The Physical Causes of Light Speed, c, and of Related Phenomena

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Preface: This paper concerns the advancement of physics theory, and science in general. It shows the importance of basing theories on *plausible premises* that are consistent with sound reasoning and *all relevant evidence*. We know from Ptolemy's geocentric theory of the cosmos that scholars accepted false evidence of heavenly bodies moving around Earth as *obvious truth* about nature, and that this impeded the advancement of scientific thinking for ~1500 years, until the Earth-centered universe was shown to be an illusion. This paper shows that the careful measurements of the speed of light, which *appear to show* that light's unimpeded speed through all inertial reference frames is a universal constant, c=299,792,458 m/s, has been a complex illusion. This light speed illusion became a law of physics (~1900) on which space-time theory is based. The illusion and theory caused a misunderstanding of basic aspects of nature**:** time, distance, and the mass-energy (m-e) comprising our universe. Readers who understand this paper will see why this claim is justified.

Evidence contradicting the law of constant light speed, c

Before explaining *why the measured unimpeded speed of light through all inertial systems is speed c*, we will point out that the law of constant *light speed, c (lsc),* is contradicted by a variety of simple and complex evidence. The Doppler shifting of starlight is an example of the contradictory evidence. The following simple and conductible "thought experiment" and current evidence *prove* that the speed of light is *not constant*.

Given: Light from a star, that has very little changing of its electromagnetic (EM) spectrum frequencies**,** is arriving in the solar system *along Earth's ecliptic plane.* This starlight EM radiation will be designated **sℓ**.

Findings: A sensitive light-frequency detector located at Earth's north pole determines that the arriving **sℓ** radiation has nearly the same frequency spectrum whenever Earth's orbital speed around the sun (~**.**0001 c) *is transverse to the arriving* **sℓ** *radiation*. This shows that the **sℓ** *radiation arriving in the solar system* has essentially the same constant frequency spectrum year after year. However, at all other times of year the frequency detector detects small, daily frequency changes and large semiannual changes of the frequencies.

These frequency changes, displayed at the detector, occur *immediately as the detector's radial velocity (i.e. velocity toward or away from the arriving* **sℓ** *radiation) changes*, and *the amount of a frequency change from one location on Earth's orbit to another location depends on the amount of the radial velocity change.* For example, twice a year when Earth's **.**0001 c orbital speed is *transverse* to the arriving starlight, this orbital speed neither adds to, nor subtracts from, the arrival speed of the starlight, and it does not cause any Doppler shifting of the **sℓ** spectrum. However, at the two times of year when Earth is orbiting directly *toward or away* from the arriving starlight, the maximum blueshift or redshift of the **sℓ** radiation occurs at the detector.

Conclusions: This verifiable evidence is *proof* that the *physical cause* of the annual cycle of changing Doppler shifts of the starlight is *the daily changing* of the **sℓ** *velocity arriving at the frequency detector* (which is caused by the detector's constantly changing radial velocity (toward or away from the arriving radiation) as Earth orbits the sun. The changing Doppler shifts occur instantly and simultaneously at the detector as the **sℓ** photons, that are arriving with changing speeds, are absorbed **(***in accord with classical physics theory***)**. This *variable light speed* conclusion refutes the law of constant lsc, which may be why lsc theory says that the changing Doppler shifts of starlight are due to the changing radial velocity of the detector relative to *the star.*

"Correlation" theories and "Physical Causes" theories

Theory based on lsc is a *correlation theory*. It uses the correlation between a change in the detector-star radial velocity to accurately predict or specify the corresponding change in the Doppler shift measured at a frequency detector. We know via the above "thought experiment" that this is *not* what is *causing* the Doppler shift changes. We know that the star cannot influence the Doppler shifting of its radiation centuries after emission. And we know that *all of the star's radiation entering the solar system and about to be absorbed continues to have a steady, unchanging Doppler shift of its spectrum*. Therefore, any change in the measured spectrum shifts as the detector orbits the sun must be occurring at the detector as the EM radiation is absorbed. Also, when the detector has any change in its velocity toward or away from the radiation, it displays the *immediate and simultaneous change in the Doppler shift* of the radiation. This is conclusive evidence that the Doppler shift changes occur during absorption at the orbiting detector, where the starlight arrives with *ever-changing speeds and thus ever-changing mass-energy.*

Correlation theories can make accurate predictions and otherwise be useful without being able to explain how and why observed phenomena occur. However, they can also be misleading and harmful if they misrepresent nature and perpetuate misinformation (like geocentrism and many other incorrect and misleading theories in the history of science). Newton's laws of motion have been good correlations with the experimental evidence (e.g. the inertia of mass-energy) while not claiming to explain the physical causes of the evidence. The inertia of all mass-energy happens to be another logical consequence of the light-propagating medium responsible for Doppler shifts and lsc. Theory based on the *law of lsc contradicts the classical physics of Galileo and Newton*. *The view explained below agrees with classical physics*, and it makes lsc theory unnecessary, which would be both a simplification and correction of current physics theory.

Appearances are often deceiving. (Aesop, ~ 600 BCE)

Measured, constant lsc shows that direct experimental evidence can cause beliefs, axioms and theories that are consistent with related experimental evidence and can make accurate predictions that support the theories, but that turn out to be inconsistent with nature and that impede the advancement of science. This paper shows that the strange, constant lsc is not a simple fact of nature, as students are taught. It has quite complex, *logical physical causes* (like the once-perplexing observations of heavenly bodies circling Earth have logical causes). In both cases, the physical causes are more complex than the simple illusions.

The current, observed evidence of the Doppler shifting (at the frequency detector, as the speed and frequency of the arriving radiation changes during absorption) shows that the radiation is propagated *through a medium*, as physicists in the 1800s believed. However, the Michelson-Morley experiments (~1887) provided contrary evidence that the speed of light is isotropic in all inertial reference frames, and thus is not propagated through a medium through which Earth is moving, and it led to the law of constant light speed, c.

The Quantum Medium View (or *qm view* or *qmv*), explained below, shows why the *measured*, constant speed of light is a complex, *logical consequence* of the light-propagating medium that the Michelson-Morley experiments were designed to reveal. The fact that the qmv explains the *physical causes* of *measured* lsc, and *all the paradoxes of space-time theory*, and the *relativistic phenomena* that lsc theory correctly predicts but misunderstands (due to its false lsc postulate), indicates that the qmv correctly represents nature. The qmv is a *physical causes theory*, and orthodox Doppler shift theory is a *correlation theory* with a flawed correlation.

The causes of the measured "*virtual*" light speed, c, are more complex and difficult to understand than simply accepting that constant lsc is just a strange fact of nature. The constant light speed, c, illusion resulted in the lsc law and postulate, the logical consequences of which are the *virtual*, space-time paradigm of relativity theory that has a good correlation with the experimental evidence, and therefore appears to be a good theory. Similarly, Ptolemy's geocentrism was based on the inexplicable evidence and axiom that all heavenly matter has an innate inclination for circular motion. This must have seemed reasonable based on the available evidence ~150 CE, and it had a good correlation with the evidence until contradictory evidence and better theory was able to explain the *physical causes* of the evidence (~1600).

This paper uses various ways of identifying important terms, facts, and other information. It contains equations that model *absolute light speeds* through the quantum medium, and other equations that model *absolute light speeds* through mass-energy systems having *constant velocity through the quantum medium*. The calculations involve only algebra and patience to see how *virtual* and *absolute* distances, times, and velocities are used.

The illusion of constant light speed, c

This explanation involves new terms and symbols for reasons that will be apparent. Understanding this explanation requires understanding the terms and symbols, and the evidence and rationale for the terms and symbols needed to specify the *absolute* phenomena causing our observed, *virtual* phenomena (e.g. lsc).

The qm view is based on the following Premise1 (and a Premise2 that pertains to gravitational phenomena). The qmv is the *logical consequences* of these premises, and lsc is a complex logical consequence of the following Premise1. It will be important to keep aware of this qmv premise, which is like the 19th century premise of an aether, but updated to reflect new evidence since the times and work of Maxwell, Michelson, Lorentz, Einstein, and Dirac in the mid-20th century.

Premise1: A quantum medium (qm) is present throughout the universe, and the entire *mass-energy* (m-e) of the universe consists of oscillations of this qm (which has physical properties but is not m-e).

Individual energy quanta (e.g. photons) are oscillations of the qm that are propagated through the qm with a constant *absolute* speed, **ca**, when not impeded directly by m-e (e.g. air, water) or indirectly by nearby large concentrations of m-e (e.g. stars), which affect the qm in their locale (according to Premise2).

A speed of 1 ca is one *absolute* light-second (**LS**) per *absolute* second (**sa**), (where 1 LS is the distance that an energy quantum travels unimpeded through the qm in 1 sa, and 1 sa is one second (**s**) *according to an atomic clock when at rest in the qm and not significantly slowed by other energy quanta in its environment*. Electrons, nucleons, and other particles having rest mass, and comprising atoms, molecules, and larger systems of matter, are dynamic *systems of oscillations* in the qm.

To distinguish between *absolute* units, which are theoretical, *fixed units of measure specified by physical standards at rest in the qm in remote space*, and *virtual units* specified by physical standards that depend on their *absolute velocity,* **va***,* (*i.e. velocity through the qm*), *and any significant m-e in their vicinity.* The symbols for absolute units typically have an "a" at the end, and virtual units will not end with an "a". For example, the seconds produced by an atomic clock *at rest in the qm* in remote space are *absolute* seconds (e.g. 1 sa), and the seconds produced by a clock in a reference frame moving through the qm are *virtual* seconds (e.g. 1 s). Because time is slowed in inertial frames moving through the qm, 1 s is a longer time duration than 1 sa, and how much longer depends on the *absolute velocity, va,* of the reference frame. Some absolute and virtual units are designated by uppercase and lowercase letters. For example, the absolute unit of distance is the absolute light-second, or "LS", and virtual light-second units are "ls", which are shorter absolute distances than a LS and they depend on the absolute velocity, va, of the inertial frame and the direction of the ls relative to the direction of va. This will become clearer when we consider the following analogy.

Spaceship Diamond System Analogy

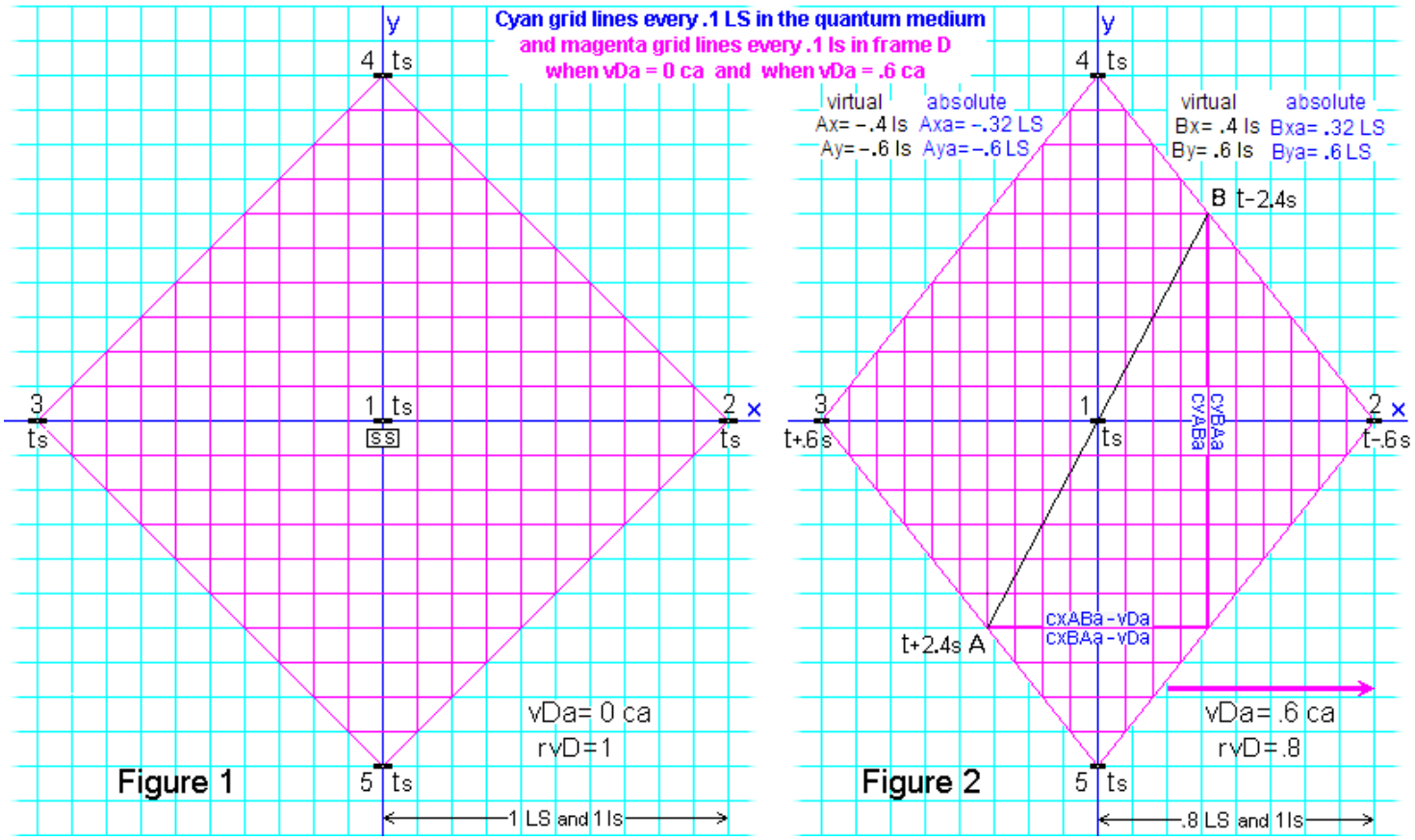
To help show why the logical consequences of the quantum medium always result in *measured*, constant, light speed, c, we will imagine five spaceships in a huge Diamond formation floating in remote space as shown in Figure1 below. The ships are numbered 1 through 5, with ship1 at the center of systemD. Figure1 shows systemD at rest in the qm (i.e. vDa=0 ca) with ship1 parked next to space station, ss, from which ship1 will accelerate and depart in the +x direction of systemD's x-y coordinate system (shown in magenta color). The *qm reference frame* is shown via cyan grid lines that are located **.**1 LS on centers in the x and y directions.

The spaceships are coplanar with ships 2 through 5 located on the x or y axis and 1 virtual light-second (ls) away from ship1, this being the *automatically controlled distance* traveled by a *round-trip* (RT) radar signal in two seconds, 2 s, according to the atomic clocks aboard the ships. The ships communicate with one another via radio signals, which are electromagnetic (EM) energy (like visible light) that orthodox physics theory assumes moves with constant speed, c, relative to the ships. The observers aboard the ships will be known as *observers*(*c*) because they assume that the law of lsc means that light is *not* propagated through a medium, and that light moves with the same isotropic speed, c, through all inertial reference frames.

The atomic clocks are kept synchronized with the master clock aboard ship1, which broadcasts its time every two seconds. The clocks, radar systems, and rocket thrusters on ships 2 through 5 automatically keep these ships 1 light-second, 1 ls, from ship1 and on the x or y axis. When systemD is at rest in the qm (as in Fig.1), the clocks on all the ships are "absolutely synchronized" because the speed of the EM signals between the ships is constant, as the observers(c) and the automatic positioning systems assume. Figure1 shows this *absolute* synchronization at t seconds on all five clocks.

Logical Consequences of Absolute Velocity, va

The qm has many logical consequences, and systemD helps explain a few that are responsible for the illusion of lsc. We will have the spaceships begin accelerating in the +x direction at a specified time, t, on the ship's clocks until D has an observed speed of **.**6 c relative to space station, **ss**. Because ss is at rest in the qm, the speed of light in frame ss is actually isotropic and equal to ca. Therefore, the observers(c) *in frame ss* observe the real, *absolute* phenomena occurring in the qm (as opposed to the *virtual* phenomena observed in systemD during and after acceleration). Thus, after acceleration, the five ships have an absolute velocity of vDa=**.**6 ca, in the +x direction, and *the minimum and maximum speeds of light through systemD are* **crn** *and* **crx** as follows**: crn=(1−va) ca** or **.4 ca** in the +x direction of D, and **crx=(1+va) ca** or **1.6 ca** in the −x direction.



In all other directions the speeds of light through systemD are between **.4** ca and 1.6 ca. In the transverse directions of systemD, the speed of light is .8 ca because light moving between ships 1 and 4 or 5 must have a **.6** ca component of its 1 ca velocity through the qm be in the +x direction (to keep up with D's vDa=.6 ca). Thus, the light's speed parallel to the *y axis* of D must be $\mathbf{sqrt(1-.6^2)^{.5}}$ or **.8 ca.**

These different speeds of light in the x and y directions in systemD show why systemD contracts along lines parallel to the x axis during acceleration (*to maintain an isotropic rate of RT energy exchange as in Fig.1*). If systemD did not contract as in Fig.2, the time for a RT energy exchange between ships 1 and 4 or 5 would be (2 LS/**.**8 ca)=**2.5 sa**, and between ships 1 and 2 or 3 the time would be (1 LS/.4 ca + 1 LS/1.6 ca) or **3.125 sa**. Thus, when vDa=**.**6 ca, distances along lines parallel to vDa are contracted to **2.5 / 3.125** or **.8** times their at-rest length *to maintain a balanced, stable, isotropic rate of RT energy exchange (as in Fig.1)***.**

<u>The slowing of time in systemD, and the physical change ratio, rv</u>

As systemD was accelerated in the +x direction from vDa=0 ca absolute velocity to vDa=**.**6 ca, there was a slowing of time throughout D because the same slowing of round-trip energy exchange that was occurring on a large scale between the spaceships was occurring at all scales of m-e down to the scale of energy exchanges at an atomic scale and the energy exchanges between atomic nuclei and electrons. This slowing phenomenon (which is similar to the natural slowing of RT motorboat traffic in all directions on a river as the river flows faster) slows the rates of atomic clocks and all other kinds of processes. Therefore, during the acceleration to vDa=**.**6 ca, the time duration between the EM time signals emitted by the ship1 atomic clock gradually increased from (2 LS distance / 1 ca speed**)** = 2 sa time, to (2 LS/**.**8 ca**)** = 2**.**5 sa.

Similarly, all the clocks in systemD are slowed, and the outer clocks receive signals from ship1 every 2 **s** according to the D clocks. The slowing of the clocks and the slowing of all other evolution in D is specified by the *physical change ratio*, which is represented by the letters **"rv"** because it is a *velocity*-dependent *ratio.* It is the ratio of a m-e system's *internal, round-trip energy exchange rate* due to the system's va=.6 ca absolute velocity (i.e. through the qm), to the system's *at-rest,* va=0 ca, *rate*.

$$rv=(1-va^2)^{.5} \quad \text{or} \quad rv=|crn \cdot crx|^{.5}$$

The rv ratio also specifies systemD's contraction *along lines parallel to* va. The contraction occurs *during the acceleration* to maintain a balanced and stable rate of RT energy exchange in D, as it was when vDa=0 ca. The contraction results in all subsystems of D having the same, balanced, at-rest RT energy exchanges. Thus, the observed 1 ls *virtual distance* between ship1 and ship2 or 3 is a .8 LS *absolute distance*, as shown in Fig.2. And the time for a RT, EM signal between ship1 and ship2 or 3 is (**.**8 LS/**.**4 ca + **.**8 LS/1**.**6 ca) = 2**.**5 sa, which is (2**.**5 sa ·**.**8) = 2 s on the D clocks, as the observers(c) expect and as the control systems provide.

The asynchronization of clocks due to va

An additional consequence of the qm that causes measured light speed, c, is the clock asynchronization that occurs due to the different speeds of EM radiation through systemD due to vDa=**.**6 ca. Rather than explain the reasons for the asynchronization of any two clocks in systemD, we will simply state our Rule that specifies the asynchronization and let readers determine the rationale for the Rule (via using information above).

Asynchronization Rule:

In any inertial reference frame moving through the qm, two clocks, which have been virtually synchronized by assuming light speed, c, are out of sync by an amount equal to the absolute velocity of the reference frame times the *observed **ls** distance* between the clocks *in the direction of absolute motion*. The forward clock is retarded relative to the rearward clock.

According to this Rule, clock2 should be (**.**6 ca · 1 ls) or **.**6 s retarded relative to clock1, and clock4 should be reading the same as clock1 because the observed ls distance between clock4 and clock1, *in the direction of va*, is 0 ls. These times are shown on *Figure2*.

Calculating the expected and the measured speed of light, c, in systemD, Figure2

We can now calculate the observed speed of light along any line through systemD, Figure2**,** to determine if the measured speed is 1 c, as the law of lsc specifies. We know that the observers(c) on the spaceships know that the distances between ship1 and the outer ships is 1 ls because a round-trip EM signal takes 2 s on their atomic clocks, and that the measured speed of light is therefore 1 c along the x and y axes of systemD, where the absolute velocity of the system is in the +x direction of the system. But what about the measured light speed in all the other possible directions? If we show that the measured speed of light along any arbitrary line through the origin is lsc, this should indicate that the speed along any line through the origin of the x-y-z coordinate system of systemD is lsc and presumably along any line through any m-e system, regardless of the system's absolute velocity (unless it can be shown otherwise).

To consider the observed speed of light in all other directions, we can imagine that systemD is a solid, thin, diamond-shape body, like a huge highway warning sign having a 2 ls distance between opposite corners. Fig**.**2 shows two points, A and B, that we can use to show that the measured speed of light along any line through systemD will be lsc. First, we will show how the observers(c) determine the *virtual distance* and the expected travel time for light signals between A and B**.** Then, we will determine the *absolute phenomena* causing the virtual light speed, c, from A to B and from B to A, observed by the observers(c).

The time measurements that observers(c) expect for light to travel with lsc from A to B and B to A

The observers(c) observe that point A is located at Ax= –**.**4 ls and Ay= –**.**6 ls on the diamond, and that B is located at Bx= +**.**4 ls and By= +**.**6 ls. Therefore, the virtual distance between A and B is $(.8^2 + 1.2^2)^{.5}$ = 1**.**442220 510185 ls, and if the speed of light is always 1 ls/s through all inertial frames, then the observed time for EM signals from A to B and from B to A should be **1.442220 510185** s.

Why the observers(c) at A and B measure *the expected speed of light, c,* from A-to-B and B-to-A

We will now determine if observers(c) in systemD will measure the above expected **1.442220 510185** s travel time for light signals from A to B and from B to A. First, we need to know the absolute distance between A and B, which is $(.64\,LS^2+1.2\,LS^2)^{.5}$ or ABda=**1.36** LS. Then we need to find the *absolute relative light speeds* from A to B and from B to A (*through systemD*), which *relative speeds* will be known as crABa and crBAa**.**

Finding the absolute relative speed of light, crABa, from A to B in systemD, Figure2

To find crABa, we will find the x and y components of the light's 1 ca velocity *through the qm*, cxABa and cyABa, which are related as follows**:** $(cxABa^2 + cyABa^2)^{.5} = 1$ ca *or* **cyABa =** $(1 - cxABa^2)^{.5}$. And *in systemD* the *ratio* of the *distance* moved by the light in the *x direction* to the distance moved by the light in the *y direction* is only (**.**64 LS / 1**.**2 LS) or (**.5333…**). Therefore, the *velocity* of the light moving in the x direction *through systemD* must be **.5333…** times the velocity in the y direction. However, because the *velocity* of the light in the x direction through systemD is reduced by the **.6** ca velocity of systemD through the qm, we can specify the following**:** (cxABa – vDa) / .5333… **= cyABa**

The two **cyABa equations** above *can be combined into one equation with one unknown* (**cxABa**), as follows**:** (cxABa – vDa) / .5333… = $(1 - cxABa^2)^{.5}$, that can be put in quadratic equation form and solved for cxABa. † Thus, **cxABa = .866358 618736** ca and **cyABa=**$(1-cxABa^2)^{.5}$ **= .499422 410131** ca, as shown in the top row of Table1 below. **Note:** cxABa is much larger than cyABa because **.**6 ca of its **.**866358 618736 ca velocity in the +x direction is needed to "keep up with vDa". As a result, the light's velocity along line AB *through systemD* is **crABa=**$[(cxABa-vDa)^2 + cyABa^2]^{.5}$ or **crABa= .566012 064815** ca, as shown in column3, and it takes **tABsa=2.402775 637732** sa to move the 1**.**36 LS from A to B, as shown in column4.

This 2**.**402775 637732 sa travel time is only **.**8·2**.**402775 637732 = 1**.**922220 510185 s on systemD clocks (column5). And since clockB is asynchronized (**.**6 ca·**.**8 ls) = **.**48 s *behind* clockA per async Rule (column6), the A-to-B travel time on clockB is (1**.**922220 510185 s −**.**48 s) = **1.442220 510185 s** (column7). This travel time from A to B (predicted by the qmv) is exactly what the observers(c) expected based on their measured virtual distance from A to B.

This correlation between the measured A-to-B distance and the measured light travel time helps verify the observers(c) belief in the constant lsc theory. We will see below that the speed of light from A to B is actually much slower than from B to A where essentially all the light's velocity through the qm is in the −y direction because *the light does not need velocity through the qm in the −x direction because location A has velocity vDa=.6 ca in the +x direction through the qm to meet the light from B*.

Finding the absolute relative speed of light, crBAa from B to A in Fig.2

Observers(c) measure the same *virtual* light speed, c, from B to A due to the large difference in the *absolute* speeds of light crABa = .566012 064815 ca moving from A to B and crBAa = 1.130717 947168 ca moving almost twice as fast from B to A, due to vDa=**.**6 ca slowing crABa and making crBAa faster.

Except for the + sign in front of vDa, the following equation, which specifies the light moving from B to A, is identical to the one above for light moving from A to B**:** (cxBAa + vDa) / .5333… = cyBAa ‡
The *upper row of data in Table1 below* pertains to the light moving from A to B, and it shows in column1 the cxABa we calculated previously. The data above the Table1 title specifies *the absolute and virtual distances, ABda and ABd, between A and B* and other factors that are logical consequences of systemD's vDa=**.**6 ca velocity through the qm and that cause the measured lsc.

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† (cxABa−vDa) /**.**5333**…= cyABa** and **cyABa =** $(1- cxABa^2)^{.5}$ combine into **(cxABa –vDa) /.5333…=** $(1- cxABa^2)^{.5}$
and squaring both sides yields **(cxABa^2 – 2·vDa·cxABa + vDa^2) / .28444… =** $(1- cxABa^2)$
and multiplying both sides by **.28444…** yields **cxABa^2 – 2·vDa·cxABa + vDa^2 = .28444… –** $(.28444…\cdot cxABa^2)$
and **1.28444… ·cxABa^2 – 1.2·cxABa + .36 – .28444… = 0** and **1.28444…·cxABa^2 − 1.2·cxABa + .07555… = 0**
where the quadratic equation formula coefficients are a=1.28444**…** b= −1.2 c= .07555**…**
and the solution is **cxABa = .866358 618736** ca,
and therefore **cyABa =** $(1- cxABa^2)^{.5}$ **= .499422 410131** ca
and **crABa=** $[(cxABa - vDa)^2 + cyABa^2]^{.5}$ **= .566012 064815** ca

‡ The quadratic equation for cx**BAa** is
1.28444… ·cxBAa^2 + 1.2·cxBAa + .07555… = 0 , where a=1.28444**…** b= +1.2 c= .07555**…**
and the solution is **cxBAa= −.067897 436626** ca
and therefore **cyBAa=** $(1- cxBAa^2)^{.5}$ **= −.997692 306324** ca,
and **crBAa =** $[(cxBAa + vDa)^2 + cyBAa^2]^{.5}$ **= 1.130717 947168** ca, as shown in Table1.

vDa=**.**6 ca rvD=**.**8 ABda=1**.**36 LS ABd=1**.**442220 510185 ls async=(**.**6 ca · **.**8 ls) = ± **.**48 s

Table1. Absolute and virtual velocities and times for light moving from A to B and from B to A

cxABa ca	cyABa ca	crABa ca	tABsa sa	tABs s	async s	tABs – async s
.866358 618736	.499422 410131	.566012 064815	2.402775 637732	1.922220 510185	−.48	**1.442220 510185**
1	2	3	4	5	6	7
cxBAa ca	cyBAa ca	crBAa ca	tBAsa sa	tBAs s	async s	tBAs + async s
−.067897 436626	−.997692 306324	1.130717 947168	1.202775 637732	.962220 510185	+.48	**1.442220 510185**

Table1 represents the complexity behind the lsc illusion. Column3 shows that the light traveling from A to B travels *through systemD* with only about 50% of the speed from B to A. Thus, *the absolute and virtual A to B travel times for light are about twice as long as the B to A travel times (columns 4 and 5)*. However, due to the **.**48s asynchronization of *clockB time behind clockA time*, the travel times displayed on clocks A and B are the same, as the observers(c) expect, (as shown in column7).

Why the quantum medium view did not appear when the luminiferous aether was in vogue

In the late 1800s there was evidence that might have led to the quantum medium view that is explained in this paper. George FitzGerald and Hendrick Lorentz both had theories of length contraction that could help explain why Michelson's experiments were not detecting the aether medium. Apparently, the evidence was insufficient to show why the measured constant speed of light could be a logical consequence of the aether.

The qm view shows that both length contraction and time dilation have been misunderstood, much like the misunderstanding of the Doppler shifts of starlight discussed above. *Doppler shifting can have more than one physical cause*. It can be caused by a change in motion of the source of sound energy *or EM radiation* through an energy propagating medium (e.g. air, water, qm), or it can be caused by a *change in motion of the receiver of the energy*. Or, it can be caused by *changes in motion of both the source and the receiver*. *But only changes in the receiver's motions cause instantaneous shifts at the receiver* (which is important evidence).

Students now learn that changing the *relative motion* between a star or a clock or other m-e system and the observer or receiver is the cause of Doppler shifting and relativistic phenomena, and there are useful correlations based on this thinking. However, the correlations lead to *fundamental misunderstandings of nature* because relative motion is not the physical cause. The following example of *real and virtual observed* length contraction and time slowing shows that the causes of these phenomena are *the changes in the motions of the bodies, clocks, observers, or other m-e systems through the qm*, not changes in relative motion.

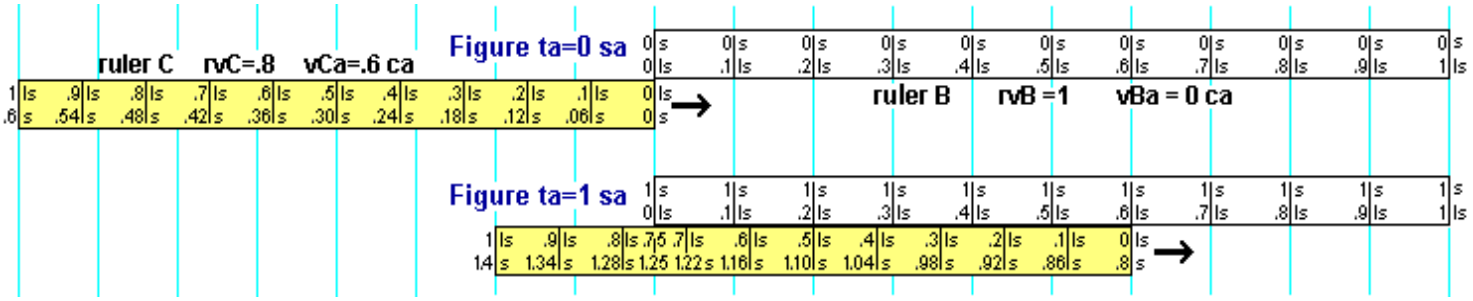
Space rulers show physical causes of relativistic length contraction and clock slowing

Referring to *figures* "ta=0sa" and "ta=1sa" on the following page, we will briefly explain another example showing how *logical physical consequences of the qm* cause observed phenomena that lsc theory incorrectly attributes to relative motion between the source of the phenomena and the observer. The figures show space rulers C and B, *that are identical and are 1LS long when at rest in the qm*. And they show that rulerC was accelerated to speed vCa=**.**6ca and is passing rulerB at absolute times **ta=0**sa and **ta=1**sa, with a speed that observers(c) on both rulers agree is vCB=**.**6c *based on the observed distances and times on their ruler***.** The observers(c) also see that the *other ruler* is only **.**8 ls long and that its clocks advance at only **.**8 times the rate of the clocks on *their ruler*. The following two equations specify what the observers(c) on C and B observe.

$$vCB = (vCa - vBa) / (1 - vCa \cdot vBa) \qquad : \qquad rvCB = (1 - vCB^{2})^{.5}$$

These observations are due to the *absolute phenomena shown in the below figures*, where rulerB is at rest in the qm and is being passed by rulerC *with velocity* vCa=.6ca, *which caused the contraction of rulerC, and the clock asynchronization on rulerC*. The clocks at the 0ls locations on the rulers were automatically preset so they would read 0s when adjacent during the passing. The other clocks on B and C were then virtually synchronized with their 0ls clock, resulting in the *asynchronization* shown on rulerC (per async Rule).

Therefore, *these rulers show logical consequences of Premise1*, and we want to show that these logical consequences are the physical causes of the observed, virtual phenomena predicted by both the qmv and by lsc theory, and that *the .6c relative motion between B and C is not the cause of the OBSERVED clock slowing and the observed contraction of rulerB and rulerC* (*which have totally different causes*).



Why observers(c) on C and B see the passing 1 ls ruler is short and clocks are slow per rvCB=.8

All observers(c) *use their clocks and distance marks* to find the passing speed, clock rate, and distances, on the other ruler. For example, they all see (via optoelectronic instruments) the following ***events*** (*that are abbreviated to save space and time*)**:** **Event1**= [**C0ls:.8s**@B.6ls:1s] , **Event2**= [**B0ls:1s**@C.75ls:1.25s]**.** Event1 means "the rulerC, 0ls location where the clock says .8s is at the rulerB, .6ls location where the clock says 1s." The observers(c) on C and B "see" these and many other events as C and B flash by one another, and the events cause the below conclusions. **Figure ta=0sa** shows that they all see [C0ls:0s@B0ls:0s].

Evidence causing observers(c) on C and B *to agree on their* .6c *relative velocity*.
• B observers see **vCB=.6c** because they see (via event1) that *location* C0ls *moved* .6ls *along rulerB in* 1s *on rulerB*.
• C observers see **vCB=.6c** because (via event2) *location B0 ls moved .75 ls along rulerC in 1.25s, and (.75ls/1.25s)*=.6c

Evidence causing observers(c) on C and B to conclude that *the other ruler is .8 ls long*:
• B observers see rulerC=**.8**ls long**:** At 1s on B, *B0ls is at C.75 ls when C01ls is at B.6ls*, so C is (**.**6/**.**75)=**.**8 x B's length.
• C observers see rulerB=**.8**ls long**:** Event1 shows C0ls moved .8s·.6c=.48 ls along B (not .6 ls) so B=(.48/.6)=.8ls long.

Evidence showing that *the clock rate on the other ruler is .8 times the rate on the observer's ruler:*
• B observers see **C** clocks run slow (rv=.8) because event1 shows clock C0ls gained .8s while clock B.6ls gained 1s.
• C observers see **B** clocks run **.**8x slow because event2 shows clock B0ls gained 1s while clock C.75 ls gained 1.25s.

Many other events seen by observers(c) on C or B result in the same conclusions about the passing rulers and clocks. On C and B, the observers(c) conclude correctly that the observed vCB=**.**6c results in rvCB=**.**8, but they do not understand why. The qmv explains the *physical causes* of the observed virtual and absolute clock slowing and length contraction at C or B that lsc theory correlates with, and attributes to, relative motion.

Readers can see that rulerB is not actually contracted, nor are the rulerB clocks slowed by their motion relative to rulerC. From our above discussion, readers should know why C is actually contracted and not B. What may not be apparent is that there is an *endless number* of combinations of **vBa** and **vCa** that result in the B and C observers(c) seeing the same **vCB=.6**c relative velocity, and making identical time, distance, and clock-rate *observations* they make in the two figures above. The following six combinations are examples.

vBa= **.3**ca & vCa=**.7627**… ca	vBa= **.6**ca & vCa=**.8823**… ca	vBa= **.9**ca & vCa= **.9740**… ca
vBa=**−.3**ca & vCa=**.3658**… ca	vBa=**−.6**ca & vCa=0**.0**	vBa=**−.9**ca & vCa= **−.652**… ca

The observers(c) *on rulerC* in figures ta=0sa and ta=1sa will observe that rulerC and clocksC are no different from when rulerC was at rest in the qm with identical rulerB. The observers(c) on rulerC expect light signals sent between C0ls and C1ls to take 1s, and they do. A signal sent from C0ls to C1ls moves with velocity 1**.**6ca relative to rulerC and it takes (**.**8LS/1.6ca) = **.**5sa or **.**4s on C's clocks. But clock C1ls is asynchronized +.6s ahead of C0ls, and when the light arrives **.**4s after leaving C0ls**:**0s, it arrives at C1ls at +.6+**.**4=1s. Readers can also determine that a time signal emitted from B1ls:0s arrives at B0ls:**1s** for similar, logical reasons. Note that *all observers(c) believe that their clocks are absolutely synchronized*, but only on rulerB is this belief true.

Is this quantum medium view of time, distance, and mass-energy correct?

What are the chances of this explanation of the physical causes for the previously inexplicable phenomenon of measured lsc(and for various other important phenomena) just happening to explain these phenomena and not being the correct explanation? And what are the odds that the same logical physical consequences of the qm that explain lsc and the Doppler shifting of starlight, and other phenomena (e.g. the inertia of all m-e, the huge

energy density of all m-e, the *inability* of observers in different reference frames to agree on observed distances, times, and masses of observed physical systems, and the need to adopt an artificial space-time system that denies absolute times, distances, and masses) *are not the actual physical causes of all these phenomena?* Doesn't the evidence indicate that the odds of the qmv not correctly specifying the physical causes are small? We tried to include essential parts of this evidence so readers can make their own judgements. The qmv shows that the law of lsc, and theory based on lsc, are fundamentally wrong, and lsc theory does not show that the qmv is wrong.

The qmv of "inertia","gravity", and related phenomena are explained at www.qmview.net . Briefly, "inertia" is a body's resistance to a change in its velocity *because accelerations require a force and work to change the balance of all the energy quanta being exchanged within the body.* Gravity is similar because, according to qmv Premise2, *massive bodies have photon-slowing gradients in the qm around them that cause energy-exchange imbalances* (like accelerations cause) *within bodies in the gradients* (e.g. causing planet orbit precession). The information in this paper is part of the information at the qmv website and documents.

Summary

The preceding explanation of measured lsc is based on the logical consequences of the *quantum medium*, which is specified in Premise1. This medium is similar to what physicists have expected for centuries, but were compelled to abandon due to *measured* lsc, and Michelson's experiments, and similar evidence that led to the law of lsc (~1900), on which space-time theory is based. Like geocentrism and other theories that were based on misunderstandings of the experimental evidence, space-time theory makes useful predictions, but it caused misunderstandings of basic aspects of nature**:** time, distance, and mass/energy. It is based on the lsc postulate, which is inconsistent with Galilean and Newtonian physics, where quantities like times, distances, and masses add or subtract in the *classical, and logical*, way. Lsc theory attributes observed relativistic phenomena to relative motion between an observer and the observed phenomena, and this causes paradoxes and other misunderstandings of nature. For example, when an observer's velocity changes and the observed rates of distant clocks suddenly change, the qmv shows that the physical cause of the observed changes in the distant clocks are changes in the observer's system due to the changing vOa. The above "diamond formation" and "space rulers" examples show why these physical changes occur.

The law of lsc has obscured the underlying physical causes of measured lsc and a wide variety of other previously inexplicable phenomena that are caused by logical consequences of the quantum medium. A simple example is the changing Doppler shifts of starlight due to Earth's revolution around the sun. This evidence, *reported by Vogel et al. in 1887*, shows that the Doppler shifts of starlight arriving from directions near Earth's orbital plane are constantly changing annually during each orbit, and that this cycle of Doppler shift changing repeats every year. This evidence cannot be explained logically if the starlight arrives with a constant speed relative to Earth as Earth orbits the sun. The qm view explains the physical causes of both the Vogel evidence and measured lsc, and it shows that neither has been correctly explained by orthodox physics theory.

Readers should understand that relative motion is a *misleading correlation* and does not *cause* the phenomena that it appears to cause. The qmv shows that the *absolute motion* that causes the phenomena also causes the observed relative motion. The well-known "Twins" or "Clocks" Paradox of space-time theory is an example. The clock that does the traveling ages less, even though both clocks have the same *relative motion*. The qmv shows that, during the RT, as the traveling clock's absolute velocity, va, changes (and the resulting rv, and clock rate change) and the clock advances at different rates for different absolute time durations, the clock's total advance during the RT equals *the sum of all the incremental advances at the different rates*.

It is an interesting fact of nature that *this sum for the traveling clock will always be less than the sum for the non-traveling clock.* Readers can easily verify this fact and see that experiments showing that traveling atomic clocks age less than nontraveling clocks are not evidence that lsc theory correctly represents nature. *The experiments are part of the extensive evidence showing that the qmv is correct.*

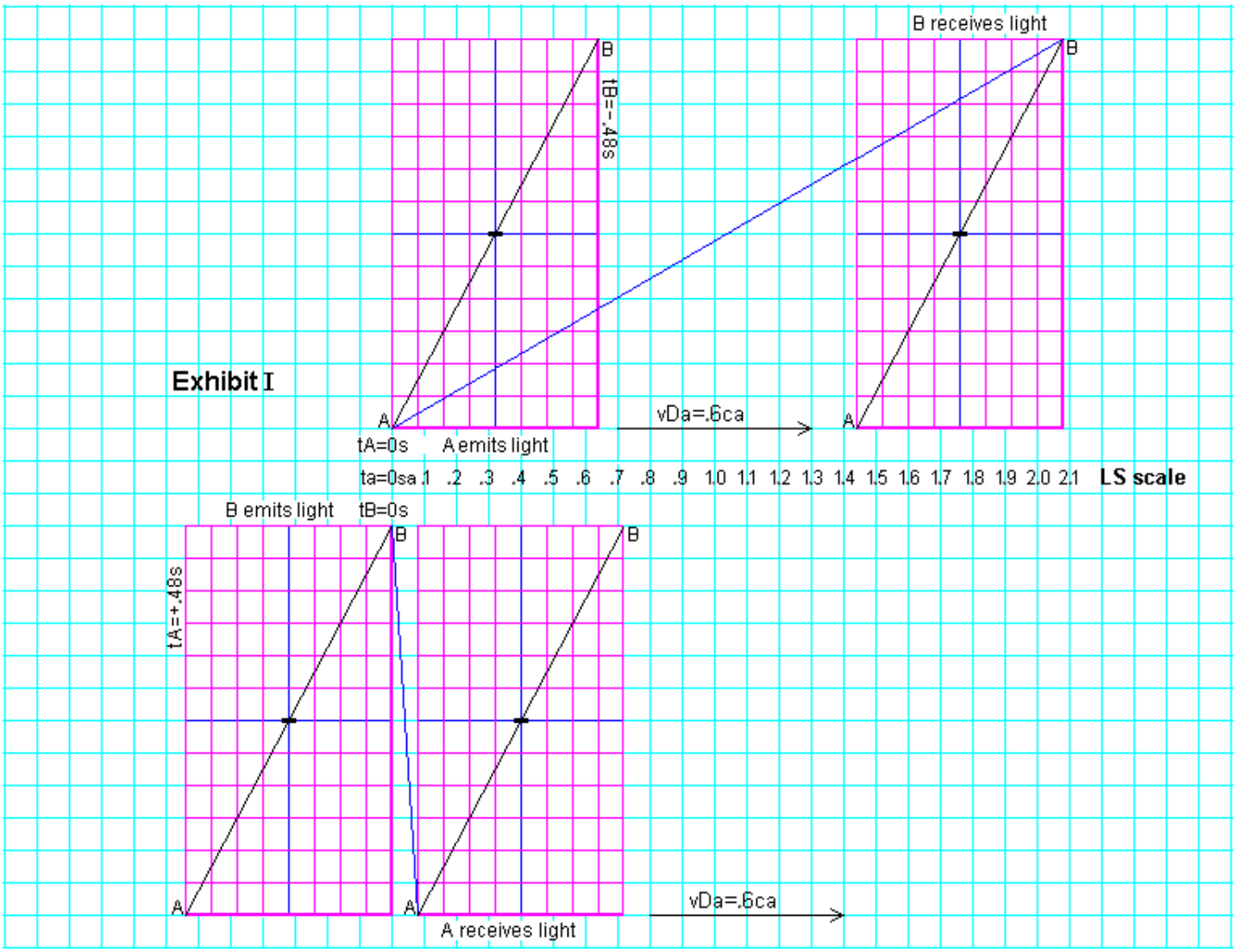
We hope that readers who have learned that experiments by Michelson and others proved that light is not propagated through a medium and that the law of lsc has been good, will now understand why Michelson's 1887 null results and measured lsc are logical consequences of a quantum medium, and will agree with eminent physicist Paul Dirac, who stated in the 1950s that "... we are rather forced to have an aether."

Visualizing the illusion of measured light speed, c

The above mathematical modeling of variable light speeds and other logical consequences of the qm that cause the measured lsc phenomenon can be difficult to understand. Exhibit I (below) shows the reasons for measured lsc *graphically*. It shows the *rectangular area of systemD between A and B* when the light leaves A at ta=0 sa and when the light arrives **2.402775…**sa later at B. And *below the horizontal LS distance scale*, it shows the locations of the AB area when the light departs **B** at **ta=0** sa and arrives **1.202775…** sa later at A.

Therefore, it takes the light about twice as long to move from A to B as from B to A. This agrees with Table1, column 4 where the **AB time and distance through the qm** is 2.402775 LS and the **BA time and distance** is 1.202775 LS. The figures in Ex.I are to scale, and the scale is specified by the LS scale between the upper and lower figures. This scale shows the locations of systemD at the absolute times when A emits a light pulse and when B receives the pulse, and when B emits a pulse and when A receives it. The scale is for the qm reference frame shown by the cyan grid through which the systemD magenta images are moving with velocity vDa=**.**6 ca. The distance between adjacent cyan grid lines is **.**1 LS.

The *upper figure in Ex.I* is to help readers visualize *the AB rectangle* and a light pulse from A being emitted at absolute time ta=0 sa as A moves parallel to *the **LS scale** **(at rest in the qm)*** with a speed of **.**06 LS/**.**1 sa (i.e. **.**6 ca) while the light pulse from A moves with speed **.**1LS/**.**1sa (i.e. 1 ca) *along the blue path from A to B*. The light pulse will catch and meet location B at the point in the qm where their paths intersect. This B location in the vDa direction *on the LS scale* will be *the B location at ta=0 sa.* (which is **.**8 ls·(**.**8 LS/ls)) = **64** LS ***plus*** (B's vDa=**.**6 ca motion for 2.402775 637732 sa = **1.441665 382639** LS) or a total of **2.081665 382639** LS, *as indicated on the LS scale*. (Note**:** 0 to 1**.**28 LS on the LS scale equals the average Earth to Moon distance.)



The lower figure shows the blue light path through the qm from B at ta=0sa, meeting location A in systemD at ta=1.202775 637732 sa when B and A have moved .721665 382639 LS with velocity vDa=.6 ca and clockA has advanced .962220 510185 s (*from +.48 s, when ta=0 sa*) to **1.442220 510185** s, which the observers(c) expect to see if the speed of light from B to A is c. Readers who still doubt that the logical consequences of Premise1 are causing measured lsc should consider the fact that the measured speeds of light in both directions *along the x-axis and the y-axis of systemD* is lsc for reasons that are similar to measured lsc between A and B.

Simple example of measured lsc for any m-e system, R, vRa, and AB line

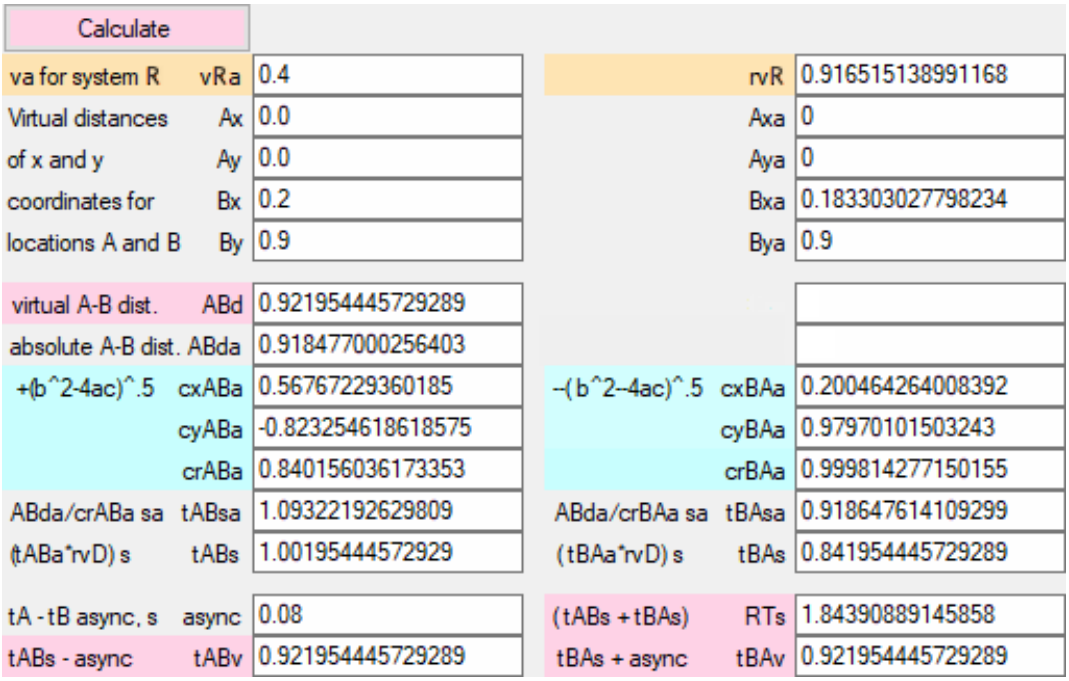
Most readers can probably now visualize systemD moving through the qm and see how this affects the speeds of light in different ways throughout the system. We can imagine *simpler and smaller systems* that are moving with other velocities through the qm, and we will now consider *a rectangular system* R *that extends from location* A *at the origin of its x-y coordinate system,* .2 ls *in the* +x *direction, and* .9 ls *in the* +y *direction to location* B *at the opposite corner of the rectangle.* This (.2 ls by .9 ls) system should be easy to visualize without an image. We will consider the case where vRa=.4 ca through the qm in the +x direction. Thus, the *light path* will be from location A at the origin (where Ax, Axa, Ay and Aya are all 0 ls and 0 LS), *to location* B where Bx=2 ls and Bxa=.2·(rvBx) LS and where By=.9 ls and Bya=.9 LS (because systemR is not contracted in the y direction). We will find the *measured, virtual* light speeds between A and B in systemR via the following steps, which are like the vDa=.6 ca case.

• Determine the observed, *virtual distance* between A and B, **ABd**= $(\mathbf{Bx^2} + \mathbf{By^2})^{\cdot 5}$ = **.921954 445729** ls, which equals the measured "lsc travel time" (in s units) *that observers(c) expect to measure at* B *and* A.
• Find **rvR**=$(1-\mathbf{.4\ ca^2})^{\cdot 5}$ = **.916515 138991**, for converting between virtual and absolute units.
• Find **Bxa** (the absolute distance in the +x direction in systemR) = **rvR·Bx** = **.183303 027798** LS
• Find the absolute distance from A to B, **ABda**= $(\mathbf{Bxa^2}+\mathbf{Bya^2})^{\cdot 5}$ = **.918477 000256** LS
• Let **cxABa**= the x-direction component of light's 1 ca velocity through the qm from A to B.
• Let **cyABa**= the y-direction component of light's 1 ca velocity through the qm from A to B.
• Make equation relating cxABa and cyABa **in qm:** $(\text{cxABa}^2+\text{cyABa}^2)^{\cdot 5}=1$ ca **or cyABa**=$(1-\mathbf{cxABa^2})^{\cdot 5}$
• Make equation relating the velocity and distance variables **in systemR: (cxABa−vRa)/(Bxa/Bya)=cyABa**
• Combine the two cyABa equations to get cxABa equation**:** $(\mathbf{cxABa}-\mathbf{vRa})/(\mathbf{Bxa}/\mathbf{Bya}) = (1-\mathbf{cxABa^2})^{\cdot 5}$
• Square both sides of cxABa equation**:** $(\mathbf{cxABa^2} - 2\cdot\mathbf{vRa}\cdot\mathbf{cxABa} - \mathbf{vRa^2}) / (\mathbf{Bxa}/\mathbf{Bya})^2 = (1-\mathbf{cxABa^2})$
• Multiply both sides by $(\text{Bxa/Bya})^2$**:** $\mathbf{cxABa^2} - .8\cdot\mathbf{cxABa} + .16 = .041481481481\cdot(1-\text{cxABa}^2)$
• Multiply and collect terms: $1.041481481481\cdot\mathbf{cxABa^2} - .8\cdot\mathbf{cxABa} + .118518518519 = 0$
• Specify quadratic coefficients a= 1.041481481481 b= − .8 c= .118518518519
• Find **cxABa** via quadratic formula **= .567672 293601** ca
• Find **cyABa** via **cyABa**=$(1-\text{cxABa}^2)^{\cdot 5}$ **: = .823254 618618** ca
• Find **crABa** = $((\text{cxABa} - \mathbf{.4}\text{ ca})^2 + .823254\ 618618^2)^{\cdot 5}$ **= .840156 036173** ca
• Find **tABsa** = ABda/crABa = **1.093221 926298** sa
• Find **tABs** = tABsa·**rvR** = **1.001954 445729 s**
• Find **asyncAB** = – (**.4 ca**·.2 ls)= **– .08 s**
• Find **tABv** (virtual time on clockB when the light from A arrives) = **(tABs – .08** s**) = .921954 445729** s

Before ending this paper, we will provide the data for the measured speed of light from B to A in the above systemR. However, it would help readers remember why measured lsc is constant if they take time to determine the B-to-A measured light speed without help. Based on *a large body of evidence*, it appears to us that a wider understanding and assessment of the qmv should be an objective of organizations and individuals trying to better understand our *physical reality*.

Realizing that *measured* lsc is a complex logical consequence of the qm can improve the way basic aspects of nature are understood. The qmv explains the physical causes of inertia and gravity, and it permits all observers to agree on absolute distances, times, and masses. And the qm view of gravity makes predictions of the gravity around neutron stars, black holes, and within spiral galaxies that are significantly different from current theory (which could alter the current thinking about how the universe evolves). The qmv would not change the way most physics is done, but it would help advance an important part of physics theory and thus help advance science in general. It may also have larger, long-term effects because even though the qmv project has been developed over many years *there is still much more to investigate*, discover, and develop.

For readers who do not have the time to determine the B-to-A absolute light speed in systemR, this speed, crBAa, and the *virtual* B-to-A light travel time, tBA**v**, are displayed on the below image of a calculator that models the travel of the EM energy between A and B, given the virtual locations of A and B and the absolute velocity of systemR or similar system. These systemR variables are specified by the vRa, Ax, Ay, Bx, and By inputs in the five boxes at the top-left of the calculator. Then, when the "Calculate" button is clicked, the data in the other boxes are calculated and displayed. For example, rvR is shown in the top-right box. Many different vRa, and A and B locations, in the first five boxes of column1, always resulted in the calculated observed virtual ABd distance in box6 equaling the calculated virtual, observed light travel times, tAB**v** and tBA**v**, in the bottom boxes of columns 1 and 2. Note: tAB**v** and tBA**v** mean the *virtual* travel times displayed on clocks B and A *after subtracting or adding the asynchronization* between clocks A and B to tAB s and tBA s (as in column7 of Table1).



This addendum is to help readers understand why measured lsc is a logical consequence of the qm specified by Premise1. However, the history of the qmv project shows that most scholars may still be reluctant to understand the qmv due to a preference for orthodox physics theory that they learned, and use, and believe is correct. The qmv shows why lsc theory is not correct, and no one has shown that the qmv is flawed. It has been pointed out that theory based on lsc is simpler than the qm, and that Occam's razor theory indicates that the simpler of two theories that make the same predictions is the better theory. There are many theories that refute Occam's razor concept -- modern Copernican theory being a complex example. Doesn't the history of science show that, in general, theories of nature tend to become more complex as science advances (because nature is usually more complex than previously believed)?

Proponents of lsc theory should consider the fact that theory based on lsc contradicts classical physics, and it denies the logical concepts of absolute or universal time, distance, and mass/energy of classical physics. *The qmv is consistent with classical physics.* It *explains* Newton's F = m·a law because a force and work are required to Doppler shift the patterns of the huge energy being exchanged within a baseball or person when changing their velocity. It explains why F = m·a needs to be modified to $F \cdot rv^2 = m \cdot a$ because, when a body's va and resulting rv are significant, a significant part of the force and work needed to change the body's velocity is needed for changing the body's mass. Therefore, rather than having orthodox physics comprised of classical physics and a contradictory space-time theory based on lsc, the qmv *expands* classical physics, making it consistent with current evidence. Shouldn't accepted theories be the most plausible representations of nature based on all current scientific evidence, *including logical physical causes* for the evidence?