How DSSU Relativity Resolves the Speed Paradox

Measurable Absolute Motion Resolves a Paradox in Einstein's Special Relativity

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*Exactly how relativity is to be modified is a subject of hot debate at the moment.
Some people argue that special relativity theory must be modified ...* –Lee Smolin[1]

*When a larger theory encompasses a narrower one,
the paradoxes of the narrow theory disappear.* –Joel R. Primack[2]

Keywords: Special relativity; relative motion; absolute motion; absolute space; Doppler effect; Doppler radar; aether; absolute inertial motion; Dynamic Steady State Universe; DSSU*.

* DSSU is a cosmology model based on the premise that all things are processes.

One of the great unsolved mysteries in standard cosmology involves the nature of the relationship between absolute motion and relative motion. By the first postulate of *Einstein's theory of special relativity* (ESR) one cannot tell if one is at rest or in uniform motion in a straight line. However, one has no problem recognizing the other forms of motion: rotation, linear acceleration, and change-of-direction acceleration. Why not inertial motion!? Jacob Bronowski, writing in Scientific American, posed the question this way,

> *Why does the special theory of relativity single out, of all possible modes of movement, the movement in a straight line at constant speed? Why cannot the traveler tell if he is in this state of movement or at rest?*[3]

And leaves the question unanswered when he states, "As far as we know there is no reason in the world ..." It is a mystery.

1. The Plan to Demonstrate the Absolute Nature of Inertial Motion

In the realm of relative motion it is often of great importance to determine and apportion intrinsic motion to the participants of relative motion. Most people are aware of, and may have experienced, the classic situation of the passenger in one railway coach (or subway car) viewing a slowly moving adjacent train and being aware of the relative movement (in the right or left direction of the train window) but momentarily unaware of which train is actually moving. Now, designating and determining *relative* motion is quite simple; a train's motion can be relative to the station, or relative to any one of several other trains, or relative to any frame of reference one might choose. ... Not so with intrinsic motion.

The question of who is in motion is not as easy as it may seem. For instance, is the person sitting in front of a computer at rest or in motion? Is an object in gravitational freefall at rest or in motion? Two spaceships cross paths in deep space —how are the intrinsic motions apportioned?

Despite the difficulty, the determination of who, or what, possesses intrinsic motion is imperative. It is imperative in theory and in practice. Without absolute motion a theory dealing with such matters is incomplete; relative motion alone, when extreme, leads to ambiguity and paradoxical situations.

Relatively moving clocks —mechanical-, biological-, and atomic- clocks— appear to slow down but do they actually slow down? Or is it only *absolutely* moving clocks that actually slow down?

Clock slowing is a very real phenomenon. The Global Positioning System proves that it is. So too does the slow-motion ("time dilated") decay of mu-mesons bombarding the Earth's atmosphere[4] detailed in most physics textbooks.

Intrinsic (or absolute) motion is special indeed.

In practical and fundamental terms, absolute motion is the essential ingredient for *actual* time dilation, known as clock retardation, and the cause of *actual* Lorentzian length contraction.

How then do we determine this motion? And, more fundamentally, how do we demonstrate the reality of *absolute inertial motion*? ...

What better way than with a paradox? (And a mystery always conceals a paradox.)

Not only is the inability to determine one's own state of inertial motion considered a mystery (at least within conventional theory) but this alleged inability compounds the mystery as it leads to a paradox.

First, some preliminary stuff to guide us to the paradox and beyond. Let us start by asking the question "What is the signature effect of absolute motion?" We cannot answer by invoking the familiar acceleration effects one encounters in an elevator, or in a car, with constant speed, rounding a circular bend in the road. ... No, that would unjustifiably exclude "*absolute* movement in a straight line at constant speed" (henceforth, *absolute inertial motion*). The signature effect of absolute motion is *clock slowing*. And how can we tell if a clock is running slow? —the simple (and incomplete) answer is by comparing the moving clock with an identical non-moving clock.

So here is our main premise: Clocks *actually* slow down if, and only if, there is absolute motion through space. Real time dilation occurs only in the presence of absolute motion through space.

This means that if one can establish clock retardation, then one can be certain of the presence of some form of absolute motion.

Now if *real* time dilation (clock slowing) can be demonstrated under the condition of inertial motion, then such inertial motion must be *absolute* inertial motion. We will then be in a position to confront ESR which does not recognize the *absolute* concept, claiming that *all* inertial motion is relative.

The presentation of the ideas will follow the pattern shown in the flowchart (Fig. 1).

Next up is a demonstration of a known type of absolute motion and the associated clock retardation —a basic version of the twin paradox. Section 3 will demonstrate *absolute inertial motion* and a situation, which, in Section 4 leads to a paradox —*the speed paradox*. Section 5 resolves it.

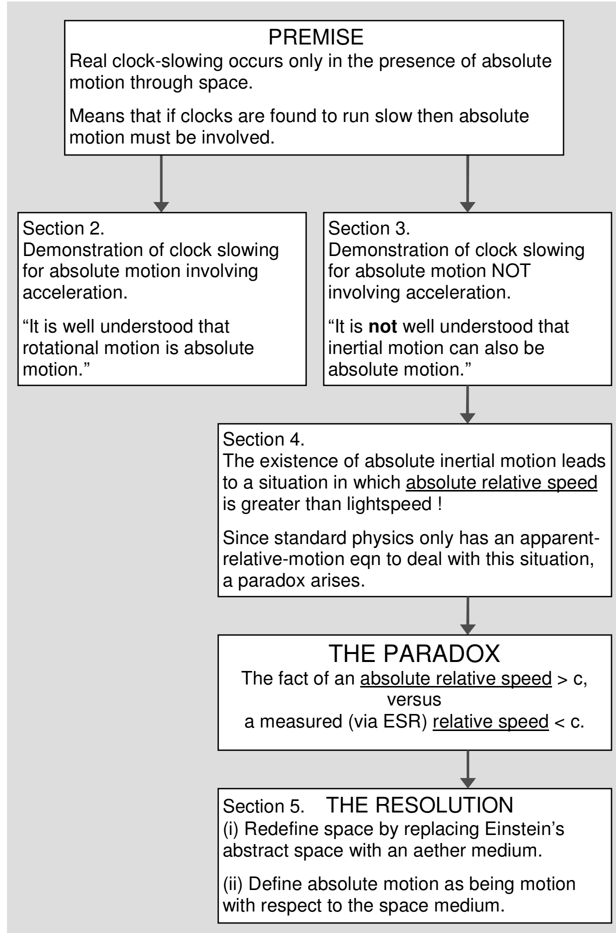

Fig 1. ***Tour guide to the speed paradox*** —and its resolution by extending Einstein's special relativity (ESR).

2. Known Absolute Motion Involves Clock Slowing

It is well understood that rotational motion is absolute motion. This includes motion along a curving trajectory. By this I am not stating anything new here; however, I do want to describe a space-travel scenario that not only serves to demonstrate known absolute motion and clock retardation but also is important later in demonstrating absolute inertial motion.

A thought experiment. A space mission is undertaken with the purpose of testing and measuring clock slowing due to motion. The space craft is piloted by a twin whose other half remains on Earth. (The twins serve as biological clocks, one for the mission and one for the 'control' part of the experiment.) The journey is a repeating circumnavigation of the local region of the galaxy to the north of our solar system. With each circumnavigation, which takes 10 years, mechanical and atomic clocks are compared 'on the fly.' As the ship passes the Earth on its way to begin another grand circular trip, the relevant data, including photos, are radioed to each other. See Fig. 2.

And sure enough *the clocks do not agree*, the traveling twin ages less than the stay-at-home sibling. The moving clocks *do* run slower than the Earth clocks. This is a version of what is popularly known as the *twin paradox*. The phenomenon that it illustrates, known as the net proper-time difference, was predicted by ESR theory. But there has been a longstanding debate over the nature and physical cause of the time difference in the paradox. Over the years alternate explanations appeared for the net proper-time difference —some within ESR, some not. There is even debate over the interpretation of what it is that experiments have actually demonstrated. And to add to the confusion, time dilation and clock retardation are treated as quite different physical phenomena yet they can produce the same effect.

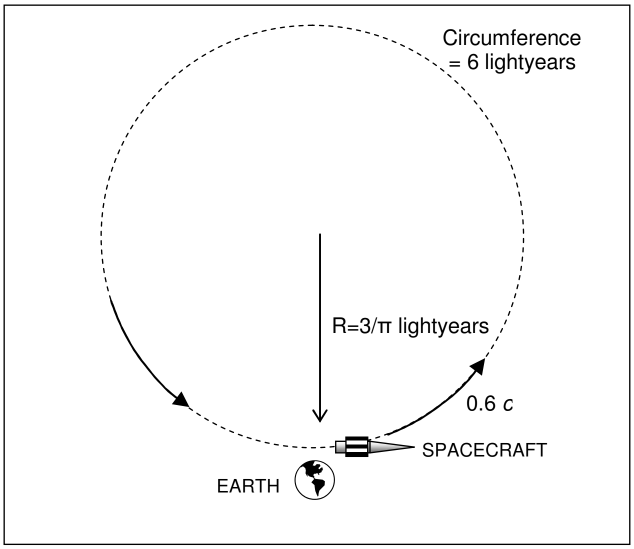

Fig. 2. *Rotational (or circular) constant-speed motion is a known form of absolute motion.* Absolute motion causes clock retardation. If a circumnavigation with speed 0.6*c* (where *c* is the speed of light) takes 10 years (Earth time) then the traveling twin will age only 8 years. The clocks differ by two years.

The conventional argument is that the Traveler, because he experiences acceleration, knows he is in motion and therefore expects his clock to run comparatively slower. Although the velocity is continually changing (in direction) the magnitude (the actual speed) remains constant. Thus ESR may be applied and "time dilation" calculated. If the speed is 6/10ths the speed of light and the circular-trip circumference is 6 lighyears then the Earth twin ages 10 years while the Traveler ages only 8 (see Fig. 2). With each successive pass the age gap widens by an additional two years. The earthbound twin grows older, the traveler remains relatively young —depending on the speed.

It is worth noting that a small-scale experiment of this nature has actually been performed in the lab and proves that clocks *do* slow down. The experiment measures the influence that circular motion has upon the *Mössbauer resonance effect*.[5]

We now proceed to the next phase of the space mission. As the first ship approaches for yet another 'fly-by,' a second ship is launched in the opposite direction of the first. It will journey around an identical astronomical circle, except that this one is to the south of our solar system (Fig. 3).

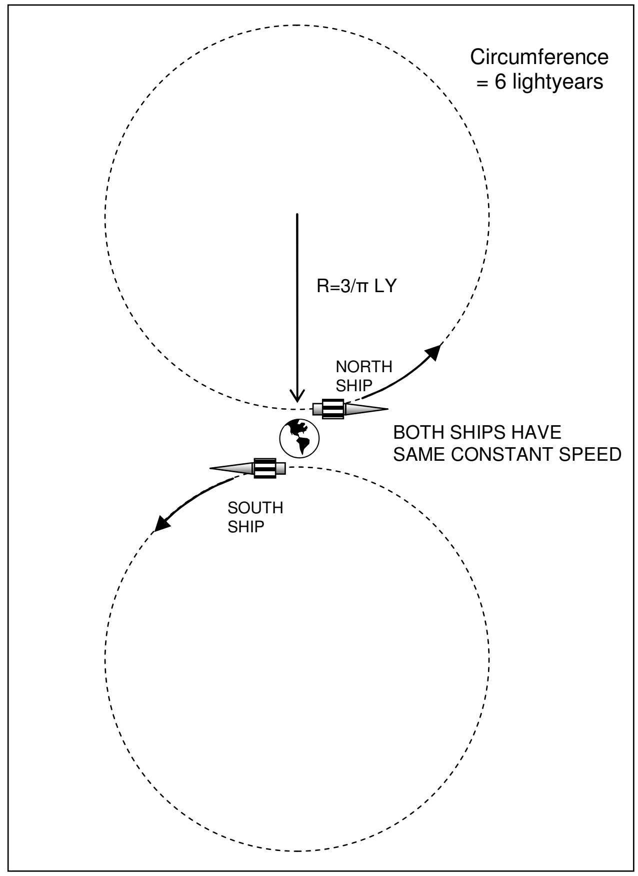

Fig. 3. Known absolute motion causes clock retardation. Both ships experience the same degree of clock slowing. The symmetry is obvious and when ship clocks are compared to each other they will agree.

Fly-by checks are made as before. Each and every time the North and South ships meet in their 10 Earth-year-long loops their clocks will agree —each traveling clock having recorded 8 years.

If we accept the results of phase one, then we must agree that when clocks are compared in phase two they will concur —they will concur because they are equally experiencing "time dilation." The situations are symmetrical.

We would *not* express a purely relative view by saying that since the clocks agree, there is now no clock slowing.

3. Absolute Inertial Motion as a Limiting Case of Known Absolute Motion

It is *not* well understood that inertial motion can also represent absolute motion.

It can be shown that absolute motion does not depend on the presence of acceleration. And, as such, it may be called *absolute inertial motion*.

A glance at Fig. 3 makes it obvious that changing the radius of the astronomical circles does not in any way change the clock retardation. The two radii need not even be the same. *Only the magnitude of the velocity can affect the time rates of the clocks*. (Clock rates are determined only by the speed *through* space.) With this in mind, we increase the radii to allow a circumnavigation of the Milky Way's spiral arms. We do not stop there; we imagine extending the radii to infinity. In the limit, the two ships will meet along parallel straight lines (noting that a straight line is but a curve of infinite radius). As Fig. 4 illustrates, the acceleration gradually vanishes and we end up with what in ESR is called *inertial relative motion.* We'll return to the ESR interpretation in a moment.

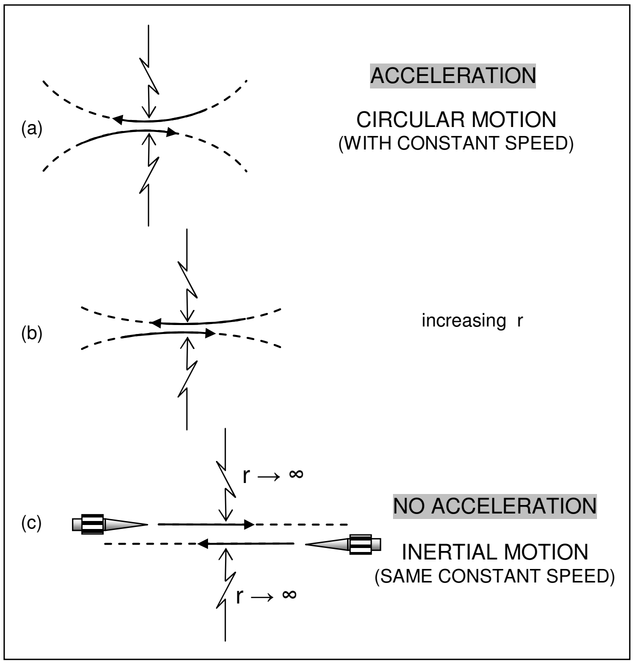

Fig. 4. Accelerated motion transforms (conceptually) into inertial motion by allowing the radius of the curved path to approach infinity, as shown by the sequence (a), (b), and (c).

Conceptually, we have transitioned from accelerated motion to inertial motion. We expect that the intrinsic motion and the accompanying clock slowing is still there (the ships' clock rates should still agree). If this were not so then we would be faced with a logical absurdity of having to find that one demon-radius, the radius with length somewhere between 3/π and infinity, which caused the destruction of absolute motion and the cessation of clock retardation. We accept the more logical conclusion that linear inertial motion is a form of absolute motion.

Of course, we could pretend, as is done in ESR, that one ship (the choice of which ship is arbitrary) is at rest in its own frame of reference and the other ship is entirely responsible for the observed relative motion. We thereby avoid all mention of absolute motion —and avoid the reality of the situation.

The argument of Fig. 4 shows that, in principle, there is no difference between the known form of absolute motion and *absolute inertial motion*. So if there is no difference, then *absolute inertial motion* must also involve clock retardation just as in the Figs. 2 & 3 situations and the *Mössbauer* experiment. This also happens to be consistent with the main premise in which the two properties are linked.

Since inertial motion slows clocks, then we have a simple resolution to the traditional *twin paradox*. See Fig. 5.

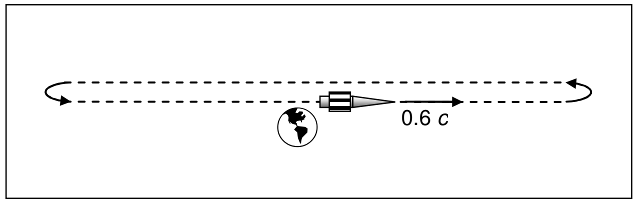

Fig. 5. Since constant-speed linear motion is a form of absolute motion, clock slowing is to be expected; hence, no *twin paradox*. (The paradox is confined to ESR.) The space journeys, instead of being circular as in Fig. 2, are straight-out and straight-back trips repeated over and over. Acceleration plays a momentary but otherwise negligible part. Practically all the clock slowing occurs during inertial motion.

In any case, we have a situation of *absolute inertial motion*. What happens when opposing absolute motion is measured?

4. The Paradox

The strange consequences when travelers have opposing absolute inertial motion.

The purpose of the next part of our thought experiment is to measure speed. The space travelers have established the reality of their absolute motion. They readily calculate the 'absolute' speed using the geometry of the circle and the measured circumnavigation time. Furthermore the speed is verified by means of Doppler measurements of the light from an Earth navigation beacon. (The emission frequency of the beacon is fixed at the frequency of pure yellow light, $f_S = 5.2\times10^{14}$ Hz and is a known quantity for the navigators involved in the mission.)

As each ship approaches the Earth for a velocity check, the Doppler shifted frequency that the Navigator reads on his instruments is $f_D = 10.4\times10^{14}$ Hz. This quantity is then used to calculate the corresponding speed using the standard ESR Doppler equation:

$$f_{\mathrm{DETECTOR}} = \frac{\sqrt{1-(v/c)}}{\sqrt{1+(v/c)}} f_{\mathrm{SOURCE}}, \qquad (1)$$

Note: This ESR Doppler equation depends only on the relative velocity *v*. When relative motion is *towards* each other, then *v* is negative.

which, after isolating the velocity parameter, gives:

$$v = \frac{1-\left(f_{\mathrm{D}}/f_{\mathrm{S}}\right)^2}{1+\left(f_{\mathrm{D}}/f_{\mathrm{S}}\right)^2}\times c\,. \qquad (2)$$

The frequency values are inserted and a velocity magnitude of $v = |-0.6\,c| = 0.6\,c$ is confirmed. Now since this speed was calculated using the 'relativity equation,' technically, it is a *relative* speed. However, since an absolute-motion Doppler equation is not yet available the participants of the thought experiment have no choice. They simply assume that the Earth is stationary. Each ship, then, is approaching Earth with an 'absolute' speed of 3/5ths the speed of light. (As followers of Einstein, they would, of course, call it a *relative* speed).

Because of the symmetry of the paths, the North Ship and the South Ship have equal and oppositely directed speeds. Furthermore, since these are now absolute motions, a Doppler reading *must verify* that the combined approach speed is 1.2 *c*.

See Fig. 6.

The ships align themselves; the paths become linear; the motions are purely inertial; all is ready; and within seconds it's all over. Doppler measurements have been captured from the on-coming 'headlight' beacons. Each ship's frequency detector registers $f_{\mathrm{D}} = 20.8\times10^{14}$ Hz (and will be explained later).

The Navigator again applies the ESR Doppler eqn (2). And here *special relativity* fails. In contradiction to reality, the *special relativity* interpretation tells him the relative speed between the ships is *only 0.88 c* nowhere near what is needed for verification!

The hard data of the earlier Doppler frequency readings (the ones with respect to Earth) clearly support a real and combined speed greater than the speed of light. The simple logic of the situation calls for a combined speed greater than *c*. The incomplete ESR theory[6] insists that reality is what you can measure and you cannot measure the relative speed to be greater than lightspeed. We have a paradox.

The existence of *absolute inertial motion* leads to a situation in which *absolute relative speed* is greater than lightspeed!

Since standard physics only has an *apparent* relative-motion equation to deal with this situation, a paradox arises.

Let us call it the *speed paradox*. Forget the twins, forget the slowing of biological clocks and the mechanical-clock retardation. This paradox deals with the frequency of incident (and reflected) light and the speed of an object.

The Paradox is: The fact of an *absolute* relative speed > c, versus a "measured" (via ESR) relative speed < c.

Yes, ESR theory says you cannot measure the relative speed to be greater than *c*. But there is a loophole. Look at what is being measured. It is not speed, not distance divided by time. What is being measured is the *frequency* of a light beam. Speed —qualitatively and quantitatively— is subject to the method of interpreting this frequency. ESR interprets the frequency, using eqn (2), to define a relative speed —an *apparent* relative speed.

There is, however, another interpretation, one that defines an *absolute* relative speed.

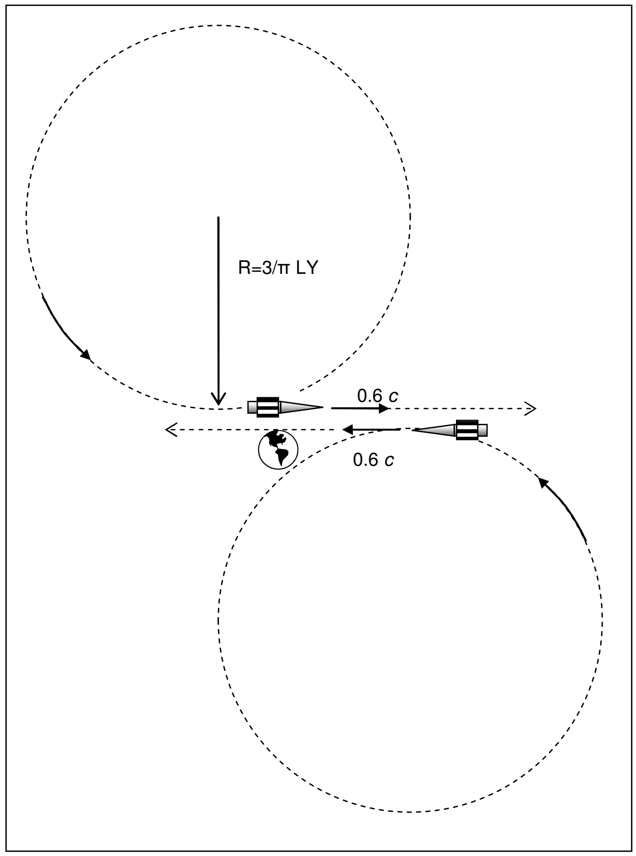

Fig. 6. *A speed paradox.* The motions shown have been proven, in the text, to be *absolute.* The geometry, the logic, and the Earth observer, all say that the ships are coming together with a combined speed of 1.2 *c*. The ESR Doppler equation says no, the relative speed is only 0.88 *c*

5. Resolving the Speed Paradox

The resolution of the paradox requires a preferred frame of reference. First we redefine the concept of space —by replacing Einstein's *abstract* space with an *aether* permeation. The rest frame of this aether medium then serves as the preferred frame.

By incorporating aether into a relativity theory we are recognizing a certain degree of absoluteness in the nature of space and we are unequivocally embracing a preferred frame of reference. Interestingly, a preferred frame of reference also plays a role in electromagnetic theory.

> ... *[T]he foundation of electromagnetic theory taught that a particular inertial system must be given preference, namely that of the luminiferous aether at rest.* –Albert Einstein[7]

Yet amazingly Einstein, in 1905, rejected that very foundation.

If ever there was a pivotal moment in the long history of relative-motion theory —a pivotal moment when things could have turned out radically different— then this is it. Einstein knew the 19th century aether was seriously flawed (see Table I). He rightfully rejected it. But he went further. In formulating his theory of relativity he more or less discarded all versions of the aether concept and —being of key importance to the present discussion— *he rejected the preferred frame of reference*. Having thrown out the notion of a space medium (the *luminiferous aether*), Einstein, a true 20th century Pythagorean[8], had no choice but to also sacrifice the preferential frame. The consequences of his fateful action, associated with the year of 1905, are broad and deep. However, it is my contention that the aether concept only needed to be modified —not discarded!

What were the grounds for the condemnation of the old aether concept? One is the fact that it did not possess dynamical properties. (I merely mention this fact but do not discuss it.) The real transgression that offended Einstein, as we may well imagine, is the fact that it predicts a variable speed of light. Specifically, according to the contemporary aether theory, if the light source is at rest with respect to the aether, *the measured speed of light will depend on the velocity of the observer*.[9] If, however, the observer is at rest with respect to aether then the speed of light will be recorded as c even if the source is moving with respect to aether.[10]

The resolution of the space travelers' speed paradox requires a modified type of aether —essentially an aether that interacts with matter. It requires an aether medium without the above problem. Such a medium was found in 2002. During the conceptual development of what is called the *Dynamic Steady State model of the Universe* (DSSU), a model based on the premise that all things are processes, a *process-aether* was developed.

For a quick comparison between the traditional aether and DSSU aether please see Table I, below. Both types are considered luminiferous; that is, both serve as the medium for conducting electromagnetic waves. Note, however, they make different predictions for the apparent speed of light for the moving observer. The DSSU aether predicts observable lightspeed variance and, also, observable invariance. Even though DSSU aether is the conducting medium, the speed of light appears constant for *all* observers when using the conventional two-way method. The 19th century version predicts only lightspeed variance —specifically for the observer moving with respect to the aether. The ancillary difference is that DSSU aether is dynamic while the 19th century version is primarily static. (Another aspect of DSSU aether is that it causes intrinsic relativistic effects such as clock slowing and length contraction.)

Let me emphasize two features: (i) The speed of light *is* intrinsically constant in DSSU aether. (ii) The speed of light appears constant (i.e., it is measurably invariant when using the out-and-reflected-back method in vacuum) for all uniformly moving observers. How does this compare to Einstein's 2nd postulate? Einstein's version of the principle of "the constancy of the speed of light" states: The speed of light in free space is the same in all inertial frames and is independent of the motion of the source or the observer. The DSSU version states: The speed of light *is* constant in the aether medium. The speed merely *appears* the same in all other inertial frames, ... etc.

A third feature —observable lightspeed variation— is noted in the Comparison Table but will not be discussed.

Before continuing with the paradox resolution, let us confirm that the DSSU aether does indeed overcome the fatal flaw of the 19th-century version. The best way is with a proof that the observed speed of a light pulse —a pulse that is conducted by the aether medium— is constant for all observers.

The absolute speed of any light pulse through aether is always $c \approx 300{,}000$ km/s. Therefore, the speed of the

Table I. Two Types of Aether Compared

Property	Traditional Aether	DSSU Aether
LUMINIFEROUS	Yes	Yes
Apparent SPEED of LIGHT Light source at-rest w.r.t. aether. Observer moving w.r.t. aether.	$v_{light} \neq c$ (The reason the traditional aether failed)	$v_{light} \neq c$ (one-way light-path measuring method) $v_{light} = c$ (two-way light-path measuring method) Note: intervals of time and length are altered by observer's motion
Apparent SPEED of LIGHT Light source moving w.r.t. aether. Observer at-rest w.r.t. aether.	$v_{light} = c$	$v_{light} = c$
DYNAMIC or GRAVITATIONAL	No	**Yes**

pulse's own frame of reference (the S″ frame moving with the pulse) is $v_{\mathrm{B}} = c$ as shown in Fig. 7. However, in the frame of the light pulse, the pulse speed is zero. That is, $u'' = 0$ as in Fig. 7.

Consider a representative observer "A" having motion axial to the light beam. Let observer *A*'s velocity-magnitude (with respect to aether) be some fraction of the speed of light. That is, let $v_{\mathrm{A}} = a\,c$, $(a < 1)$.

What velocity magnitude does the observer measure for the light pulse? What does observer *A* determine for the value of u' in Fig. 7 ?

The only known dynamic-aether equation for making the necessary conversion between the frames (of Fig. 7) is the aether-referenced *velocity transformation equation*. It is derived from the famous *Lorentz transformation equations*, and therefore shares their validity. The equation is:[11]

$$u' = \frac{u''\left(1 + v_{\mathrm{A}} v_{\mathrm{B}} / c^2\right) + \left(v_{\mathrm{A}} + v_{\mathrm{B}}\right)}{\left(1 + v_{\mathrm{A}} v_{\mathrm{B}} / c^2\right) + u''\left(v_{\mathrm{A}} + v_{\mathrm{B}}\right)/c^2} \,. \tag{3}$$

Its purpose is to take the velocity u'' of an object (even a light pulse) observed/measured from frame S″ and transform it into the velocity u' of the same 'object' as measured from frame S′. Loosely speaking, it allows a comparison of what observer *A* in moving frame S′ sees with what observer *B* in moving frame S″ sees. Since this is an aether-referenced equation, these frames are moving with respect to aether.

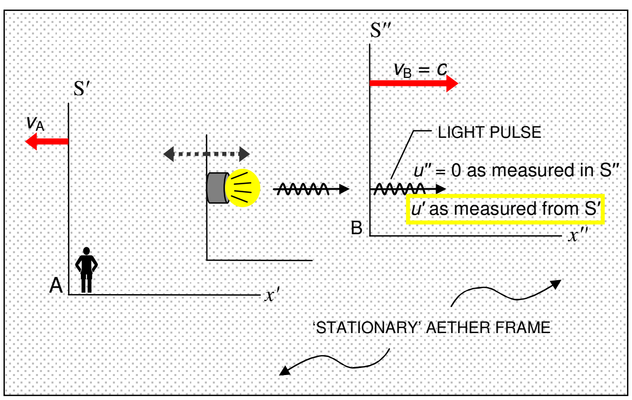

Fig. 7. *The speed of light is constant through aether — and the relative speed of light appears constant for all observers*. The velocity v_{A} of the observer and the velocity v_{B} of the light pulses are ***absolute velocities with respect to the aether medium***. Motion of the light source does not, in any way, affect the speed of the light pulses through aether. Light pulses (or waves) are conducted by the aether at a constant rate of $c \approx 300{,}000$ km/s. Observer *A* measures the velocity of the light pulse as (u') —as predicted in the text, its value is always c.

After making the appropriate substitutions,

$$u' = \frac{0 + (ac + c)}{\left(1 + (ac)c/c^2\right) + 0} \,,$$

which readily reduces to

$$u' = c \,.$$

That is what the DSSU equation predicts. In order to check the validity of the prediction one must perform a so-called two-way light-path experiment. Light pulses are beamed out and reflected back; from the measured time and distance, the speed is determined (at least in principle). In practice, validity can be determined by the lack of measurable difference in different spatial directions. And indeed, the Michelson-interferometer-type experiments —when conducted in vacuum mode— have consistently shown lightspeed isotropy and serve to confirm our prediction.

Essentially this "two-way light-path measuring" requirement (shown in the comparison table) makes DSSU theory compatible with ESR. As for the "one-way light-path measuring method" (also shown in the comparison table), it is of no concern to the present Paper.

Thus, the DSSU equation predicts that all observers will measure the same constant value for the *relative* speed of light —regardless of observers' motion *and* regardless of light-source motion.

The reader should now feel reassured that the proposed aether is clearly unlike the 19th-century predecessor.

As mentioned earlier, the DSSU relativity equations are based on the Lorentz transformation. But so are the Einstein equations. The latter are actually contained within the DSSU model (as will be made evident shortly with the Doppler equation). What all this means is that Einstein could have developed a relativity theory based on a space medium. A pivotal point in history, indeed. If Einstein had been an Aristotelian instead of a Pythagorean, he might have constructed an aether-space with relativistic properties —and an implicit preferred frame of reference.

We now have a serviceable preferred frame of reference. For the sake of argument, we assume the Earth is at rest in the preferred frame.[a] Henceforth, absolute motion means motion referenced to the space medium. Now, just one more ingredient and we will be ready to resolve the paradox. ...

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[a] The Earth, of course, is involved in its own revolving motion about the Sun and also about the galactic core; although measurable, it is negligible compared to the 0.6 c speed of the spacecraft. Furthermore, it is quit possible that the Earth is undergoing *absolute inertial motion*, which, as Jacob Bronowski informs us, cannot be determined. Earth clocks may also have undergone undetermined retardation. And when we compare spaceship clocks to Earth clocks (as in the *twin paradox*) all we can say is that the spaceship clocks have a higher real retardation than Earth clocks. But *here* none of this matters. The Earth's motion and clock status does not enter the DSSU Doppler equation, which will be instrumental in resolving the speed paradox. Think of the Earth as just a convenient marker in space and pretend it is comoving *with* space.

What is needed is a Doppler equation that works for absolute-motion —that works in our preferential reference-frame— while at the same time retains the capacity to deal with pure relative motion. In other words, it must also accommodate the legitimate requirements of ESR. The derivation of the *absolute Doppler equation* uses, once again, the Lorentz transformations. The derivation procedure is detailed in the Appendix A1. The end result is the ***DSSU longitudinal Doppler equation***:

$$f_{\text{MOVING DETECTOR}} = f_{\text{MOVING SOURCE}} \sqrt{\frac{1-(v_S/c)}{1+(v_S/c)}}\sqrt{\frac{1-(v_D/c)}{1+(v_D/c)}}\,. \qquad (4)\ \&\ (a7)$$

The collinear speed (through aether) of the light Source is v_S, and of the light Detector is v_D. When values are assigned, the sense of direction must be included. The "+ and –" sign rules are given in the Appendix A1.

This equation may also be expressed in terms of the wavelengths of the Source and Detector by simply substituting $f = c/\lambda$ with the appropriate subscript.

Returning now to the Navigator (who has followed the same logical steps detailed in the Appendix) and his efforts to determine the absolute motion of the oncoming ship. His own ship's velocity is known, $v_D = -0.6\,c$, obtained by Doppler measurement of the Earth beacon as in the Section 4 Fig. 6 example; also known is the frequency, $f_S = 5.2\times10^{14}$ Hz, emitted by the on-coming ship. The latter frequency, because of the Doppler effect, increases to 20.8×10^{14} Hz when measured by the Navigator on his own detector. For the equation, then, $f_D = 20.8\times10^{14}$ Hz. The values are inserted into eqn (4), which is then solved for v_S .

The result is $v_{\text{SOURCE}} = -0.6\,c$; and in total agreement with reality. The two ships are coming together (indicated by the negative sign) with a combined speed of 1.2 times the speed of light. Similarly, once the ships have passed each other and are separating, the Detector measures a frequency of 1.3×10^{14} Hz and the speed of the ships will be $+0.6\,c$ and $+0.6\,c$ giving an absolute separation speed of 1.2 times lightspeed.

What if there had been neither an Earth-beacon nor any other kind of reference marker which the Navigator could use to measure the velocity of his own ship and its detector?

This poses no serious problem. With the recognition of the reality of aether it becomes a technical matter to measure one's own velocity (speed and direction) *even in a sealed lab experiment.* The direction and magnitude of aether flow can be determined with a gas-mode Michelson-Morley interferometer[12] and more recently with a combination optical and radio frequency interferometer.[13]

6. Doppler Radar Method to Determine Absolute Inertial Motion

The previous method requires that an observer knows the frequency of the source. We had earlier noted that all the beacons were emitting the same frequency —a frequency supposedly selected by mutual agreement on the rules of space travel. But since the necessary information is easily communicated between space travelers, any convenient frequency could be used.

But what if the oncoming object is not a spaceship? What if it is an asteroid-like object and one wishes to measure its absolute speed? One must then apply a Doppler radar method.

A suitable expression may be obtained by applying the Doppler eqn (4) two times to the situation shown in Fig. 8, first to the emitted frequency f_{em} and the impacting frequency f_{imp} and, second, to the reflected frequency f_{ref} and the detected frequency f_{det}. The two expressions are combined. The result is the DSSU Doppler radar equation:

$$\frac{f_{em}}{f_{det}} = \frac{(1+v_A/c)}{(1-v_A/c)}\frac{(1+v_B/c)}{(1-v_B/c)}, \qquad (5)$$

where v_A and v_B are collinear velocities with respect to aether.

Solving for v_B gives an expression for the absolute velocity of the radar's target (labeled "B" in Fig. 8):

$$v_B = \frac{(f_{em}/f_{det})(1-v_A/c)-(1+v_A/c)}{(f_{em}/f_{det})(1-v_A/c)+(1+v_A/c)}\times c\,. \qquad (6)$$

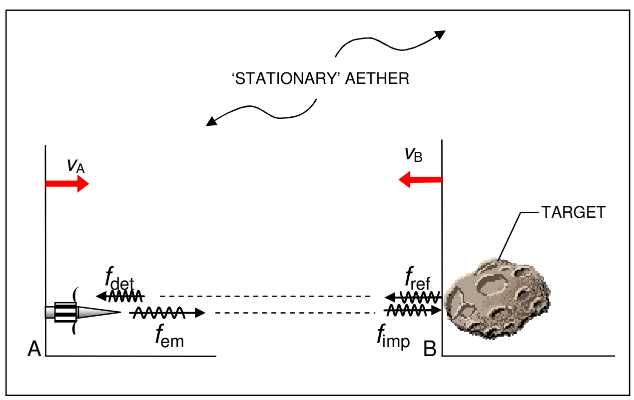

Fig. 8. Doppler radar scenario within aether permeated space. Spacecraft "A" emits radar signal with frequency f_{em} and detects the return signal as frequency f_{det}. The signal impacts the target with a frequency f_{imp} and is reflected with frequency f_{ref}. In the reference frame of "B", frequency f_{imp} equals f_{ref}.

The spacecraft velocity is the same as before; so is the emitted frequency. Assume now that the return signal measures $f_{det} = 82.2\times10^{14}$ Hz. What is the absolute velocity of the target object? Substituting $-0.6\,c$ for v_A

and 1/16 for the frequency ratio into the above equation gives:

$v_B = -0.6 \times c$, where the negative sign indicates motion towards the observer.

In the aether frame, the spacecraft and asteroid are heading towards each other with a combined speed of,

$$\left|-0.6c + (-0.6c)\right| = 1.2 \times \text{lightspeed} .$$

7. Intrinsic Versus Apparent Relative Motion

Absolute relative motion, in the context of space travel, may be defined as relating the motion of "objects" to each other by first referencing them to the aether frame (loosely called the absolute frame). Intrinsic relative motion involves motion *with respect to aether*.

Apparent relative motion, in the same context, involves relating the motion of "objects" using their apparent velocities *with respect to any arbitrarily chosen frame*.

Case in point, had we used the *apparent relativity* of conventional ESR formulation we would have chosen one of the ships as an apparent rest-frame. We would have found, as detailed in Fig. 9, that the ships (moments after rendezvousing as in Fig. 6) are separating with a relative speed of 0.88 *c* ... How do we know this is only *apparent* and not the true separation velocity? We know because we made an invalid assumption. The Observer in the South Ship is *not at rest! (and neither is the Earth racing away)*. No such claim can be made when we are interested in the reality of the motions.

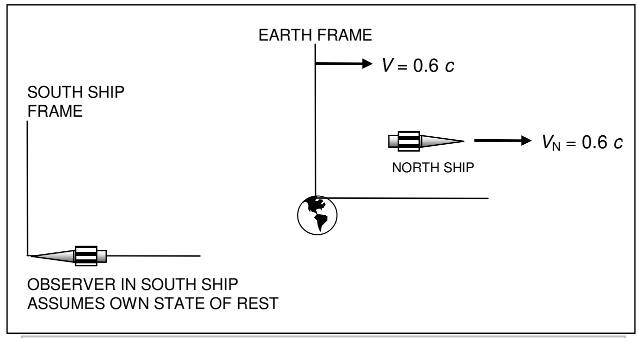

Fig. 9. *Apparent relativity.* Using the ESR textbook method of transforming velocity from one frame to another (the velocity of the North Ship in the Earth frame is converted to a velocity in the South-Ship frame):

$$v_{\text{N in S FRAME}} = \frac{v_N + v}{1 + \left(v_N v / c^2\right)} = 0.88 \ \ c .$$

However, we know that the transformation and the resulting velocity do not represent reality. *We made an invalid assumption —when we ignored the absolute motion of the observer.*

Ordinary relative motion is simply *apparent relative motion*. When we designate our moving ship as arbitrarily being a 'rest' frame we are free to measure *apparent* relative velocities. We follow the rules of ESR and the Lorentz transformations. For instance we could simply take Doppler radar readings and apply the corresponding ESR equation; or we could use the ESR *velocity transformation equation* for a velocity within another moving frame (provided these two velocities required by the equation are known). However, the relative velocity so measured or calculated (in our case 0.88 *c*) is only apparent. This process of measuring and calculating the relative velocity represents compliance with Postulate #3 (of both ESR theory and DSSU Relativity theory as in Table II below) *—No observer can ever measure anything moving faster than lightspeed c when using a radar method.* The equations make it explicit. Thus the

Table II	
EINSTEIN RELATIVITY	DSSU RELATIVITY
(1) The relativity postulate. The laws of physics are the same for observers in all inertial frames. All uniform motion is relative; absolute uniform motion does not exist. (2) (The time relativity postulate is not explicitly stated because it leads to ambiguity.) (3) The speed of light is constant. Light is always propagated in a vacuum with a velocity independent of the motion of the source or the observer.	(1) **Relativity postulate.** The laws of physics are the same for all inertial observers. All uniform motion is both apparently relative and absolutely relative. Motion can be measured relative to aether (the preferential frame of reference). (2) **The time relativity postulate.** Clocks run fastest when absolute motion is zero. Clocks slow down in relation to speed through aether permeated space. (3) **The speed of light postulate.** Since aether serves as the conductor of electromagnetic waves, the speed of light is absolute and constant through aether; and is independent of the motion of the source. Furthermore, the two-way measured speed of light is independent of the motion of the observer; the one-way measured speed is not.
ESR is, in part, a theory of apparent inertial motion.	DSSU relativity is, in part, a theory of absolute and relative inertial-motion.

Observer always measures relative velocity to be *less than the speed of light*.

Absolute relative motion. When measuring, or dealing with, absolute motion, the velocities with respect to aether are always less than c. It is only when these absolute velocities are combined in order to determine the absolute *relative* motion that speeds exceed c. And the maximum permissible can approach twice the speed of light. If v_A and v_B are collinear velocity components:

$$\text{absolute relative velocity} = v_A + v_B\,, \tag{7}$$

where $-2\,c < (v_A + v_B) < 2\,c$, and the usual sign-rule applies.

Table II above compares the postulates of conventional relativity and DSSU relativity.

One of the problems with ESR is that it is not a complete theory.[14] Einstein's theory of special relativity is, in the present context, a theory of apparent motion. It states clearly you cannot 'see' something moving towards you, or away from you, with a speed greater than lightspeed —*even though it may actually be so moving* as in the *speed paradox* scenario.

DSSU relativity is a theory of *absolute as well as relative motion*. It recognizes that absolute inertial motion exists. Motion can be measured relative to the aether medium which acts as the preferred frame of reference. When two absolute inertial motions are combined they present an example of *absolute relative motion*. By measuring one's own absolute motion and combining it with the Doppler-radar-acquired intrinsic motion of some target object, it is theoretically possible to determine speeds greater than c. (The only requirement is that the object and the observer must be moving in opposite directions with an average speed greater than one-half the speed of light).

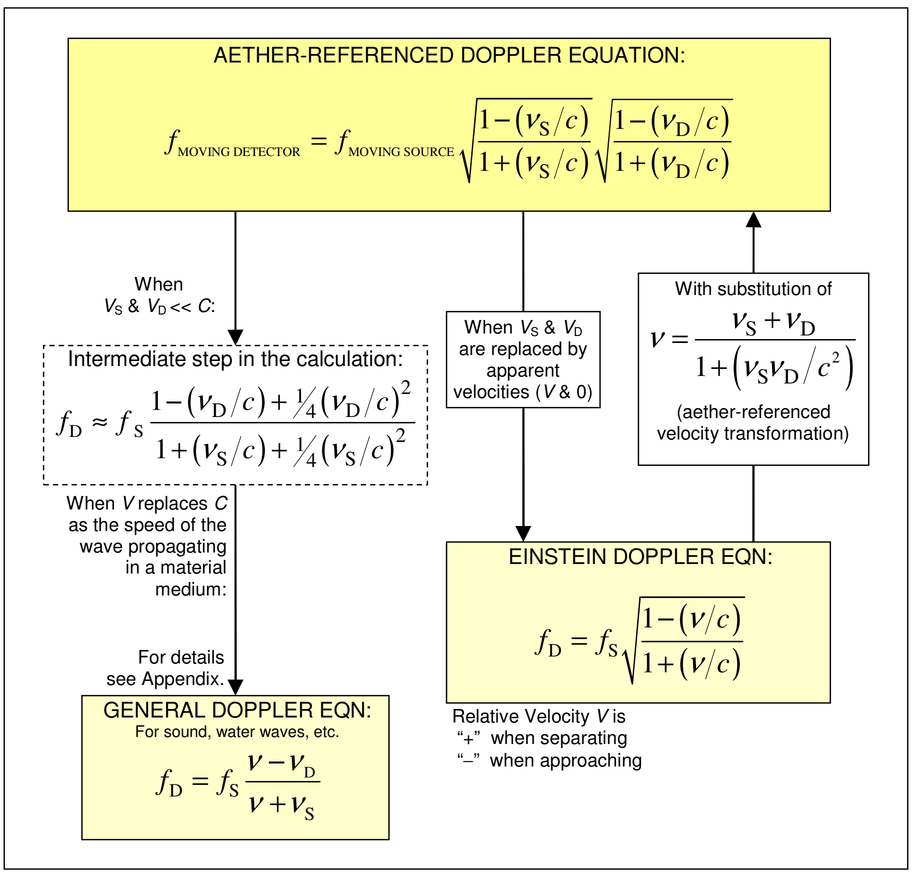

Fig. 10. *The DSSU aether-referenced equation reduces to the General Doppler and converts to the ESR Doppler*. All subscripted speeds/velocities are referenced to the wave propagating medium —aether in the case of the DSSU equation, and air, water, etc., in the case of the General Doppler. It is important to note that (i) the DSSU equation is completely general within its domain of aether-referenced motion, and (ii) the Einstein Doppler equation is completely general within its domain of pure relative motion. f_S and f_D are the wave frequencies emitted by the Source and received by the Detector, respectively. (For more detailed sign rules see Appendix.)

8. Unifying Aspects of the Aether-Referenced Doppler

The DSSU Doppler equation is coded in terms of absolute motion; but knowing the absolute motions of the two frames means that the apparent relative motion can also be determined. The key is the aether-referenced *velocity transformation equation*. By following the procedure outline in the Fig. 10 flowchart (and detailed in the Appendix A3 & A4) it is possible to convert from the *aether* Doppler equation to the *special relativity* Doppler equation, and *vice versa*. Furthermore, the aether Doppler equation can be reduced to the general Doppler equation. The latter is the one used for sound waves and water waves, and density waves in a material medium. It is quite possible that within the DSSU formula lies the conceptual unification of the two Doppler phenomena of physics.

Let me just emphasize that the "aether-referenced velocity transformation equation" (shown in Fig. 10 and in the text as eqn (3)) achieves the conversion by using the *absolute motion* of two reference frames. On the other hand, the *Einstein velocity transformation equation* (shown in Fig. 9 caption) achieves the conversion by using the *relative motions* of the reference frames. In both cases, the result of the transformation is an apparent relative speed/velocity. For the record, the transformation is also known as the *Relativistic Law of Addition of Velocities*.

The highlight of the flowchart is the two-way link between the DSSU and the ESR Doppler equations. The link whereby one can be transformed into the other is fully explained in Section A3 and A4.

It is important to realize that the ESR Doppler is *not* a special case of the DSSU equation. It is by no means obvious, but both equations give the same answer; they must because the frequency Detector displays the actual frequency and does not care which equation the Detector-frame Observer decides to use as a check.

Then it must be that *both* expressions are general. The DSSU expression always uses aether-referenced velocities; within its domain it is general. The ESR Doppler expression always uses purely relative velocities and within its domain it, too, is completely general.

Why is this so important? ... It means that within its domain, within its sphere of applicability, there is nothing wrong with the functionalism of Einstein's special relativity.

Although the DSSU and ESR Doppler expressions are characteristically restricted by the type of velocity employed in each, there is a way to unify them under one equation. As pointed out above, the DSSU Doppler equation contains the necessary information to express the purely relative situation. It is therefore possible to recast the DSSU equation as a *Unified Doppler equation* —one which reduces to either the aether-referenced Doppler or the relative-motion Doppler. The recasting and reduction are discussed in Section A5 of the Appendix.

In conclusion. When ESR formulates inertial motion, it deals with pure relative motion. Subject "A" is permitted to assume himself to be at rest and say that "B" is the one who is moving and the one experiencing time dilation. Subject "B" can make the same claim. With a theory devoid of an absolute frame of reference —with only relative motion by default— two subjects are given license to make paradoxical assertions!

DSSU theory incorporates the idea of *absolute relative motion*. With little more than a 'relative' Doppler measurement and the new Doppler equation the true and absolute motions of "A" and "B" are made known. Furthermore, with the *DSSU Traverse Doppler Effect expression* it is possible to make an *absolute* comparison of moving clocks (see *Appendix A2*).

What should be seen as truly remarkable, if one reflects on the long-standing neglect and outright disparagement of absolute motion and aether, is that it has taken far too long, over 100 years, for Physics to move beyond the unnatural restrictions imposed by Einstein's relativity.

In 1905 Einstein introduced a theory that ignores aether and the preferred frame. Tentatively at first, then whole-heartedly, Physics and Philosophy embraced his unnatural and incomplete theory of space and motion. The consequences have been profound. Although Einstein's non-absolute view had, for the most part, little detrimental effect on the field of particles physics, *it long delayed the discovery of the process that bestows the fundamental property of mass.* But the omission of aether and the preferred frame in his general-relativity theory was disastrous. The unquestioned acceptance of the almost sacred formalism of Einstein and the religious-like zeal to condemn any meaningful challenge to fundamentals has *prevented the development of a fully functional theory of gravity.*

In a recent special report [15] detailing a new type of light-speed-anisotropy experiment for measuring absolute motion, Professor Cahill of Flinders University, Australia, expressed the view that the failure to recognize the existence of absolute motion (and the physical dynamic 3-space that defines it) "would have to be the biggest blunder ever in the history of science". □

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Appendix

A1. Derivation of DSSU Doppler Equation for Light

Consider an observer at rest with respect to aether (our absolute-rest frame of reference). He detects repeated 'events' of light pulses, or wave peaks, being emitted from a receding beacon (such as the one attached to the starship commissioned earlier). He analyzes the following two events (each of which has a space-and-time 'location' in the moving frame):

Event 1. A wave crest is emitted at the origin of the moving frame in Fig. A1.
Event 2. An instant later the same wave crest reaches x_2' on the horizontal axis of the moving frame.

The distance between the events is $\Delta x'$ and the time interval between the events is $\Delta t'$. The $\Delta x'$ increment represents the source wavelength. The $\Delta t'$ increment represents the period of the light wave.

The position coordinates of the two events must be converted into the coordinate system of the observer. This is immediately accomplished with the Lorentz transformation equations:

For Event 1 $\quad x_1 = \gamma\left(x_1' + v_S\, t_1'\right)$;

For Event 2 $\quad x_2 = \gamma\left(x_2' + v_S\, t_2'\right)$;

where v_S is the recession speed of the source and gamma, γ, is the Lorentz factor $1/\sqrt{(1-(v_S/c)^2)}$.

The distance, in the observer's frame, between the two events is:

$$\begin{aligned}\Delta x &= x_2 - x_1\\ &= \gamma\,(x_2' + v_S\, t_2') - \gamma\,(x_1' + v_S\, t_1')\\ &= \gamma\,(x_2' - x_1' + v_S\, t_2' - v_S\, t_1')\end{aligned}$$

$$\Delta x = \gamma\left(\Delta x' + v_S\,\Delta t'\right). \qquad \text{(a1)}$$

Noting that:
Δx represents the wavelength detected: $\lambda_{DETECTED}$ or λ_D
$\Delta x'$ represents the emission wavelength: λ_{SOURCE} or λ_S
$\Delta t'$ represents the period of the wave:

$$\Delta t' = \Delta t_{SOURCE} = T_{SOURCE} = \lambda_S / c$$

By substitution, eqn (a1) is restated as,

$$\lambda_{DETECTED} = \gamma\,(\Delta x_{SOURCE} + v_{SOURCE}\,\Delta t_{SOURCE})\,,$$

$$\lambda_{DETECTED} = \frac{1}{\sqrt{1-(v_S/c)^2}}\left(\lambda_S + v_S\lambda_S/c\right). \qquad \text{(a2)}$$

Then by completing the substitution and performing some algebraic manipulation, it becomes,

$$\lambda_{DETECTED} = \lambda_S\sqrt{\frac{1+(v_S/c)}{1-(v_S/c)}} \qquad \text{(source receding)} \quad \text{(a3)}$$

Note that when the source is receding, v_S is positive; when the source is approaching, v_S is negative. Since the wavelength equals the speed of light divided by the frequency f (that is, $\lambda = c/f$), it follows that

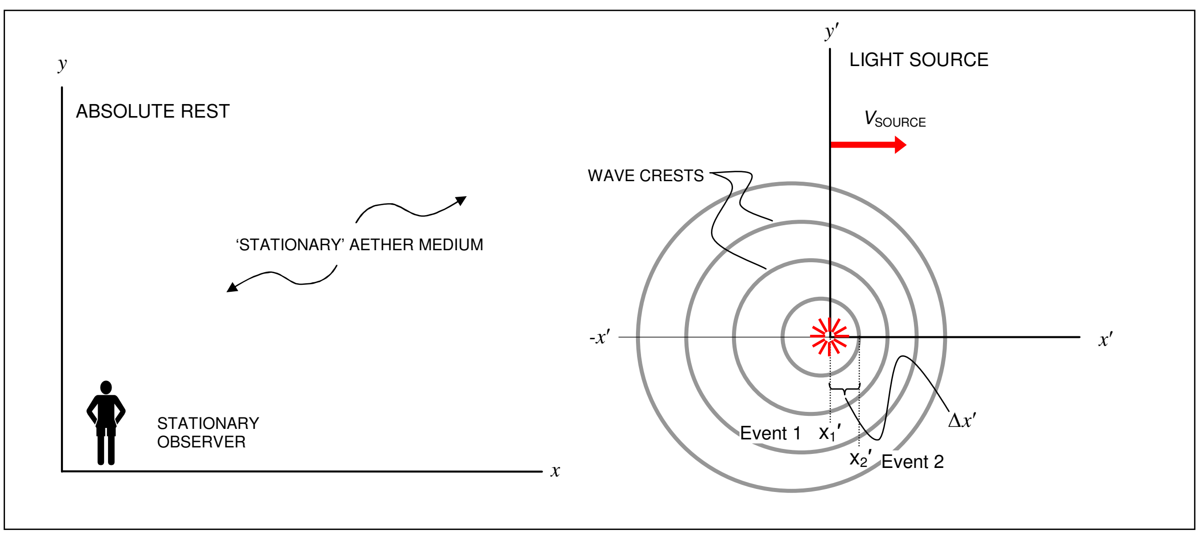

Fig. A1. *Wavelength $\Delta x'$ emitted by the moving light source is analyzed by the absolute-rest observer.* The analysis requires the transformation, of events *1* and *2*, *from* the coordinate system of the light source and *to* the coordinate system of the detector (or observer). Event *1* (having position coordinate x_1' and time coordinate t_1') is the emission of a wave crest; event *2* (having coordinates x_2' and time t_2') is the arrival of the wave crest at x_2'.

$$f_{\text{DETECTED}} = f_{\text{S}}\sqrt{\frac{1-(v_{\text{S}}/c)}{1+(v_{\text{S}}/c)}} \ . \quad \text{(source receding)} \quad \text{(a4)}$$

Doppler shifts for light (but not for sound), are always symmetrical; observer and source could switch frames. The observer could be placed in the moving frame and the source placed in the rest frame. The detected frequency will be the same. The same equation (with altered subscripts) applies:

$$f_{\text{MOVING DETECTOR}} = f_{\text{REST SOURCE}}\sqrt{\frac{1-(v_{\text{D}}/c)}{1+(v_{\text{D}}/c)}} \qquad \text{(a5)}$$

Now if an observer at rest re-transmits the identical frequency just received from a moving source, in accordance with (a4), then *the re-transmission represents a new **rest source***. That is,

$$f_{\text{REST DET}} = \underbrace{f_{\text{MOVING SOURCE}}\sqrt{\frac{1-(v_{\text{S}}/c)}{1+(v_{\text{S}}/c)}} = f_{\text{(NEW) REST SOURCE}}}_{\text{substitute into (a5)}} \qquad \text{(a6)}$$

Finally, a third-party moving observer detects the "new rest source" which is actually the Doppler-modified signal of the original moving-source transmission of Fig. A1. In fact, the third-party ***moving*** observer can relate directly to the original moving-source by simply combining eqns (a5) and (a6). It is through this combination of (a5) and (a6) that we obtain the ***(DSSU) Absolute Doppler equation***:

$$f_{\text{MOVING DETECTOR}} = f_{\text{MOVING SOURCE}}\sqrt{\frac{1-(v_{\text{S}}/c)}{1+(v_{\text{S}}/c)}}\sqrt{\frac{1-(v_{\text{D}}/c)}{1+(v_{\text{D}}/c)}} \qquad \text{(a7)}$$

The velocities of Detector and Source are entirely independent. Their scalar values, v_{D} and v_{S}, with respect to aether-space, are assigned positive or negative signs according to the following simple rule:

Sign rule for collinear and independent absolute velocity components:
Use POSITIVE sign when *absolute velocity* is away from Detector or Source.
Use NEGATIVE sign when *absolute velocity* is towards Detector or Source.

A2. The Aether-Referenced Traverse Doppler Equation for Light

As two ships approach each other during a "fly by" (as previously described) the Doppler effect rapidly diminishes as the ships' alignment changes from being collinear to being side-by-side. In fact, during the instant when the ships are just passing each other (going in opposing directions) the basic Doppler effect vanishes. However, there remains what is known as the ***traverse Doppler effect*** which can still be measured —being measurable during this brief moment of close passage. It is described as the change in the frequency f at Source or Detector caused solely by the slowing of clocks due to motion.

We begin with the *standard traverse Doppler equation* for light:

$$f = f_0\sqrt{1-(v/c)^2}$$

where f_0 is the *proper time* frequency.

When the relative speed is due entirely to the absolute motion of the Source then the relative speed v may be replaced by the absolute speed v_{S} of the Source, so that,

$$f_{\text{REST DETECTOR}} = f_{\text{MOVING SOURCE}}\sqrt{1-(v_{\text{S}}/c)^2} \ . \qquad \text{(a8)}$$

When the relative speed is due entirely to the absolute motion of the Detector then the relative speed v may be replaced by the absolute speed v_D of the Detector, so that,

$$f_{\text{REST SOURCE}} = f_{\text{MOVING DETECTOR}}\sqrt{1-(v_{\text{D}}/c)^2} \ . \qquad \text{(a9)}$$

Obviously the frequency f emitted by a rest Source will be the same as that frequency detected by a rest Detector. That is,

$$f_{\text{REST DETECTOR}} = f_{\text{REST SOURCE}} \ ,$$

and from (a8) and (a9),

$$f_{\text{MOVING SOURCE}}\sqrt{1-(v_{\text{S}}/c)^2} = f_{\text{MOVING DET'R}}\sqrt{1-(v_{\text{D}}/c)^2} \qquad \text{(a10)}$$

Thus, the ***DSSU traverse Doppler equation*** is:

$$f_{\text{MOVING DET'R}} = f_{\text{MOVING SOURCE}}\frac{\sqrt{1-(v_{\text{S}}/c)^2}}{\sqrt{1-(v_{\text{D}}/c)^2}} \ . \qquad \text{(a10)}$$

This aether-referenced *traverse Doppler equation* serves as a basic test for time dilation or clock slowing.

The above equation may be rewritten in terms of T the time period of oscillation of the emitted light wave instead of the frequency. Since $\text{T} = 1/f$,

$$\mathrm{T}_{\text{MOVING DET'R}} = \mathrm{T}_{\text{MOVING SOURCE}} \frac{\sqrt{1-(v_D/c)^2}}{\sqrt{1-(v_S/c)^2}} . \qquad \text{(a 11)}$$

It is evident in (a 10) and (a 11) that when Detector and Source have the same speed then there will be no *traverse Doppler effect* and clock rates will be identical in both frames. This is to be expected for motion in tandem. Remarkably, it is also true when Detector and Source are racing in opposite directions. Amazing, but not surprising, since this is the reality that was earlier demonstrated with the "fly-by" missions.

A3. How the DSSU Doppler Formula Converts to the Special Relativity Formula

The DSSU Doppler is a formula using absolute velocities/speeds (aether-referenced motion).

The ESR Doppler is a formula using apparent relative velocities/speeds (self-referenced motion).

The DSSU expression reduces to the ESR by converting the absolute motion to apparent motion.

Consider the point of view of the Observer. His own frame of reference, his spaceship, the one fitted with the frequency Detector, does not appear to be moving (with respect to Observer). Thus, v_D in the DSSU formula is discarded and replaced by zero. (Caution. This does *not* mean v_D = zero.)

Next, the absolute speed v_S of the signaling spaceship is discarded and replaced by its *apparent* speed v.

Implementing these changes converts the *DSSU Doppler* (a7) into the *ESR Doppler* expression:

$$\frac{f_D}{f_S} = \left(\frac{1-(v_S/c)}{1+(v_S/c)}\right)^{1/2} \left(\frac{1-(v_D/c)}{1+(v_D/c)}\right)^{1/2} , \qquad \text{(a7)}$$

$$\frac{f_D}{f_S} = \left(\frac{1-(v/c)}{1+(v/c)}\right)^{1/2} \left(\frac{1-0}{1+0}\right)^{1/2} ,$$

$$\frac{f_D}{f_S} = \sqrt{\frac{1-(v/c)}{1+(v/c)}} \quad \text{(for light as in \textit{special relativity}),} \qquad \text{(a12)}$$

in which, the relative speed v is "+" when separating and "–" when approaching.

A more general ESR Doppler expression often appears in textbooks.

"By a postulate of relativity, the velocity of light is the same relative to all observers. The theory of relativity yields the frequency"[16]:

$$\frac{f_D}{f_S} = \frac{1+(v/c)\cos\theta_0}{\sqrt{1-(v^2/c^2)}} . \qquad \text{(a13)}$$

For collinear motion (separating), angle θ_0 equals 180 degrees and, therefore, cos θ_0 equals −1. Then with a bit of algebraic manipulation, the textbook eqn (a13) reduces to eqn (a12) which is the one that appears in the Fig. 10 flowchart in Section 8.

Now here is something interesting. Assume that the source frequency is unknown. Under Einstein's relativity there is no way to calculate v —it therefore must be measured somehow. However, with DSSU's relativity, unknown v can be determined, given v_D and v_S. This can be done with the aether-referenced *relativistic velocity transformation equation* (see eqn (3)),[17]

$$v = \frac{u\left(1+\left(v_S v_D/c^2\right)\right)+\left(v_S+v_D\right)}{\left(1+\left(v_S v_D/c^2\right)\right)+u\left(v_S+v_D\right)/c^2} \qquad \text{(a14)}$$

(which transforms an apparent velocity u within one frame into an apparent velocity v for an observer in another frame) is used to determine v as follows:

Since the frequency Source is not moving within its own frame (the Source spacecraft) u is equal to zero. Then,

$$v = \frac{v_S+v_D}{1+\left(v_S v_D/c^2\right)} . \qquad \text{(a15)}$$

This equation serves three purposes: (i) converts the absolute speeds v_D and v_S to a relative speed; (ii) ensures the predicted observable relative speed v is always less than c; (iii) links the *ESR Doppler* to the *DSSU Doppler* equation.

A4. How the ESR Doppler Converts to the DSSU Doppler Equation

The conversion simply involves substituting the velocity transformation eqn (a15) into the ESR expression,

$$\frac{f_D}{f_S} = \left(\frac{1-(v/c)}{1+(v/c)}\right)^{1/2} \qquad \text{(a12)}$$

After some basic algebra, the *DSSU Doppler* appears.

This serves as a verification of the proof, for the Doppler equation, given in the Appendix Section A1.

A5. The Unified Doppler and How it Reduces to the Absolute and Relative Expressions

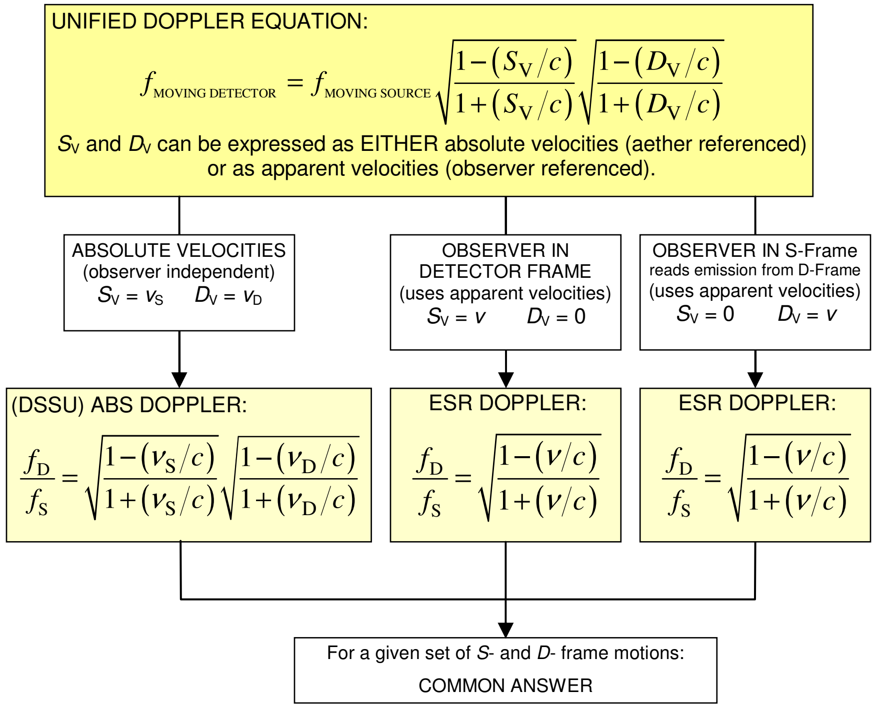

Fig. A2. *The Unified Doppler equation reduces to the DSSU- and the ESR-Doppler expressions*. When the substitutions are made, they must be consistent. The two velocities must both be aether referenced or they must both be apparent (i.e., relative). For a given set of *S*- and *D*- frame motions, all the reduced equations give the same numeric result.

There are two types of velocities. All objects, all frames of reference, can be thought of as having two simultaneous velocities: one relative to the observer (or some point chosen by the observer) and one with respect to the aether rest-frame. One is observer dependent, the other is observer independent.

What this means is that all instances of motion can be expressed in two ways. The motion of the Source (and the Detector) can be expressed as absolute *or* as relative. In terms of symbols, the motion, S_V, of the Source can be expressed as absolute velocity v_S or as relative velocity v_{apparent}; and the motion, D_V, of the Detector can be expressed as absolute velocity v_D or as relative velocity v_{apparent}.

Metaphorically, S_V and D_V are 'fruit' velocities. Each can represent itself as an apple-type velocity or as an orange-type velocity.

The DSSU Absolute Doppler equation is obviously coded in terms of absolute velocities. However, the equation contains the necessary information to express the purely relative situation. That is, from the two absolute-velocity parameters, in the equation, the desired relative velocity can always be determined. (It can be done with eqn (a15).) The Absolute equation deals with apples, but it also contains the information of the oranges. This dual information has been formalized in Fig. A2 where the Absolute (ABS) Doppler is rewritten as a Unified Equation that codes for both types of velocities.

The symbols S_V and D_V in the Unified expression are the undifferentiated 'fruit' velocities of the Source and the Detector respectively. The flowchart above shows how the Unified equation reduces to the ABS- and the ESR-Doppler expressions. The only rule involved is that one must be consistent —no mixing of apples and oranges.

Note that for any given set of S- and D- frame motions, the ABS and ESR equations give the same numeric result. The algebraic confirmation that the reduced equations agree with each other is provided by egn (a15) (by simple substitution).

A6. How the (DSSU) Absolute Doppler Equation Reduces to the General Doppler

Start with the ABS Doppler eqn (a7):

$$f_D = f_S \frac{\left(1-(v_S/c)\right)^{1/2}}{\left(1+(v_S/c)\right)^{1/2}} \frac{\left(1-(v_D/c)\right)^{1/2}}{\left(1+(v_D/c)\right)^{1/2}}, \tag{a7}$$

and rearrange terms so that

$$f_D = f_S \frac{\left(1+(v_D/c)\right)^{-1/2}}{\left(1+(v_S/c)\right)^{1/2}} \frac{\left(1-(v_D/c)\right)^{1/2}}{\left(1-(v_S/c)\right)^{-1/2}}. \tag{a16}$$

When v_D and v_S have values much less than c then (v_D/c) and (v_S/c) are considerably less than unity. Apply the binomial approximation to obtain:

$$f_D \approx f_S \frac{\left(1-\tfrac{1}{2}(v_D/c)\right)}{\left(1+\tfrac{1}{2}(v_S/c)\right)} \frac{\left(1-\tfrac{1}{2}(v_D/c)\right)}{\left(1-\tfrac{1}{2}(v_S/c)\right)}, \tag{a17}$$

$$f_D \approx f_S \frac{1-(v_D/c)+\tfrac{1}{4}(v_D/c)^2}{1+(v_S/c)+\tfrac{1}{4}(v_S/c)^2}. \tag{a18}$$

The two squared terms are quite insignificant since the motions of Source and/or Detector will never be much above the speed of sound. The squared terms are dropped, to give the non-relativistic form:

$$f_{\mathrm{D}} = f_{\mathrm{S}} \frac{c - v_{\mathrm{D}}}{c + v_{\mathrm{S}}} \ . \tag{a19}$$

We let v replace c as the speed of the wave propagation in its medium. (For example v could be the speed of sound through air of a certain density, or waves on the surface of a pond). The result is the ***General Doppler effect*** expression:

$$f_{\mathrm{D}} = f_{\mathrm{S}} \frac{v - v_{\mathrm{D}}}{v + v_{\mathrm{S}}} \ , \qquad \text{(for sound, water waves, etc.)} \tag{a20}$$

where v is a positive constant with a value that depends on the properties of the medium. The sign rules for the velocities of the Detector and the Source are: **Negative** when motion (with respect to medium) is towards the other; **Positive** when motion (with respect to medium) is away from the other.

Although the ABS Doppler (a7) has been reduced to the General Doppler (a20), when we attempt to apply these two equations to an acoustic scenario they will not necessarily give the same results. (In such an attempt the c in eqn (a7) is no longer the speed of light but is replaced by the speed of sound.) If the magnitudes of the velocities (of Source and Detector) are equal then the two equations *do* give the same result. Otherwise they do not. The General Doppler will, of course, give the correct value; the mis-applied ABS Doppler will do so only for the special case (of equal speeds).

The reason for the discrepancy is straight forward. The ABS Doppler is so designed that when the speed of a wave Source, or of a wave Detector, approaches the speed with which the medium 'conducts' the waves then the clock-slowing approaches infinity. This feature is built into the equation by the Lorentz transformations. The Doppler equation for sound is not so restricted.

What this means is that light-pulse generators stop emitting waves when traveling at the speed of light. But sound-pulse generators do not stop emitting waves when traveling at the speed of sound. Clock-time affects one but not the other. It is for this reason that the ABS equation cannot be used directly for material-medium Doppler applications.

The trick is to reverse or remove the Lorentz restriction at some stage in the process of the reduction. The step between eqn (a18) and eqn (a19) is an attempt to do this.

In closing, with the discovery and repeated experimental confirmation of the existence of a luminiferous-and-gravitational aether (see research and historical review articles [18] and [19]) the need arises for a theory of absolute motion —motion through aether permeated space. The need is for a theory in which relative motion is joined to a theory of aether-referenced motion; a theory in which Einstein's theory of relativity is subsumed by a more general theory of *absolute and relative* motion. □

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