ToR-compatible explanations of these phenomena [(33)]. This is another interesting part which any undergraduate student of science philosophy knows however: any theory can be made to fit any experimental data. But explaining this would exceed the purpose of this paper. To the above I would add the following quite interesting note: The M-M experiment's null result could also be explained by the Earth standing still. After the famous Michelson-Morley experiment of 1887, one of Albert Einstein's biographers, Ronald W. Clark, describes what came next: "The problem which now faced science was considerable. For there seemed to be only three alternatives. The first was that the Earth was standing still, which meant scuttling the whole Copernican theory and was unthinkable" [(34)]. For more on how the geo-centric model is an equally (or more) valid model for the solar system (along with any other –centric model) read "Earth at the center of the universe?" article or my paper "From Galileo to Hubble: Copernican principle as a philosophical dogma defining modern astronomy". Again, such a discussion is outside the scope of this paper. For the analysis at hand we take for granted that anything related to the orthodox reading of the Theory of Relativity is valid, since we only care about the philosophical interpretation of that theory and not its proof.

2.2 Maxwell's equations vs. M-M experiment

The problem scientists had at hand was the inconsistency between Maxwell's equations and the M-M experiment with the Galileo transformations.

Before Einstein scientists believed that there had to be a medium for light to propagate: Ether [(1)] (for some people, Einstein did not refute that. He just changed its name to 'space').

Since the Maxwell's equations did not agree with the results of the M-M experiment, something had to change. And the dices were rolled to change the Maxwell's equations. To infer the invariance of the speed of light we postulate (i.e. take for granted as an axiom) the validity of Maxwell's equations in all inertial frames. This is related to the postulates of ToR and this is the reason why the invariance of the speed of light must be added as a separate postulate [(9)]. One can also see this through the looking glass: The invariance of the speed of light is a postulate [(9)] mainly because it holds the belief that Maxwell's equations are physical laws. Again, the result is the same.

At the end, in Einstein's special theory of relativity, the constancy of the speed of light in all reference frames was assumed as a principle based on the results of the famous Michelson - Morley experiment and not based on any theoretical construct. (Interesting note: Maxwell's equations result in invariant speed of light only if the 1st postulate of Einstein is valid. Could this postulate be wrong?!)

2.3 Lorenz transformations vs. M-M experiment

Lorenz transformations are the key [(14)] [(15)] for the Theory of Relativity. And these are the transformations used to calculate the length contraction or the time dilation. What most people do not know though is that the Lorenz transformation was yet another victim of the M-M experiment.

The γ factor [(15)] was put in afterwards to account for the M-M experiment, so as to make the Maxwell equations invariant as they "should" be (!) [(16)] It was the Michelson-Morley experiment that forced Lorentz to introduce an extra hypothesis that, for all practical purposes, made the Maxwell equations correct in any frame [(12)].

The crude way of adding axioms should not be a surprise to anyone. This is the way axioms are set. What should surprise though is the easiness with which basic principles of science are replaced or discarded (more on that below). An easiness which could trigger immediate thoughts on replacing the principles of the Theory of Relativity as well, unless we infer that this theory is some kind of a 'holy monster' which cannot be touched on the pain of (scientific) death…

As the 'victims' of the theories pile up, it is important to see what is the result after all. Is the new theory resulting in a more consistent view of the cosmos or are the problems generated more than the solutions offered?

3. Paradoxes by accepting the illusion as real

The way we see the cosmos through the eyes of the Theory of Relativity results in many conclusions which contradict our common sense for the cosmos. These contradictions are also

related to paradoxes which – along with the comments mentioned above regarding axioms and the nature of scientific theories – pave the way towards the questioning of the relation of the ToR with reality.

The problem with ToR lies in its inability to answer simple questions that kids would ask. Asking those questions is usually forbidden in the academic environment – doing so simply shows how little you understand of the subject and you are treated with contempt if not with laughter. And yet, as a wise man once said, a theory is as good as it can be explained to a small child in simple terms. The proponents of relativity use to parrot the same things over and over again, basing their arguments on the 'obvious' or on the genius of Einstein – if he thought of relativity who are you to question it? Still, it is those simple questions which usually put grand theories to the ground.

Let us make some of those questions…

Regarding time dilation, the results of the theory seem valid until someone starts questioning the basics: Who is moving?

This phenomenally simple question could be really hard to answer – especially in the relativistic cosmos. Am I running away from you? Or are you running away from me? In the infamous twins' paradox, who of the two twins is travelling nearly as fast as light? The answer is that there is no way to determine who is moving. Time dilates for me or for you, depending on the choice of reference system. Could all this be an optical illusion? [(25)]

Note that for the twins' paradox the easy explanation proposed by almost all textbooks is that the twin travelling away from Earth at some point experiences an acceleration to change course back to his home planet; an acceleration that the twin on the Earth does not experience. This makes it obvious – at least for most people – that this is the twin travelling fast. But again this is an easy way out for a problem with specific conditions and does not say anything regarding the essence of the problem: The paradox begins at the point when the first twin launches his rocket from Earth long before this acceleration is experienced. Are we to assume that 'reality' waits for the acceleration to 'decide' what will happen with time for that twin? And if the twin decides never to return to Earth? What will then happen and how will the problem of who is moving be solved? And even if we consider that there could be a way to determine who moves (which there isn't), there is still a deep misunderstanding on the result of the trip. Kirsten Hacker, PhD Accelerator Physics, University of Hamburg (2010) made it clear that depending on how the deceleration is treated, the twin paradox will have a different result in general and special relativity [(35)]. And she also pointed out that the moment the travelling twin lands back on Earth he will experience a deceleration which will make his clock be synchronized with his brother's, so at the end there will be no difference in the time experienced by the two twins. In essence, she explains rather eloquently, is it like when you try to catch a bowling ball falling from a great height. At the moment you catch the ball, you will experience as if it has greater weight than it actually has, but a moment later things will balance and you will experience its real weight.

The proponents of the Theory of Relativity claim that the above are not an issue at all: time dilates for the moving observer when I am standing still, or for me if you see the picture from the eyes of the moving observer (who is standing still at his own reference system).

Well, this may be fine but for a philosopher this would mean that this theory has no relation whatsoever with reality. Remember that what is discussed here is not the scientific validity of the Theory of Relativity (i.e. its ability to provide a concise model of the cosmos based on specific unproved assumptions), but the relationship of the theory with reality.

It can also be shown that SR breaks down because there is a clear disconnect between its axiomatic concept of length contraction, which is in contradiction with Maxwell's first equation, that mandates that if distances are shortened within a macroscopic body, then the energy of the atoms of which it is made of will be increased, which is something that SR is unable to account for [(23)].

It can also be easily shown that if we accept length contraction, then there are violations of basic physical laws only based on the movement on the observer.

Supposing that we observe a box where a gas is in that box in equilibrium. The length of the box contracts when the box appears moving (note that the word ‘appears’ is very often used in books or papers related to the Theory of Relativity, in a clever way to discard the difficult discussions on the actual relationship between the theory and the reality). If the contraction of the box was considered real, then this has some odd consequences. First, a pressure and/or a temperature gradient across the walls of the box would build up in an observer-dependent way, as a Gas Laws-required effect of the volume change. Such "creation" of a pressure and/or temperature gradient would be a clear violation of the law of energy conservation. Second, the contraction of the box results in a shift from thermodynamic equilibrium to disequilibrium, which is a clear violation of the principle of relativity, one of the postulates leading to Einstein's theory. Taking all these together, the STR if its outcomes are considered real is in definite conflict with the Gas Laws, which again supports the view that its consequences should not be considered real, but some kinds of optical illusion [(25)].

Last but not least, why does it matter what happens with light after all? Even if we assume that what Einstein says about the properties of light and electromagnetic radiation in general, why would that have any impact on other things? This is a question usually disregarded by most. All the examples used by the proponents of the reality of ToR are related to clocks using light pulses to measure time. So? What if we use clocks using mechanical mechanisms to count time? What about our biological internal clock? Why should that be affected by anything relativity has to say? Frank Shu, is one of the few noting down this problem in his book ‘Astrophysics’ [(37)]. The answer he gives though is not at all satisfactory. To bypass the problem he simply states that scientists believe that the implications of the theory for light will also affect everything else we experience because in some mysterious ways not yet revealed they are also related or affected by electromagnetic radiation. Not so much of an explanation for a theory which we are told that re-defined the cosmos is it?

4. Proof that is not proof

There are many people who claim that the Theory of Relativity and – most importantly – its weird consequences are 'proved'.

A review of the basics regarding science philosophy is needed once more. A scientific theory might be very well mathematically and theoretically proved, but yet not supported by experiments. This is clearly evident in the case of ToR which for many years was the subject of attempts to 'prove' it even after Einstein had 'proved' it. This is also valid the other way around: A theory could be proved by experiment but not yet proved with theoretical means (see for example the M-M experiment which has not yet a theoretical explanation, or the theory of quantum mechanics which has currently a dozen potential interpretations). All of the above imply the same message: A theory is a theory and it has nothing to do with reality (supposing that the latter is represented by the experiment).

In the Theory of Relativity there exist many proofs of the theory which fall on the experiment-side, which are not so much proofs as they seem to be.

For example, the behaviors of clocks in Hefele-Keating experiment interpreted as the results of relativistic time dilation caused by the relative speed of an inertial reference frame are actually absolute and do not change with the change of inertial reference frames; the corrected calculation of Fizeau experiment based on Newton's velocity addition formula is much closer to the experimental measurement than the result calculated based on the relativistic velocity addition formula. In fact, Hefele-Keating experiment indicates the existence of a medium in the space that can slow down the frequencies of atomic clocks when they have velocities relative to the medium, and Fizeau experiment reveals the existence of a medium called aether relative to which the speed of light is constant, though it is possible that the medium to slow down atomic clocks may be different from aether as multiple media may coexist in the space [(22)].

The GPS satellites and their infamous re-calibration based on the ToR is another example. If the Theory of Relativity does not have a relation to reality, why do the GPS satellites work while being using the STR predictions? They could not be working well based on those, the proponents of the realistic interpretation of the theory claim.

We may think this is the case [(17)], but US Naval Observatory (the creators of GPS to replace LORAN) say that GPS does NOT use relativity calculations at all (repeat, it does NOT use relativity calculations)! OCS is anyway connected with the satellites to measure time [(19)].

And even if you don't account for general relativity (by slowing down the clocks prior to launch) your GPS would work just fine because the error is the same for all satellites [(18)].

So if we are to use the GPS satellites as a proof, they could be proof for ether as easily as being a proof of the Theory of Relativity. What they surely are not, is the connection between relativity and reality…

Conclusion

When Tesla was asked his opinion about the Theory of Relativity, he said…

“Einstein's relativity work is a magnificent mathematical garb which fascinates, dazzles and makes people blind to the underlying errors. The theory is like a beggar clothed in purple whom ignorant people take for a king... its exponents are brilliant men but they are metaphysicists rather than scientists.” [(26)]

Many believe that Nikola Tesla was suffering from dementia when he made this statement. This may be so. But it may be not. What is important is that Tesla said what many think but are afraid to claim publicly: Theories are just theories. Based on axioms, which are by definition not proved. So how does a statement as the above sound absurd, but the statement of people today that the Theory of Relativity is ‘proved’ sound logical and scientific?

Do not take this article as an irrational case against the validity of the Theory of Relativity. The theory (and any other theory) can well stand as a scientific theory (this is a tautology actually) and still have no physical meaning whatsoever. You do not need to go far to see that this is so obviously true that it starts to be scary. Think of the negative numbers for example: they are used in every mathematical operation and equation and yet, if you try to find -2 oranges somewhere in nature you will not be able to do so!

We must think of theories as useful (yet, very limited) tools to interpret the cosmos, but not as the cosmos itself. Only then will we become true scientists: People who like to analyze the cosmos so as to understand it, but who also keep an open mind so as to acknowledge the limitations of the methods they use. In the near future the Theory of Relativity will be replaced by another different theory. This is the fate of all theories. And yet, the cosmos will still be the same...

And while we try to measure the speed of light from Earth…

The cosmos will laugh at us from above…

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