The Constancy of One-Way Light Velocity and the Possibility that Space is a Foamy Fluid

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Abstract

Recent measurements of **one-way** light velocity showed that it is isotropic and constant. Similar results for **two-way** light velocity are explained by length contraction and time dilation – real (Lorentz) or virtual (Einstein). This explanation is **not** relevant for **one-way** light velocity. To explain a possible constant one-way light velocity, not measured in his time, Einstein (1939) considered space to be an elastic fluid, confined by stars. The observational evidence that Earth carries space (Frame Dragging) by both its rotational and linear motions, strengthens this understanding. This, together with recent results of one-way measurements, can explain the second postulate of SR, since instruments on Earth are stationary relative to the Earth-confined space.

Key Words: Space; Inertial systems; Light velocity; Special Relativity

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1 Introduction

1.1   We consider electromagnetic waves, like gravitational waves, to be space waves. The current understanding, however, is that electromagnetic waves have their own unidentified "medium", which follows the topology of space.

We explain one-way constant light velocity by considering our instruments to be stationary relative to the local space of Earth, un-related to the CMB frame. Thus space, and hence the "medium", must be **confined locally** by the Earth and carried along by its linear and rotational motions through global space. Thus, to maintain continuity, we raise the possibility, following Einstein (1939), that space is an **elastic fluid**. This local confinement of space should also occur in stars.

This conjecture can explain the second Special Relativity (SR) postulate.

1.2   Light Velocity

Lorentz (1904) explained the constant light velocity found in the **two-way** measurement by Michelson-Morley (1887) as the result of **real** length contraction and time dilation.

Einstein (1905), however, **postulated** one-way constant light velocity (and necessarily also two-way) as a law of nature. The result was **virtual** length contraction and time dilation. Thus, the Lorentz cause and effect were reversed; length contraction and time dilation became virtual instead of real.

We believe that Einstein (1939) was hinting that constant light velocity might be the result of space (and hence the electromagnetic "medium") being carried by the Earth and by other stars, although he did not mention this specifically. In this case, instruments for measuring light velocity on Earth are **at rest** relative to the Earth's local space. This local carrying of space, while maintaining a global space continuity, is only possible if space is an elastic **fluid** – Einstein's *compressible fluid* (1939).

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Recent measurements of **one-way** light velocity by Ahmed, et al, [1] (2013), and by Gurzadyan and Margaryan [2] (2018) utilizing a different technology, showed full isotropy.

Note that both one-way **time of flight** or **velocity** experiments, accuracy is (v/c), and not $(v/c)^2$, dependent. Therefore, in discussions and calculations, length contraction or time dilation, which are $(v/c)^2$, dependent can be ignored.

2   Our Logic of Argumentation

In **one-way** times of flight or velocity measurements there are two possible results and

terzum non datur:

Anisotropy

Anisotropy could be the result of the Earth, stars, and material bodies in general, sliding through space. This is possible if, for example, elementary particles, and hence material bodies, are space wavepackets, as the GDM suggests. The entire global space can serve as a special frame that coincides with the Cosmological Microwave Background (CMB) frame. In this case, we can consider space to be an elastic **foam**.

Velocity, relative to this frame, is considered Real and yields a CMB Doppler shift. This Real velocity should yield a real Lorentz length contraction and Larmor time dilation.

Isotropy

Isotropy could be the result of space (and hence the electromagnetic "medium") being carried by the Earth and by other stars, but **not** necessarily by "small" bodies. In this case, instruments for measuring times of flight of light pulses or light velocity on Earth must be **at rest** relative to the Earth's local space.

This carrying of space, while maintaining space continuity, is only possible if space is an elastic **fluid** – Einstein's *compressible fluid.*

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These confined zones of space, in stars, are individual special frames. Relative velocity of a "small" body to one of these frames, if it is within the space zone of this frame, should yield a real Lorentz length contraction and Larmor time dilation. Its velocity should be termed Real rather than Relative.

Note that, in the case of anisotropy, there is only one special frame, which is the global space frame, whereas in the case of isotropy there are many special frames beside the global one.

Note that, in contrast to SR, in both the above cases neither space nor time is subjective.

3 Electromagnetic Waves are Space Waves

This contention is based on the following:

In [3] we define electric charge density, with **space density** as its single variable. This definition alone, without any phenomenology, yields the theory of Electrostatics. In [4] we derive the attributes of electric charge and elementary particles. The Lorentz Transformation (LT), is derived [5], based on our model of elementary particles. Our Electrostatics together with the LT, and neglecting the field contribution to charge density, yield the entire Maxwell Electromagnetic theory [6]. Taking into account the field contribution to charge density, as in gravitation, yields a full nonlinear electromagnetic theory that resembles QED.

The confidence in our Electromagnetic theory is based on the following:

The essence of electric charge and its field has been a mystery. So far, no theory has been able to derive the attributes of electric charge: bivalency, stability, quantization, equality of the absolute values of the bivalent charges, the electric field it creates and the radii of the bivalent charges. Our model of elementary electric charge and its field [3] enables us [4], for the first time, to derive simple equations for the radii and masses of the electron/positron, muon/anti-muon and quarks/anti-quarks. These equations contain only the constants G, c, $\hbar$ and α (the fine

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structure constant). The calculated masses, based on these equations, comply with the experimental data in CODATA 2014.

Note that the Standard Model of elementary particles, despite its successes, and String Theory, fail to derive and calculate the radii and masses of the elementary particles, and fail to explain what charge is.

Note also that our argumentation, in this paper, is independent of the specific understanding of whether Electromagnetic waves are space vibrations or the vibrations of their own "medium" that follows, as GR requires, the topology of space.

4   Einstein's "Stationary" System

4.1   History

Einstein was bothered by his (1905) "constant light velocity" postulate, since it did not comply with the understanding of the common behavior of different waves in their respective media. Hence, he was very careful in the way he phrased the second postulate of Special Relativity (SR), (see below). Only thirty-four years later (1939) he came up with a non-explicit explanation as to why the second postulate of SR is correct and how it complies with the common behavior of waves. We have adopted this explanation, since **one-way** light velocity constancy, narrows the options.

4.2   Einstein's Special Relativity (SR) Second Postulate

The original second postulate of SR, [7] p41 (1905), is:

Any ray of light moves in the "stationary" system of co-ordinates with the determined velocity c, whether the ray is emitted by a stationary or by a moving body.

In text books, however, the second postulate is expressed in a **different** manner:

The speed of light in vacuum has the same value in all directions and in all inertial reference frames.

Or:

The speed of light in free space is the same for all observers in inertial reference frames.

4.3   Einstein's "Stationary System" and Space as a Fluid

To clarify the term "stationary system" Einstein (1939) constructed a system of many gravitating masses [8], each moving along a geodesic circular orbit about the center of the system, under the influence of the gravitational field of all the masses. This system, referred to in the literature as an "Einstein cluster", has spherical symmetry.

Einstein, regarding Space, concluded that: … *it would be necessary, therefore, to introduce **a compressible liquid …***

This medium is not identified **explicitly** in the paper, but logically it is the gravitational field, which, according to GR, is simply space.

Papers on Space as a fluid, discussing theory and possible experiments, are [9] and [10].

5   On Space Dragging and Deforming

5.1   Frame Dragging

Frame Dragging is the deformation of the Schwarzschild metric (deformation of space) due to rotation or linear motion of the Earth and stars. These phenomena have been detected. A book on the subject is [11], and a report on the measurement of the Earth's dragging of inertial frames is [12].

5.2 Bent Manifolds and Deformed Spaces

Note that in a paper [13], with the above title, we show that: Riemannian geometry, the geometry of a n-dimensional **bent manifold**, in a hyper-space with additional dimensions is also the geometry of a n-dimensional **deformed space**.

Hence the metric of a 3D space zone can be regarded as the metric of a deformed elastic space that occupies this zone. This duality, bent versus deformed, enables us to understand General Relativity (GR) intuitively, and inspires our imagination.

6   The Cosmological Microwave Background (CMB) Frame

At large, the CMB is an isotropic and homogenous blackbody radiation bath, with a 2.7°k peak temperature. The CMB was predicted theoretically by Gamow and discovered accidentally by Penzias and Wilson [14]. In 1989 the CMB was measured by the Cosmic Background Explorer (COBE) satellite [15]. Motion relative to the background radiation is accompanied by a Doppler shift. This shift enables the measurement of the observer's velocity relative to the radiation bath, namely to the CMB frame.

We consider the CMB frame to be our global space frame, since the CMB bath is the vibrations of space. Alternatively, according to the current understanding, these vibrations of the EM "medium" reside in this space and follow its topology.

7   SR in Textbooks

In textbook SR, all inertial systems are equivalent, length contraction and time dilation are **not real**, and simultaneity is **relative**. In SR, neither space nor time is objective.

Only **spacetime,** (which we consider a legitimate and useful mathematical "trick") **is objective and absolute**, since the interval ΔS^2 is invariant under the Lorentz Transformation.

8 Our Modified Special Relativity – MSR

8.1 MSR

The first SR postulate is turned into a definition of a Law of Nature.

Definition: A physical law is a Law of Nature if it is the same in all inertial systems.

Instead of SR **postulates**, MSR presents **laws:**

First Law: Rays of light move in the local space of a "stationary" system with velocity c, relative to this system, whether the rays are emitted by a stationary or by a moving body, in the local space of this system.

Note that all stars are "stationary" systems. But **it is not clear** how small a material system can be and still serve as a "stationary" system.

Second Law: Real velocity of an inertial system (velocity relative to the "stationary" system in which the inertial system resides) is accompanied by a real Lorentz contraction and a real Larmor slowing-down of clocks in this system.

8.2 Conclusions

8.2.1 Two Systems

Two inertial material systems, moving at the same **v**, cannot be considered as one combined inertial system, since space between them is not affected [16]. This is argued by J. Bell, see Ref. [14] in [16].

8.2.2 On Global and Local Spaces

Space between galaxies is subjected to the Hubble flow, whereas the space inside galaxies is not (no cosmological redshift). The CMB resides in the **global** space in and around galaxies and its frame defines real velocity relative to the global space.

A **local** "stationary" space is that of any star, the Earth included.

8.2.3 On Relative and Real Velocities

Relative velocity is the velocity between any two inertial systems.

Real velocity is the velocity of an inertial system relative to a "stationary" system - global or local.

Real velocity is accompanied by real length contraction and time dilation (the slowing of clocks). If we consider only relative velocities, length contraction and time dilation are **not real**, see Born [17] p254.

8.2.4 On Lorentz Length Contraction and Larmor Time Dilation

Lorentz length contraction is related to material bodies, and might also relate to local spaces. It is determined by real velocity, as suggested by Lorentz (1904) [18], and in [16].

Larmor time dilation is the slowing rate of clocks, and is determined by real velocity (Note that we do **not** consider time to be fundamental [16]).

We can infer real velocities of inertial frames, by measuring our own real velocity, and our relative velocities to the other frames. Thus, internal observers of all frames will agree whether events occur at the same time or not, despite the fact that their clock rates might differ. **Simultaneity is thus absolute**, in contrast to textbook SR in which it is relative.

Note that in Section 3 [4] the Lorentz transformation appears as a result of the elementary particle model presented.

Note that **not** every inertial system is a "stationary system" and hence **not** all inertial systems are equivalent. Note also that the velocity of highly-accelerated particles in Labs on Earth is their real velocity.

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9 Summary

Special Relativity is a *freely invented* (Einstein's expression) – postulated theory. Only one-way light velocity measurements, which yield results that comply with the second postulate of the theory, reveal the nature of space. Light cannot be a space wave or a wave of other media that follows the topology of space, and with a constant light velocity unless the measuring instruments are stationary relative to space. Hence space must be confined in stars, Earth included, and carried by them. Space continuity, however, requires space to be a kind of fluid.

Acknowledgements

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