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Einstein's Revision to Relativity

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Einstein declared in 1905 that the aether was superfluous, since then many relativists have treated the aether as not existing especially in the context of Special Relativity (SR). Then later in 1920 Einstein changed his mind and decided that the aether existed. He did not however go back and update his Special Relativity with this change of mind. Relativity with aether is different to Relativity without, as this article will explain, and Einstein's Relativity should have been updated to his 1920 change of mind. It means that the constancy of light speed has been misinterpreted and that it should be interpreted the same way as the constancy of sound waves (or any other waves) would be interpreted; namely as subject to the classical addition of velocity rule. This revelation has been obscured both by Einstein neglecting amendments to his theories when he changed his mind and by his bad writing style.

Einstein in his famous 1905 paper on Special Relativity (SR) starts declaring the two postulates upon which SR is based in the following sort of way [1]:

"…..Examples of this sort, together with the unsuccessful attempts to discover any motion of the earth relatively to the ``light medium," suggest that the phenomena of electrodynamics as well as of mechanics possess no properties corresponding to the idea of absolute rest. They suggest rather that, as has already been shown to the first order of small quantities, the same laws of electrodynamics and optics will be valid for all frames of reference for which the equations of mechanics hold good.[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."

Then based on that he says:

"The introduction of a ``luminiferous ether" will prove to be superfluous inasmuch as the view here to be developed will not require an ``absolutely stationary space" provided with special properties, nor assign a velocity-vector to a point of the empty space in which electromagnetic processes take place."

The first point is that Einstein might just have meant discard aether in the context of an "absolutely stationary space" but keep the idea of aether as a medium for light waves, but he declares the aether superfluous, and many relativists have taken this to mean – no aether.

So the second point is – Einstein writes very badly. If he meant discard aether as (1)"stationary frame" or as (2) medium or as (3) both it is not clear from his writings which of these three possibilities he really meant. These sort of feature of ambiguity and vagueness permeates Einstein's writings. It leads to the third point-

The third point being that the bad ambiguous writing style of Einstein means that Einstein can get subject to different interpretations; that means people read him and form different ideas as to what his theory means. i.e. his theory as he has left it is thus inconsistent, and that is hardly a basis upon which to form modern physics as we have done.

In 1920 Einstein states his change of mind on aether as follows, summarising what he has said in the lecture [2]:

"Recapitulating, we may say that according to the general theory of relativity space is endowed with physical qualities; in this sense, therefore, there exists an ether. According to the general theory of relativity space without ether is unthinkable; for in such space there not only would be no propagation of light, but also no possibility of existence for standards of space and time (measuring-rods and clocks), nor therefore any space-time intervals in the physical sense. But this ether may not be thought of as endowed with the quality characteristic of ponderable media, as consisting of parts which may be tracked through time. The idea of motion may not be applied to it."

Once again, Einstein is up to his usual standards of being unclear. He does not make clear whether this should be just in the context of the General Relativity (GR) that this should be made or not. Ideally he should have after deciding this gone back to SR and updated the theory with his idea of treating space as having the properties of an aether. He however appears not to have done that; presumably assuming that no change was needed. If that were the case then he was mistaken, because SR would then need amending/updating. For example in his 1920 book dealing with "The Apparent Incompatibility of the Law of Propagation of Light with the Principle of Relativity" that would particularly need changing. He proceeds first with the long preamble to lull the reader into the false sense of security that everything he is saying is obvious before delivering a flawed piece of reasoning [3]:

"THERE is hardly a simpler law in physics than that according to which light is propagated in empty space. Every child at school knows, or believes he knows, that this propagation takes place in straight lines with a velocity c = 300,000 km./sec. At all events we know with great exactness that this velocity is the same for all colours, because if this were not the case, the minimum of emission would not be observed simultaneously for different colours during the eclipse of a fixed star by its dark neighbour. By means of similar considerations based on observations of double stars, the Dutch astronomer De Sitter was also able to show that the velocity of propagation of light cannot depend on the velocity of motion of the body emitting the light. The assumption that this velocity of propagation is dependent on the direction "in space" is in itself improbable."

"In short, let us assume that the simple law of the constancy of the velocity of light c (in vacuum) is justifiably believed by the child at school. Who would imagine that

this simple law has plunged the conscientiously thoughtful physicist into the greatest intellectual difficulties? Let us consider how these difficulties arise."

"In short, let us assume that the simple law of the constancy of the velocity of light *c* (in vacuum) is justifiably believed by the child at school. Who would imagine that this simple law has plunged the conscientiously thoughtful physicist into the greatest intellectual difficulties? Let us consider how these difficulties arise."

"Of course we must refer the process of the propagation of light (and indeed every other process) to a rigid reference-body (co-ordinate system). As such a system let us again choose our embankment. We shall imagine the air above it to have been removed. If a ray of light be sent along the embankment, we see from the above that the tip of the ray will be transmitted with the velocity *c* relative to the embankment. Now let us suppose that our railway carriage is again travelling along the railway lines with the velocity *v,* and that its direction is the same as that of the ray of light, but its velocity of course much less. Let us inquire about the velocity of propagation of the ray of light relative to the carriage. It is obvious that we can here apply the consideration of the previous section, since the ray of light plays the part of the man walking along relatively to the carriage. The velocity w of the man relative to the embankment is here replaced by the velocity of light relative to the embankment. *w* is the required velocity of light with respect to the carriage, and we have w = c-v. The velocity of propagation of a ray of light relative to the carriage thus comes out smaller than *c."*

All of it is obvious up to here, the sensible answer is w = c-v as he says, and the idea of constancy of light speed does not appear to fit with that w = c-v as he says.

He continues:

"But this result comes into conflict with the principle of relativity set forth in Section V. For, like every other general law of nature, the law of the transmission of light *in vacuo* must, according to the principle of relativity, be the same for the railway carriage as reference-body as when the rails are the body of reference. But, from our above consideration, this would appear to be impossible. If every ray of light is propagated relative to the embankment with the velocity *c,* then for this reason it would appear that another law of propagation of light must necessarily hold with respect to the carriage—a result contradictory to the principle of relativity."

He says "principle of relativity", but what he means by that is his version of the principle with his assumption of light speed constancy, because pre-Einstein, the relativity theory exists as Galilean relativity. In section V he does little more than state that the existing maths does not conform to his version of the Principle of relativity. It's all to lull the reader to go along with what he is saying. He is giving explanation of the problem without giving any reasoned solution. And when he says: "-a result contradictory to the principle of relativity."— What he means is his version of the principle of relativity with its constancy of light speed; and that is correct- it is contradictory to his version of the principle but not contradictory to the existing Galilean principle of relativity. By not saying there are two versions of Relativity

principle he misappropriates it and gives the false impression that the Relativity principle is only his version of it. This is because he next says:

“In view of this dilemma there appears to be nothing else for it than to abandon either the principle of relativity or the simple law of the propagation of light *in vacuo.* “

This is where one groans. He now says the only two choices are his version of Relativity principle and his version of the propagation of light.

His version of Relativity principle includes light speed constancy.

His version of propagation of light in vacuo is that it is light speed constancy.

The existing pre-Einstein situation is—

Galilean Principle of Relativity with its no light speed constancy and propagation of light in vacuo with no light speed constancy.

Presumably what he is meaning is that either the existing principle of relativity (due to Galileo) is wrong or his assumption of light speed constancy is wrong.

But true to Einstein’s skill with ambiguity, he does not make that clear.

He continues:

“Those of you who have carefully followed the preceding discussion are almost sure to expect that we should retain the principle of relativity, which appeals so convincingly to the intellect because it is so natural and simple. The law of the propagation of light *in vacuo* would then have to be replaced by a more complicated law conformable to the principle of relativity.”

That is still his version of the principle of relativity he is talking about. So without any justification whatsoever he has thrusted his version of the Principle of relativity and his version of light propagation upon us.

He does however try to justify it from experiment:

“The development of theoretical physics shows, however, that we cannot pursue this course. The epoch-making theoretical investigations of H. A. Lorentz on the electrodynamical and optical phenomena connected with moving bodies show that experience in this domain leads conclusively to a theory of electromagnetic phenomena, of which the law of the constancy of the velocity of light *in vacuo* is a necessary consequence. Prominent theoretical physicists were therefore more inclined to reject the principle of relativity, in spite of the fact that no empirical data had been found which were contradictory to this principle.”

He is trying to back his theory up by Lorentz’s work, but Lorentz’s work is based upon Lorentz’s theory not Einstein’s theory i.e. it is not based upon the things that Einstein is theorising.

Einstein avoids giving reasoned justification for his theorising and he avoids giving explanation as to why Lorentz's experimental work should be interpreted by his theory instead of Lorentz's theory. (And of course – Essen [4] has revealed that there is no experimental evidence for SR, merely that experiments are being interpreted by the beliefs of SR. So such issues as Lorentz versus Einstein on theory would not have been addressed.)

Now we see what Einstein did was —to the lull the reader into a false sense of all of this is obvious followed by a leap to something contradictory with what was being said was obvious, and give no explanation as to why to make that leap. It staggers belief that the science community should swallow such tactics by Einstein.

Picking up again the w = c-v case:

"The velocity *w* of the man relative to the embankment is here replaced by the velocity of light relative to the embankment. *w* is the required velocity of light with respect to the carriage, and we have w = c-v. The velocity of propagation of a ray of light relative to the carriage thus comes out smaller than *c.*"

Based upon the 1905 idea that light is not in an aether then w might not be w = c-v, but treating light as travelling in an aether as per Einstein 1920, then light would be the same as any other wave travelling in a medium then w = c-v would apply.

So, by his 1920 revision – light waves like any other wave has the property of its speed being independent of the speed of its source in the frame of the source, but is still subject to the usual rule of adding velocity as described in classical mechanics. i.e. a sound wave in an aircraft moving faster than sound outside the aircraft still has sound in the aircraft moving at same speed relative to its source – that is the constancy of sound speed. The constancy of light speed with light wave the same as any other wave would then mean the same.

i.e. by treating light as a wave like any other wave by Einstein's revision of 1920 that light is a wave in a medium/aether (where space is that medium/aether) means that the constancy of light speed has been interpreted incorrectly, and classical velocity addition still applies.

One difficulty is that some people have trouble thinking of empty space moving; but again Einstein has changed things from the existing Newtonian physics; he has coordinate frames moving and he is tying them into the space. So there are observers with their different coordinate frames moving with respect to each other, and he is thinking of this as space moving. Ideally Einstein should have separated things-coordinate frame separate to the space it resides in. Similarly he should have separated field properties from space, instead of thinking field properties meshed in with space itself. So, when we cut through the confusion created by Einstein seeking to change everything, we are still back to the idea of light waves travelling in a medium- which Einstein was going back to in 1920. [*]

This sort of insight has been noted by several writers, for instance Simhony [5] and Stavinsky [6].

Simhony works from his version of aether theory which he calls epola, in his summary he says:

"We dismiss the postulated universal constancy of the vacuum light-velocity."

i.e. he dismisses the basis of SR; his theory is light in a medium, so is subject to classical velocity addition. He says:

"Entering any epola region [his version of aether], light propagates with velocity fixed by the physical conditions in this region."

Einstein with his 1920 update should have been making the same claim for light in his amended theory of light travelling in space (where space has properties of a medium/aether).

Under Stavinsky's analysis of the mistakes made by Einstein, Stavinsky decides to talk of light travelling in "gravitational field"—and that "gravitational field" is the equivalent of a medium for light waves. (Under a more advanced theory, one would have to say that light travelled in more fields than just gravity (i.e. a unified field), but treating "gravitational field" as aether/medium for light waves suffices for the moment. He concludes:

1. Light propagates not in a vacuum but in a gravitational field of a planet, star, galaxy, etc., which in conjunction with the planet, star or galaxy constitutes a single system of reference. These gravitational fields move relatively to each other together with their carrier (planet, star, galaxy).

2. Light propagates in this gravitational field at 300000 km/sec, and is independent from the velocity of its source.

3. But the velocity of light in relation to the source of its origin or any moving system of reference is subject to the rule of adding velocity, as described in classical mechanics.

4. In the above described moving systems time and space are absolute, regardless of the system relative to which they are considered.

His conclusion (2) is a bit open to confusion if read solely from that, but it needs to be taken in conjunction with the other conclusions; especially (3) where he concludes light waves obey the classical mechanics rule of velocity addition, same as any other wave.

Conclusion

The confusion with the issue of - is light a wave in a medium or not, added to the other confusions that Einstein has introduced has obscured the issue that really SR of 1905 updated to Einstein's change of mind in 1920 would be completely different mathematically, with a change in what was meant by light speed constancy. When

Einstein was writing about w = c-v not fitting in with his theorising, he was not taking into account the possibility of what happens for waves in a medium. When he changed his mind about light, he should have amended his theorising according in that article. But he did not; he left the maths stand on an idea that he changed his mind on, apparently unaware of what he had done.

References

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[3] Albert Einstein (1879–1955). Relativity: The Special and General Theory. 1920. VII. **The** Apparent Incompatibility of the Law of Propagation of Light with the Principle of Relativity.

[4] Essen – a site to start from his works would be: http://www.btinternet.com/~time.lord/

[5] The Story of Matter and Space, M. Simhony 1999, Library of Congress TXU 790-547 p 59

[6] Flaws in the logic of Einstein's Special Theory of Relativity, by Ilya Stavinsky, Published in magazine Philosophical Researches #4 Moscow 12/2000 http://mars.superlink.net/~dialect/theory.html

[*] extra added for clarification 2009-03-26