Contradiction Divides Two Aether Theories

An exploration into the three parts of the speed-of-light postulate

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Abstract: Two aether theories are briefly described and then compared on the basis of how they handle relative motion. It is shown that the "modern Maxwell-Lorentz aether theory" leads to a contradiction; while the DSSU* aether theory maintains logical integrity and maintains agreement with Einstein's special relativity. There is a discussion that examines the apparent conflict between Einstein's postulated constancy of the speed of light for all uniformly-moving observers on the one hand, and, on the other, the evidence that the speed of light-pulses actually varies with the motion of the observer. The final section brings together three essential components that make up an *extended postulate* for the speed of light. The *extended postulate*, in turn, becomes the important part of a realistic aether theory.

*DSSU is the acronym for Dynamic Steady State Universe, which is a model based on the premise that all things are processes.

Résumé: Deux théories de l'éther sont brièvement décrites et alors comparées sur la base de la façon dont elles manipulent le mouvement relatif. Il est montré que la "théorie moderne d'éther de Maxwell-Lorentz" mène à une contradiction; tandis que la théorie d'éther de DSSU (DSSU est l'acronyme pour l'Univers Équilibré Dynamique qui est un modèle basé sur l'idée que toutes les choses sont des processus) maintient l'intégrité logique et maintient l'accord avec la relativité spéciale d'Einstein. Il y a une discussion qui examine le conflit apparent entre la constance postulée de la vitesse de la lumière d'Einstein pour tous les observateurs uniformément mobiles d'une part et, d'autre part, l'évidence que la vitesse des impulsions-lumière varie réellement avec le mouvement de l'observateur. La section finale rassemble trois composants essentiels qui composent un *postulat prolongé* pour la vitesse de la lumière. Le *postulat prolongé*, alternativement, devient la part importante d'une théorie réaliste d'éther.

Keywords: Maxwell-Lorentz aether theory; DSSU aether theory; Lorentz transformation; Special relativity; speed of light; absolute motion; absolute space; aether; length contraction; clock retardation.

Two aether theories are briefly described and then compared for a simple relative-motion situation. It is shown that one of the two theories leads to a contradiction; while the other maintains logical integrity *and* maintains agreement with Einstein's special relativity (ESR).

1. Two Aether Theories

The first of the two aether theories to be described is called the "modern Maxwell-Lorentz aether theory" (which I will often refer to as the MML aether theory). It is supported by the works of S. Gift[1], J. Levy[2], F. Selleri[3], and others.

The MML aether theory uses a static space-medium. The medium, of course, is luminiferous.

The speed of light is constant with respect to the aether, which serves as the preferred frame of reference. Its intrinsic value is *c* and is independent of the motion of the light source.

The MML aether theory involves lightspeed variation relative to a moving observer.

However, under specific conditions, the speed of light in vacuum appears constant to all observers regardless of uniform motion. That is, the *two-way* speed is measurably invariant. As Stephan Gift describes it, "Light speed invariance is a remarkable illusion."[1]

The MML theory employs the following coordinate transformation equations:

$$x = \gamma\left(x_o - \upsilon t_o\right), \tag{1}$$

$$y = y_o ,$$
$$z = z_o ,$$

$$t = t_o / \gamma . \tag{2}$$

The symbols x_o, y_o, z_o, and t_o are the space and time coordinates of the aether frame of reference.

The symbols *x, y, z,* and *t* are the corresponding coordinates as "seen" in (or from) a moving frame of reference.

These equations are based on the classical Galilean transformations but with the incorporation of two non-classical features: (i) the contraction of the length of objects moving through the aether; the contraction by which a rod of length l_o in the aether rest-frame, when moving with absolute speed υ, is shortened to a length $l = l_o/\gamma$. Often called the FitzGerald-Larmor-Lorentz contraction, it was experimentally confirmed by H. Ives[4] in the mid-20th century. And (ii), a reduction in clock-time due to aether-referenced motion; the feature whereby any system of frequency f_o, when stationary in aether, has a frequency $f = f_o/\gamma$ when in motion.[1]

The non-classical factor, called the gamma factor, is given by

$$\gamma = \left(1-\upsilon^2/c^2\right)^{-1/2}. \tag{3}$$

The opposing model is the DSSU[a] aether theory. In many ways it is similar to the Lorentz's aether theory. However, there are some fundamental differences most notably the use of a dynamic space-medium as opposed to Lorentz's static aether.

Like all aether theories, the DSSU space-medium is luminiferous. The speed of light is constant with respect to the aether medium. Its intrinsic value is c and is independent of the motion of the light source.

The speed of light in vacuum appears constant to all observers regardless of uniform motion. To be more precise, the speed of light in vacuum *appears* constant when measured by the traditional out-and-reflected-back method. However, in addition to this *invariance* the theory allows for actual observed lightspeed *variance*. More on this later.

The following coordinate transformation equations (*the Lorentz transformations*) are employed:

$$x = \gamma\left(x_o - \upsilon t_o\right), \tag{4}$$

$$y = y_o,$$
$$z = z_o,$$

$$t = \gamma\left(t_o - \upsilon x_o/c^2\right). \tag{5}$$

There are two aspects to motion —motion in the presence of aether— which need to be explained. Once it is acknowledged that motion occurs within a preferred frame —within a detectable aether— then obviously one must also acknowledge *absolute inertial motion*. The presence of aether implies absolute (or intrinsic) motion with respect to it. What this entails is a partial loss of symmetry of relative motion between two independent frames of reference. When velocities are aether-referenced, there occurs a loss of symmetry. If "A" is stationary in the aether then the *intrinsic* relativistic effects (clock-slowing, length-contraction) that "A" determines for "B" need not agree with such effects that "B" determines for "A." When relative motion involves absolute or intrinsic effects, then symmetry is lost. Let me emphasize that this only arises when velocities are aether-referenced. However, when the aether frame is not referenced then relative motion simply means *apparent* relative motion; which, in turn, means that Einstein's equations remain valid.

The key point is this: If an aether theory is to represent physical reality, then *that* theory must retain *the symmetry of apparent relative motion*.

2. The Modern Maxwell-Lorentz Aether Theory Leads to a Contradiction

The basic modern-Maxwell-Lorentz transformation equations relate any *uniformly moving frame* to the *aether frame*. In order to demonstrating the contradiction in this aether theory, we first need to obtain the transformation equations between *two* uniformly-moving frames of reference.[b]

We apply eqns (1) and (2) to moving systems S' and S'', which are moving in the *positive* direction with respective velocities υ_A and υ_B through aether-space (Fig. 1).

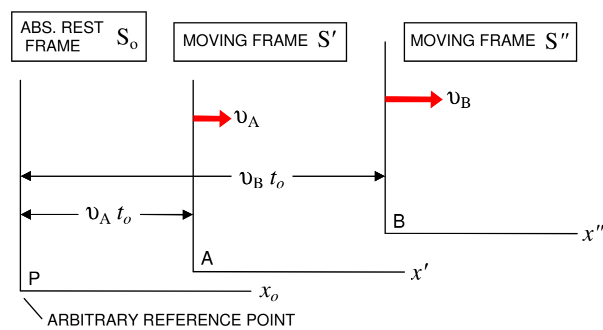

Fig. 1. Inertial reference frame S' has velocity υ_A and inertial reference frame S'' has velocity υ_B relative to the absolute rest frame S_o.

The x and t coordinates of some event in system S', are then related by

$$x' = \gamma_A\left(x_o - \upsilon_A t_o\right), \tag{6}$$

$$t' = t_o/\gamma_A, \tag{7}$$

where the gamma factor is subscripted because (when expanded) it contains a υ_A term.

And the x and t coordinates of some event in system S'', are related by

$$x'' = \gamma_B\left(x_o - \upsilon_B t_o\right), \tag{8}$$

$$t'' = t_o/\gamma_B, \tag{9}$$

[a] DSSU is the acronym for Dynamic Steady State Universe, which is a model based on the premise that all things are processes.

[b] A word about notation: To indicate conventional relative motion, I have used the unsubscripted symbol υ (or "$\upsilon_{apparent}$"). To indicate aether-referenced motion, I have used the subscripted symbols such as υ_A and υ_B. This meaning also applies to the notation for the Lorentz factor: γ, γ_A, and γ_B.

where the gamma factor is subscripted because (when expanded) it contains a υ_B term.

Equations (8) and (9) are solved for t_o and x_o giving

$$x_o = \frac{x''}{\gamma_B} + \upsilon_B \gamma_B t'' , \tag{10}$$

$$t_o = \gamma_B t'' , \tag{11}$$

which, when applied to (6) and (7) give:

$$x' = \gamma_A \gamma_B \left[\frac{x''}{\gamma_B^2} + \left(\upsilon_B - \upsilon_A \right) t'' \right] , \tag{12}$$

$$t' = \left(\gamma_B / \gamma_A \right) t'' . \tag{13}$$

Now let us place observers (we'll call them A and B) into the two moving systems as shown in Fig. 2.

Observer A wishes to derive an expression for the apparent relative motion of B.

From Fig. 2, it should be obvious that the velocity of B with respect to A's point of view is,

$$\upsilon_{\text{apparent B}} = \frac{\Delta x'}{\Delta t'} .$$

Using eqn (12),

$$\Delta x' = x_2' - x_1' ,$$

$$\Delta x' = \gamma_A \gamma_B \left[\frac{\Delta x''}{\gamma_B^2} + \left(\upsilon_B - \upsilon_A \right) \Delta t'' \right] . \tag{14}$$

Also,

$$\Delta t' = t_2' - t_1' = \left(\gamma_B / \gamma_A \right) \Delta t'' . \tag{15}$$

Then,

$$\frac{\Delta x'}{\Delta t'} = \frac{\gamma_A \gamma_B \left[\left(1/\gamma_B^2 \right) \Delta x'' + \left(\upsilon_B - \upsilon_A \right) \Delta t'' \right]}{\left(\gamma_B / \gamma_A \right) \Delta t''} . \tag{16}$$

The term $\Delta x''$ is zero since point B does not move along the x''-axis; and $\Delta t''$ cancels out.

Thus, this observer asserts that the MML aether model predicts that the apparent relative motion of B relative to A is

$$\upsilon_{\text{apparent B}} = \frac{\Delta x'}{\Delta t'} = \gamma_A^2 \left(\upsilon_B - \upsilon_A \right) . \tag{17}$$

Now what if the other observer follows the same procedure to determine, or predict, the apparent relative motion? ... Observer B will predict that the apparent relative motion of A relative to B should be

$$\upsilon_{\text{apparent A}} = \frac{\Delta x''}{\Delta t''} = \gamma_B^2 \left(\upsilon_A - \upsilon_B \right) . \tag{18}$$

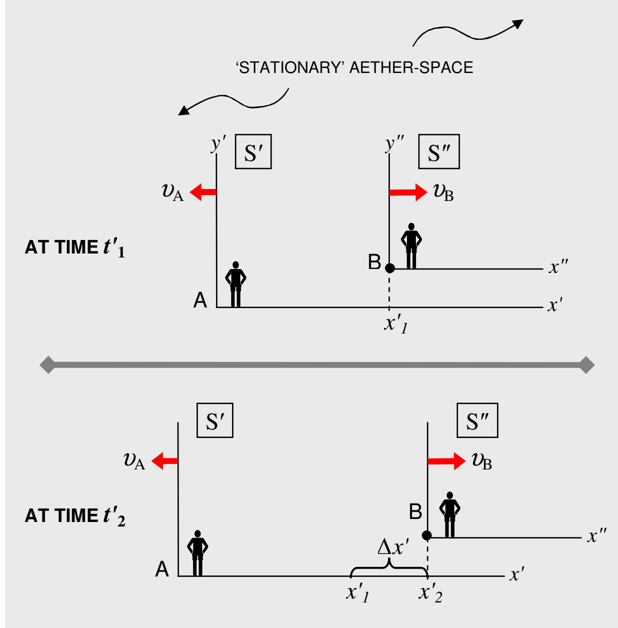

Fig. 2. *Two inertial reference frames (of the MML aether theory) each having independent absolute motion.* Observer A measures the position of point B at two different times. The goal is to determine the *apparent* velocity of separation.

What this means is that if the aether-referenced velocities are not both of the same magnitude, then the respectively predicted relative motion will not agree. That is, if $\upsilon_A \neq \upsilon_B$, where υ_A and υ_B are absolute speeds, then,

$$\left| \upsilon_{\text{apparent A}} \right| \neq \left| \upsilon_{\text{apparent B}} \right| .$$

Now, if observers A and B cannot agree on their relative motion, then symmetry, which is an essential element of Einstein's special relativity, would be lost!

How different, or unequal, are the separate predictions obtained by A and B ? —for what really should be their common (shared) *relative* motion.

Let us simplify the comparison. Assume A is at rest in the aether, that is, $\upsilon_A = 0$ and $\gamma_A = 1$. The *apparent* relative speed of B, according to eqn (17), will be $|\upsilon_B|$. So, from A's perspective the apparent relative speed is a linear relationship as shown in Fig. 3.

However, from B's perspective (looking at A who is apparently receding), the apparent relative speed is radically different. The relative speed is *not* linear. When $\upsilon_A = 0$ is applied to eqn (18) the predicted relative speed is

$$\upsilon_{\text{apparent A}} = \gamma_B^2 \left| \left(0 - \upsilon_B \right) \right| ,$$

which is represented by the upper curve in Fig. 3.

According to the MML aether theory the *apparent relative motion* depends on one's aether-referenced motion.

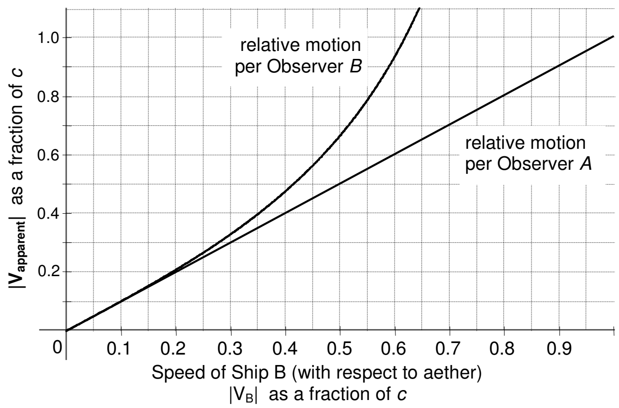

Fig. 3. Relative velocity as predicted by at-rest Observer *A* (lower curve) and by moving-Observer *B* (upper curve).

Section 3 will demonstrate an aether theory in which there is no conflict over apparent relative motion — regardless of one's aether-referenced motion.

3. The DSSU Aether Theory Retains Symmetry

The aether model being employed here uses the standard Lorentz transformations. To be consistent with my previous papers I have chosen to refer to it as the DSSU aether theory. I should make it clear that the theory, as used in this section, is similar to the Hendrix Lorentz aether theory [[5], [6]].

The basic Lorentz transformations (3) and (4) are applied to reference systems S_o and S' as shown in Fig. 4. We start with the equations for converting the parallel *x*-axis coordinates and the time coordinates,

$$x' = \gamma_A \left(x_o - (-\upsilon_A) t_o \right) \tag{19}$$

$$t' = \gamma_A \left(t_o - (-\upsilon_A) x_o / c^2 \right). \tag{20}$$

Solving for the aether frame coordinates,

$$x_o = \gamma_A \left(x' - \upsilon_A t' \right), \tag{21}$$

$$t_o = \gamma_A \left(t' - \upsilon_A x' / c^2 \right), \tag{22}$$

where the Lorentz factor γ_A is subscripted because it contains the aether-referenced velocity υ_A.

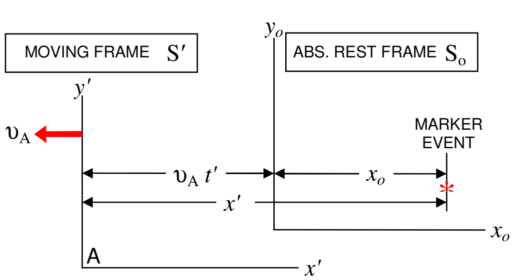

Fig. 4. Inertial reference frame S' has absolute velocity υ_A with respect to the aether rest frame S_o.

Similarly, the Lorentz equations can be applied to another uniformly moving system S'' as shown in Fig. 5. Coordinates are related as,

$$x'' = \gamma_B \left(x_o - \upsilon_B t_o \right), \tag{23}$$

$$t'' = \gamma_B \left(t_o - \upsilon_B x_o / c^2 \right), \tag{24}$$

where the Lorentz factor γ_B is subscripted since it contains the aether-referenced velocity υ_B.

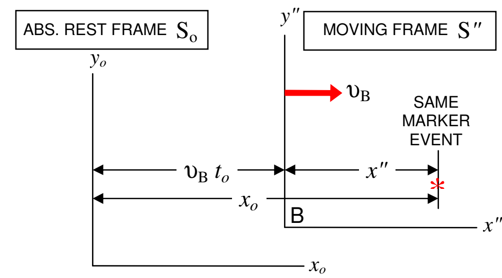

Fig. 5. Situation of inertial motion between reference frames S_o and S'' to which the basic Lorentz equations are applied.

By combining the two sets of Lorentz equations above —by substituting (21) and (22) into (23) and (24)— we obtain the equations that directly relate the coordinates of independently moving systems *S(prime)* and *S(double prime)*. The result is the *extended transformation* equations,

$$x'' = \gamma_A \gamma_B \left(x' \left(1 + \upsilon_A\upsilon_B /c^2\right) - t' \left(\upsilon_A + \upsilon_B\right)\right), \tag{25}$$

$$t'' = \gamma_A \gamma_B \left(t' \left(1 + \upsilon_A\upsilon_B /c^2\right) - x' \left(\upsilon_A + \upsilon_B\right)/c^2\right). \tag{26}$$

Which means, an observer in some moving Frame *A* (our S') is able to calculate x'' and t'' coordinates of some event that occurred in moving Frame *B* (our S'') by using measurements x' and t' obtained from *A*'s own frame. (Observer *A* determines his own speed υ_A by directly measuring absolute motion with respect to aether-space; and determines υ_B by direct communications or applying the DSSU Doppler formula.[[7]])

By solving for x' and t' in eqns (25) and (26), one obtains the corresponding transformations from S'' to S':

$$x' = \gamma_A \gamma_B \left(x'' \left(1 + \upsilon_A\upsilon_B /c^2\right) + t'' \left(\upsilon_A + \upsilon_B\right)\right), \tag{27}$$

$$t' = \gamma_A \gamma_B \left(t'' \left(1 + \upsilon_A\upsilon_B /c^2\right) + x'' \left(\upsilon_A + \upsilon_B\right)/c^2\right). \tag{28}$$

Derivation of the Apparent Velocity in Terms of Aether-Referenced Velocities

Suppose that the two systems shown in Fig. 6 move apart by a distance $\Delta x'$ in a time interval of $\Delta t'$. Observer *A* notes that at time t'_1 the position of point "B" projected onto the horizontal axis is x'_1. A brief time later observer *A* records that at time t'_2 the point "B" (projected onto the same axis) is now positioned at x'_2.

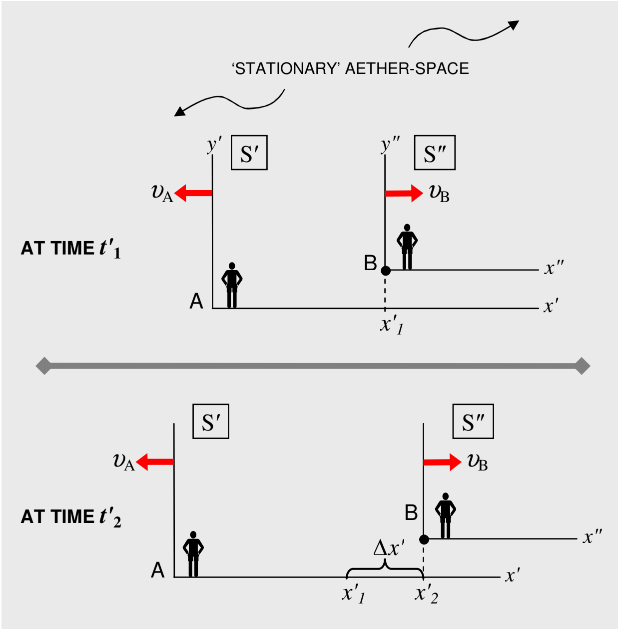

Fig. 6. *Two inertial reference frames (of the DSSU aether theory) each having independent absolute motion.* Observer *A* measures the position of point *B* at two different times. The goal is to determine the *apparent* velocity of separation.

Using equations (27) and (28) we then obtain:

$$\Delta x' = x'_2 - x'_1$$

$$\Delta x' = \gamma_A \gamma_B \left[\Delta x'' \left(1 + {}^{\upsilon_A \upsilon_B}\!/_{c^2} \right) + \Delta t'' \left(\upsilon_A + \upsilon_B \right) \right] \tag{29}$$

and

$$\Delta t' = t'_2 - t'_1$$

$$\Delta t' = \gamma_A \gamma_B \left[\Delta t'' \left(1 + {}^{\upsilon_A \upsilon_B}\!/_{c^2} \right) + \Delta x'' \left(\upsilon_A + \upsilon_B \right) / c^2 \right] . \tag{30}$$

The ratio of $\Delta x'$ to $\Delta t'$ is, of course, the relative velocity of *B* as measured by *A*. The ratio gives the *apparent* velocity of *B*,

$$\upsilon_{\text{apparent B}} = \frac{\Delta x'}{\Delta t'} ,$$

$$= \frac{\gamma_A \gamma_B \left[\Delta x'' \left(1 + \upsilon_A \upsilon_B / c^2 \right) + \Delta t'' \left(\upsilon_A + \upsilon_B \right) \right]}{\gamma_A \gamma_B \left[\Delta t'' \left(1 + \upsilon_A \upsilon_B / c^2 \right) + \Delta x'' \left(\upsilon_A + \upsilon_B \right) / c^2 \right]} . \tag{3-11}$$

This expression can be greatly simplified. First, the term $\Delta x''$ is zero since the chosen point *B* does not move along the x''-axis (i.e., "B" is nonmoving in its own frame); secondly, $\Delta t''$ cancels out.

Thus, with the DSSU aether theory, the *apparent* relative motion of *B* (from *A*'s point of view) is,

$$\upsilon_{\text{apparent B}} = \frac{\upsilon_A + \upsilon_B}{1 + \left(\upsilon_A \upsilon_B / c^2 \right)} . \tag{32}$$

If a similar analysis were to be performed from Observer *B*'s viewpoint, the expression on the right-hand side would remain unchanged. (Actually, the symmetry is obvious. Switch υ_A and υ_B and nothing changes.) And so,

$$\upsilon_{\text{apparent A}} = \upsilon_{\text{apparent B}} .$$

The symmetry between the observers is affirmed. The symmetry that defines *special relativity* retains its validity within a theory of absolute motion. This is quite remarkable.

A word about velocity direction. *A sign rule is required for independent absolute (aether-referenced) motion.* Any velocity (or velocity component) referenced to the aether medium follows the simple sign convention: Use positive sign when *absolute velocity* is away from the "other" frame of reference. Use negative sign when *absolute velocity* is towards the "other" frame. This, of course, means that the instant when two frames cross paths, the signs change.

4. Consequences

There are several important features worth emphasizing.

1. The left-hand side of the expression (32) symbolizes the *apparent* motion. But on the right-hand side, the velocities υ_A and υ_B are aether-referenced motion. Each such velocity (υ_A, υ_B, υ_C, etc.) is intrinsic to a particular reference-system or object and is independent of external observers regardless of their uniform motion.

2. The left side of the eqn (32) consists of a pure relative motion. The right side, however, consists of strictly absolute motion. The significance of the left side being purely relative is that the entire expression may be substituted into any ESR equation. This means that any ESR equation can be expressed as an aether-based formula without loss of validity (i.e., the laws of physics will still be the same for everyone).

3. Because of the symmetry, the relative velocity does not need to be subscripted. We, therefore, have

$$\upsilon = \frac{\upsilon_A + \upsilon_B}{1 + \left(\upsilon_A \upsilon_B / c^2 \right)} . \tag{33}$$

This equation can be used for conversions between relative velocity and corresponding aether-referenced velocities. Most importantly, it can be used to "extend" any ESR equation into a *DSSU extended relativity equation*.

The derived equation serves as the *extended relativity conversion expression*.

4. Any theory that extends ESR must, of course, conform to its successful aspects. Specifically, apparent relative speed must be limited to the speed of light in vacuum. That is, the apparent speed as expressed in eqn (33) must be less than *c*, and as can be seen in the lower graph of Fig. 7, the present aether theory *does*

conform. Even when two "observers" are approaching or separating —each traveling at, say, 99% lightspeed with respect to aether— the apparent velocity remains less than *c*. (Although, the absolute coming-together-, or separating-, speed may actually approach twice the speed of light.)

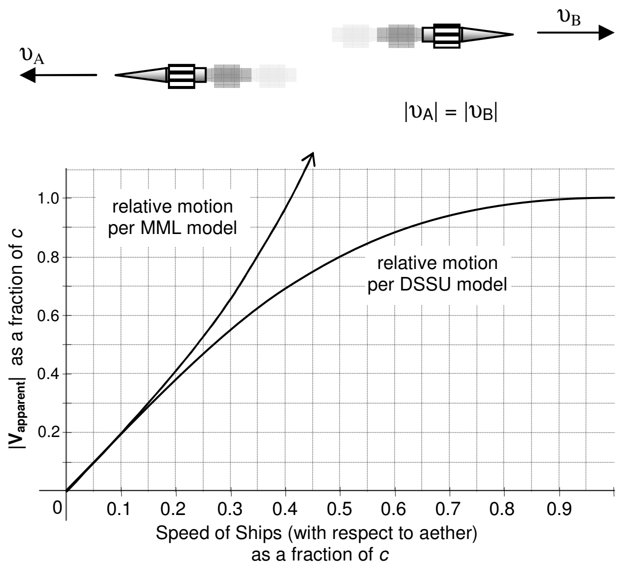

Fig. 7. Observers in ship *A* and ship *B* have identical *absolute speed* (with respect to aether-space). What is "observed" from either traveling frame? The graph shows the *apparent relative speed* predicted by the modern Maxwell-Lorentz (MML) model and by the DSSU aether model. The latter agrees with conventional *special relativity*.

The MML model, in contrast, predicts that when $|\upsilon_A| = |\upsilon_B| > 0.414\, c$ then apparent relative speed will exceed the speed of light! (See Fig. 7, upper curve.) Thus, the model not only has a serious symmetry problem, but also an apparent-speed problem.

5. The Motivation for an Aether Theory

There are several reasons for incorporating an aether theory into physics.

The most self-evident reason is to provide a conducting medium for light —to answer the basic question of *what is it that determines or "fixes" the speed of a photon?* What defines its magnitude and makes it 300,000 km/s and not 150,000 km/s? Einstein's geometric space does not, and cannot, say. Einstein's space is empty space.

There is a need for an explanation for the domain of *non-symmetrical relativity* in agreement with one-way light-path experiments (Gift's analysis of the Roemer effect[1]; DeWitte[8]; Cahill[9]).

Another reason is to provide an aether based explanation for *symmetrical relativity* entirely consistent with the results obtainable with ESR. An aether-based relativity theory must be all inclusive; it must, therefore, encompass Einstein's relativity equations.

Those pursuing Galilean relativity find it indispensible. Arguing from the principle of Galilean invariance, Sela, Tamir, Dolev, and Elitzur have shown that the resulting causal paradoxes make the introduction of aether into physics unavoidable.[10]

An aether medium also turns out to be enormously important in the causal mechanism of gravity.

For the reader interested in the aether theory from an historical perspective, an overview and chronology entitled, *History of the Aether Theory*, is available at the Cellular Universe website.[c]

Let us, for the moment, focus on symmetrical relativity —Einstein's relativity. ESR, of course, does not use nor require an aether medium. However, if our Universe is permeated with aether then an aether-based relativity theory must have the capacity to replicate the successful results (the observationally confirmed predictions) of ESR.

In order to duplicate the results of ESR we need to understand the restrictive nature of Einstein's 2nd Postulate. If we do not take this restriction into account, then we may, after looking at the evidence cited in this section, be tempted to declare Einstein's lightspeed postulate to be wrong. Let me explain.

The measure of the speed of anything is meaningless without employing a time interval. So, how do we define a time interval? Einstein must have understood that in a discussion at this fundamental level the intuitive notion of time intervals (say, between events at different places) is inadequate. And so, he provided us with an operational definition of simultaneity and time-interval at different places as follows: Suppose time-intervals at different points of a given coordinate system are measured by clocks of similar construction; we may then synchronize these clocks by means of light signals. *A* emits a light ray at time t_A by *A*'s clock; it is received and reflected by *B* at time t_B by *B*'s clock, and returns to *A* at t'_A by *A*'s clock. Then *B*'s time t_B is *defined* to be simultaneous with *A*'s time $½(t'_A + t_A)$. [11]

What is significant is that this definition makes the speed of light the same in both directions (directions *AB* and *BA*) by virtue of the time interval employed. And when extended to any pair of relatively moving observers (in uniform motion) it makes the speed of light, in a closed path, constant in all directions.[12] Furthermore, there has never been a violation of Einstein's narrowly-defined speed of light. In fact, the Michelson-Morley type experiment when conducted in vacuum mode provides unequivocal confirmation for the definition.

But what about the lightspeed anisotropy clearly detected in the extensive Dayton Miller experiments[13]? They do not represent a violation because they were *not* performed in a vacuum.

A light pulse (through vacuum) measured in the out-and-reflected-back fashion will always register a speed *c* —will always conform to Einstein's postulate. This speed constancy, as Stephan Gift succinctly put it, is a most remarkable illusion.

[c] www.CellularUniverse.org/AA3AetherHistory.htm

Now what about the experimental evidence [8, 9, 13] that is driving physics towards the adoption of an aether theory? ... Rather than representing a violation of ESR theory, it simply exposes the incompleteness of Einstein's theory.

The experimental evidence consists of the one-way measure of the speed of light. It is found that the speed of a light pulse is not constant but depends on the motion of the observer. The fact that the measured one-way speed of light is not constant, as Gift [14, 15] and others [16, 17] have amply demonstrated, tells us that ESR is incomplete. Something is missing.

That "something" is, of course, the preferred frame of reference which Einstein had discarded so very long ago. The missing component is the preferred frame that the aether represents.

Motivation for Extending Special Relativity

When Professor Gift questions the validity of Einstein's lightspeed postulate, as in his statement, "One-way light speed testing is therefore necessary in order to determine the validity of the light speed invariance postulate"[1], he is overlooking the restrictive nature of the definition in Einstein's theory.

Certain one-way measurement experiments of the speed of light are outside the scope of ESR —and not a question of ESR's validity. The lightspeed variance that clearly does arise from such one-way measurements can only be explained within an absolute space (or aether) theory. Evidently ESR needs to be extended —extended to include the preferred frame that Einstein had discarded.

When Professor Gift proposes using the modern-Maxwell-Lorentz aether theory to explain the evidence of lightspeed variance (variance that depends on the motion of the observer) he overlooks the lack-of-symmetry paradox in the theory. He overlooks the contradiction (detailed in Section 2) that arises from the theory's transformation equations when applied to relatively moving observers.

The conclusion, again, is that Einstein's theory does not need to be replaced; rather it needs to be extended.

6. The DSSU "Extended" Speed of Light Postulate

I will now detail how the DSSU aether theory accommodates, in addition to a defined *absolute* lightspeed, two definitions of *relative* lightspeed.

The physical nature of electromagnetic waves is that they are conducted by aether and it is the properties of the aether medium (whatever those properties may be) that determine the magnitude of the conduction-propagation speed. If, as is the case with our model, the density of the aether medium does not vary, then neither does the speed of conduction of light waves. Thus, the core definition holds that the speed of light is constant with respect to aether.

The core-definition speed is approximately 300,000 km/s, with respect to aether at rest.

It follows that the *observed* speed of light is determined by the aether AND the motion of the observer through the aether. (See Fig. 8.) The speed of a light pulse (speed with respect to the observer) varies according to the speed of the observer's frame. If υ is the observer's speed with respect to aether, then the one-way speed of light is theoretically predicted to be $c \pm \upsilon$. This result can be derived from the Doppler Effect[18], and is supported by considerable experimental evidence [9, 14, 15].

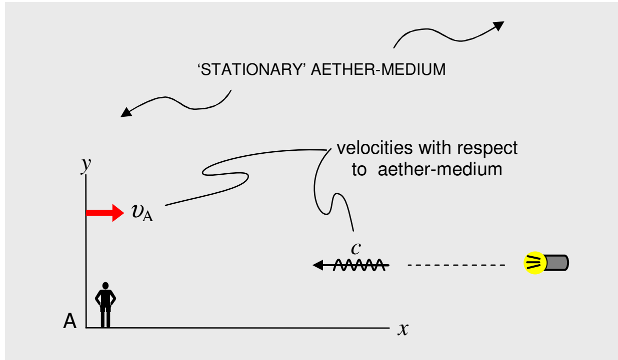

Fig. 8. The speed of the light pulse is c —with respect to aether by definition. The speed of the observer is υ_A —with respect to aether by choice. Then, the speed of the light pulse *with respect to the observer* must be $|c \pm \upsilon|$. (Note that the motion of the light source is irrelevant; although it can affect the frequency, it cannot affect the speed of the pulse.)

Thus the core definition makes the speed of light intrinsically constant. But because of the presence of aether (something which Einstein chose not to deal with) the "observed" speed of light must be variable. We construct a definition, then, that has a variable speed of light; however, there is a condition. For this *variant* speed to be "observed" one must use the one-directional-path method (and somehow overcome the difficult task of clock-synchronization at both ends of the path interval).

But, of course, there is another definition of light speed which requires that the "observed" speed is *not* variant.

The challenge for our aether theory (in fact, any sort of absolute space theory) is this: In addition to the *variance* of the speed of light as just described, it must also be able to accommodate Einstein's postulated *invariance*. By postulate, Einstein's observers, regardless of uniform motion, always measure the same value for lightspeed.

First, we need to examine what method Einstein's observers are using to actually measure the light. What axioms or definitions are bolstering the postulated invariance? The precise details may be extracted from Einstein's operational definition of simultaneity and time-interval (as given in the previous section). Essentially, Einstein requires that the light pulse be measured using an out-and-reflected-back method.

All the experiments based on this method have, for over 100 years, given consistent results. There is no question as to the validity of Einstein's postulated (definition-restricted) speed of light.

We make this our second definition of relative lightspeed.

Can our aether theory conform to the additional requirement of this *invariance* definition? ... Can the results of the traditional two-way test be explained within the aether model knowing full well that the method was originally designed for an abstract-space theory?

In short, does DSSU theory predict constant *c* (regardless of observer's motion through aether)? Let us see.

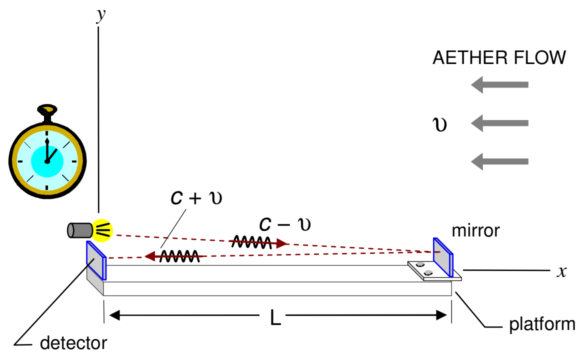

Fig. 9. "Two-way" method for measuring lightspeed in accordance with the *invariance* definition. We already know that the speed of the light pulse is constant *c* with respect to aether. (We know this because we are using an aether theory.) But what is the measured (the apparent) speed of the light pulse?

Consider the set-up shown in Fig. 9. Ignore the impracticality of trying to use a stopwatch to time the round-trip motion of a light pulse; simply focus on the equation for the apparent speed of light,

$$c_{\text{apparent}} = \frac{2L}{\Delta t} . \tag{34}$$

The apparent speed of light is the distance the pulse travels divided by the clock time-interval that the round-trip takes. The right side of the expression is simply the way in which speed —any speed— is defined.

The pulse being measured has an absolute speed *c* with respect to aether. The speed υ is the flow of the aether itself (this is the same as saying that the apparatus frame is absolutely moving through the aether with speed υ). Now, to be consistent, length *L* and clock time Δ*t* must also be expressed in terms of their motion *through* aether.[d]

To be consistent with "absolute" *c* and "absolute" υ, everything on the equation's right side, the *apparent* length and *apparent* time-interval, must be converted into intrinsic terms. This means that both *length contraction* and *clock retardation* (as in the original meaning of time dilation) must be taken into account. In an aether-based theory these two physical effects result from the motion of bodies *through* the aether.

The intrinsically contracted length is,[19]

$$L_{\text{intrinsic}} = \frac{L}{\gamma} , \tag{35}$$

and the intrinsic time interval is,[19]

$$\Delta t_{\text{intrinsic}} = \gamma \, \Delta t . \tag{36}$$

What is it that makes these expressions intrinsic? The expanded gamma factor (see eqn (3) far above) contains the all-important distortion-causing *aether velocity*.

By substituting (35) and (36) into (34),

$$c_{\text{apparent}} = \frac{2L_{\text{int}}\gamma}{\Delta t_{\text{int}}/\gamma} = \frac{2L_{\text{int}}\gamma^2}{\Delta t_{\text{int}}} . \tag{37}$$

The round-trip time can now be formulated using the velocities shown in Fig. 9,

$$\Delta t_{\text{int}} = \frac{L_{\text{int}}}{c-\upsilon} + \frac{L_{\text{int}}}{c+\upsilon} = \frac{2L_{\text{int}}}{c}\frac{1}{\left(1-\upsilon^2/c^2\right)} ,$$

$$\Delta t_{\text{int}} = \left(\frac{2L_{\text{int}}}{c}\right)\gamma^2 ; \tag{38}$$

with which eqn (37) simplifies to:

$$c_{\text{apparent}} = \frac{2L_{\text{int}}\gamma^2}{\left(2L_{\text{int}}/c\right)\gamma^2} = c . \tag{39}$$

The *apparent* speed of light equals *c*, which is a *constant* (and has the well known value of about 300,000 km/s).

Thus, the "invariance definition" of our aether theory agrees with Einstein's relativity postulate for the speed of light.

It is the contraction of length and the slowing of clocks that gives us the remarkable illusion of the constancy of the speed of light under the conditions just described.

But change the conditions and the light pulse may reveal its *observer-dependent speed variance*. The Roemer experiment, which involved measurable changes in the speed of the light coming from the occultations of Jupiter's moon Io, is a good example. The variation of $(c \pm \upsilon_{\text{orbit}})$ was caused by the orbital motion of the Earth.[14]

But keep the ESR's restrictive conditions in place and the aether theory *does* verify what is claimed by ESR relating to the apparent constancy of the speed of light.

Table I, below, gives all three component parts of the speed of light postulate for the new theory.

[d] The expression $\left((c)_{\text{PER AETHER}} \pm (\upsilon)_{\text{PER AETHER}}\right)$, from Fig. 9, is an aether-referenced speed and so must be applied over an aether-referenced length $L_{\text{int}} = L/\gamma$ and using an aether-referenced time $\Delta t_{\text{int}} = \gamma \, \Delta t$.

Table I. The speed of light postulate for the new theory (DSSU extended relativity) comprises three definitions.

Speed of Light Postulate			
Three ways to define the speed of light	Speed relationship	Motion of observer	Remarks
Constant with respect to the light-conducting medium:	$v_{\text{intrinsic}} = c$	Irrelevant	Speed is determined by the properties of aether (notably its constant "density")
Non-constant and non-symmetrically relative (Not ESR compliant):	$\upsilon_{\text{rel}} \begin{cases} < c \\ = c \\ > c \end{cases}$	Away from source At rest within aether Towards source	Measuring method: *One-way light path*
Constant and symmetrically relative (Einstein's Postulate):	$v_{\text{rel}} = c$ Propagation speed of light as a remarkable illusion!	Any uniform motion	Requires Einstein's defined measuring method: *Two-way light path*

Table notes: The two-way-light-path method involves light pulses beamed out and reflected back to the observer. The Michelson interferometer uses this method. With the other, the one-way-light-path method, no reflection is involved. An example of this method is S.J.G. Gift's analysis of the Roemer effect (the variation in the period of Jupiter's moon Io as observed from Earth from opposite sides of Earth's Solar orbit). Of course, c ≈ 300,000 km/s

7. Concluding Discussion

When researchers are critical of ESR's constancy-of-light-speed postulate they tend to overlook that this speed has a rather narrow definition. The scope of its limitation needs to be understood. Physics can then move on by adopting a dual definition.

Einstein's view of the world was highly abstract. His relativity theory deals with what is *apparent* —strictly with what is observer dependent. He does it explicitly by denying an absolute frame of reference (no aether), and he does it implicitly in the way he defines simultaneity and time-interval. It implies that the speed of light is defined by an out-and-reflected-back method (the *two-way* method). The result is a *symmetrical* version of relativity and a postulate for an *invariant* apparent speed of light.

But there is also apparent lightspeed *variance*. Stephan Gift has correctly determined, in his analysis, the motion of light pulses with respect to Earth and found that the speed of the pulses varies. He has, in effect, verified the definition requiring the *one-way-path method*. But this does *not* allow Gift to claim, as he does, "a measured variation of the one-way speed of light ... directly invalidates the light speed invariance postulate and hence falsifies special relativity."[[1]] Such a claim cannot be credible because the two-way lightspeed invariance is sufficient —even in the presence of one-way lightspeed variation— to maintain the validity of the equations of Einstein's special relativity.[[20]]

To be fair, Gift does have a counterargument. His interpretation of the relativistic sum-of-velocities equation "demands" one-way lightspeed invariance. Unfortunately, it neglects the fact that Einstein's core definition (his two-way light-path requirement) has prior authority over Einstein's postulates. Any interpretation of ESR equations are restricted accordingly.

Returning to the main point of the discussion. There are two definitions for the apparent speed of light.

The variance definition: The observed speed of light when measured by the *one-way method* depends on the motion of the observer. The applicable equation, for "low" speeds, is

$$c' = c \pm \upsilon\,, \qquad \upsilon << c\,. \tag{40}$$

The invariance definition: The observed speed of light when measured by the *two-way method* does not depend on the motion of the observer. This is the ESR-compatible definition. The supporting equation is

$$c' = \frac{c+\upsilon}{1+\left(c\upsilon/c^2\right)} = c\,, \tag{41}$$

which is simply an application of the sum-of-velocities formula of special relativity. As applied here, the variable c' represents the observed speed of a photon (or light pulse), which has a speed of c with respect to its source; the source itself is moving with speed υ with respect to the observer. *Regardless of the value of υ the expression always reduces to the constant c.* Essentially, this is the mathematical expression of Einstein's lightspeed invariance postulate.

Needless to say, a careful distinction must be maintained between the variance and invariance definitions —between the asymmetrical and symmetrical domains of relativity. In this regard, eqn (41) has no relationship to eqn (32) or (33).

Any realistic aether theory must incorporate three elements: (i) constant c with respect to aether, (ii) the ESR *illusion* of constant lightspeed, and (iii) the experimentally determined *non-constant* speed of light.

A functional aether theory must be able to explain all the apparent relativistic effects coded in Einstein's special relativity. It must also be able to explain all the absolute effects imposed by aether and detectable by experimentation.

The "modern Maxwell-Lorentz aether theory" does not meet these requirements; as shown in Section 2, it leads to a contradiction and unlimited speed.

The DSSU aether theory, on the other hand, fulfills all the above requirements. The theory includes the *apparent* effects due to motion as well as the corresponding *intrinsic* effects. In a practical sense, it serves to extend traditional *special relativity* into a very special frame of reference. □

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