Relativity of Electro Magnetic Fields and Waves – Review and clarification

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Abstract

The constancy of the speed of light, which is one of the two postulates of Special Relativity (SR) theory, is known to have a firm experimental and intuitive basis. However, SR requires length contraction time dilation hypothesis. In this paper, a new theory of light has been proposed as an alternative to this hypothesis. This paper proposes that light wave contracts towards or expands away from the source depending on the relative velocity (V) of the observer and the source so that the velocity of light in vacuum relative to any observer is always equal to C(3 x 10 8). The apparent velocity (C') of light relative to the source depends on the relative velocity (V) of the source and the observer so that the speed of light relative to an observer is always equal to C, i.e. C' - V = C (vector difference), in the reference frame of the source, and C' + V = C (vector sum), in the reference frame of the observer. Expansion or contraction of the wave is not a mere speculation but is a direct consequence of the principle of relativity and the well known phenomena of Doppler effect of light, in which speed of light remains constant and wavelength changes. The center of the spherical wave fronts moves at the velocity that the source had at the instant of emission, and yet the speed of light is the same constant C for any observer! According to SR , the center of a light wave front from a moving source is at the 'point in space where the source was' at the instant of emission. This is why SR doesn't predict stellar aberration in the reference frame of the earth. This assumption has to be investigated carefully with respect to the principle of relativity itself. The new theory agrees with the experimentally established fact that the speed of light is independent of the speed of the source (and the observer). It explains stellar aberration in both the earth and stellar reference frames. It predicts the null result of Michelson-Morley experiment. It agrees with Einstein's notion of motion, his two postulates and is in accordance with Galilean invariance principle. The Relativity of Electromagnetic Waves theory has been shown to better conform to the principle of relativity than Special Relativity does.

The purpose of this paper is to review and clarify the Relativity of EM Waves theory [2] already proposed by this author.

The constancy of the speed of light, which is one of the two postulates of Special Relativity (SR) theory, has a firm experimental and intuitive base. It follows directly from Einstein's notion that space is empty (absolute space or ether doesn't exist) and the peculiar nature of light wave propagating in vacuum. It seems unintuitive only when one is instinctively used to thinking of space as absolute.

Three other known postulates of light exist. According to the ballistic theory of light proposed by Ritz, the speed of light in vacuum is a constant *C* with respective to the source at the time of emission [1]. This theory is perhaps the most straight forward explanation for the null result of Michelson-Morley experiment (MMX). This postulate, however, has been rejected as it is not in agreement with the experimentally established fact that the speed of light is independent of the speed of its source. It doesn't predict the Sagnac effect also. The ether theory has been ruled out by lack of any experimental evidence supporting it, beginning from the null result of MMX. Another postulate of light is the one proposed by Spencer and Moon. According to this postulate, the center of the spherical wave fronts is always at the

source no matter how the source moves [1]. This theory can also explain the MMX null result, but predicts that the speed of light depends on the speed of the source. Moreover, the motion (acceleration) of a source is instantaneously 'felt' at all points in space, which is not an intuitively sound idea.

Therefore, Einstein's light postulate is the preferred postulate of the three. However, in its current form, this postulate requires length contraction and time dilation hypothesis. Moreover, it doesn't predict stellar aberration in the reference frame of the earth [1].

According to SR, the center of a spherical wave front is at the 'point in space where the source was' at the time of emission.
This is why SR doesn't predict stellar aberration in the reference frame of the earth. This assumption has to be investigated carefully with respect to the principle of relativity itself. If it is not, then this would be a self contradiction in the theory. If the center of the wave fronts does not move with the source, then this would be interpreted as ' absolute motion of the source in that reference frame'. In this case, all reference frames would be just different 'absolute reference frames', with relativistic transformations from one 'absolute reference frame' to another.

Therefore, a new theory of light is needed which can explain all phenomena of light, agrees with experimental results, is in accordance with the principle of relativity (Galilean invariance principle and Einstein's notion of motion and his two postulates). In this paper, a new theory of nature and velocity of light is proposed. It is stated as follows.

1. *Objective absolute space doesn't exist (Einstein's notion of space). In all analysis of source observer problems, either the observer or the source can equivalently be considered stationary with the other one moving.*

2. The light wave spatially contracts towards (or expands away from) the source depending on the relative velocity (V) of the observer and the source [2]. The apparent velocity (C') of light wave relative to the source depends on V so that the velocity of light relative to any observer is always equal to C, i.e

$C' - V = C$ *(vector difference) in the reference frame of the source, or*

$C' + V = C$ *(vector sum), in the reference frame of the observer.*

The velocity (C') of light relative to the source is an apparent velocity and is not a physically measurable quantity.

3. The center of the spherical wave fronts moves at the velocity that the source had at the instant of emission, and yet the speed of light is the same for all observers.

Light wave contracts towards or expands away from the source depending on source-observer relative velocity V so that the velocity of light relative to an observer is always [3] equal to C (3 x 10 8) . Irrespective of all motions of the source and the observer (unaccelerated or accelerated), the center of the wave fronts always moves with the source and yet the speed of light is always equal to C relative to all observers. If the observer and the source are radially approaching each other with relative velocity V, the velocity (C') of light relative to the source will be C-V, so that the velocity of light relative to the observer will be C , i.e., (C-V)+V = C. If the observer and the source are radially receding away from each other with relative velocity V, the velocity (C') of light relative to the source will be C+V, so that the velocity of light relative to the observer will be equal to C again, i.e., (C+V) - V = C. If an observer and a source are moving in the lateral direction relative to each other, the velocity (C') of the wave

relative to the source will be such that the speed of light relative to the observer is again equal to C, i.e., $C'2 + V2 = C2$. The general relation between the three vectors (C', C , V) is stated as : $C = C' - V$ (vector difference). The velocity (C') of light relative to the source is an apparent velocity and is not a physically measurable quantity. The contraction (or expansion) of the wave towards (or away from) the source not only results in a change in the apparent velocity C', but also will result in longitudinal and transverse Doppler frequency shifts. Hence, Doppler shift is always accompanied by an apparent change in the velocity (C') of light relative to the source.

In the general case, the source observer relative velocity consists of both radial and lateral components. The lateral component also results in contraction of the wave towards its source, which is a transverse Doppler effect. The total Doppler frequency shift will be the resultant of both longitudinal (radial) and transverse Doppler effects.

Expansion or contraction of the wave is not a mere speculation but is a direct consequence of the principle of relativity and our existing knowledge. Suppose that an observer is moving with velocity V towards a light source. The contraction of the wave towards the source for that observer becomes self evident from two well established views and facts :

1. the speed of light relative to that observer is a constant C, irrespective of his velocity V
2. the wave length of the light changes (decreases) due to Doppler effect.

If an observer moves towards a stationary sound source, the wave length remains constant for that observer. But the speed of sound increases and will be $C + V$, where C is the speed of sound relative to the medium (air) and V is the speed of the observer relative to the air. There will not be spatial contraction of the sound wave because the wavelength doesn't change.

In the case of an observer moving towards a light source, since $C = f.\lambda$, the constancy of the speed of light requires a change in the wavelength of light, which has been confirmed experimentally [5], and this is due to contraction of the wave.

To make this more clear, assume that there are n cycles of the light wave in the space between a stationary observer and a light source, at an instant of time. Imagine another observer who is exactly at the position of the stationary observer at that instant of time, but moving towards the source with some velocity. Now, the wave length will be shorter for the moving observer. So all the cycles in the space between the source and the observer will have shorter wave lengths for the moving observer. Therefore, the number of cycles in the space between the moving observer (who is at the same point as the stationary observer, at this instant) will be greater than n. And hence contraction of the wave ! This is self evident!

Imagine a stationary light source S and a stationary observer A who is at distance D from the source. Assume that the source is just emitting the peak of a light pulse at time $t=0$. Assume that another observer B is at the same point as stationary observer A at this instant ($t=0$), but moving with velocity V towards the source. The postulate proposed in this paper is stated as follows:

Although observer B is moving towards the source with velocity V, he/she will not detect the light pulse earlier than stationary observer A. The two observers detect the peak of the light pulse exactly at the same time, T, where T= D/C.

After some analysis, it can be shown that the apparent velocity (C') of light relative to the source will be equal to C-V. The speed of light relative to observer B will then be equal to C' $+V = (C-V)+V = C$. Thus, the speed of light relative to the source apparently decreases from C by the amount V so that the speed of light relative to observer B will always be equal to C, irrespective of relative velocity (V). However, observer B receives a temporally compressed (Doppler shifted) pulse. Observer B receives a compressed (less pulse width) form of the pulse received by observer A.

An experiment can be done to test this hypothesis. A laser light source placed on the moon transmits a

narrow light pulse towards the earth. The light pulse is detected by two detectors, a stationary one on the ground and another detector placed on an aircraft flying towards the moon with a speed of about 500 m/s . It takes about one second for the light pulse to reach the earth. Within one second, the aircraft will travel a distance of 500 meters. It takes about 1.66 micro seconds for light to travel 500 meters. The experiment is so arranged that (which is not difficult) the light pulse is transmitted from the source on the moon at the instant that the aircraft is just passing by the stationary detector on the ground. Therefore, the detector on the aircraft is expected to receive the light pulse earlier than the stationary detector on the ground, by about 1.66 microseconds, according to classical and existing theories of light and space/motion. According to the Relativity of EM Waves theory, however, both detectors will detect the light pulse at exactly the same instant of time, about one second after its transmission from the moon. However, the pulse received by the detector on the aircraft is a temporally compressed (Doppler shifted) form of the pulse detected by the stationary detector.

The center of the spherical wave fronts moves at the velocity that the source had at the instant of emission [1], and yet the velocity of light relative to the observer is always equal to *C*. The velocity that light acquires from motion of its source is compensated for (cancelled) by the contraction or expansion of the wave which is a result of source observer relative motion, so that the speed of light relative to the observer is always equal to *C*. Thus the Relativity of EM Waves theory of light has both a feature of Einstein's light postulate (speed of light as independent of speed of source and speed of observer) and of emission theory of Ritz (the center of the spherical wave fronts always moving with the source at the instant of emission). This is made possible by the spatial contraction or expansion of the wave relative to its source.

The Relativity of EM Fields/ Waves theory can not explain Sagnac effect. The explanation of Sagnac effect is proposed in another paper written by this author [4], in which a new paradigm of absolute motion is introduced.

Conclusion

The Relativity of Electromagnetic Waves theory has been shown to better conform to the fundamental principle of relativity than Special Relativity does. The new theory agrees with MMX null result, explains stellar aberration and predicts longitudinal and transverse Doppler effects. It predicts stellar aberration both in the reference frame of the earth and the reference frame of the star. It agrees with the source speed independence of the speed of light. It is in accordance with Galilean invariance principle and Einstein's notion of motion. Of the theories and postulates of light known so far, none can satisfy all these at the same time.

References and notes

1. *Stellar Aberration and the Postulates on the Velocity of Light*, Domina Eberle Spencer and Uma Y. Shama

2. *A Novel Solution to the Century Old Light Speed Paradox; Relativity of Electromagnetic Fields/Waves* by Henok Tadesse

3. The exception here is if the source and observer have the *same* velocity. This has been explained by this author in another paper 'Absolute Motion is Intrinsic'

4. *Absolute Motion is Intrinsic*, Henok Tadesse, 2013

5. *On the Second Postulate of the Theory of Special Relativity,* Wikisource the free online library