Relativity of Time in the Aether Medium of the DSSU
–Absolute Motion and Intrinsic Time

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... time is either the same as motion or a condition of motion. –Aristotle, *On Man in the Universe*

Time is measured by clocks. Clocks, however, are not just machines manufactured by humans; a clock can be any regular motion in the universe. –Joel Primack, *The View from the Center of the Universe*

Abstract: In a simple and traditional manner the DSSU relative-time expression is derived and compared with Einstein's *special relativity theory* (ESR). The DSSU is a universe permeated by a nonmaterial aether. This means there is a preferred frame-of-reference —a frame in which absolute motion and intrinsic time become meaningful. Absolute motion has been repeatedly detected[1] and is now considered to be scientific fact. With the DSSU time formula it is possible to calculate the *intrinsic* time corresponding to aether-referenced motion. To illustrate the method, a hypothetical space-travel experiment is described. It is shown that the DSSU formula reflects the reality of the situation —a reality lacking within ESR. Remarkably, the formula can also be used to calculate apparent *relative* time, thereby encompassing Einstein's *special relativity* motion. The DSSU formula is also applied to a gravitational-aether situation —the clocks of the GPS navigation system moving within the Earth's gravitational aether. The intrinsic time of clocks subjected to aether flow while in Earth orbit is compared to the intrinsic time of a clock subjected to aether flow while stationary on the Earth's surface.

The article compares three Worldviews of space and time and concludes with a summary of *DSSU relativity* with its three postulates.

Keywords: Aether, Absolute motion, Intrinsic motion, Relative motion, Special relativity, Time, GPS clocks, Dynamic space, DSSU, Dynamic Steady State Universe.

The present paper further develops DSSU theory[2] by exploring the affects on clocks resulting from motion in a universe permeated by aether.

Since there are many kinds of aether, both historical and contemporary, it is important to specify the nature of the aether-type central to much of the following discussion.

The *space* (more properly, the *space medium*) of the *Dynamic Steady State Universe* (DSSU) is considered the essence substrate of the universe.

Although it has absoluteness qualities it is unlike the absolute space of the Newtonian universe. While Newtonian space is static, DSSU 'space' is dynamic. While Newtonian space is merely a container, DSSU 'space' is the essence quasi-substance of the universe. While Newtonian space is a nothingness vacuum, DSSU 'space' is an interacting discretized aether.

It is interesting to note the manner in which Isaac Newton tried to make his *space* more useful. His idea was to place an *aether* substance into all that emptiness. Newton had suggested that *some sort of ether transfers the action of gravity by its currents.*[3] It was a remarkably prescient concept. It may well have been the first historical expression of a dynamic gravitational aether. Unfortunately the idea was not pursued.

DSSU aether must obviously be unlike Einstein's *relativized* space. As we all know Einstein tried to do away with the aether concept. But let's take a closer look.

The name alone —*relative* space— makes it clear; it is *not* an absolute space and Einstein intended no absolute qualities. At least that's what was in the master plan of the theory of relativity. But the absoluteness qualities of the vacuum were difficult to discard. In fact, Einstein could not entirely reject the aether concept. He merely discredited the 19th-century version with its Galilean-Newtonian relativity. His general theory of relativity, which makes gravitational fields its central concept, does not preclude the existence of aether.[4] Albert Einstein, in his essay *On the Aether (1924)*, commented to the effect that relativity theory could be said to ascribe physical properties to spacetime itself and *involve a kind of "aether."*

Nevertheless, the denial of physical, or quasi-physical, space has deep roots extending into the very foundation of general relativity theory.

In the real world *space* is dynamic. Whether *space* is deemed to be physical or non-physical —*space* must be dynamic. The non-physical *space* of general relativity is dynamic through its curvature —positive or negative. The quasi-physical space of the DSSU is dynamic by inhomogeneously flowing, expanding, and contracting.

The proponents of general relativity believe *space* is non-physical and describe the dynamic activity of space by employing the term *geometro-dynamics*, thereby underscoring the fact that Einstein's *space* is a mathematical construct —a 4-dimensional geometrized space-time. The foundation of general relativity is a four-coordinate mathematical *space*.

While physicists preach the redundancy of aether, in practice, they repeatedly fill so-called 'empty space' with all kinds of things such as fields, strings, loops, energy fluctuations, and a zoo of virtual particles —effectively turning the vacuum into an aether-like medium.

Another important feature of the DSSU aether medium: It is consistent with the historical evidence of the detection of aether. There have been over six well documented experiments during the twentieth century. But the most famous, and unfortunately the most misunderstood, was the Michelson and Morley Experiment dating back to 1887. Contrary to popular belief, the existence of aether was *not* disproved; the interferometer tests did not give null readings. Michelson and Morley did not report null results.[5] Their measurements of aether flow were, for reasons unknown at the time, considerably less than what had been expected. The mystery behind these historically important experiments was finally resolved more than a century later.[6]

It seems reasonable then, even imperative, to postulate the existence of a 'space' fluid. In the Dynamic Steady State Universe, *space* consists of some sort of *fundamental discrete entities*; space is a sea of fundamental essence fluctuators giving it a certain degree of absoluteness. DSSU theory takes the bold step of combining an essence-substance space with the constancy-of-lightspeed-for-all-observers *space* of Einstein's special relativity.

The DSSU essence fluid is superlatively tenuous, without viscosity, offering no measurable resistance to the motions of material bodies, while at the same time having a high spatial density (referring to the count density of discrete units). Calling this medium the *aether* may sound somewhat archaic; but it has the distinct advantage that everyone knows what you're talking about.

Without some kind of aether, the following questions become unanswerable (as they are unanswerable in Standard Cosmology): What is the basic substratum of our universe? What could be the agent whose presence impedes acceleration and thus produces inertia? What could be the agent whose presence imposes a strict speed limit on all motion through space? What is the agent that contracts objects in motion? What is the agent that alters the time measured by moving clocks?

Let us examine the physical and apparent change in clocks due to absolute and relative motion in the aether.

1. THE BASIC RELATIVE TIME EXPRESSION

The classical relativity-of-time expression —this is the same one used in Einstein's special relativity— is surprisingly easy to derive.

Consider two observers moving with constant speed relative to each other. We may say with certainty that they will agree on their relative speed (the speed with which they are approaching each other or receding from each other). However, they will not necessarily agree on the timing between two events. If the relative speed is significant, each will measure a different time interval between the same two events. Practical considerations aside, each will observe the other's clock running slower.

In order to demonstrate this *clock slowing* effect, it has become a tradition to bring Einstein's relativistic train-coach into service. One observer, appropriately called the Traveler, occupies the car's window seat adjacent to the train-station platform. In our thought experiment he is having his picture taken by a photographer, on the other side of the coach, who triggers the shutter and flash just as the train races through the station. The other observer is standing on the station platform and notices the flash inside the coach in front of him. A split second later and a little further down the track he sees the Traveler 'light-up' as the flash of light reaches him (the Traveler).

The Traveler sees the light coming directly across the width of the coach —perpendicular to the long axis of the coach. The station-platform Observer on the other hand 'sees' a diagonal lightpath. Now, according to Einstein's great insight —known as the speed of light postulate— *both observers measure the same speed of light*! ***Even though the path clearly appears to have two different lengths*** the speed of light remains constant at 300,000 kilometers per second.

Both observers use the same simple relationship:

$$(\text{path length}) = (\text{speed of light}) \times (\text{clock time}) .$$

If there is disagreement on the path length, as is the case, (and light speed is constant) then there must be a compensating disagreement on the time interval. The equation makes it explicit.

The agreement of observed lightspeed is accomplished only by the fact that clock time does not run at the same pace. For the apparent longer path to be completed in synchronization with the apparent shorter path, the corresponding measuring clocks must run at different rates. For the Traveler (who obviously sees a shorter path), time *must* run slower. For the bystander, the path of the light beam looks longer, and the time the beam takes along its path also seems longer (and does measure longer). Referring to **Fig. 1**: More time increments or clock-ticks are required for light to go from source S to O' in the bystander's frame of reference than from S to O in the Traveler's frame.

The Traveler and Observer do not agree on elapsed time; but what about *x-axis* displacement. As far as the Traveler is concerned, the two events involved no movement in the x-direction and he will readily admit that he kept perfectly still while seated during the picture-taking sequence —the two events being the initial flash and subsequent illumination. In his frame of reference the camera is fixed at S and he remained in his seat at point O. The bystander on the other hand sees the second event displaced by an amount he readily calculates: the train's speed multiplied by the brief interval of time between the events ($\Delta x = v \times \Delta t$, where x is the distance parallel to the railway tracks). Thus, they agree neither on elapsed time nor on x. However, they do agree on the length SO (as they would for any length perpendicular to the direction of travel).

Line SO has the same apparent length in both frames; although each measures it differently. Using the elementary equation by which *distance = (speed × time)* the Traveler will find that the length SO equals the speed of light multiplied by a measured time interval as determined by his own clock (which gives his own relative time). He finds:

$$SO = c\,\Delta t_{\text{TRAVELER}}\,. \tag{1}$$

The Observer, in turn, applies the same elementary equation. But first he calculates the altitude of the *velocity triangle* (shown in **Fig. 1**) by applying the theorem of Pythagoras to the triangle's two known values: the hypotenuse, c the speed of light; and the base, v the speed of the train. And so, using the speed component $\sqrt{(c^2 - v^2)}$, and a time interval measured with his own clock (which gives his own relative time), he determines that:

$$SO = \sqrt{c^2 - v^2}\,\Delta t_{\text{OBSERVER}}\,. \tag{2}$$

Combining the results of (1) and (2) allows one to state:

$$\text{Length } SO = c\,\Delta t_{\text{TRAVELER}} = \sqrt{c^2 - v^2}\,\Delta t_{\text{OBSERVER}}\,,$$

$$\frac{\Delta t_{\text{TRAVELER}}}{\Delta t_{\text{OBSERVER}}} = \frac{\sqrt{c^2 - v^2}}{c}\,. \tag{3}$$

This is the central formula of relativity. It means: *Time literally passes slower for the traveler in the ratio* $\sqrt{(c^2 - v^2)}$ *to c*. It may be further simplified to:

$$\Delta t_{\text{TRAVELER}} = \sqrt{1 - \left(v/c\right)^2}\,\Delta t_{\text{OBSERVER}}\,. \tag{4}$$

Using the binomial theorem the equation may be expressed as:

$$\Delta t_{\text{T}} \cong \Delta t_{\text{O}}\,(1 - ½(v/c)^2)\,,$$

$$\Delta t_{\text{T}} \cong \Delta t_{\text{O}} - ½\Delta t_{\text{O}}(v/c)^2\,.$$

Thus, one tick on the Traveler's clock is equivalent to one tick on the Observer's clock less $½\Delta t_{\text{O}}(v/c)^2$. It means that the Traveler has lost $½\Delta t_{\text{O}}(v/c)^2$ seconds when compared to the stationary clock. It may be best to think of it this way: While Observer's clock makes a full tick, the Traveler's clock makes a fractional tick.

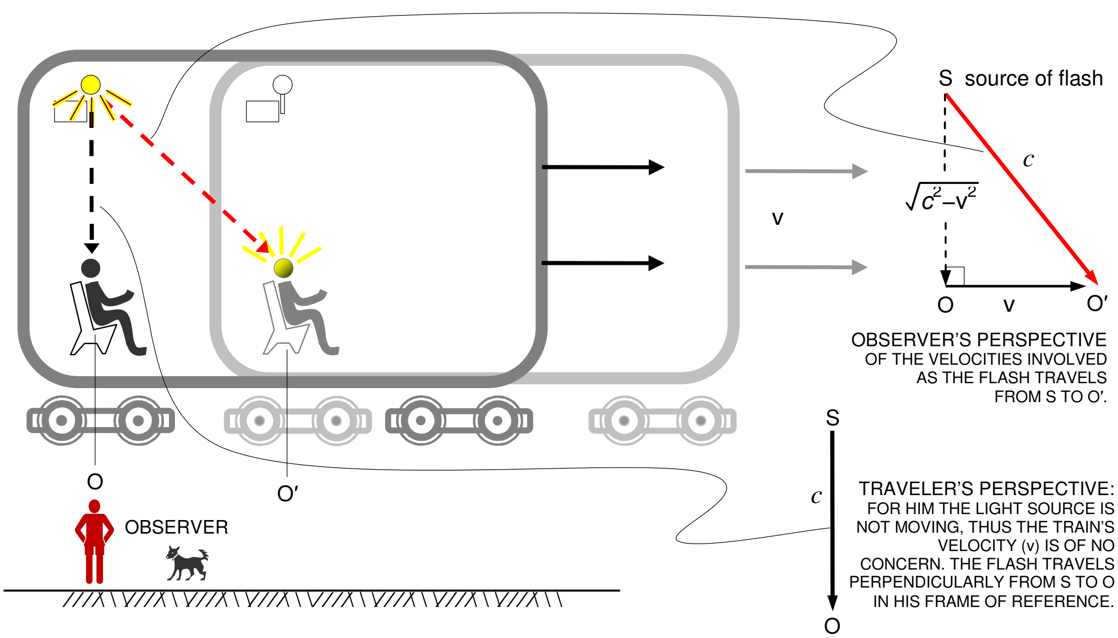

Fig. 1. The path of light joining two events (the camera flash and the subsequent illumination of subject) are described differently by two observers when one is moving, with significant speed, relative to the other. Although the Traveler and the Observer both agree on a fixed speed of light, c, ***they do not agree on the path length***. The bystander clearly 'sees' a longer lightpath (dashed red arrow) and analyses the observations as in the vector triangle above, right.

It is a fundamentally important equation, and as stated at the outset, surprisingly easy to derive. What is truly amazing is that the derivation is based on a theorem of the geometry of a right-angled triangle —on a theorem which may be well over 3500 years old.

2. EQUATIONS WITH AETHER REFERENCING AND COMPARISON WITH CLASSICAL FORMULA

The concept of absolute space incorporates the notion that rest and motion are defined with respect to it.
–Henning Genz[7]

The fundamental difference between ESR and DSSU relativity: Einstein's relativity uses only the relative difference in motion (recall, by his own postulate absolute inertial motion does not exist), while DSSU relativity incorporates the difference between absolute motions. In the context of ESR, both Observer and Traveler may be in motion (inertial motion) but only the difference is important. It means, in practical terms, that the Observer's own frame, moving or not, is automatically designated as the rest frame from which v is measured. However, in the DSSU the intrinsic motions of both Observer and Traveler must be used, if the intrinsic time difference is sought.

Thus, when using equation (4) one needs to be specific about the velocity. The Observer's velocity is, thus, subscripted with 'a' for *aether* (and may also be given a letter or number for identification). In those instances when dealing with simple relative speed, the symbol v, by itself, is used.

Equation (4) is the classical *relativity-of-time* expression. But what about determining the *intrinsic* time. If one specifies that the Observer's clock is *at rest* with respect to the absolute rest frame (aether) and the Traveler's clock is moving with velocity v_a through aether, then (4) can be rewritten as:

$$\Delta t_{\text{MOVING CLOCK}} = \sqrt{1-\left(\frac{v}{c}\right)^2}\,\Delta t_{\text{ABS.REST.CLOCK}}\,, \qquad (5)$$

and thereby define intrinsic time intervals for any moving clock. *Intrinsic time* means that the rate of the clock's ticks depends on the physical speed through aether in which the clock is moving.

The "absolute rest clock" may be thought of as a hypothetical timekeeping device floating in deep space. Technically speaking its state of motion is described as *comoving freefall.*

Next, apply the definition to any two moving clocks, so that:

$$\Delta t_1 = \sqrt{1-\left(\frac{v_{a1}}{c}\right)^2}\,\Delta t_{\text{ABS.REST}}\,,$$

$$\Delta t_2 = \sqrt{1-\left(\frac{v_{a2}}{c}\right)^2}\,\Delta t_{\text{ABS.REST}}\,.$$

Clock 1 and clock 2 may be related by simple division to obtain the DSSU intrinsic-time equation:

$$\Delta t_1 = \frac{\sqrt{1-(v_{a1}/c)^2}}{\sqrt{1-(v_{a2}/c)^2}}\,\Delta t_2\,. \qquad (6)$$

Table 1.

	DSSU RELATIVITY All velocities are with respect to aether.	CLASSICAL EINSTEIN RELATIVITY All velocities are relative to observer.
Basic Equation:	$\Delta t_{\text{MOVING CLOCK}} = \sqrt{1-(v/c)^2}\,\Delta t_{\text{ABS.REST}}$ (5)	$\Delta t_{\text{MOVING CLOCK}} = \sqrt{1-(v/c)^2}\,\Delta t_{\text{OBSERVER}}$ (8)
Time interval recorded on clock 1:	$\Delta t_1 = (1-(v_1/c)^2)^{1/2}\,\Delta t_{\text{ABS.REST}}$	$\Delta t_1 = (1-(v_1/c)^2)^{1/2}\,\Delta t_{\text{OBSERVER}}$
Time interval recorded on clock 2:	$\Delta t_2 = (1-(v_2/c)^2)^{1/2}\,\Delta t_{\text{ABS.REST}}$	$\Delta t_2 = (1-(v_2/c)^2)^{1/2}\,\Delta t_{\text{OBSERVER}}$
Ratio of the two intervals:	$\frac{\Delta t_1}{\Delta t_2} = \frac{\sqrt{1-(v_1/c)^2}}{\sqrt{1-(v_2/c)^2}}\,\frac{\Delta t_{\text{ABS.REST}}}{\Delta t_{\text{ABS.REST}}}$	$\frac{\Delta t_1}{\Delta t_2} = \frac{\sqrt{1-(v_1/c)^2}}{\sqrt{1-(v_2/c)^2}}\,\frac{\Delta t_{\text{OBSERVER}}}{\Delta t_{\text{OBSERVER}}}$
The derived expression relating any two clocks:	$\Delta t_1 = \sqrt{\frac{1-(v_1/c)^2}{1-(v_2/c)^2}}\,\Delta t_2$ (6)	$\Delta t_1 = \sqrt{\frac{1-(v_1/c)^2}{1-(v_2/c)^2}}\,\Delta t_2$
Time Equations:	$\Delta t_{\text{TRAVELER}} = \sqrt{\frac{1-(v_T/c)^2}{1-(v_O/c)^2}}\,\Delta t_{\text{OBSERVER}}$ (7)	Designating t_2 as the new Observer's clock requires $v_2 = 0$ resulting in: $\Delta t_{\text{TRAVELER}} = \sqrt{1-(v/c)^2}\,\Delta t_{\text{OBSERVER}}$ (8)
Speed qualifier:	The speeds v_T and v_O are the magnitudes of velocities measured with respect to aether.	v is simply the magnitude of the apparent velocity of the Traveler.

And in terms of more conveniently named clocks:

$$\Delta t_{\mathrm{TRAVELER}} = \frac{\sqrt{1-\left(v_{a\mathrm{T}}/c\right)^2}}{\sqrt{1-\left(v_{a\mathrm{O}}/c\right)^2}}\Delta t_{\mathrm{OBSERVER}} \,. \tag{7}$$

Again, the speed of each clock *with respect to aether* is being used.

The summary Table above shows how, starting with the basic equation involving a moving clock and a reference clock, the DSSU intrinsic-time equation is obtained. Alongside each step is shown the comparable one in Einstein's theory.

Assume, in the scenario of Section 1 above, that the Observer and his frame of reference are *at rest* in the absolute sense. Then when the DSSU time-equation (7) is applied, $v_{a\mathrm{O}}$ will, of course, be zero and $v_{a\mathrm{T}}$ will equal the relative speed v; and the equation simplifies, becoming indistinguishable from the ESR equation (8) in Table 1. The two theories predict the same clock-time slowing. However, they agree *only* for the special case when the Observer has no intrinsic motion —the observer is at rest with respect to the local aether. More commonly the DSSU and ESR equations will disagree, sometimes substantially, as the following thought experiment demonstrates.

3. SPACE TRAVEL AND APPARENT VERSUS INTRINSIC CLOCK-TIME

Einstein's historic 1905 paper on special relativity contains the axiom that two observers, each of whom appears to the other to be moving with a constant speed in a straight line, cannot tell which of them is moving.[8] Einstein based this axiom on the assumption that aether (or local absolute space) does not exist.

The comparable uniform-motion postulate in DSSU theory states that: Relative to the aether medium, intrinsic motion can be measured; consequently there exists a preferred local frame of reference.

Since absolute motion does not exist in ESR, then neither does absolute time. And if absolute time does not exist then what ESR measures must be assumed to be *apparent* clock-time.

DSSU theory acknowledges the existence and detectability of absolute motion. And absolute motion implies *real* (intrinsic) clock-time.

The launch of a hypothetical space journey will serve to test the two theories. We join the Observers aboard a starship that has successfully escaped the gravitational well of the solar system. Gradually a steady cruising speed of 1/4 of the speed of light is attained. Once in deep space far from any gravitational interference, we are ready to take measurements. In less than the blink of an eye, a second starship races past us at 1/2 lightspeed (heading in the same direction, as shown in **Fig. 2**). Doppler measurements of the rapidly receding tail-lights confirm the two ships are separating with a speed of (½ *c* – ¼ *c* =) 1/4 *c*. Also Doppler readings of the Sun's light verify our own speed to be 1/4 *c*. We are now ready to apply the time relativity equations.

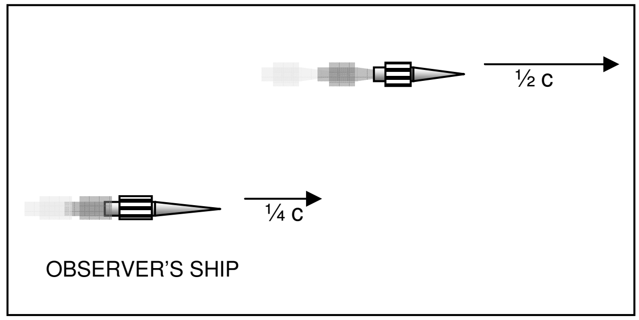

Fig. 2. *Inertial space-travel scenario analyzed in the text*. When the two starship crews compare clocks, DSSU theory requires that both velocities be used in the time relationship calculation; ESR requires only their relative speed.

The DSSU eqn (7), with $v_{a\mathrm{T}}= 0.5\,c$ and $v_{a\mathrm{O}}= 0.25\,c$ gives,

$$\Delta t_{\mathrm{TRAVELER}} = \frac{\sqrt{1-\left(0.5/c\right)^2}}{\sqrt{1-\left(0.25/c\right)^2}}\Delta t_{\mathrm{OBSERVER}} \,,$$

$$\Delta t_{\mathrm{TRAVELER}} = 0.894\ \Delta t_{\mathrm{OBSERVER}} \,. \tag{9}$$

Note that the Traveler's time is a fraction of our own time. It makes perfect sense, they're moving faster so their clock runs slower. Furthermore if the Traveler wants to determine our ship's passage of time it would be very easy to do. The Traveler (knowing he is on the faster ship) can similarly measure the velocities and calculate,

$$\Delta t_{\mathrm{SLOWSHIP}} = \frac{\sqrt{1-\left(0.25/c\right)^2}}{\sqrt{1-\left(0.5/c\right)^2}}\Delta t_{\mathrm{FASTSHIP}} \,,$$

$$\Delta t_{\mathrm{SLOW\ SHIP}} = 1.12\ \ \Delta t_{\mathrm{FAST\ SHIP}} \,.$$

Significantly, the Traveler is able to find and report that more time passes on our clock than on his own. No disagreement. *Both Traveler and Observer are able to agree on the reality of the situation.* (Here is one way to physically compare the times: Clocks are synchronized at the instant of passing, then are later compared at some common destination.)

Now when Einstein's relativity is applied in this experiment, *only* the relative speed between the two ships is considered to be important. The ships approach then separate with speed $v = 1/4\,c$. The relativity eqn (8) predicts:

$$\Delta t_{\mathrm{TRAVELER}} = \sqrt{1-\left(0.25\,c/c\right)^2}\,\Delta t_{\mathrm{OBSERVER}} \,,$$

$$\Delta t_{\mathrm{TRAVELER}} = 0.968\ \Delta t_{\mathrm{OBSERVER}} \,. \tag{10}$$

Once again the Traveler's time is a fraction of our own time —the Traveler's clock runs slower. But the predicted value in (10) is considerably at odds with DSSU theory in (9). ESR *understates* the time difference (the clock slowing). What is even more dramatic is that those on the faster ship (who perform the symmetrically identical calculation) predict that the slower ship's clock runs slower. This is contrary to reality! The reality is that the slower the motion, the faster the clock ticks. Clearly ESR can only provide information on the *apparent* clock slowing.

As stated earlier, ESR agrees with DSSU reality only in the special case when the observer is at rest —where "at rest" is defined with respect to the space medium. It would seem that DSSU is the broader theory that encompasses ESR. It makes perfect sense: relative motion can never encompass absolute motion, but absolute motion can always be described in relative terms. An absolute motion equation can always be converted to a relative motion equation (but not *vice versa*). This idea will be expanded in Section 5.

4. EARTH CLOCK AND ORBITING CLOCK COMPARISON

The idea here is to apply the DSSU intrinsic-motion equation to a gravitational situation, one involving the intrinsic time of clocks subjected to aether flow while in orbit as compared to the intrinsic time of a clock subjected to aether flow while stationary on the Earth's surface.

This 'experiment' compares the beacon clocks of a fully functional navigation system operating 24 hours a day, every day of the year, and finds that they agree with the DSSU equation to an astounding degree of accuracy.

The navigation system is known as the Global Positioning System (GPS) —one of the world's great modern marvels. Originally designed to serve the United States military, the GPS was developed and tested in the 1970's. During the following two decades the system evolved and its applications expanded. The GPS, by offering unprecedented position as well as chronometer accuracy, has revolutionized the transportation industry and greatly benefited field researchers involved in biology, botany, ecology, geology, and natural resources exploration, among others. The operation of the system involves a constellation of 24 Earth orbiting satellites, each transmitting coded signals. The signals are decoded by ground receivers, and used in a process called *trilateration*. The purpose of the system, of course, is to allow users with a GPS receiver to determine their location on the Earth, including altitude, latitude, longitude, and to be informed of the precise *universal coordinated time* maintained by a reference atomic clock at the U.S. Naval Observatory in Bethesda, Maryland. If the user is in a moving land vehicle, aircraft, or vessel the coded signals also provide speed and bearing.[9]

The System's designers tell us the functional details are complex. In the words of Chris Hillman, "the devil is in the details." When physicists say that something is complex, believe it. Fortunately the details of the system are of no concern, since the focus is only on the system's clocks —their moving speeds and their ticking rates.

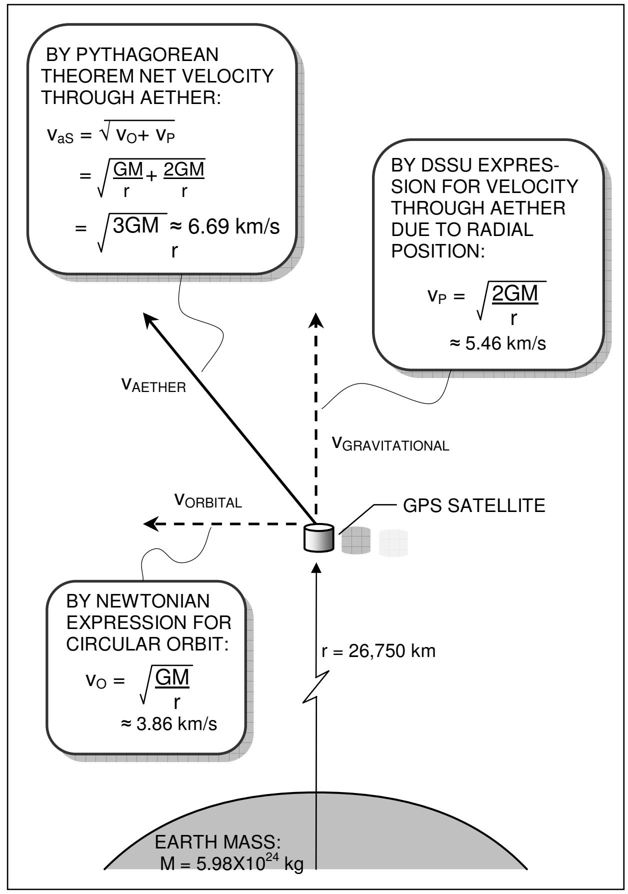

Fig. 3. *Two motion-components of a GPS Earth orbiting satellite.* Their vector addition determines the *net speed through-the-aether,* v_{aS}, which as it turns out is equal to 6.6897 km/s. The overriding importance of a speed relative to aether is that this, and only this, motion determines the actual clock rate. In the text, v_{aS} is used to calculate the clock-slowing factor which gives a measure of how much slower the satellite clock runs when compared to an ideal at-rest clock.

In the following analysis, one clock, the Earth surface clock, is located at the Bethesda Observatory, while the other (there are 24 others) is in an inclined polar orbit 26,750 km from the center of the Earth. The time intervals recorded are Δt_{GROUND} and $\Delta t_{\text{SATELLITE}}$ respectively.

The first challenge is to calculate the velocity magnitude of the orbiting satellite —not with respect to the Earth, but with respect to the aether. This means determining and combining the orbital motion (tangential velocity through aether) and the gravitational motion (radial velocity through aether associated with elevation) to obtain the *net speed through-the-aether* of the satellite and its on-board atomic clock(s). The calculations, using Newtonian mechanics and the DSSU aether velocity expression[10] and the Pythagorean Theorem, are shown in **Fig. 3**.

Here again is the DSSU time relativity equation:

$$\Delta t_{\text{SATELLITE}} = \frac{\sqrt{1-\left(v_{a\text{S}}/c\right)^2}}{\sqrt{1-\left(v_{a\text{G}}/c\right)^2}}\,\Delta t_{\text{GROUND}}\,. \qquad (7)$$

Expressed in words it means:

elapsed time recorded on satellite clock = *clock-slowing factors* X *elapsed time recorded on ground clock*

Since the $(v_a/c)^2$ terms have values considerable less than unity, the binomial theorem can be applied, so that:

$$\Delta t_S \approx \frac{1-\frac{1}{2}\left(v_{aS}/c\right)^2}{1-\frac{1}{2}\left(v_{aG}/c\right)^2}\Delta t_G \ . \tag{7a}$$

Two of the values are ready to be plugged in. The speed of light $c = 2.9979\times10^5$ km/s; and the speed of the satellite v_{aS} is equal to 6.6897 km/s. Now for v_{aG} the speed of the ground clock: In conventional relativity this would mean its speed as it (and the city of Bathesda) spins with the Earth on a daily schedule. However, according to DSSU theory *the direction is mainly vertical* to the Earth's surface. Of course, the clock does not move away from the Earth's surface; it is the aether that is flowing vertically downward and streaming through the clock. The 'ground' clock has a speed that is constant and is determined by its radial position from the Earth's center of mass. The speed is found by substituting values for G (6.673×10^{-11} Nm^2/kg^2), Earth mass M (5.98×10^{24} kg), and Earth radius R (6.38×10^6 m) into the DSSU aether-flow equation.[10] The calculation gives the surface clock *speed through-the-aether* as,

$$v_{aG} = \sqrt{2GM/R} = \sqrt{125.09\times10^6} = 11.184 \text{ km/s}.$$

The three speeds are substituted into eqn (7a) to give the predicted elapsed time that the satellite clock should record:

$$\Delta t_S \approx \frac{1-\frac{1}{2}\left(6.6897/2.9979\times10^5\right)^2}{1-\frac{1}{2}\left(11.184/2.9979\times10^5\right)^2}\Delta t_G \,,$$

$$= \frac{1-\left(0.248,97\times10^{-9}\right)}{1-\left(0.695,91\times10^{-9}\right)^2}\Delta t_G$$

$$= 1.000{,}000{,}000{,}446{,}940\ \Delta t_G \,,$$

$$= [1+ (446.94\times10^{-12})]\ \Delta t_G \,.$$

The calculation could also have used eqn (5) for each clock separately and formed an expression[11] of the difference. Conceptually it might be easier. It makes the same prediction and serves as a check:

Difference in elapsed time = (**satellite clock** (the faster clock) − **surface clock** (the slower clock)) x (rest clock elapsed time)

When speeds are much less than c the expression simplifies to:

$$\Delta t_S - \Delta t_G \approx \frac{v_{aG}^2 - v_{aS}^2}{2c^2}\Delta t_{ABS.REST} \,, \tag{11}$$

$$= \frac{(11.184\text{km/s})^2 - (6.6897\text{km/s})^2}{2\times(2.9979\times10^5\text{km/s})^2}\times\Delta t_{ABS.REST} \,,$$

$$= 446.90\times10^{-12}\times\Delta t_{ABS.REST} \,.$$

And this is the *elapsed-time difference* that the DSSU aether model predicts: The satellite clock should run faster than the Bethesda clock —faster by 446.90 clock ticks per trillion. And what was the *actual* clock difference?

> *When the first atomic clock was sent into orbit in June 1977* [aboard a GPS test satellite] *there were some who doubted that relativistic effects were real. A frequency synthesizer was built into the satellite clock system so that after launch, if in fact the rate of the clock in its final orbit was that predicted by general relativity, then the synthesizer could be turned on bringing the clock to the coordinate rate necessary for operation. The atomic clock was first operated for about 20 days to measure the clock rate before turning on the synthesizer.* ***The frequency measured during that interval was +442.5 in 10^{12} faster than the clocks on the ground****; if left uncorrected this would have resulted in timing errors of about 38,000 nanoseconds per day.* –Neil Ashby[12]

Now the next question is, what was the actual correction incorporated into the synthesizer to synchronize the faster clocks with the Earth-base clock? The GPS system will not and cannot work unless all the clocks are synchronized (with each other and with *universal coordinated time, UTC*) and periodically readjusted to maintain synchronicity. Chris Hillman explains:

> *The major way in which the ... discrepancy due to relativistic effects is accounted for is by building into the GPS software, used to keep the satellite clocks in synch with each other and to synchronize GPS time with UTC,* ***an effective downward frequency shift of 446.47 parts per trillion*** *in the orbiting atomic clocks.*[13]

The satellites reduce the frequency (the number of clock ticks) by 446.47 parts per trillion *before* transmitting the 'time' signal down to Earth. Compare this with the 446.90 parts per trillion figure —the pocket-calculator approximation just detailed. Remarkable! particularly, when one considers that there are, as Chris Hillman warns, "numerous extremely complex *Newtonian* physical issues ... also about a dozen distinct str [special relativity] and gtr [general relativity] effects which must be taken into account in the design and operation of the system."[13] Also, this predicted value matches, within a remarkable 0.1% accuracy, the actual experimental measured time difference. The value is extraordinarily close in spite of the numerous real and potential, fixed and transient, sources of errors. "And of course, orbital injection is never perfect," as Hillman points out, "and none of the GPS satellites are in perfect circular orbits, or aligned precisely as designed."

Significantly, the calculation used nothing more than the DSSU intrinsic-time expression applied to the respective clock motions which are referenced solely to aether. Note that the ground based clock was *not* treat as stationary. In general, the relative velocity between two clocks is, in itself, an incomplete concept. *Each clock's speed relative to aether must be considered.* It then becomes evident that the Earth clock is the 'slow' clock and the orbital clocks of the Global Positioning System are the 'fast' clocks.

Note: An unexplained issue here is that the analysis does not take into account the significant background aether flow. This background flow is approximately 500 km/s; yet the analysis provided the correct value (as judged by the evidence).

5. WORLDVIEWS OF SPACE AND TIME

It should be emphasized that "time" has no independent existence. Only motion, such as the motion of subatomic particles and gross objects and astronomical bodies, is real. While motion is real; *time* is merely an abstracted aspect of motion (the manifestation of change). *Time* serves as part of the description of what is real —and what is real must, by its very nature of existence, involve motion. When the motion of one object is compared to some repeating internal motion of a clock (even if the motion is at the atomic scale) we call the correspondence "a measurement of time." In agreement with Aristotle, *time* without motion has no meaning.

DSSU theory includes a *time-relativity postulate*. It simply states that *time*, as measured by any kind of mechanical- biological- or quantum- clock, runs fastest when the clock's absolute motion is zero. And *time*, similarly measured, slows down as a consequence of increasing speed through aether.

The fact is that time, as measured by moving clocks, passes slower; clock-time slows for the 'traveler' in relation to the intrinsic motion through aether. The traveler's *time* is proportional to absolute-rest *time* by the factor $(1-(v_a/c)^2)^{1/2}$, where v_a is the speed of the traveler with respect to the traveler's local aether. Acceleration in itself is irrelevant. Acceleration is *not* the determining factor or characteristic in clock slowing —the speed *through* aether is the sole criterion.

DSSU theory, as a model of the universe, is highly effective —not just in its ability to explain the relativity of time, but also in explaining the many other phenomena and observations to which it has been applied. The theory's success is rooted in the definition and properties of *space* —or more properly, the space medium. Space is permeated by a non-mass, non-energy, aether. This gives it a rather unusual absoluteness quality.

The space medium consists of discrete units. Discreteness, no matter how small and simple the units may be, is essential. Any successful cosmology theory must postulate discrete entities for the composition of *space*. Neither Newton nor Einstein recognized this. Newton's space is a continuum —a continuum of emptiness. Einstein's space is a continuum[14] —a continuum of coordinate geometry and curvature. The Newtonian and Einsteinian universes lacked the essential entities that could cause motion-induced intrinsic-time changes.

Because of the dynamic nature of aether, there can be no universal frame of reference —Einstein was right on this. However, on the largest scale of the Universe, DSSU theory presents a spatial universal frame of reference in agreement with Newton's view. More properly called the *cosmic frame-of-reference*, it does not refer to space itself but rather to the DSSU's cosmic-scale cellular structure —a quasi-static pattern sustained by dynamic aether and its derivative processes.

Table 2, above, organizes the relevant concepts of space and time by placing them into historical perspective. It summarizes the essential similarities and differences of three worldviews of space and time.

> *... [O]ne reaches the conclusion that the old picture according to which space and time are continuous must be abandoned. On the Planck scale, space appears to be composed of fundamental discrete units.* –Lee Smolin[15]

For a new theory to be valid it must encompass those related theories that have been proven to work in their

Table 2. **Three Worldviews of Space and Time**

NEWTON (18th &19th centuries)	EINSTEIN (20th century)	DSSU (21st century)
Absolute space & time Space is static	NO absolute spacetime (Spacetime is mathematically curved)	Space is permeated by a non-mass, non-energy, aether. Time without motion has no meaning.
Universal space & time	NO universal frame of reference (No preferred frame of reference)	No universal frame of reference. Aether is local preferred reference frame. Cosmic-scale cell structure serves as a Euclidean frame of reference on largest scale.
Absolute motion: yes	Absolute motion: no	Aether-referenced motion
Galilean rules of relativity	ESR rules of relativity (but incomplete)	DSSU rules of relativity
Space is a continuum	Space is a continuum	Space is 'quantized'

DSSU Equation of intrinsic time and motion:

$$\Delta t_{\text{TRAVELER}} = \frac{\sqrt{1-(v_{a\text{T}}/c)^2}}{\sqrt{1-(v_{a\text{O}}/c)^2}}\Delta t_{\text{OBSERVER}}$$

Reduces to Einstein's relativity eqn when observer's speed is restricted to $v_{aO} = 0$ and traveler's speed is the apparent speed v:

Where v is obtained by taking the magnitude of the difference of the two vectors $\mathbf{v}_{aO}$ and $\mathbf{v}_{aT}$.

$$\Delta t_{\text{TRAVELER}} = \sqrt{1-(|v_{a\text{T}}-v_{a\text{O}}|/c)^2}\,\Delta t_{\text{OBSERVER}}$$

Einstein relative time and motion:

$$\Delta t_{\text{TRAVELER}} = \sqrt{1-(v/c)^2}\,\Delta t_{\text{OBSERVER}}$$

When both speeds are restricted to low speeds the eqn further reduces to:

Newtonian-Galilean absolute time:

$\Delta t_{\text{TRAVELER}} =$

particular domain of application. In other words DSSU theory, in addition to breaking new ground, must also explain what ESR already explains and ESR in turn must explain what Newton's theory explains. The DSSU equation (having the widest application) under restricted conditions must reduce to the ESR form which also under further restricted conditions must reduce to the Newtonian-Galilean form. The procedure is detailed in the flowchart above.

Note that in the first equation in the flowchart the directions of motion do not matter at all —only their intrinsic magnitudes are important. However, in the procedure of reducing the DSSU equation to the ESR equation, the directions of motion *are* important; since they, as vectors, enter into the calculation of the magnitude of the relative motion. The Einstein equation then processes this relative speed (to obtain relative time).

To illustrate the fact that intrinsic time (DSSU) can be totally different from apparent time (ESR) consider a situation in which Traveler and Observer are both speeding at 1/4 lightspeed in *opposite* directions. There would then be no *intrinsic time* difference between the clocks. But the *apparent time* difference —a consequence of a relative speed of $0.25c + 0.25c$— would be substantial.

The three theories correspond only where their realms of validity overlap.

6. DSSU RELATIVITY POSTULATES

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 to account for the [discrete] structure of spacetime ...
–Lee Smolin[16]

DSSU relativity has a postulate for each of motion, time, and light (radiation).

(1) **The motion relativity postulate.** Relative to aether, motion can be measured. This is known as local absolute motion. There exists a preferred frame of reference —the aether medium. Absolute (or intrinsic) rest means an object is experiencing comoving freefall. The laws of physics are the same for all observers in all inertial frames.

(2) **The time relativity postulate.** Clocks run fastest when intrinsic motion is zero. Time slows in relation to speed through aether.

(3) **The speed of light postulate.** The speed of light is constant through aether; and is independent of the motion of the source. Aether serves as the conductor of electromagnetic waves.

Einstein 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 unresolved paradox.
(3) The speed of light is constant. Light is always propagated in a vacuum with a velocity independent of the motion of the source.

The DSSU Fundamental Difference

Space is a quantized composition of fundamental entities. This aether-permeated-space defines a preferred, detectable, frame of reference; and serves as the conducting medium for light.

Needless to say, the measured speed of light will always be constant no matter what the relative velocity of the source and the observer may be. In agreement with Einstein's hypothesis, all observers regardless of motion will always measure the same speed of light. But as we have seen, the path length of a light beam may vary among different inertial observers. Everyone agrees on the speed of light.

The speed of light c in a vacuum —that is, through aether— is an ultimate speed that cannot be exceeded by any entity carrying either energy or information. The explicit understanding is that aether serves as the medium for the propagation of electromagnetic waves. And it is a property of aether that determines their fixed speed. Furthermore, this explains why the motion of the light source does not change the wave speed (but does change the wave's length).

The several deviations from Einstein's relativity —such as absolute inertial motion, preferred frame, light-propagation medium— are the direct consequences of introducing aether and defining space as an aether sea of discrete entities.

In conclusion, the fundamental difference between DSSU and ESR relativity is that the one recognizes the fact of local absolute motion while the other denies it. The practical difference is that the former includes the difference between intrinsic motions (speeds with respect to local aether) while the latter uses only the relative difference in motion. ESR presents us with only a partial depiction; DSSU relativity encompasses a complete picture of the relativity of time. □

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NOTES AND REFERENCES

[1] R. T. Cahill. 2002. *Absolute Motion and Quantum Gravity* (http://www.mountainman.com.au/process_physics/HPS11.pdf)

[2] C. Ranzan. 2008. *DSSU: The Nonexpanding Universe, Structure, Redshift, Distance*, Published on Cellular Universe Website (www.CellularUniverse.org/Th0NonExpandU.htm)

[3] H. Genz. 1994. *Nothingness, The Science of Empty Space* (Perseus Books, 1999) p158

[4] Ibid., p177

[5] Albert A. Michelson and Edward W. Morley. 1887. *On the Relative Motion of the Earth and the Luminiferous Ether* (The American Journal of Science, Vol.**34**, No.203)

[6] R. T. Cahill, *The Michelson and Morley 1887 Experiment and the Discovery of Absolute Motion*, Progress in Physics, Vol.**1**, Issue 3, pp25-29 (2005) [Posted at: http://www.ptep-online.com/]

[7] H. Genz, *Nothingness, The Science of Empty Space*, p148

[8] A. Einstein. 1952. *Relativity, The Special and the General Theory* (Random House, NY, 1961); also J. Bronowski, *The Clock Paradox*, Scientific American Feb 1963, p134.

[9] Chris Hillman and John Baez, per Website: http://math.ucr.edu/home/baez/RelWWW/wrong.html (2001 Jan)

[10] C. Ranzan. 2008. *Space Flow Equations and Expansion-Contraction Rates* Published on Cellular Universe Website (www.CellularUniverse.org/Th5AetherEqns.pdf)

[11] **Time difference between any two clocks *1* and *2***, having velocities v_1 and v_2 with respect to aether:

Using eqn (5), write: $\Delta t_1 = (1 - (v_1/c)^2)^{1/2} \times \Delta t_{ABS.REST}$ and $\Delta t_2 = (1 - (v_2/c)^2)^{1/2} \times \Delta t_{ABS.REST}$.
Let t_1 be the faster clock (experiencing slower v) and let t_2 be the slower clock (experiencing faster v).
Then: $\Delta t_1 - \Delta t_2 = [(1 - (v_1/c)^2)^{1/2} - (1 - (v_2/c)^2)^{1/2}] \times \Delta t_{ABS.REST}$.
For speeds << c, use the approximation given by the binomial theorem, $(1- (v/c)^2)^{1/2} \approx 1- ½(v/c)^2$.
Thus: $\Delta t_1 - \Delta t_2 \approx [(1 - ½(v_1/c)^2) - (1 - ½(v_2/c)^2)] \times \Delta t_{ABS.REST}$

$$\approx \left((v_2^2 - v_1^2)/ 2 c^2\right) \Delta t_{ABS.REST} . \qquad (11)$$

[12] N. Ashby, as found on Website: http://math.ucr.edu/home/baez/RelWWW/wrong.html

[13] C. Hillman, per Website: http://math.ucr.edu/home/baez/RelWWW/wrong.html (2001 Jan)

[14] A. Einstein. 1952. *Relativity, The Special and the General Theory* (Random House, NY, 1961) p62, 104, 170

[15] L. Smolin, *Three Roads to Quantum Gravity* (Basic Books, 2001) p169

[16] Ibid., p217