Special Relativity: Scientific or Philosophical Theory?

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Abstract: In this article, we argue that the theory of special relativity, as formulated by Einstein, is a philosophical rather than a scientific theory. What is scientific and experimentally supported is the formalism of the relativistic mechanics embedded in the Lorentz transformations and their direct mathematical, experimental and observational consequences. This is in parallel with the quantum mechanics where the scientific content and experimental support of this branch of physics is embedded in the formalism of quantum mechanics and not in its philosophical interpretations such as the Copenhagen school or the parallel worlds explanations. Einstein theory of special relativity gets unduly credit from the success of the relativistic mechanics of Lorentz transformations. Hence, all the postulates and consequences of Einstein interpretation which have no direct experimental or observational support should be reexamined and the relativistic mechanics of Lorentz transformations should be treated in education, academia and research in a similar fashion to that of quantum mechanics.

Keywords: Special relativity, Einstein theory, Lorentz transformations, relativistic mechanics.

1 Introduction

As it is well-known, the crisis related to a number of critical physical issues such as the speed of light in free space, the existence of a luminiferous medium, and the failure of the Maxwell equations to be form invariant under the Galilean transformations have motivated the research in the end of the nineteenth century to find a solution that can address all these inconsistencies and difficulties. Several renowned physicists of that time, such as Lorentz and Poincare, suggested scientific solutions and philosophical interpretations to address these issues. The most prominent of these attempts is the proposal of Lorentz who suggested certain mathematical transformations of space coordinates and time that seemed to provide a reasonable solution to most of those difficulties.

In his attempt to provide a logical interpretation of the Lorentz transformations while building on the attempts of his predecessors, Einstein [1] adopted the two famous postulates of special relativity which are the constancy of the speed of light in free space for all inertial observers and the covariance of the physical laws in inertial frames of reference. He then derived the Lorentz transformations from these postulates and extracted a number of consequences and interpretations. Apart from the formalism of the Lorentz transformations and their direct mathematical consequences, such as the transformations of velocity and other physical quantities, Einstein attempt was shrouded by a number of assumptions and conclusions which are either of philosophical nature or have no direct experimental evidence. The whole package of formalism and his interpretation and attachments was then marketed as the theory of special relativity which, with time, gathered momentum thanks to the gradual support from experiments and observations and the endorsement of renowned scientists of that time and hence it gained general acceptance by the main stream science.

Special relativity of Einstein contains three main elements:

(A) The formalism of Lorentz transformations and their direct mathematical consequences.

(B) Philosophical issues which are beyond the reach of science and scientific research such as the abolishment of absolute space and time.[1]

(C) Scientific issues which are not verified directly by experiment or observation such as the constancy of the speed of light in free space for all inertial observers and being the ultimate physical speed in Nature.

Since the theory of special relativity was accepted as a whole, all these three categories were accepted as scientific products; moreover any evidence supporting the relativistic mechanics of Lorentz transformations was regarded as evidence for the whole package and hence several philosophical premises and scientific issues which have no direct experimental support have enjoyed general acceptance thanks to the experimental and observational support for the formalism of Lorentz transformations. In addition to all that, the theory of special relativity is treated by many as the only viable theory and hence the quest for an alternative theory that can be as good as special relativity or even better has been stopped and even suppressed as if this theory is the ultimate truth and the only feasible so-

[1]It is difficult to give a universally-accepted definition of scientific and philosophical premises and the difference between them. However, in this respect we adopt a simple definition to distinguish between the two, that is a scientific premise is an idea that can be verified by direct experimental and observational evidence while a philosophical premise cannot as it has some non-experimentally-verifiable content. We should also point out that even some premises and theories which are scientific by nature may not be qualified as such if there is no unquestionable evidence in their support.

lution. Different philosophical and scientific interpretations of the Lorentz transformations which were circulating in the early days of the above-described historical developments also ceased to be considered or developed further with the opposition of any attempt to develop new interpretations to rationalize the formalism of relativistic mechanics of Lorentz transformations or provide an alternative formalism, interpretation and rationalization altogether.

At about the same time and in parallel to the development of the relativistic mechanics, the quantum mechanics was also under development. Similar to the relativistic mechanics, the quantum mechanics was made of two main parts:[2] a formal mathematical part and a philosophical interpretive part where these two parts were developing side by side. While the quantum mechanics kept the separation between these two parts and have generally considered the experimental and observational evidence as support to the formalism only and not to any particular interpretation, the relativistic mechanics did not develop in this way and hence the two parts were mixed in a single entity in the form of special relativity thanks to the dominance of Einstein reputation and his many supporters, as indicated above.

2 Examples of Challenges to Special Relativity

Special relativity of Einstein has been challenged by many scientists and philosophers in the early years of its release. Nowadays, there are still challengers and opponents to special relativity but this opposition is less fierce and sometimes it is shy and hidden due to the coordinated and well organized efforts to suppress any opposition. We believe that not all criticisms and concerns about the logical foundations and scientific premises of special relativity have been addressed properly. This does not mean that we endorse these criticisms and concerns, but we think these should have been and must be addressed properly. A few examples of these legitimate criticisms and concerns are:

(A) The twin paradox where different conflicting answers have been given to address this paradox such as calling for general relativity or explaining the difference by the acceleration and deceleration of the traveling twin. Most of these answers are arbitrary, superficial and lack depth and content. We are not here to discuss and analyze these answers so we refer the reader to the vast literature about this paradox hoping we may come back to this matter in the future. However, even if we accepted all the answers provided to address

[2]For the sake of simplicity in presentation, we can classify the above (C) category as philosophical although the issues in this category are scientific by nature.

the original version of the twin paradox, no convincing answer has been given to some of the revised versions of this paradox. In particular, we should mention Dingle discussion [2] of this issue among other issues and the rejection which he faced.

(B) The claims made by a number of scientists about the variation of the speed of light or exceeding this speed (i.e. the value $c \simeq 3 \times 10^8$ m/s) in some astronomical observations and experimental proceedings where this speed is supposed to be the ultimate speed for any physical movement according to special relativity. In particular, we refer to several claims from respected scientists questioning the constancy of the speed of light and also to the recent experiment in the Large Hadron Collider (LHC) where the initial claim of exceeding the speed of light vanished suspiciously by a mysterious technical fault in the electronics and connections.

We repeat that this is just a sample of the logical and scientific inconsistencies and controversies which have been or can be claimed to be contained in special relativity. As we indicated above, it is not necessary that we agree on the validity of these criticisms; what these criticisms highlight is that the philosophical and logical foundations and interpretations and some scientific attachments of the relativistic mechanics of Lorentz transformations as embedded in special relativity require reexamination since there are challenges and claims which are not addressed properly, and from what we are aware of most of these rejections are based directly or indirectly on the experimental and observational support which the relativistic mechanics has enjoyed where this support, in our view, can be used as evidence for the formalism of the relativistic mechanics of Lorentz transformations but not for Einstein interpretations and attachments.

3 Importance of Philosophical Interpretations of Scientific Theories

Although there may be a general tendency to restrict science to its experimental and observational domain and separate it from any association with philosophical issues, the reality is that no science is completely free from such philosophical issues at least at the level of postulates and primary premises which the science rests upon especially for the theoretically-oriented natural sciences. Moreover, the philosophical ideas and interpretations which are embedded in science usually provide an insight in the formalism and why Nature behaves in a certain way by trying to rationalize its behavior. After all, science is an attempt to understand the physical world and make sense of it, and this may explain

why science does not stop at the formal rules and mathematical formalism even if these work perfectly but it tries to provide explanatory statements of descriptive and qualitative nature to make sense and rationalize the rules and formalism. Adding to all this, the philosophical ideas, which may stay in the background of the scientific theory, provide an incentive and steering force which points to the direction that should be followed in the future development and hence they act like a dynamo and compass for scientific research. Therefore, the importance of the philosophical component of any scientific theory should not be underestimated where this underestimation can lead to a rejection of the call for reexamination of certain philosophical issues justifying this by an excuse that as long as the formalism is working we can keep the philosophical framework of the theory even if it is controversial or imperfect or even wrong.

4 Philosophical Issues

As indicated above, and apart from the unverified scientific elements, special relativity contains philosophical elements which are beyond the realm of science and hence these issues should be clearly distinguished from the formalism of relativistic mechanics and should be deprived from the automatic endorsement which they enjoyed so far from any real or alleged success of the relativistic mechanics. A prominent example of these issues is the claim that special relativity has abolished absolute space and time forever. Views which sound like "Einstein changed our understanding of the world forever by abolishing Newtonian space and time" are very common in the literature of special relativity. Apart from being implicit statements of reaching the final truth, no one can abolish such fundamental and valuable ideas like absolute space and absolute time, neither Einstein nor anybody else. Assuming that these fundamental concepts are not built into the roots and fabric of our intellectual structure and mental blueprint like the basic rules of logic, they are at least very useful conceptual tools which have been and will remain available and useful for building philosophical and scientific theories that can provide better understanding and superior physical and conceptual adaptation to the outside world. If Einstein chose to abolish these concepts from his view of the world, as represented by his theory, he is free to do so, but neither he nor anybody else can abolish these fundamental ideas from the view of the world of other thinkers or deprive them from the legitimacy to exist and be used in science or philosophy or any other discipline if they are found to be useful, convenient and illuminating.

As an indication to how fundamental these concepts are and as a sign to the failure of this alleged abolishment, there are many places in special relativity where one feels that these concepts are still there, at least in the background, and they are still needed to present, formulate and visualize the settings of special relativity itself and its physical environment despite the apparent denial of their existence. This will be automatically rejected, as usual, explaining this by our habits, cultural heritage and likewise but, apart from the fact that all these excuses can be challenged, this is just another indication of how fundamental these concepts are when they propagate even to our habits and cultural heritage. Anyway, any answer to this concern will certainly fail to put an end to these controversies; what is important of all these is that Einstein philosophical views are not final or universal and they could be and should be challenged at least for the sake of motivating further progress in science and human thinking in general.

5 Comparison between Relativistic Mechanics and Quantum Mechanics

Returning to the above comparison between the development of relativistic mechanics and quantum mechanics, despite the fact that Lorentz transformations have been interpreted differently, at least in the early days of relativistic mechanics, or can in principle be interpreted so, we see the dominance of Einstein interpretation. As a consequence, Einstein views of relativistic mechanics are presented in academia and education and employed in scientific research as the sole interpretation of the Lorentz transformations. The theory of Einstein contains several philosophical issues and scientific aspects which cannot be proved or have not been proved directly by experiment or observation. The total acceptance and complete adoption of Einstein views made the relativistic mechanics the mechanics of Einstein theory as if it is the only possible interpretation and made all the philosophical and scientific issues, whether they can be proved or not or have been proved or not, scientific facts which automatically get credit and support from any genuine or alleged success of the relativistic mechanics of Lorentz transformations.

Unlike relativistic mechanics, quantum mechanics is presented and adopted in its bare formalism as the scientific theory while its different interpretations are appended as possible explanations to rationalize the stated formalism. We believe that, for the sake of equality and scientific impartiality, if not for any other reason, relativistic mechanics should be treated like quantum mechanics, and hence relativistic mechanics should be presented in

a more formal and scientific fashion through its bare formalism which can then be followed by Einstein interpretation and his attachments, or any other interpretation and attachment, if this is needed at all.

6 Relativistic Mechanics in Education, Academia and Research

Regarding the presentation and treatment of relativistic mechanics and special relativity in education, academia and scientific research we have a number of points:
(A) We call for a total revision of the structure of relativistic mechanics so that it is presented and treated like quantum mechanics, that is the bare formalism of the relativistic mechanics should be stated as the real scientific theory, while any philosophical or logical interpretation (prior or post) should be appended, if necessary, and labeled as such. Einstein interpretation should then be treated like any other interpretation where the audience will have the freedom to choose and embrace any interpretation if they decided to do so or even to develop their own interpretation. This will not affect the efficiency and productivity of the educational, academic and scientific process; in contrast it should improve understanding and creativity. Quantum mechanics is certainly more subtle and difficult to understand and harder to make sense of than special relativity; however, there is no known failure in education, academia or research due to lack of foresight. Anyone can learn and apply the rules of quantum mechanics with no difficulties even if he is not aware at all of any interpretation or school of thought to rationalize these rules. A major advantage for adopting the formalism of relativistic mechanics of Lorentz transformations instead of special relativity is that the possibilities will be open for investigations in directions forbidden by special relativity such as the possibility of considering speeds exceeding the speed of light, at least in some theoretical speculations, to prevent blocking possible venues for scientific progress. The fanatic adoption of special relativity which includes some questionable taboos may hinder the scientific progress in some aspects and directions of research.
(B) We also call for abandoning the personalized presentation of Einstein and his views in education, academia and research and the deliberate and non-deliberate endorsement not only of his views but also of his personal credential. We call for abandoning these types of exaggeration which is shrouded with mystic affection and religious devotion. This type of presentation may seem enthusiastic, entertaining and motivating but it certainly leads

to worshiping of individuals, killing the spirit of creativity and giving a wrong message that certain individuals are super-human and certain theories are final and cannot be challenged or replaced. This sort of presentation, which is very common in the circulating literature about Einstein and his theories, is not only against the spirit of science and a divergence towards a religious-like loyalty and devotion but it also inflicts costly damage to the educational, academic and scientific process.

(C) There are many instances where the challenge to special relativity, and Einstein views in general, is depicted implicitly or explicitly as motivated by personal grudge or envy to Einstein and his legacy or a conspiracy to defame him and devalue his legacy. Although there may be historical reasons to believe that some of the early opposition to Einstein views was motivated by such factors, the contemporary opposition is generally different in motives and objectives. It should be understood that challenging Einstein is like challenging any other scientist and the majority of opponents these days are not motivated by hate or jealousy or any other emotion or conspiracy, but different people have different views and something that looks obvious and correct to an individual can look absurd and wrong to another. This sort of personalizing the debates and challenges, which takes special importance in the debates related to special relativity, should be stopped and any opposition to this theory or any other theory should be dealt with scientifically and professionally without involving any kind of accusation or demoralization which are professionally and morally wrong.

(D) There are many direct and indirect suggestions in the literature of special relativity that "understanding" (which usually means accepting) special relativity is an intelligence test. In fact special relativity is one of the simplest theories in physics, all is needed to understand this theory is a modest imagination with a little arithmetic and basic algebra plus the Pythagoras theorem; all of these are taught at the final years of primary schools or the first years of secondary schools. If one can understand statistical mechanics and quantum mechanics he should be able to understand special relativity. What some people find difficult to "understand" (or rather digest) about special relativity is the consistency of its logical and philosophical structure as these people feel there are potential inconsistencies in this theory, and that is why they fail to "understand". Anyway, no theory should be put on the list of IQ test and hence these attempts to degrade any opposition or questioning of the validity of special relativity should disappear from education, academia and scientific research. In particular, labeling these attempts as "crackpot" which is common even in some respected scientific circles should stop at least for the sake of courtesy and politeness if not for the sake of free thinking and scientific spirit.

(E) Assuming that all the theories and views of Einstein are completely right, the search for alternative theories should never stop because our search for alternative theories should not be restricted to where we believe that our theories may be wrong or incomplete but even where we believe that our theories are totally perfect. Our search for the better, and even the equal, should continue not only for the purpose of enjoying the leisure of thinking and creating models and ideas but also for many practical reasons. What looks completely right today may not look so tomorrow. Having alternative theories will always make us richer and more comfortable in dealing with any future challenges whether theoretical or practical. In fact there are many examples in science and mathematics where we have more than one correct theory or method, one of which is better to use in one context while another is better in another context. So even if special relativity is completely correct in our view, a critical examination of relativistic mechanics and Einstein views and the search for alternative theories must continue. Of course this critical examination and search for alternatives should apply to all branches, theories and views in science and is not limited to relativistic mechanics and Einstein views.

7 Issues to be Reexamined

The following premises, which are largely regarded as direct or indirect implications and consequences of special relativity, should be considered as potential candidates for reexamination either because they are philosophical by nature, rather than scientific, or because they have no sufficient direct evidence from experiment and observation:
(a) The abolishment of absolute space and time.
(b) The abolishment of the independence of time from space.
(c) The relativity of simultaneity.
(d) The interpretation of time dilation effect, at least in some of its forms.
(e) The interpretation of length contraction effect, at least in some of its forms.
(f) The constancy of the speed of light in all inertial frames.
(g) The imposed limit of c as the ultimate speed for any physical object.
(h) The logical foundations of the theory and if it is self-consistent and consistent with the rules of logic in general or not.
The call for reexamination of these issues does not mean that the above issues are already classified; all we say is that these issues require reexamination so that any acceptance or rejection of one of these issues should be based either on a well established philosophical

and logical stance or on direct experimental or observational evidence. As stated above, some of the above issues, such as the abolishment of absolute space and time, are philosophical by nature and hence they are beyond the domain of scientific verification. Any theory has full right to adopt its own concepts, definitions, conventions and philosophical framework as long as it is self-consistent and does not lead to illogical consequences and absurdities or conflicts with experiment and observation.

8 Conclusions and Final Thoughts

We summarize the main issues discussed in the present article in the following bullet points:

• We call for a separation between the formalism of relativistic mechanics of Lorentz transformations from any unverifiable philosophical issues or unverified scientific attachments. We also call for thorough tests for the logical structure of special relativity to see if it is consistent or not as claimed by some.

• With regard to the abolishment of absolute space and time, apart from the above rejection of this alleged abolishment, there is no sensible meaning of this abolishment which is largely claimed by the followers of special relativity. Concepts like "absolute space" and "absolute time" are no more than conceptual tools that can be used in any physical or philosophical theory if they proved to be practically useful or can provide a better insight and sense of direction in our physical and conceptual adaptation to the physical world. In fact, denying these concepts and replacing them with alternative concepts like "relative space" and "relative time" is based on a more extreme belief in absoluteness and objectivity of the physical reality as depicted by our theories and our conceptual models than the ones that are supposed to be abolished. This feeling of "absolute relativity", which is based on a strong belief in the objectivity of the relativistic definition of space and time, should be replaced by a more modest stand about the reality of these relativistic concepts.

• Even if special relativity appears to us as the only viable interpretation of Lorentz transformations or the most endorsed interpretation by logic and science, the door should be kept open for potential interpretations that may emerge in the future at least out of respect of the spirit of science and for the sake of our continuous search for a better understanding to the world. The fanatic rejection of any examination of this theory will block any attempt to advance the science in this very important field of physics and remind us of the dogmatic embracement of Aristotle and his science and philosophy which resulted

in hindering the scientific progress and free thinking for many centuries.

• All attempts to degrade and demoralize critics of scientific theories should be stopped especially those attempts which violate the rules of courtesy and civility like labeling certain types of criticism as crackpot. No theory should be treated as the final word or embraced with the zeal of a religious belief.

• It should always be kept in mind that we did not reach, and will never reach, the ultimate "truth" neither in relativistic mechanics or in any other field of knowledge. We should not repeat the mistakes of our ancestors, who at many stages of history believed that they reached the ultimate truth and hence they kept consuming ideas and practices which proved to be imperfect, to say the least, and can be improved. Knowledge, and science in particular, is based on a continuous search for the "truth" and relentless attempts to improve our understanding and adaptation to the outside world. Even if the existing theories are completely correct, we should still keep searching for alternative theories and expand and improve the existing ones. A correct theory may be replaced by another correct theory which is simpler to understand and use for instance. We should not allow fundamentalist views to exist and flourish in science as long as we believe that science should keep growing and improving.

• The word "forever" should be removed from the vocabulary of science in general and relativistic mechanics in particular where this word occurs very often. There is no "forever" in science since it is a continuously developing and improving process. Science becomes forever only when it is dead and mummified. Some people seem to think that a day will come when science becomes complete and we have the final version of the "truth" and hence they are looking for that day where we all retire from doing science and all we do then is to keep consuming perfect theories and practices which were developed by our ancestors. This view, which sounds like a fundamentalist religious view, is against the law of evolution which is one of the most fundamental laws of Nature, at least from our current viewpoint. In fact even the constancy of the laws of Nature in time and space should not be taken as a well-established and undisputed fact. So, if Nature itself is potentially changing its rules in space and time then there will be no point in looking for the final version of these rules. Anyway, science is no more than conceptual models and not perfect imprints and reflections of the rules of Nature, therefore even if these rules are fixed spatially and temporally there is always space for modification, perfection and alternatives in our models and views of the world. There is an element of creativity in science which makes it a mix of objective impressions with subjective added values.

References

[1] A. Einstein. On the Electrodynamics of Moving Bodies. *Annalen der Physik*, 17:891, 1905.

[2] H. Dingle. *Science At the Crossroads.* Martin Brian & O'Keeffe, first edition, 1972.