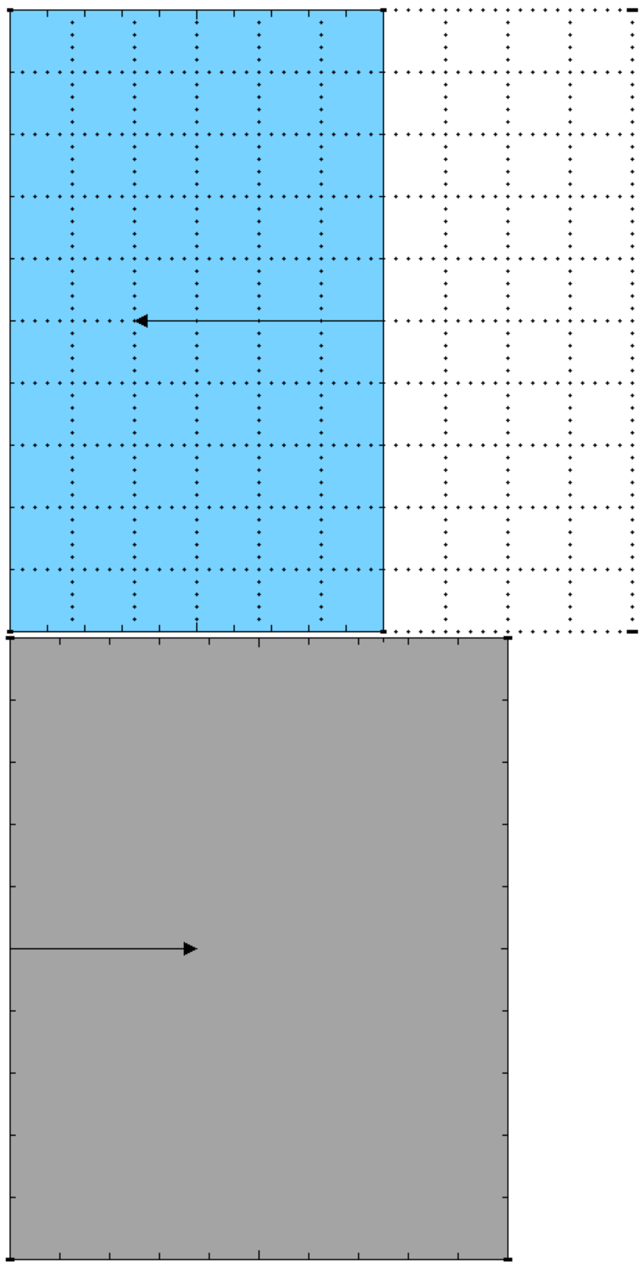
Quantum Medium View

How the ether was misunderstood
Space & time illusions
A deeper understanding of nature



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- *Physical causes for relativistic and related phenomena.* (© 2000 and poster presented at AAAS 2002 Annual Meeting)
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Quantum Medium View:

How the ether was misunderstood, space & time illusions,
and a deeper understanding of nature.

P. F. Allport

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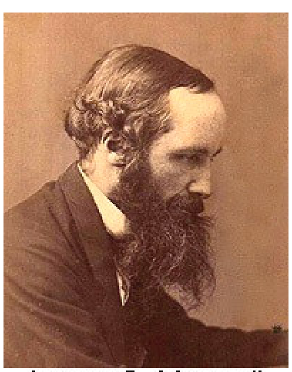
Background and Ether

Light: so important and poorly understood

In 1995 a manuscript describing the quantum medium view was submitted to a leading physics journal and the response was, “You have committed yourself to an interesting but perhaps futile cause. Why should science look toward a new theory if the present one is unchallenged? Would a new model have any advantage?” The following pages explain the many advantages of the quantum medium view. They show why this view is far more likely than present theory to be an accurate representation of nature. The differences between this view and present theory (i.e. orthodox theory) are due to different assumptions about how light propagates through the cosmos.

It is surprising that we don’t know more about light given the fact that it plays the leading role in our existence and understanding of nature. We know that it comes to us from the sun or distant stars as streams of photons -- incredibly small amounts or quanta of energy moving with a velocity of about 300 million meters per second. But we do not know what photons are or how they move.

The following pages present evidence that photons are propagated through a medium, and that their energy is in the form of oscillations in this medium. The physical evidence of the medium has increased in recent years, but the medium is far from obvious for reasons that will be explained. The theoretical evidence is compelling. The fact that the logical consequences of the medium explain a wide variety of very important phenomena for which there are no other good explanations makes the medium’s existence highly probable.



James C. Maxwell

The ether of Maxwell, Lorentz, et al

The idea of an ether through which light is propagated dates back to Aristotle and to Hooke, Huygens and Young who believed that all matter moves freely through the ether. During the 19th century most physicists were confident that light was propagated through a medium. The medium could explain how light moves through the cosmos and could explain a variety of related phenomena.

The Doppler redshift and blueshift in the observed oscillation frequency of light is one example of many phenomena explained by an ether. Modern physics theory (i.e. orthodox theory), which assumes there is no ether, cannot explain what causes the Doppler shifts of light, as we will now discuss briefly. Most people are not familiar with this phenomenon but are aware of the Doppler shift of sound energy that travels to them via sound waves moving through air. Passengers aboard a train passing the clanging bell at a railroad crossing can hear the Doppler shift in the sound of the bell as the train passes. They hear higher pitch clangs as the train approaches the bell and lower pitch clangs after passing the bell.

The cause of the higher pitch is the train's motion through the medium toward the bell. This motion shortens the time between successive sound waves that are received and it results in more waves being received per second and a higher-than-normal pitch. After passing the bell, the train's motion lengthens the time between sound waves that are received and it causes a lower-than-normal pitch. Changing the observer's motion toward or away from the source of sound changes the frequency of the observed sound waves and the observed pitch of the sound, even though the emission frequency at the bell and the sound's speed through the medium do not change.

Similarly, changing an observer's motion toward or away from a light source changes the frequency of the light. This phenomenon is observed as Earth revolves around the sun, as shown in Figure 1. At position E1 in its orbit around the sun, Earth's motion around the sun adds to Earth's velocity toward the star, (or decreases Earth's velocity away from the star). And at position E2 Earth's motion around the sun has the opposite effect on its velocity relative to the star.

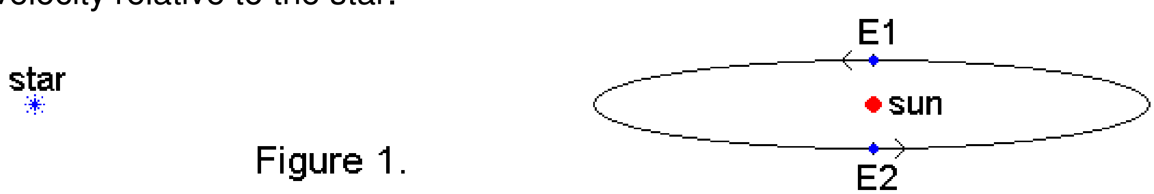


Figure 1.

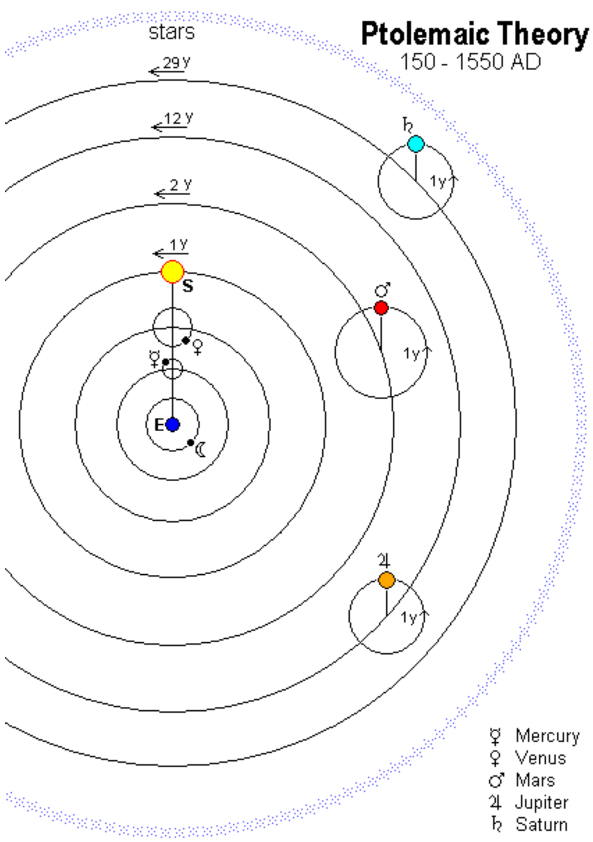
This change in velocity toward or away from the star causes an observed Doppler shift in the light from the star. As Earth moves from E1 to E2 and then back to E1 the light is first redshifted and then blueshifted. This is easily explained by the quantum medium view in the same way the Doppler shifts of sound energy are explained.

Orthodox theory cannot explain why these observed Doppler shifts occur. According to the "light postulate" of orthodox theory, the starlight arriving at E1 has the same speed relative to Earth as the starlight arriving at E2. And surely the light arriving at E1 has the same characteristics as the light arriving at E2. Therefore, orthodox theory provides no reason for any difference in the light frequencies and colors observed at E1 and E2.

Orthodox theory obscures its inability to explain this and related phenomena by attributing the redshifts and blueshifts to changes in *relative motion* between the source and observer. As Earth orbits the sun, the relative velocity between the star and Earth changes and this is said to ***cause*** the observed redshifts and blueshifts. This is like a theory of sound saying that the Doppler shifts heard aboard the train are caused by changes in the train's velocity relative to the railroad-crossing bell. This simple theory of sound, which ignores the medium, would allow one to accurately predict the pitch of the bell by knowing the relative velocity between train and bell, but it obscures the underlying cause of the Doppler shifts. By ignoring the medium, it is a serious oversimplification, which results in a misleading picture of nature.

Misleading evidence, then and now

It will be shown later why the light postulate of relativity theory is probably a serious oversimplification of nature underlying orthodox physics theory. It is this light postulate and the evidence supporting this postulate that says the speed of the starlight relative to Earth in Fig. 1 is independent of Earth's motion toward or away from the star.



The light postulate is similar to the assumption underlying Ptolemy's theory of the cosmos -- that Earth is at the center of the universe. In both cases, the assumptions are simple, easy to grasp, and based on verifiable-but-inexplicable evidence. Ptolemy's assumption was supported by very convincing evidence of the sun, moon and other heavenly bodies moving around Earth. This idea is far easier to understand than the relatively complex idea that Copernicus, Galileo, and others proposed

The Ptolemaic theory shows that direct empirical evidence can be very misleading. It can result in a mathematical theory and corresponding picture of nature that are out of tune with physical reality even though the theory agrees with observations and accurately predicts phenomena. The fact that a theory withstands the test of time does not mean it is sound. The Ptolemaic model of the cosmos endured for more than a thousand years.

Thus for centuries students were taught fundamental ideas about nature that were false, and the false ideas were passed down from generation to generation. This perpetuation of dubious information continues, as most people in academia realize from high-profile debates concerning science wars and creation science. And it is happening in their midst as a modern myth built on the belief, "the speed of light is constant," influences what is taught to physics students, liberal arts students and the general public.

This is what the following pages show. They show why the light postulate leads to conclusions that make it necessary to abandon the logical model of nature developed by Galileo, Newton and others which holds that the speed of the starlight relative to Earth in Fig. 1 changes as Earth orbits the sun. It will be shown that it is unnecessary to abandon this logical system, contrary to what is taught and widely believed.

The fact that the light postulate results in a theory that makes accurate predictions and agrees with experimental evidence convinced most physicists that the postulate is correct and that relativity theory is a good representation of nature. Many are unconcerned that orthodox theory cannot explain why the *observed* speed of light is independent of the observer's motion toward or away from the source of light. This phenomenon, which is so perplexing in the context of orthodox theory, is a natural consequence of the quantum medium. This will become apparent later. But first we will discuss why the ether fell out of favor. Why did physicists abandon the ether if it could explain so much otherwise inexplicable phenomena?

<u>Why the ether became passé</u>

In 1887 Albert Michelson and Edward Morley conducted their now-famous experiment to detect the ether. At the time, Michelson was confident of the ether's existence and there was good reason to believe that the experiment would be able to detect Earth's motion through the ether. The experiment was based on Michelson's interferometer which could detect small phase shifts in beams of light. Figure 2a shows the concept of this experiment that was conducted at the Case School in Cleveland, Ohio.

The apparatus consists of a light source S, a semi-transparent mirror X, that transmits part of light beam L to mirror M1 and reflects part of L to mirror M2, and an instrument I that detects light beam L' which is light that has been reflected by M1 combined at X with light that has been reflected by M2. If the light traveling from S to I via M1 takes the same time to reach I as the light traveling via M2, then the light from the two paths will be in phase, and this can be observed using instrument I. However, if the travel time via M1 and the travel time via M2 differ slightly, constructive and destructive interference occurs between the light from the two paths and this causes bright and dark interference fringes that can be observed at I.

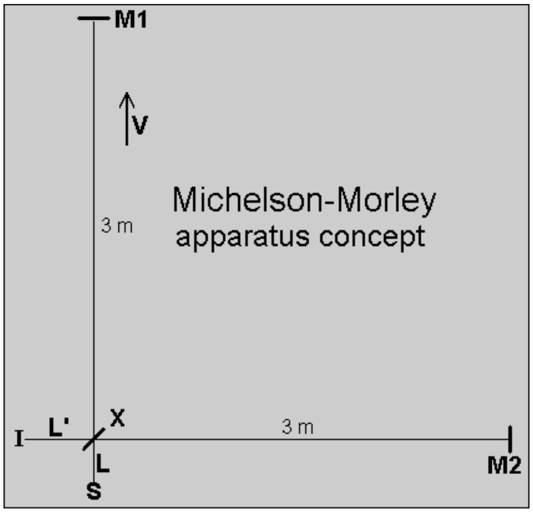


Figure 2a.

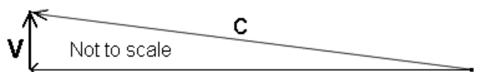


Figure 2b.

It was reasoned that Earth is not at rest in the ether because Earth is revolving around the sun with a speed of about 30,000 meters/second (m/s). (The sun also moves around the center of our galaxy with a speed of about 220,000 m/s.) Thus Earth probably has a significant velocity relative to the ether. This velocity is represented by the velocity vector v in Fig. 2a. The velocity vector is shown aligned with the light path between X and M1 but the entire apparatus is mounted on a turntable so that v can be aligned with the light path between X and M2, or aligned in some other direction.

To help explain the experiment, we will make simplifying assumptions. We will assume that the distance from X to M1 or M2 is 3 m and that velocity v through the ether is 30,000 m/s or .0001 times the speed of light c. In this case, the light moving from X to M1 will have a velocity of (300,000,000 – 30,000) or 299,970,000 m/s *relative to the apparatus* and it will take .000,000,010,001,000,1 s to travel the 3 m distance. After being reflected at M1, the light returning to X will have a velocity of (300,000,000 + 30,000) or 300,030,000 m/s *relative to the apparatus* and it will take .000,000,009,999,000,1 s to travel the 3 m distance. Therefore the time for the light to travel from X to M1 and back to X is .000,000,020,000,000,2 s. How does this travel time compare with the travel time from X to M2 and back?

The light traveling between X and M2 will have a velocity of 299,999,998.5 m/s relative to the apparatus because it must also have a component of its 300,000,000 m/s velocity through the ether be 30,000 m/s in the direction of v. The velocity vector diagram of Fig. 2b shows that the velocity of light between X and M2 must be the square root of the difference between c squared and v squared, which is 299,999,998.5 m/s. Therefore, the time required for the light to travel the 6 m distance from X to M2 and back to X is (6 / 299,999,998.5) or .000,000,020,000,000,1 s. This time duration is faster by .000,000,000,000,000,1 s than the time required for the light traveling from X to M1 and back to X, and it represents a phase shift of the light that Michelson's apparatus can detect! Therefore,

Albert A. Michelson

turning the apparatus so it has different orientations relative to v should cause changes in the interference pattern observed at I -- *if* the light is propagated through an ether and *if* the apparatus is moving with a significant velocity through the ether and *if* some other factor affecting the experimental results has not been overlooked.

Michelson was perplexed and perhaps disappointed that no change in the interference pattern was observed when his apparatus was rotated. Probably most physicists who knew of the experiment were surprised. The experiment certainly indicated that the speed of light relative to the apparatus was the same in all directions, and this had a profound effect in the world of physics. Today physics textbooks usually explain the Michelson-Morley experiment and cite it as proof that light is not propagated through a medium.

We will now discuss why this experiment and many similar experiments since then were unable to detect the anticipated light-propagating medium through which Earth moves.

Consequences of the Quantum Medium

Characteristics of the light-propagating quantum medium (i.e. ether)

The following simple premise defines fundamental characteristics of the quantum medium. These characteristics are in keeping with the ether assumed by Maxwell, Lorentz, et al.

> **Premise I:** Photons are oscillating systems of energy in a quantum medium through which the photons and other quanta of energy are propagated at a constant absolute speed when not impeded by matter (e.g. air, water) or slowed in the vicinities of large concentrations of mass/energy (e.g. stars).

We refer to the ether as the **quantum medium** (**qm**) because, unlike in 1900, we know that light is comprised of quanta of energy and that atoms are comprised of quanta of mass/energy (e.g. electrons, protons, neutrons) that interact over distances that are large compared to the apparent size of the quanta. Lacking modern knowledge about the atom, physicists in 1900 had less opportunity to realize why the Michelson-Morley experiment could not detect the light-propagating medium. But Hendrik Lorentz and George Fitzgerald were on the right track to suspect that the motion of the experimental apparatus through the medium could be causing a contraction of the apparatus along lines parallel to v, and that this


Hendrik A. Lorentz

contraction might result in the round-trip travel time between X and M1 always being the same as the round-trip travel time between X and M2. Most physicists considered this suggestion wishful thinking and an ad hoc way to maintain the possibility of a light-propagating medium. The following pages show that this contraction is one of many interrelated consequences of the medium.

New terms and symbols

To explain the quantum medium view clearly, it is necessary to introduce new terms and symbols that are not part of the lexicon of orthodox theory. When these terms and symbols are first introduced and defined, this will be done with **bold type**. The **absolute speed of light** (**ca**) is the **speed of light through the quantum medium when the light is not impeded by matter or by the proximity of large concentrations of mass/energy.**

The **absolute velocity** (**va**) of a body or reference frame is its **velocity through the qm**, and the velocity is usually specified in terms of ca. Therefore, a spaceship with an absolute velocity of va=.5 ca has a velocity through the qm of half the speed of light through the medium.

An **absolute second** (**sa**) is **1 second according to clocks at rest in the qm.** A **virtual second** (**s**) is **1 second according to a clock moving through the medium.** Later it will become apparent why a virtual second depends on the clock's velocity through the medium and why it is a longer time duration than an absolute second.

An **absolute light-second** (**LS**) is the **distance that light travels through the qm in 1 sa** and a **virtual light-second** (***ls***) is the **distance between two points in an inertial reference frame where a round-trip light signal between the two points takes 2 s according to clocks in the reference frame.** An **absolute meter** (**ma**) is **1 LS/300,000,000** and a **virtual meter** (**m**) is **1 *ls*/300,000,000.**

The Glossary of Terms and Symbols on page 51 includes these definitions. We will use the symbols / and · to indicate division and multiplication respectively, and to avoid cumbersome numbers such as 300,000,000 and .000,000,001 we will generally write them as $3 \cdot 10^8$ and $1 \cdot 10^{-9}$ respectively.

The math and equations in this booklet are relatively simple and are essential for understanding both the internal consistency of the quantum medium view and how this theory explains physical causes for phenomena. Although the booklet is not long, it takes time to become familiar with the terms and symbols and to follow the math in the examples. This is necessary for a basic working knowledge of the theory.

A general understanding of the quantum medium view is possible by skipping over the math, just as a rough awareness of the Michelson-Morley experiment is possible without following the math. However, it is recommended that readers try to follow carefully the math and examples.

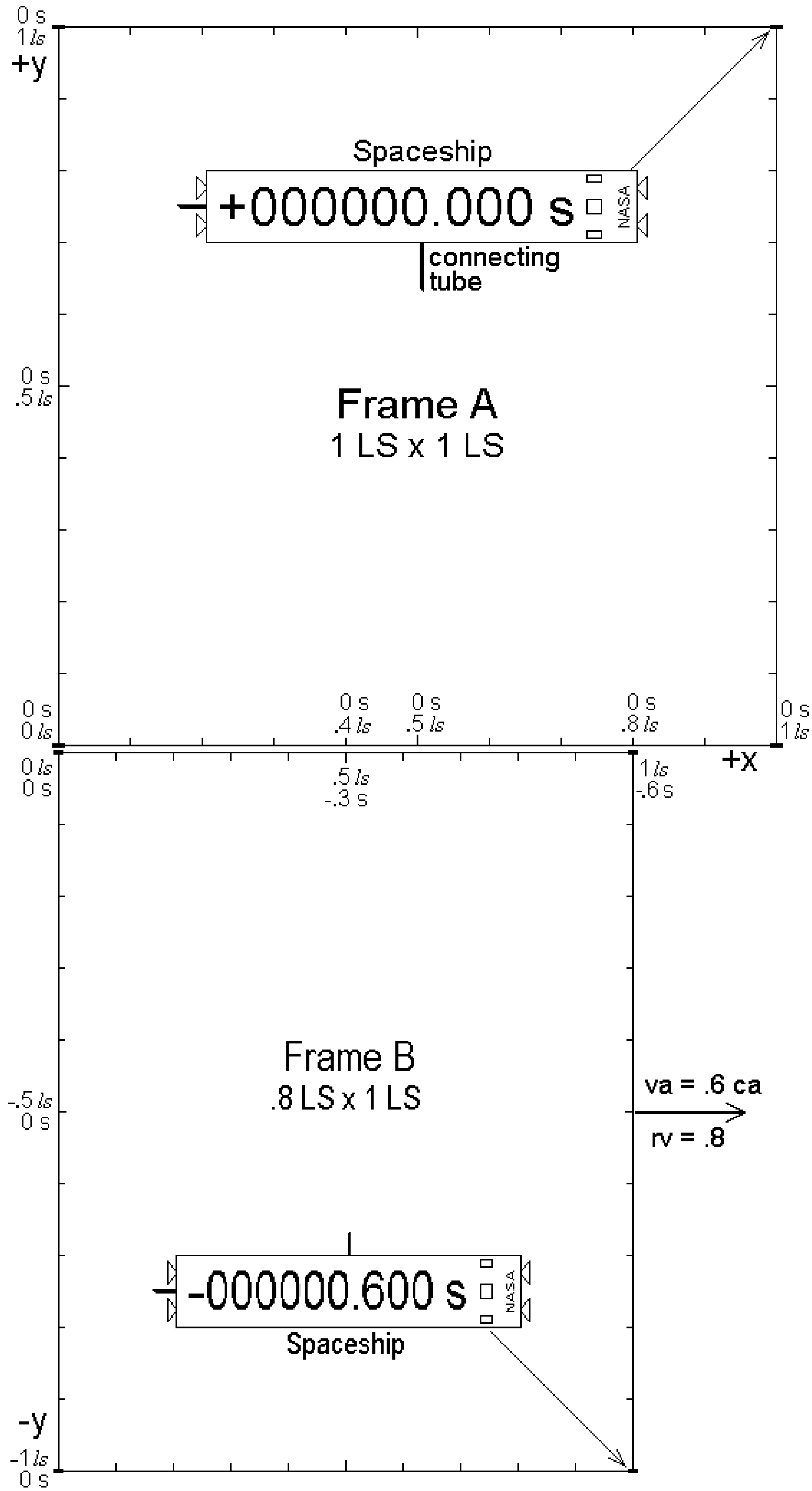


Figure 3. Space frames A and B at time ta=0 sa.

Experiment showing consequences of the quantum medium

An imaginary experiment will now be used to show consequences of the quantum medium that were not previously understood. The experimental apparatus is shown in Figure 3. It includes two enormous "space frames," frame A and frame B, each comprised of four spaceships at the corners of the frame and four slender, 300,000,000 m long connecting tubes between the ships. In Fig. 3 the spaceships are represented by small black rectangles that have been enlarged so they can be seen. Space frames A and B are in the same plane but are in different inertial reference frames that are moving relative to one another with a velocity that observers on A and B determine is .6 c. The symbol c means the customary constant speed of light, about $3 \cdot 10^8$ m/s. An **inertial reference frame** can be defined as **an x, y, z coordinate system that has a constant velocity through the qm and in which bodies at rest in the reference frame remain at rest even when free to move in any direction.** The reference frame of a spaceship floating without rotation in deep space far from any gravity-causing massive body would closely approximate an inertial reference frame, commonly referred to as an "inertial frame" or "reference frame" or simply "frame."

Space frame A is at rest in the qm, and its dimensions are 1 LS x 1 LS as shown. Space frame B is moving with a velocity of va=.6 ca through the qm, and its width along the x axis is only .8 LS for reasons that will become apparent.

Speeds of light in space frames A and B

Because space frame A is at rest in the qm, the speed of light in A is constant. This constant speed of light in A results in absolute standards of distance and time in A. Space frame B's motion through the qm causes different speeds of light in different directions in frame B.

In frame B, which is moving through the qm with an absolute velocity of .6 ca in the +x direction, the speed of light in the +x direction is only .4 ca. And the speed of light in the –x direction is 1.6 ca. In any inertial reference frame having an absolute velocity va, the **speed of light** (**cr**) **relative to the reference frame** ranges from the **minimum speed of light** (**crn**) to the **maximum speed of light** (**crx**), where crn and crx are specified by the following equations.

$$\mathrm{crn} = 1 - \mathrm{va} \qquad (1)$$

$$\mathrm{crx} = 1 + \mathrm{va} \qquad (2)$$

These equations represent an inherent asymmetry in any system moving through the qm. The asymmetry has interesting consequences. We will see how it affects the standards of distance, time and mass in the system.

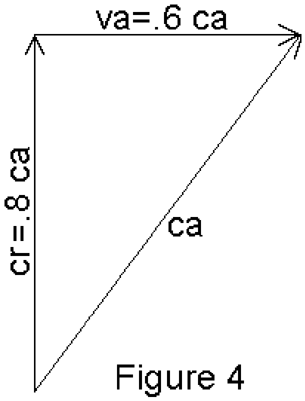


Figure 4

Along the y axis of frame A the speed of light is cr=1 ca, but in frame B cr=.8 ca along the y axis. Photons moving along the y axis of B must have a component of their 1 ca velocity through the qm be .6 ca in the +x direction in order to keep up with frame B's motion through the qm. This is shown by the vector diagram in Figure 4. It can be seen that when va=0, then cr=1 ca, as in frame A. As va increases, cr along the y axis decreases. The vector diagram of Fig. 4 is a right triangle, which shows that the relative velocity of light in any direction transverse to the direction of va is the square root of the difference between ca squared and va squared. When ca is the unit of velocity, ca^2 is 1. Therefore, the velocity of light in the transverse direction is $\sqrt{1-va^2}$, and when va=.6 ca, cr=.8 ca.

Time aboard frames A and B

Time aboard frames A and B is kept by "light clocks" comprised of 1 m long boxes within which light signals oscillate back and forth. Each clock has a counter that keeps track of the number of oscillations and registers 1 s for every $1.5 \cdot 10^8$ round trips of the oscillating light signal, 0.1 s for every $1.5 \cdot 10^7$ round trips, 0.01 s for every $1.5 \cdot 10^6$ round trips, etc. The light clocks are initially positioned in frames A and B so the oscillating light signals are moving parallel to the y axis, but it will later be apparent that the time kept by these clocks does not depend on their orientation in their reference frame and that the time kept aboard A and B does not depend on using light clocks.

In frame B the light clocks run at only .8 times the rate of the clocks in A because the velocity of light along the y axis or in any other direction transverse to the x axis is moving at only .8 ca relative to frame B, as we see in Fig. 4.

Clocks are located aboard every spaceship and at every distance mark on the space frames. The time kept by each clock is displayed in large numbers as shown on the spaceship enlargements in Fig. 3. The time displays can be seen by all observers aboard both space frames (who must use telescopes because the distances between the ships are about as far as from Earth to the moon).

Figure 3 shows the relationship between frames A and B at the instant in time when the y axes of the systems are coincident as the frames pass one another. The observers at the origins of frames A and B previously set their clocks so the clocks read 0 s when they meet as shown in Fig. 3. For example, when the clocks were 600 *ls* apart prior to meeting, the clocks were set to read –1000 s because the observers knew that the distance between the clocks was decreasing at the rate of .6 c or .6 *ls*/s and that in 1000 s the clocks would meet. The instant in absolute time when the clocks meet will be referred to as ta=0 sa, and this time is shown by the clock at the origin of frame A which keeps absolute time because it is at rest in the qm.

Each clock in frames A and B has been virtually synchronized with the clock at the origin of its reference frame. This is done by an observer at each clock who sets the clock to read D s later than the time she sees on the origin clock, D being her distance in *ls* from the origin. This virtual synchronization method allows for the time required for the light showing the time on the origin clock to reach the observer. For example, the observers at the +1 *ls* and –1 *ls* locations on the x and y axes all set their clocks to read 1 s later than the time they see on the origin clock.

Synchronization and asynchronization of clocks in A and B

In frame A all the clocks are absolutely synchronized as a result of being virtually synchronized by the observers. This is because the speed of light cr relative to frame A is the same in all directions, as all observers assume. But in frame B, where the speed of light varies, most of the clocks are absolutely *asynchronized* (i.e. not synchronized) with the origin clock. Clocks are **absolutely synchronized** or **absolutely asynchronized** if they would appear synchronized or asynchronized respectively to observers at rest in the qm who allow for the travel time for the light from the clocks.

The clock at the +1 *ls* location on the x axis of B is .6 s out of sync with the origin clock because the speed of light cr along the x axis is crn or .4 ca. Therefore, if the observer at the +1 *ls* location sees the origin clock reading –1.6 s, she sets her clock to read –.6 s because she believes that the light containing the –1.6 s time on the origin clock took 1 s to reach her. But the light actually took (.8 LS/.4 ca) or 2 sa to reach her, and during this 2 sa the origin clock advanced 1.6 s (from –1.6 s to 0 s) because it is running at only .8 times the rate of clocks in A, which keep absolute time. Similarly, the clock at the .5 *ls* location on the x axis of B will read –.3 s when the origin clock reads 0 s.

The following simple rule helps determine the asynchronization of any clock in frame B or other inertial frame moving through the qm.

RULE: In any inertial reference frame moving through the medium, two clocks which have been virtually synchronized 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 set retarded relative to the rearward clock.

According to this RULE, the clocks along the y axis of B should be absolutely synchronized because the observed distance between the clocks is zero *in the direction of absolute motion*. We will check this and will see that the synchronization is the result of offsetting errors by the observers as follows. The light which left the origin clock when it read t s was moving along the y axis with a speed of .8 ca relative to B, as discussed above, and the light took (1 LS/.8 ca) or 1.25 sa to travel to the y=–1 *ls* location. During this 1.25 sa the origin clock advanced (.8 ·1.25 sa) or 1 s, and it reads (t+1) s, which is the same time the observer at the y=–1 *ls* location has set on her clock by assuming that the travel time for the light was 1 s.

Distance aboard frames A and B

The distances in Fig. 3 have all been established by observers aboard the space frames who use light signals and laser light ranging equipment to measure distances. For example, the spaceships at the +1 *ls* locations on the x and y axes of frame A are located where light signals can be sent to mirrors at the origin of the coordinate system (i.e. the x=0, y=0 location) and the signals return 2 s after they are sent according to clocks in frame A. Similarly the +.6 *ls* marks are located where a round-trip light signal to the origin takes 1.2 s on clocks in A. In frame A this method of measuring distances results in a square space frame where 1 *ls* is always 1 LS and 1 m is always 1 ma.

In frame B the observers measure distances exactly the same way. But in frame B the 1 *ls* distance along the x axis is only .8 LS due to the speeds of light, crn and crx, and the slower rate of the clocks in B. The time for a light signal from the 1 *ls* location on the x axis of B to the origin is (.8 LS/1.6 ca) or .5 sa. And the time for the return signal is (.8 LS/.4 ca) or 2 sa. Therefore, the time for a round-trip signal from the spaceship at the 1 *ls* location to the origin is 2.5 sa, and during this 2.5 sa the clock on the ship advances (.8 · 2.5 sa) or 2 s and the observer concludes that the ship is properly located 1 *ls* from the origin. It will become apparent that frame B's .8 LS width does not depend on the observers using light signals to measure distances. They could have used 1 m long measuring rods or could have counted the revolutions of wheels of known circumference as the wheels rolled along the connecting tubes.

Along the y axis of frame B the 1 *ls* distance is 1 LS because the speed of the round-trip light signal is moving at only .8 ca relative to frame B but the clocks are also slowed to .8 times their at-rest rate, **at-rest** meaning **when a clock or any other system is at rest in the qm**.

Energy exchange rate and physical change ratio, rv

The slowing of the clocks in frame B and the foreshortening of frame B along lines parallel to va are two of many effects of frame B's absolute velocity. A fundamental consequence of any change in va is a corresponding change in the rate of round-trip energy exchange throughout the system.

If a spaceship (or any physical system) in frame A in Fig. 3 is accelerated to the velocity va of frame B, it will become foreshortened for the same reason frame B is foreshortened -- to achieve rates of energy exchange in the system that appear to observers or other subsystems of the system to be identical to the rates when the system was at rest in the qm. As the absolute velocity of the system increases, a greater decrease in the rate of round-trip energy exchange occurs along lines parallel to va than along lines transverse to va *unless the system contracts in the direction of absolute motion*. A foreshortening between atoms and within atoms occurs to avoid an imbalance in energy exchange between and within the atoms. Atoms and the constituents of atoms experience the same interactions in foreshortened configurations moving through the qm as they experience when not foreshortened and at rest in the qm.

The foreshortening causes different standards of distance in the system. In frame B the standard of distance in the direction of va is less than the standard in the transverse direction and less than the standard in frame A. A 1 m long measuring rod in frame B is only .8 ma long when oriented parallel to va, and its length increases to 1 ma as it is turned perpendicular to va. Observers in B, like observers on Earth, are unaware of such changes in the lengths of measuring instruments. On Earth the maximum change in length of a meter rod due to changing its orientation in space is only $7 \cdot 10^{-7}$ ma if Earth's velocity through the qm is .0012 ca as appears likely for reasons discussed later.

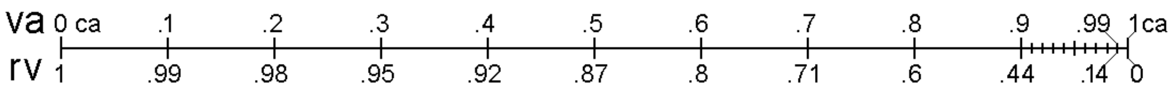
If the system could be accelerated to an absolute velocity approaching ca, the rate of round-trip energy exchange within the system would approach zero. The rates of all clocks and other processes within the system would approach zero. The energy within the system would be greatly increased because almost all of the photons within the system would have huge blueshifts and corresponding high energies. But observers in the system would not detect the blueshifts or energy increase because the photons would be redshifted upon being absorbed. This will be discussed in more detail later.

For any physical system moving through the qm, the foreshortening of the system, the slowing of processes in the system, and the increase in internal energy of the system can be quickly determined via the system's **physical change ratio** (**rv**) which is **the ratio of the rate of round-trip energy exchange in the system to the at-rest rate.** This ratio is a function of crx and crn, or va, as follows.

$$\mathrm{rv} = \sqrt{\mathrm{crn} \cdot \mathrm{crx}} \qquad (3)$$

$$\mathrm{rv} = \sqrt{1 - \mathrm{va}^2} \qquad (4)$$

In frame B, where va=.6 ca, crn=.4 ca, and crx=1.6 ca, the preceding equations give rv=.8. The following alignment chart with va and rv scales shows the relationship defined by Eq. (4). It shows that significant physical



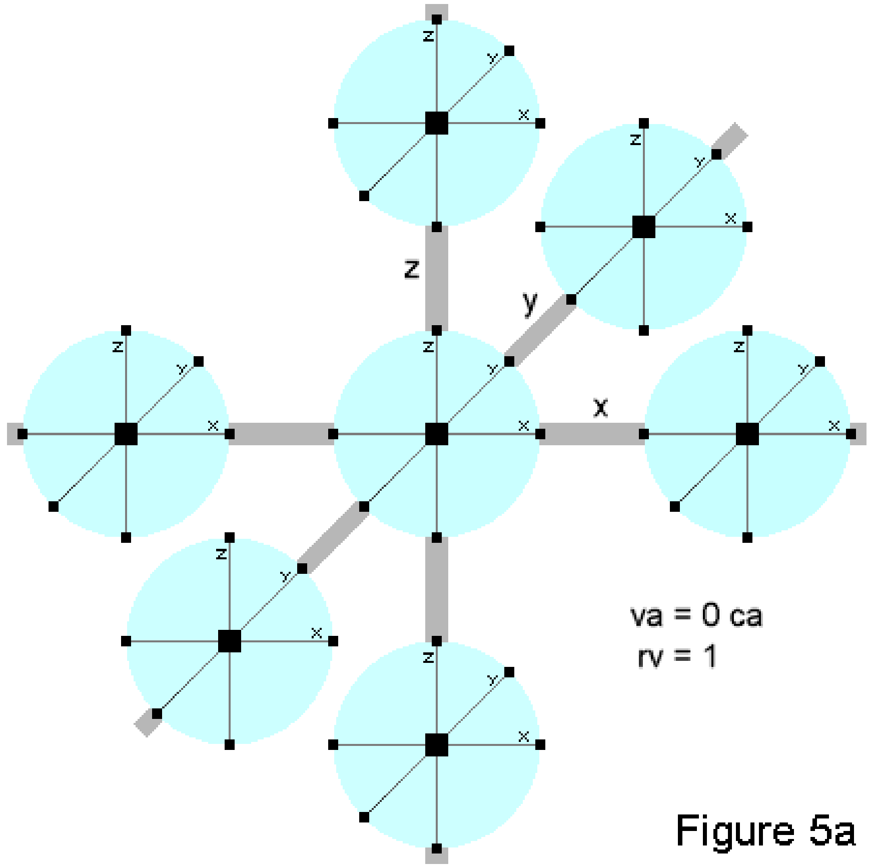


Figure 5a

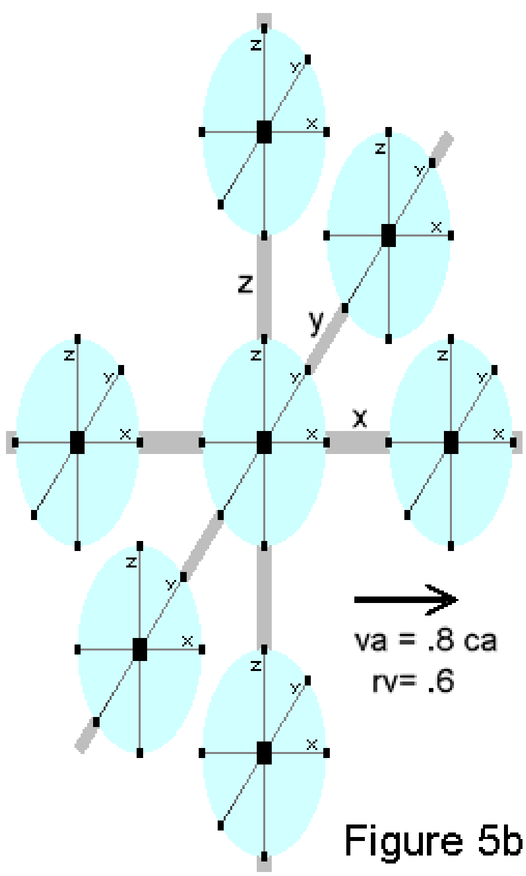


Figure 5b

changes in a system do not occur until its velocity through the qm is a significant fraction of the speed of light and that large changes occur as va approaches ca.

Changes on all scales due to a system's absolute velocity, va.

To appreciate the physical effects in a body due to its motion through the medium we will refer to figures 5a and 5b. These figures show a complex system having x, y, and z axes along which subsystems are located. The subsystems are comprised of components represented by black squares. The symbols ■ and ▪ represent nucleus and satellite systems of mass/energy on small scales and large scales. On an atomic scale they represent subatomic particles interacting with one another in their dynamic, atomic and subatomic configurations. For example, ■ can represent a system of protons and neutrons in the nucleus of an atom and ▪ can represent an electron that is interacting with other electrons and with its atom's nucleus. Because the positions and momentums of the subatomic systems are constantly changing, the interactions must involve exchanges of energy between these subsystems, and the energy is transferred through the medium according to Premise I. On a large scale, the squares could be spaceships in formations with the nucleus ships ■ in the center of the formations exchanging quanta of energy with satellite ships ▪ spaced a given distance from the nuclei of their formations.

Whether a system of mass/energy is a large-scale system such as a formation of spaceships or a small-scale system such as an atom, the system must experience a slowing of the rate of round-trip energy exchange within the system and a foreshortening of the system due to its velocity through the qm. And whether ■ and ▪ are spaceships or subatomic particles, an observer (or other subsystem) in the system in Fig. 5b will not sense the slowed rate of round-trip energy exchange or the foreshortening of the system. Like the system, the observer is foreshortened and all processes in the observer are slowed, as occurs throughout the entire system.

Premise I, that energy on the smallest scales (e.g. photons and perhaps gluons, etc) is propagated through the qm, means that even the smallest known systems of mass/energy (e.g. electrons, muons, quarks) are affected by their motion through the qm. Eq. (4) applies to all systems of mass/energy, even at these smallest known scales. Experimental evidence of the effects of the absolute velocity of small-scale systems will now be discussed.

Evidence of slowing of small-scale processes due to va > 0

The slowing of small-scale processes occurs for the same reasons the rate of the round-trip light signals is decreased in space frame B moving through the qm. Regardless of the scale, the average speed at which energy is moving through the system is decreased as the system's absolute velocity is increased. Even though the average of crx and crn along the x axis of frame B in Fig. 3 is 1 ca, crn has more influence on the average speed of light along the x axis because photons moving with velocity crn are in existence 4 times as long as photons moving with velocity crx.

Therefore, we would expect that the frequency of the light emitted by an atom would decrease as the atom's velocity through the qm increases, and we would expect that all other atomic processes would be similarly affected. (For nonphysicists, Appendix I contains information about light that is essential for understanding the qm view.) For example, cesium 133 atomic clocks are based on the very specific microwave radiation frequency that causes the cesium atoms to change from one state to another. What this change of state involves is not well understood, just as the constituents of atoms are poorly understood. But we can be confident that the change of state involves energy exchanges within the atom and that the transition requires just the right amount of energy. We would expect this energy and corresponding frequency of the radiation required for the transition to decrease when the atoms' velocity through the qm is increased and the energy exchange rate throughout the atom decreases. This expected decrease in frequency has actually been observed in an experiment in which atomic clocks were transported around Earth in jet aircraft. The results are in agreement with Eq. (4).

The purpose of the atomic-clock experiment was to determine if traveling clocks would actually lose time relative to nontraveling clocks. The fact that the clock slowing was observed is cited as more proof that orthodox theory is correct. But orthodox theory (i.e. special relativity theory) is ambiguous about this clock-slowing phenomenon. It attributes the slowing of a traveling clock relative to the time kept by a nontraveling clock to its motion *relative to the nontraveling clock*. This is similar to attributing the Doppler shifts in the starlight and railroad crossing bell clangs to the *relative motion* between the energy sources and the observers. It permits theory to agree with experimental results but it also results in the "Twins Paradox" of relativity theory where a clock or twin makes a trip and returns home having aged less than the clock or twin who stays home.

Here's the paradox. If the *relative motion* between clocks causes a clock that makes a round trip to age less than an identical clock that stays home, then the stay-at-home clock must be slowed relative to the traveling clock because, during the trip, the stay-at-home clock was moving relative to the traveling clock. But it is impossible for each clock to be slowed relative to the other. Over the years, attempts were made to explain this paradox, but it remains as another problem for orthodox theory which cannot explain what is causing the traveling clock to age less. Appendix II discusses this further.

The slowing of a traveling clock relative to its stay-at-home counterpart is a natural consequence of the quantum medium, and the slowing is correctly predicted by Eq. (4). The cause of the slowing is the change in *absolute velocity* of the traveling clock. The clock's absolute velocities and corresponding physical change ratios during the trip always result in the clock advancing less than had it not made the trip.

For example, assume that two clocks are located at the origin of frame A or frame B in Fig. 3 and that one clock is sent on a high-speed, round trip to the 1 *ls* location on the x axis and that each leg of the trip takes 1000 s on the frame's clocks. If this occurs in frame A which is at rest in the qm, the absolute velocity of the traveling clock during the trip is (1 LS/1000 sa) or va=.001 ca and the physical change ratio is rv=.999,999,5 according to Eq. (4). Therefore, during the round trip the traveling clock advances (.999,999,5 ·2000 sa) or 1999.999 s. The stay-at-home clock has a physical change ratio of 1 and advances 2000 s, or .001 s more than the traveling clock.

These observations of a 2000 s time for a 2 *ls* round trip at a speed of .001 c that resulted in a .001 s slowing of the traveling clock are independent of the absolute velocity of the reference frame and independent of the direction in which the 2 *ls* round trip is made. If the experiment is conducted in frame B of Fig. 3, exactly the same observations are made in B, even though the actual round-trip travel time is 2500 sa and the actual speeds and distances are not the speeds and distances observed in B. This is because frame B's standards of time and distance are distorted by B's motion through the qm. This will be apparent in the next few sections which explain why observers in frame B observe a foreshortened frame A on which the clocks appear to run slow.

Observations aboard frames A and B

Preparations for the experiment of Fig. 3 have been described and we can now determine the observations that are made aboard frames A and B. The observations depend on what the observers see and how they interpret what they see. The observers in A and B all see the same events occur during the experiment but the interpretations of what is seen differs from A to B due to different standards of distance and time in A and B. The observations are exactly as predicted by orthodox physics theory (i.e. special relativity) and as indicated by extensive experimental evidence.

The observers aboard frame A observe that frames A and B are momentarily as shown in Fig. 3, which is the absolute state of frame A and frame B at time ta=0 sa. The observers in A see that frame B is foreshortened and that the clocks along the x axis of B are asynchronized and that all clocks on B are running slower than the clocks aboard A. The observers do not understand the reasons for the strange foreshortening of frame B and the slowness of the clocks in B. The observers in A observe **the absolute velocity of frame B relative to frame A** (**vBAa**) because they observe absolute distances and absolute times. This absolute relative velocity is .6 LS/sa or .6 ca, although in A it is observed as .6 *ls* / s or .6 c.

In frame B the observers make observations that are the "mirror image" of those made in frame A. In B it appears that frame A is moving with a velocity of .6 c in the –x direction relative to frame B. This correct observation of velocity is due to offsetting errors in observed time and observed distance, as will be seen shortly. It is also observed in B that frame A is foreshortened and that the clocks along the x axis of A are asynchronized and are running slower than the clocks in B. If the observers are familiar with orthodox theory, they will attribute the observations to the relative motion between A and B. They will be aware that aboard each frame it appears that the other frame is shorter and the clocks are slower. They will be inclined to accept the conclusions of orthodox theory that absolute standards of distance and time do not exist and observers moving relative to one another cannot agree on distances and times.

We will first show why the observers in frame B observe a nonexistent (i.e. virtual) slowness of clocks in A relative to clocks in B and a nonexistent foreshortening of frame A. Later we will show that observers moving relative to one another can be in complete agreement on the distances, times, and masses they observe and that the inability of observers in different frames to agree has been caused by the illusion that the speed of light is constant in all inertial frames.

Virtual slowing of clocks in frame A ("time dilation")

It can now be explained why the observers in frame B of Fig. 3 observe the clocks in frame A running slow. We will use the above RULE and Eq. (4) to help determine time and distance *events* that all observers in frames A and B see as the frames pass one another. The events involve the clocks and distance marks located on the x axes of A and B. Each event will be designated by brackets, [ ]. All observers aboard frames A and B see the event, [The clock at the x=0 *ls* location on frame A reading 0 s is next to the clock at the x=0 *ls* location on frame B reading 0 s.] This event is shown in Fig. 3, and it can be represented by [Ax=0:0 is next to Bx=0:0], where "Ax=0" and "Bx=0" specify the clocks at the x=0 *ls* locations in frames A and B respectively, and ":0" specifies that the time on the clocks is 0 s. Figure 3 also shows the event [Ax=.8:0 is next to Bx=1.0: –.6].

At time ta=0 sa when these events occur, the distance between the x=.8 *ls* location in A and the origin in B is .8 LS and the relative velocity between the frames is .6 ca. Therefore, at time ta=1.3333 sa the following event occurs. [Ax=.8:1.3333 is next to Bx=0:1.0666]. The x=.8 *ls* clock in A reads 1.3333 s because rv=1 for frame A and clocks in A keep absolute time. The origin clock in B reads 1.0666 s because it was reading 0 s at time ta=0 sa and because the physical change ratio for the clock is rv=.8 so that during 1.3333 sa it advanced only (.8 · 1.3333) or 1.0666 s.

Based on these events they see, the observers aboard frame B conclude that the x=.8 *ls* clock on frame A moved along frame B from x=1.0 *ls* to x=0 *ls* in 1.6666 s (from –.6 s to 1.0666 s) and that during the 1.6666 s the x=.8 *ls* clock on frame A advanced 1.3333 s or only (1.3333 / 1.6666) or .8 times the rate of clocks on B. For similar reasons, observers aboard frame B will see all other clocks aboard A running at .8 times the rate of the clocks aboard B. This virtual slowing of clocks on frame A is the "relativistic slowing" or "relativistic time dilation" predicted by special relativity which attributes the slowing to the relative motion between the clocks and the observer. Relativity theory cannot explain why increasing or decreasing frame B's velocity in the direction of the x axis causes the clocks in A to change their rate relative to the rate of clocks in B. This is another example of the inability of orthodox theory to explain phenomena.

The observers aboard frame A correctly observe that the clocks in B are running slower than the clocks in A but, like observers in B, they do not understand the physical causes of their observations.

Virtual relative velocity

Based on these same events, the observers aboard frame B determine that the .8 *ls* mark in frame A moved from the 1 *ls* mark in B where the clock was reading –.6 s to the origin of B where the clock was reading 1.066 s. Therefore, the observers in B see the .8 *ls* mark in A move 1 *ls* through frame B in 1.666 s and conclude that the velocity of frame A past frame B is (1 *ls* /1.666 s) or .6 c. This is the correct velocity because the observed distance and observed time are both 25% greater than the actual distance and time. It will be shown later that when two inertial frames are both moving through the qm, observers aboard the frames will all agree on the relative velocity between the frames, but this observed relative velocity on which they agree will not equal the actual, absolute relative velocity.

Virtual contraction of frame A ("length contraction")

Based on the above events, the observers aboard frame B also see the origin clock in B advance 1.066 s while it moved from the origin of A to the .8 *ls* location in A. The observers conclude that the clock moved (1.066 s · .6 c) or .64 *ls* along frame A, not .8 *ls* as shown by the distance scale on A. Therefore, the observers in B conclude that frame A is only (.64 *ls* /.8 *ls*) or .8 times the width of frame B. This virtual foreshortening of frame A is the "relativistic length contraction" that is predicted by special relativity and attributed to the relative motion between frames. Again, the theory cannot explain why changing the velocity of frame B causes a change in the foreshortening of frame A. The fact that this and a wide variety of similarly strange phenomena are natural consequences of the quantum medium is very strong evidence of the medium's existence. More of the evidence will be discussed later.

The events used in the above explanations were selected for convenience, but an unlimited number of other events could be used to reach the same conclusions. The reader can verify this by using Eq. (4), the asynchronization RULE, and a calculator to determine other combinations of events that all the observers can see and use to determine what is occurring during the experiment.

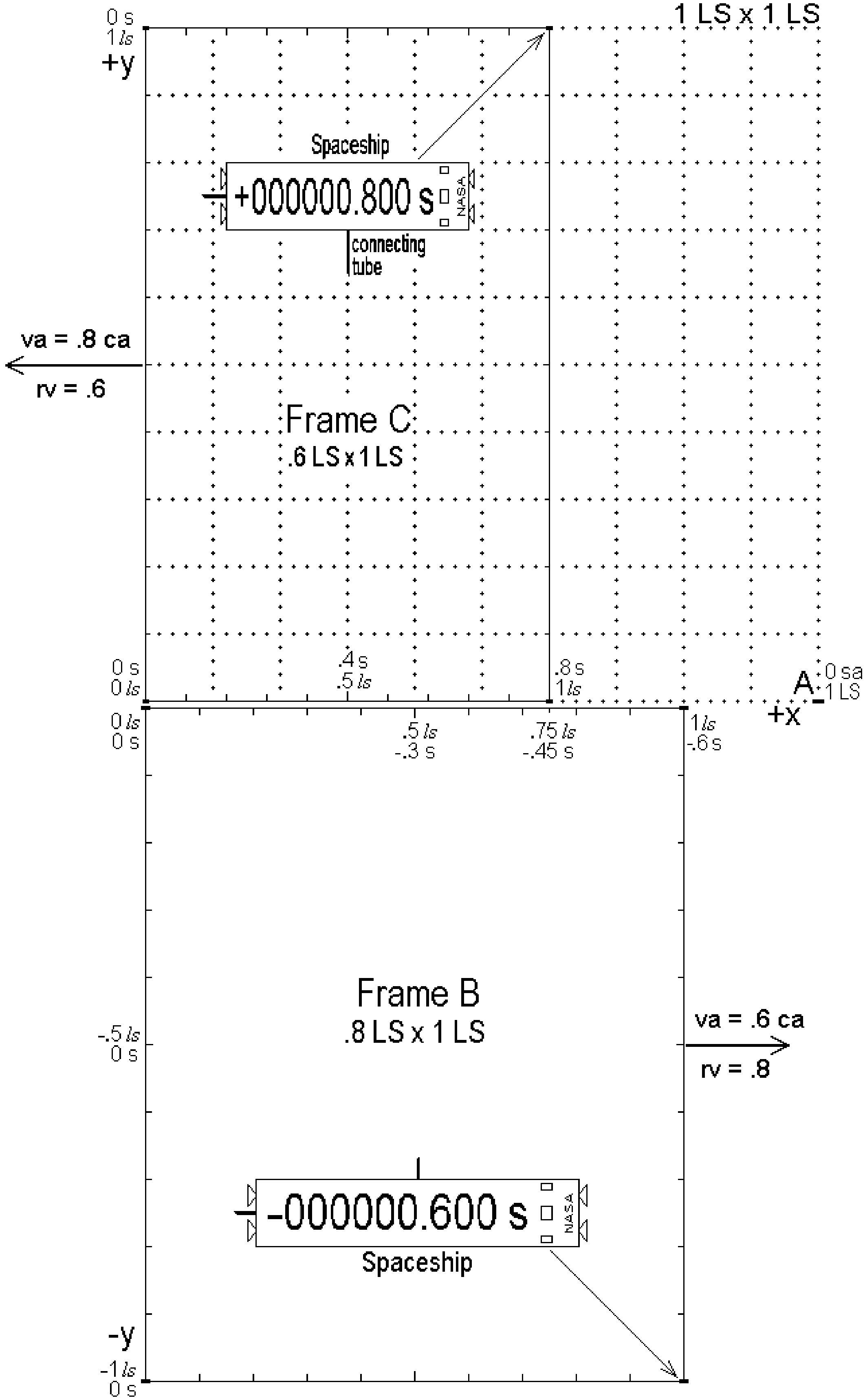


Figure 6. Space frames B and C at time ta=0 sa.

Frames B and C with absolute relative velocity, vBCa=1.4 ca

Figure 6 shows a variation of the experiment of Fig. 3 in which a frame C has an absolute velocity va=.8 ca in the −x direction. The clocks aboard C have been virtually synchronized and thus are absolutely asynchronized as shown. Notice that the clock at the 1 *ls* location on the x axis of C is set .8 s advanced relative to the origin clock because it is rearward of the origin clock as frame C moves through the qm. The absolute velocity of B relative to C is 1.4 ca but the observers aboard B and C observe otherwise as we will now determine.

At time ta=0 sa the y axes of B and C are aligned and the clocks at the origins of B and C read 0 s as shown. Therefore, all observers aboard B and C see the event [Cx=0:0 is next to Bx=0:0]. They also see the event [Cx=1:.8 is next to Bx=.75:−.45]. This event occurs at the .6 LS distance on the x axis of a reference frame at rest in the qm. This absolute reference frame is shown by the 1 LS x 1 LS grid of dotted lines. In frame B the .6 LS distance along the x axis is (.6 LS / rvB) or (.6 /.8) or .75 *ls*, and in frame C it is (.6 LS / rvC) or (.6 /.6) or 1 *ls* as shown.

Due to the 1.4 ca absolute relative velocity vBCa between frames B and C, Bx=0 will arrive at Cx=1 in (.6 LS/1.4 ca) or in .42857 sa when the Bx=0 clock reads (.42857 · .8) or .34286 s and the Cx=1 clock reads .8+(.42857 · .6) or 1.05714 s. Therefore, all the observers see the event [Bx=0:.34286 is next to Cx=1:1.05714].

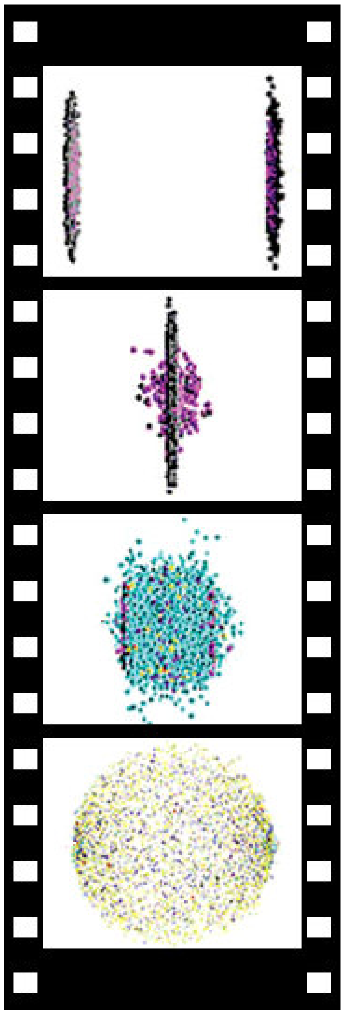
Frames B and C with virtual relative velocity, vBC=.94 c

Based on the preceding events, observers in frame B determine that the Cx=1 location moved .75 *ls* along the x axis of B in (.34286 s+.45 s) or .79286 s, and that the velocity of C relative to B is (.75 *ls* /.79286 s) or .94594 c. Similarly, the observers aboard C determine that Bx=0 moved 1 *ls* along the x axis of C in 1.05714 s and that the velocity of B relative to C must be (1 *ls* /1.05714 s) or .94594 c, the same relative velocity determined in B based on the times and distances observe in frame B.

Therefore, the experiment shows that the virtual relative velocity determined by the observers in B and C is less than ca, even when the absolute relative velocity is 1.4 ca. We can derive an equation for the observed velocity of B relative to C (vBC) based on knowing the absolute velocity of B (vBa) and the absolute velocity of C (vCa). This derivation is explained in Appendix III, and the equation is as follows.

$$\mathrm{vBC} = \frac{\mathrm{vBa} - \mathrm{vCa}}{1 - (\mathrm{vBa} \cdot \mathrm{vCa})} \tag{5}$$

This equation is similar to the velocity addition equation of special relativity and it sheds light on why the experimental evidence has indicated that two inertial frames cannot have a relative velocity greater than c. The quantum medium view shows that the relative velocity between two physical systems can be almost twice the speed of light. For example, at Brookhaven National Laboratory on Long Island, New York, gold nuclei are accelerated to almost the speed of light in the lab's Relativistic Heavy-Ion Collider, a 1.2 km diameter accelerator. The gold nuclei can be accelerated in opposite directions so that their relative velocity is nearly 2 ca when they collide or pass one another.



Due to their high absolute velocities, the gold nuclei are highly foreshortened for reasons discussed above and as shown in the top frame of the images of two colliding gold nuclei. The images were created by Lawrence Livermore National Laboratory, a collaborator in the collider experiments. Later it will be seen why gold nuclei, or any other systems of mass/energy, must have absolute velocities less than ca, which always results in their relative velocities being less than 2 ca.

According to orthodox theory, the *relative velocity* of the two gold nuclei heading toward one another prior to collision (top image) is less than the speed of light, even though each has a velocity of nearly the speed of light relative to the accelerator. Most physicists are comfortable with this way of thinking because it works and they are accustomed to it.

Figure 6 shows spaceship A (small rectangle) parked at rest in the qm at x=1 LS on the x axis of the 1 LS x 1 LS grid. Observers aboard this ship see frame B moving with a velocity of .6 c in the +x direction and see frame C moving with a velocity of .8 c in the −x direction. In accordance with special relativity, the observers will use the theory's "velocity addition equation" to determine the velocity of B relative to C. This equation is generally written $w=(u+v)/(1+u\cdot v)$ where w, u, and v correspond to observed velocities vBC, vAC, and vBA in Fig. 6. The equation gives a relative velocity of w=vBC=.945945 c, which is the same relative velocity we determined previously for all observers aboard B and C in Fig. 6.

As we progress through this brief explanation of the quantum medium view, it should become increasingly apparent that the view is consistent with experimental evidence and consistent with the predictions of special relativity which has been shown to be in agreement with experimental results. It should also be apparent that the quantum medium view explains physical causes for the experimental results and that special relativity does not reveal these causes.

Virtual physical change ratio or gamma γ of special relativity

It has been shown that observers aboard any two frames B and C that have absolute velocities in the same or opposite direction observe a virtual relative velocity according to Eq. (5). This virtual relative velocity determines the "relativistic length contraction" and "relativistic time dilation" observed aboard B and C according to the following equation where **rBC** is the **virtual physical change ratio.**

$$\mathbf{rBC} = \sqrt{\mathbf{1} - \mathbf{vBC}^{\mathbf{2}}} \tag{6}$$

Using this equation in the case of Fig. 6, $\mathbf{rBC} = \sqrt{\mathbf{1} - \mathbf{.945945}^2}$ or rBC=.32432. This means that an observer aboard B or C will determine that the other frame is only .32432 times as long in the x direction as her frame and that clocks on the other frame are running at only .32432 times the rate of her clocks.

We can check this using events that occur as B and C move relative to one another in Fig. 6. Observers aboard B see clock Cx=1 change from .8 s to 1.05714 s as it moves from Bx=.75:−.45 to Bx=0:.34286. Therefore, the observers on B see clock Cx=1 advance (1.05714−.8) or .25714 s while the clocks on B advance (.34286+.45) or .79286 s, and the observers conclude that the clocks on C are running at only (.25714/.79286) or .32432 times the rate of the clocks on B. This is the same slowing that is "predicted" by the virtual physical change ratio rBC of Eq. (6), as we determined above. Similarly, the reader can verify that observers aboard C see the same slowness of the clocks aboard B.

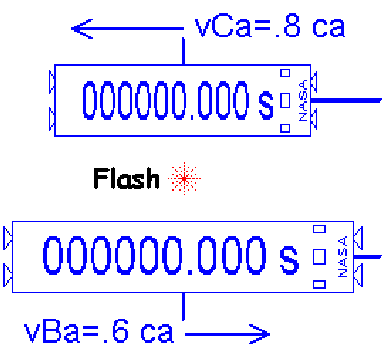
The term rBC of Eq. (6) is comparable to the gamma γ used in the transformation equations of special relativity. It accurately specifies the observed "relativistic" phenomena given the observed relative velocity, but it does not reveal the underlying phenomena responsible for the observations.

Simultaneity of events

In the quantum medium view, **events are absolutely simultaneous if they are determined to be simultaneous by an observer at rest in the qm who allows for the travel times for light from the events to the observer.** This determination of absolute simultaneity is possible because the speed of light in the observer's frame is constant, as the observer assumes. Later it will be shown that observers in frames moving through the qm also can determine the absolute simultaneity of events.

The ideas of synchronization and simultaneity are similar. If two clocks are placed next to one another they can be synchronized so the display of a particular time t on one clock is simultaneous with the display of time t on the other. When clock readings or other events occur at different locations, synchronization and simultaneity are more complex. Referring back to Fig. 6, clocks along the x axes of frames B and C are not absolutely synchronized because the speeds of light between the clocks are not as assumed by the observers who virtually synchronized the clocks. Without knowing the speeds of light between the clocks, the observers at the origin and 1 *ls* locations cannot know if their clocks are absolutely synchronized. They can only be certain that the time displayed on one clock is within 1 s of being simultaneous with the same time displayed on the other clock.

One might think that the synchronization between clock Bx=0 and clock Bx=1 could be checked by using a portable clock which is placed next to Bx=1 and synchronized with clock Bx=1 and then transported to Bx=0 and compared with the time on clock Bx=0. Let's see if this will work. We will place a portable clock (PC) next to clock Bx=1 and absolutely synchronize it with clock Bx=1. Then we will transport clock PC to Bx=0 at a constant observed velocity of 300 m/s or 10^{-6} c. At this velocity, the 1 *ls* trip will take 10^6 s on the clocks or $1.25 \cdot 10^6$ sa because rvB=.8. The absolute velocity of PC relative to B is the absolute distance traveled divided by the absolute time traveled (.8 LS/$1.25 \cdot 10^6$ sa) or .00000064 ca. Therefore, the absolute velocity of clock PC is (.6 ca–.00000064 ca) or .59999936 ca and, via Eq. (4), the physical change ratio for PC is rvPC=.80000048. During the $1.25 \cdot 10^6$ sa trip, PC advances ($1.25 \cdot 10^6$ sa · .80000048) or 1000000.6 s while clock Bx=0 and clock Bx=1 advance 1000000 s. Therefore, when clock PC arrives at clock Bx=0, these clocks read the same.



A consequence of relativity theory is that two events that occur in different locations and are observed to be simultaneous in one frame, are observed to be not simultaneous in a different frame. For example, in the experiment of Fig. 6, let the observers at the origins of B and C set off a bright flash of light when they are momentarily next to one another at time ta=0 sa. At this same time, event [Bx=.75:–.45 is next to Cx=1:.8] occurs as shown in Fig. 6. Therefore, aboard frame B this event occurs .45 s before the flash and on frame C the event occurs .8 s after the flash. This byproduct of special relativity has been confusing for many, including those with an aptitude for physics, as indicated by the following statement from the *Physics Education Research* supplement to the American Journal of Physics, July 2001, pgs s24-s35.

> After instruction, more than two-thirds of physics undergraduates and one-third of graduate students in physics are unable to apply the construct of a reference frame in determining whether or not two events are simultaneous.

This reflects the confusion inherent in relativity theory. It is confusing when it is not clear why observers in different frames disagree on the order in which events in different locations occur. The disagreement is a result of the light postulate.

On the Propagation of Light

Light postulate of relativity theory

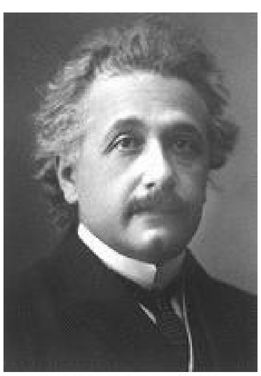
The light postulate represents Albert Einstein's starting point for his ingenious reconciliation of various problems or inexplicable phenomena faced by the physics community around 1900. Relativity theory is the result of his following the consequences of the light postulate to their logical conclusions. If he had reservations about the postulate, they are not apparent in the following from his book, *Relativity, The Special and the General Theory* (Crown Publishers, New York, 1961, p. 17)

> There is hardly a simpler law in physics than that according to which light is propagated in empty space. Every child at school knows, or believes he knows, that this propagation takes place in straight lines with a velocity c=300,000 km/sec.

The book goes on to say that experiments show that the speed of light is independent of the color of the light and "the velocity of motion of the body emitting the light" and that it is improbable that the velocity of propagation of light in space depends on the direction of propagation. This leads to the following sentences.

> In short, let us assume that the simple law of the constancy of the velocity of light c (in vacuum) is justifiably believed by the child at school. Who would imagine that this simple law has plunged the conscientiously thoughtful physicist into the greatest intellectual difficulties?

Einstein resolved these difficulties in a remarkable way that had tremendous scientific benefits. But this booklet suggests that the great intellectual difficulties to which Einstein refers can be resolved in another way that avoids the intellectual difficulties that so many have experienced in trying to understand the ideas of time, distance, and mass that relativity theory requires. The light postulate makes nature more perplexing, not less.



Albert Einstein

The light postulate has a profound influence on physics and our civilization. Perhaps the influence is less than Ptolemy's assumption that heavenly bodies circle Earth, but the impact is huge. It led to Einstein's discovery of the connection between mass and energy and to the ability to release nuclear energy. It led to a variety of less dramatic technology. No less important, it led to ways of thinking in which an objective reality seems not to exist. It contributed to the notion that nature is not necessarily logical and that any mathematical model of nature is sound if it is consistent with scientific evidence.

In the quantum medium view, the law of the constancy of the velocity of light is incorrect, in spite of its agreement with experimental evidence and widespread acceptance by students and teachers during the past 100 years. It is hard to argue against experimental evidence and popular beliefs. However, we will try by referring back to Fig. 6 and the light flash emitted by the observers at the origins of frames B and C.

Experiment to observe the propagation of light

According to orthodox theory and experimental evidence, photons from the flash in Fig. 6 will travel along the x axes of frames B and C and the dotted grid, and the observers in each of these reference frames will observe that the light is moving with velocity c relative to their frame. Orthodox theory cannot explain how it is possible for a photon, which is moving in the +x direction, to have the same velocity in all three frames. Should not the velocity of the photon through frame C be much greater than the velocity of the photon through frame B? It is interesting that all observers in the three frames do observe that the light from the flash moves much faster along the x axis of C than along B in spite of their acceptance of the light postulate and their belief that the speed of light is a constant in all inertial frames.

We will determine events that occur as the light flash moves along the x axes of the three frames. The light flash has a velocity of 1.8 ca in the +x direction along frame C and it arrives at Cx=1 at ta=(.6 LS / 1.8 ca) or at ta=.3333 sa. During this .3333 sa, frame C moves with a velocity of 1.4 ca relative to frame B. Therefore, Cx=1 moves (.3333 sa · 1.4 ca) or .4666 LS along B. This distance is (.4666 LS / .8) or .5833 *ls* on B or from .75 *ls* to .1666 *ls* on B. At ta=0 sa the clock at Bx=.1666 reads (−.1666 · .6) or −.1 s (according to the asynchronization RULE) and at ta=.3333 sa it has advanced (.3333 · .8) or .2666 s and it reads .1666 s. The flash arrives at the Cx=1 clock reading .8+(.3333 · .6) or 1 s. Therefore, all observers see [the flash arrives at Bx=.1666:.1666 is next to Cx=1:1].

The flash has a velocity of .4 ca in the +x direction along B and it arrives at Bx=1 at ta=(.8 LS / .4 ca) or at ta=2 sa. During this 2 sa the flash's photons move (2 sa · 1.8 ca) or 3.6 LS along the x axis of frame C or to the (3.6 LS / .6) or 6 *ls* location on C (if frame C is extended in the +x direction). During the 2 sa travel time for the flash, the Bx=1 clock advances (2 sa · .8) or 1.6 s from −.6 s to 1 s. During the 2 sa travel time for the flash to reach Cx=6, the Cx=6 clock advances (2 sa · .6) or 1.2 s from 4.8 s to 6 s. Therefore, all observers see [the flash arrives at Bx=1:1 is next to Cx=6:6].

The following table is based on the preceding two events that occur when the flash arrives at Cx=1 and at Bx=1 and are seen by all observers. The observations shown in the table are in agreement with the predictions of orthodox theory. Notice that every observer determines that the time required for the flash to move along frame B is six times the time for the

	Observed aboard A	Observed aboard B	Observed aboard C
When flash occurs	0 s	0 s	0 s
When flash arrives at Cx=1 & Bx=.1666	.3333 s	.1666 s	1 s
When flash arrives at Bx=1 & Cx=6	2 s	1 s	6 s

flash to move along frame C. Nevertheless all observers determine that the speed of light along the x axis of their frame is 1 c. Should not these observations cause the observers to wonder how they can all determine that the speed of light is c in their frames and at the same time determine that it is much faster through C than through B? How is this possible? We have shown above how it is possible.

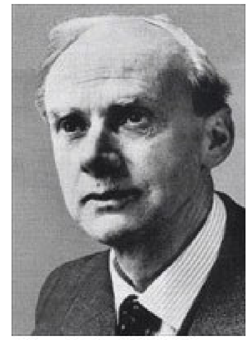
Physical evidence of a light-propagating quantum medium

Over the centuries, physicists found many reasons to suspect that our universe includes an all-pervasive medium responsible for observed phenomena. Around 1900 the primary reason may have been the medium's compatibility with the wave theory of light which was then in vogue. Now, with the popularity of the quanta or particle notion of light, the medium helps explain phenomena related to the particles. The medium also fits with other observed phenomena for which there are no other good explanations, and we will briefly discuss some of the evidence.

According to orthodox theory, our universe includes a "quantum vacuum," sometimes called a "false vacuum" or "quantum foam," which is seething with energy and from which and into which photons and other quanta are constantly materializing and disappearing. Inasmuch as quanta cannot materialize out of nothing, it is reasonable to assume that the quantum vacuum is comprised of something. We suggest that this quantum vacuum and the quantum medium are the same and that, as stated in Premise I, photons are propagated with a constant velocity through this medium.

Many would say that light particles do not need a medium in which to propagate. This is a possibility because we simply do not know how photons move. But it is not probable because the idea of light particles being emitted by atoms in a star, then traveling through empty space, and eventually arriving at our eyes always with the same velocity relative to our eyes and independent of our motion relative to the star does not lend itself to a plausible explanation. The notion of a photon being like a tiny particle is probably very misleading. Photons oscillate or vibrate with certain frequencies, and the oscillations must involve physical phenomena of which we are unaware. Premise I suggests that the oscillations are oscillations in the medium.

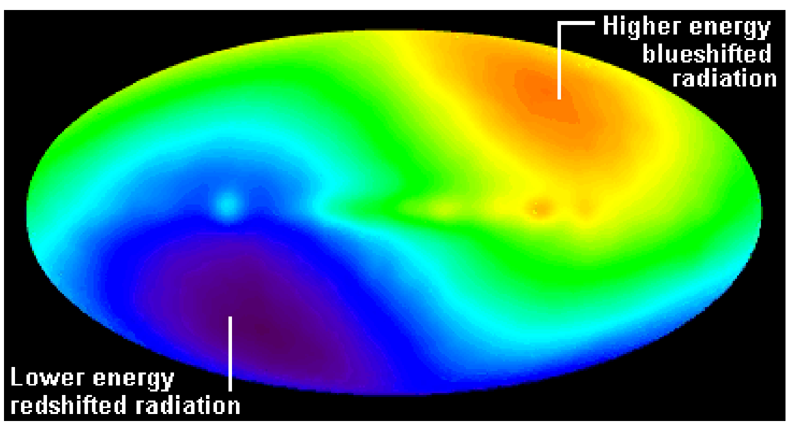
Paul Dirac, the Nobel prize physicist who showed that quanta of energy can be converted into quanta having mass, also showed that quanta can be the result of a medium. Photons, electrons, and other quanta all may be dynamic systems of energy in Maxwell's electromagnetic medium. This important finding has not had a significant impact due to the popular-but-false belief that a light-propagating medium has been proven impossible.



Paul A. M. Dirac

The special theory of relativity has a second postulate, the principle of relativity, which requires that all inertial frames be equivalent. Nature should not appear different from one frame to the next. This is logical but it creates a problem for orthodox theory. How can the observations in a reference frame that is at rest relative to the quantum vacuum of orthodox theory be the same as the observations in a reference frame moving with high velocity through the quantum vacuum? Is it not logical to expect differences in how the activity in the quantum vacuum is perceived in the two frames? Surely every frame does not have its own quantum vacuum.

In 1964 the cosmic microwave background (CMB) radiation was detected. This radiation is believed to be a remnant of a "big bang" billions of years ago, and it has been studied extensively. The radiation comes to us from all directions as one would expect, but the CMB radiation arriving from the direction of the constellation Leo is higher-frequency radiation, on



Observed dipole in the frequency of CMB radiation in universe.

average, than the CMB radiation coming from the opposite direction. A plausible explanation for this observed large-scale anisotropy in the pattern of CMB radiation is that the radiation is isotropic on a large scale in the medium through which it is propagated and the solar system is moving through the medium with a velocity of .0012 times the speed of light through the medium. This velocity in the direction of Leo would cause Doppler shifts in the *observed* CMB radiation that would result in the *observed* dipole. The NASA image above shows the pattern of the CMB radiation observed via the COBE satellite. Their image shows the lower frequency, redshifted radiation in blue and the higher frequency, blueshifted radiation in red. This dipole supports the quantum medium view because if the CMB radiation is propagated through a medium, a dipole will result. It is impossible for the sun to be at rest in the medium because the sun is rotating around the center of our galaxy, the galaxy is in motion in its cluster, etc.

Therefore, in an inertial frame moving with a velocity of .0012 c in a direction opposite to that toward Leo, the CMB radiation will be isotropic on a large scale. There will be no blue-red dipole. We suggest that this frame is at rest in the qm and that clocks and distance measuring instruments in this frame keep absolute time and measure absolute distances.

It seems likely that more indications of our motion through the medium will become available in the future, but only time will tell. Various experiments can provide direct evidence of the medium, and Appendix IV gives an example, but no experiment has yet provided conclusive evidence. By its nature, the medium is much more difficult to detect than one would imagine. For those who are unaware of the reasons for this difficulty, it is easy to conclude that the medium does not exist. This is encouraged by physics texts that cite the Michelson-Morley experiment as proof.

Observers(c) and observers(cr)

It should now be clear that the observations made in any inertial frame depend on the speeds of light in the observer's frame. In frame A of Fig. 3 (and perhaps in remote space in the frame of CMB symmetry), the speed of light cr relative to the frame is always ca. Therefore, the observers in A observe the actual, absolute phenomena occurring in the qm even though they are unaware of why the speed of light is constant in their frame. Shortly we will encounter observers who realize that the speed of light is different in different frames, and who can then agree on the times, distances, and masses they observe.

Therefore, it will help to distinguish between the two types of observers as follows. **Observers(c) assume that the speed of light c is constant in all frames** and **observers(cr) assume that in all frames moving through the medium the speed of light cr is not constant.**

How observers in different frames agree on times, distances, masses.

Observers in different inertial frames can agree on the times and locations of events they see in nature once they agree on an absolute frame. Even if the assumed absolute frame is moving through the qm with a velocity comparable to the sun's motion around our galaxy's center, the observations will be in exact agreement and the observed phenomena will be very close approximations of the absolute phenomena occurring in the qm. This is an important advantage of the quantum medium view. It preserves the logical concepts of absolute time, distance, and mass, and an absolute physical reality behind all observations.

Figure 7 shows inertial frames B and C moving relative to one another and relative to an agreed-upon absolute reference frame A at rest in the qm. Each axis of each frame has distance marks (not shown) which are 1 ma apart when at rest in the qm. In B and C the marks along the Bx and Cx axes are closer together, for reasons explained previously (just as the .1 *ls* marks on the x axes of frames B and C in Fig. 6 are closer together than if the frames were at rest in the qm). Each distance mark has a clock

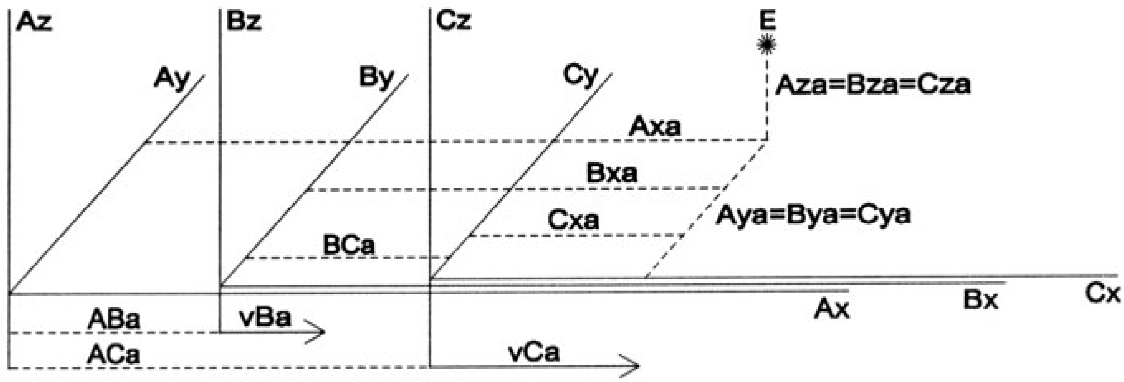


Figure 7. Coordinate systems A, B, C, and event E at time ta.

which is absolutely synchronized with the other clocks in its coordinate system, as explained below. Observers(cr) in reference frames B and C can determine their absolute velocities, vBa and vCa, by observing the absolute distance marks and clocks on the Ax axis as the origins of their coordinate systems pass the marks and clocks (or by realizing that their absolute velocity is equal to their virtual velocity relative to frame A). The observers(cr) in A, B, and C know that all clocks and distance scales in A indicate absolute times and distances. Also, every observer knows the absolute speeds of light between any two locations in any system. For example, in B the speeds of light moving parallel to the x axis are (1+vBa) ca and (1−vBa) ca, and for light moving along lines parallel to the y or z axes the speed is rvB ca. All observers(cr) know, via Eq. (4), the physical change ratios for systems B and C.

Every observer knows that in B and C every clock is slowed and all distance scales are foreshortened in the direction of absolute motion in proportion to the physical change ratio for the system. Thus all observers can convert all clock and distance scale readings into absolute units, regardless of the coordinate systems of the observers, clocks, or distance scales. They can also convert all masses into absolute units as we will discuss later. All observers know that an absolute second, 1 sa, is a time duration equal to rv s on any clock, where rv is the clock's physical change ratio. An absolute time (ta) specifies the time in absolute seconds, sa, before (−) or after (+) a particular event occurs.

At time ta=0 sa, the origins of A, B, and C were coincident and the origin clocks displayed 0 s. Because every observer in the three coordinate systems knows the speed of light from the clock at the origin of her coordinate system to her clock, she can absolutely synchronize her clock with the origin clock. Therefore, within each system, all clocks in the system are absolutely synchronized. At any absolute time ta, all clocks in A read ta s, all clocks in B read (ta · rvB) s, and all clocks in C read (ta · rvC) s.

Because observers(cr) in B and C can determine absolute times and distances, they can determine the absolute velocity of C relative to B, vCBa. Absolute velocities add in the classical way as follows.

$$vCa=vBa+vCBa \tag{7}$$

The absolute distances between the origins of the coordinate systems, ABa, ACa, and BCa depend on the absolute velocities and absolute time.

$$ABa=vBa\cdot ta\ ,\ \ ACa=vCa\cdot ta\ ,\ BCa=vCBa\cdot ta \tag{8}$$

The absolute distances add in the classical way.

$$ACa=ABa+BCa \tag{9}$$

At time, ta, event E occurs at location (Axa, Aya, Aza). In system B the event occurs at location (Bxa, Bya, Bza), and in system C it occurs at (Cxa, Cya, Cza), where these absolute distances are related to the labeled distances on the axes of the coordinate systems as follows.

$$\begin{gathered} Axa=Ax,\ \ Aya=Ay,\ \ Aza=Az \\ Bxa=Bx\cdot rvB,\ \ Bya=By,\ \ Bza=Bz \\ Cxa=Cx\cdot rvC,\ \ Cya=Cy,\ \ Cza=Cz \end{gathered} \tag{10}$$

That is, Bxa, Bya, and Bza are the absolute distances of the event along the Bx, By, and Bz axes, and Bx, By, and Bz are the labeled distances on the axes at absolute distances Bxa, Bya, and Bza.

All observers(cr) in all the coordinate systems therefore know the absolute location of any event and the absolute time of the event. Consequently, all observers(cr) agree on the absolute time durations between different events, and the observers agree on the order of the events. Thus, all observers(cr) in A, B, and C use the same absolute units of time, distance, and mass, and they all agree on the phenomena occurring in the qm. They do not need to make transformations between the observations made in one reference frame and the observations made in other reference frames because the observations are the same in all the reference frames.

Mass/energy and Inertia

The equivalence of mass and energy

It is generally accepted that all mass is a form of energy and that the relationship between a mass and its equivalent energy is correctly given by Einstein's equation, $E=m \cdot c^2$, where m is the mass in kilograms (kg), E is the energy in joules (J) or newton·meters (N·m) or ($kg \cdot m^2/s^2$), and c^2 is the speed of light squared or $9 \cdot 10^{16}$ m^2/s^2. In the quantum medium view the speed of light is 1 ca, the speed of light squared is 1, and Einstein's equation is as follows where the unit of energy is the kilogram or $9 \cdot 10^{16}$ J.

$$e = m \tag{11}$$

Therefore, a 1 kg mass represents an energy of 1 kg or $9 \cdot 10^{16}$ joules. The fact that 1 watt (W) of power is 1 J/s, means that a 1 kg mass has enough internal energy to power a 1000 watt light bulb for $9 \cdot 10^{13}$ s or for more than 2 million years if all the energy could be tapped.

How can so much energy be stored in a small amount of mass? In what form is the energy? In the quantum medium view, all the internal energy of a mass is in the form of quanta of energy whose energy is the result of oscillations in the medium. We will now discuss theoretical reasons for this view of mass/energy.

Why a body's mass depends on its absolute velocity

To explore the influence of absolute velocity on mass, we will employ another imaginary experiment in which energy is exchanged between photon-exchanging instruments located at the origins and the 1 *ls* locations on the x and y axes of inertial frames A and B shown in Figure 8. Frame A is at rest in the qm and frame B has an absolute velocity of .6 ca in the +x direction. The purpose of the experiment is to demonstrate on a large scale how a system's absolute velocity affects the transfer of energy between subsystems on all scales.

The photon-exchanging instruments used in this experiment will be referred to as "photon exchangers" or "exchangers." They are capable of emitting individual photons when they are periodically triggered by clocks or by the reception of photons from other exchangers. In Fig. 8 each photon moving between the exchangers is represented by an arrow. The photon is located at the tail end of the arrow and the arrow's length shows the photon's velocity *relative to the exchangers* between which it is transferring energy. For example, along the Bx axis the two photons moving in the −x direction have long arrows because they are moving with a velocity of 1.6 ca relative to the exchangers. These photons with long arrows move rapidly through frame B and they have relatively low energy in the qm because they were redshifted as they were emitted. The opposite is true of the short-arrow, low-velocity, high-energy photons moving in the +x direction.

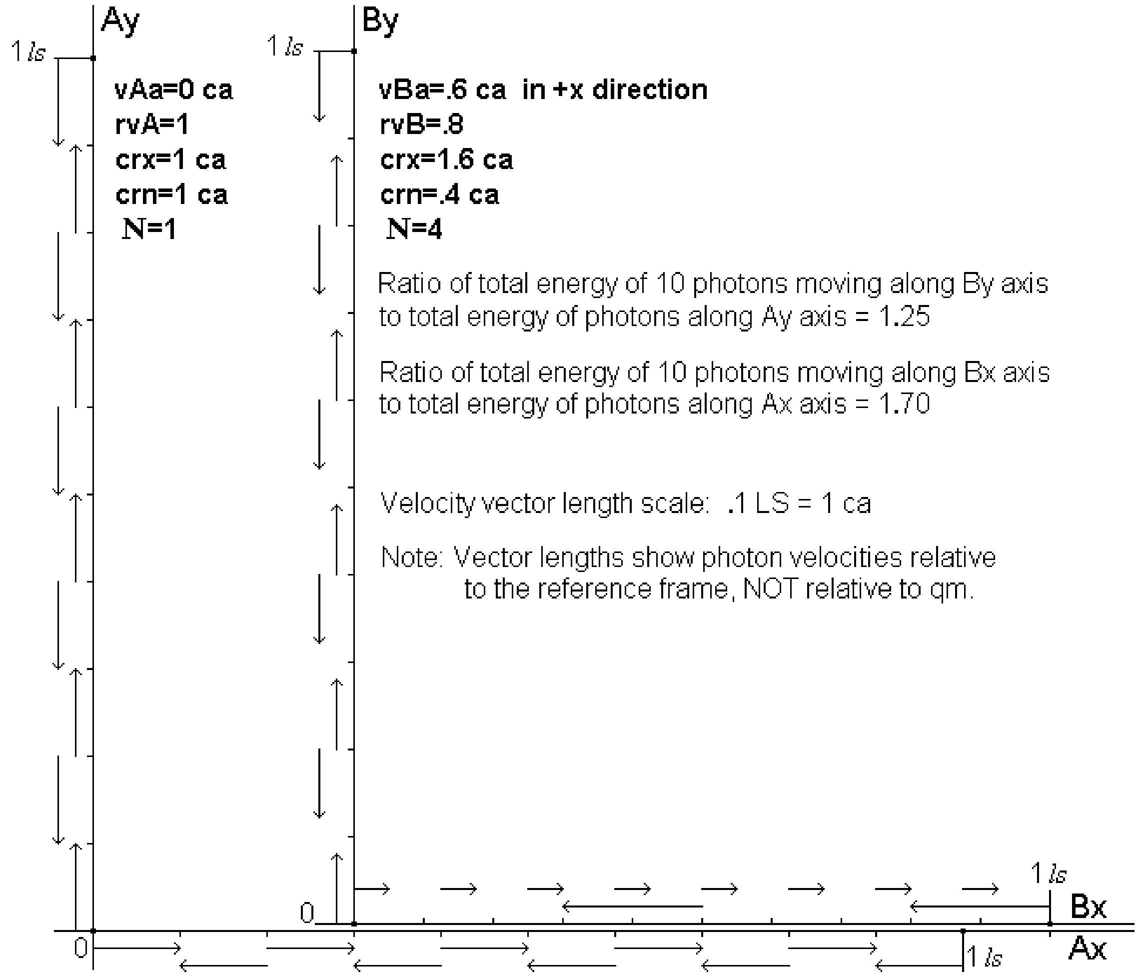


Figure 8. Photons transferring energy between origin and 1*ls* locations in A and B.

Each exchanger at the origin of frame A or B emits a photon every .2 s and each exchanger at a 1 *ls* location emits a photon whenever one is received from the origin. Therefore, at any time in frame A there are 5 photons moving toward Ax=1 *ls* and 5 photons moving toward Ax=0 *ls*, as shown in Fig. 8.

In frame A all the photons have a certain oscillation frequency f which is characteristic of the exchangers, similar to an atom emitting a photon having a frequency that is characteristic of the atom. According to orthodox theory, the energy of a photon depends only on this oscillation frequency f and Planck's constant h as follows.

$$\mathrm{e} = h \cdot f \tag{12}$$

We will let epA represent the energy of each photon moving along the x or y axis of frame A. Therefore, along each axis of frame A the total photon energy is 10 epA. We will now compare this energy with the total energy of the 10 photons moving along the Bx axis and the total energy along By.

The energy-exchange experiment in B appears to observers in B the same as the experiment in A appears to observers in A. However, the photon energies, velocities, and spacings are much different in B. Frame B has an absolute velocity of .6 ca and a physical change ratio of rvB=.8 via Eq. (4). Therefore, the emission frequency of the exchangers in B is only .8 times the frequency in A. Also, exchangers in B emit photons every .25 sa rather than every .2 sa as in A. Nevertheless, 10 photons are traveling between the origin of B and the 1 *ls* locations, just as in A, as Fig. 8 shows.

The 8 photons moving in the +x direction along the x axis of B have a combined energy of (8 · .8/.4) epA or 16 epA because there are 8 photons, each of which was emitted with a frequency of .8 times that in A but was blueshifted by a factor of 1/.4 due to the exchanger's velocity through the qm. The two photons moving in the −x direction of B have a total energy of (2 · .8/1.6) epA or 1 epA. Therefore, the ratio of the total energy of the photons moving along the x axis of B to the total energy of the photons moving along the x axis of A is (16+1)/10 or 1.7.

Figure 8 also shows photons traveling along the y axes of A and B. These photons were also emitted at .2 s intervals on the clocks in these frames. In B, the 10 photons traveling along the By axis must have a +x direction component of their 1 ca velocity through the qm equal to .6 ca. Therefore, the velocity of the photons along the By axis is .8 ca as shown. These photons must be moving through the qm at an angle of 53.13° to the Bx axis. The energy of these photons is affected by the lower emission frequency in B and by the Doppler shift at emission as follows.

$$\mathbf{epB} = \mathbf{epA}\,\frac{\mathbf{rvB}}{\mathbf{1} - (\mathbf{va} \cdot \mathbf{cos}\boldsymbol{\theta})} \qquad (13)$$

When Θ=53.13°, epB=1.25 epA. Therefore, the total energy of the 10 photons moving along the By axis is 1.25 times the energy of the 10 photons moving along the Ay axis.

Following this same procedure for comparing the total energy of the photons moving along the x and y axes in B to the energy in A, we could do the same along other lines that pass through the origin of the frame and are in the xy plane. We could determine the total internal wave/particle energy being exchanged within a body in B compared with its total internal energy when it is brought to rest in the qm. This is lengthy and will not be included here. It was found that a body's internal energy is just sufficient to account for its kinetic energy and its observed inertia if it is assumed that a body's observable mass is a consequence of its internal wave/particle energy. This assumption, that a body's mass is a consequence of its inernal energy, is consistent with Eq. (11).

In the quantum medium view, the basic unit of mass and energy is the **absolute kilogram** (**kga**), **1 kg of mass/energy at rest in the qm** (far from any massive systems). In the quantum medium view, a body's **kinetic energy (ke) is the energy that the body can supply in the process of being brought to rest in the qm**. A body moving through the qm has a mass (m) that is the sum of its at-rest mass (m_o) and its kinetic energy (ke) as follows.

$$\mathbf{m = m_o + ke} \qquad (14)$$

A body's mass m is also related to its at-rest mass and physical change ratio as follows.

$$\mathbf{m = \frac{m_o}{rv}} \qquad (15)$$

Equations (14) and (15) are consistent with orthodox theory and with experimental evidence.

<u>Inertia and asymmetry ratio N</u>

Figure 9 shows the patterns of wave/particle energy between photon exchangers <u>located 2 *ls* apart</u> on the x axes of four inertial frames moving in the +x direction with absolute velocities of 0 ca, .6 ca, .8 ca and .9 ca. Just as in Fig. 8, each exchanger emits a photon every .2 s according to the clocks in its frame. The photon patterns in the frames where va=0 ca and va=.6 ca are the same as in Fig. 8. Figure 9 shows that the asymmetry of the pattern of wave/particle energy increases as the absolute velocity of a frame increases. As the absolute velocity increases, more of the photons have higher energies and slower velocities through the frame. This results in greater overall energy and mass in the frame.

In any inertial frame, the **asymmetry ratio** (N) is a function of the absolute velocity of the frame as follows.

$$\mathrm{N} = \frac{\mathbf{1+va}}{\mathbf{1-va}} \qquad (16)$$

N is the ratio of the maximum and minimum speeds of light in the frame. It is the ratio of the quantity of photons moving in the direction of va to the quantity moving in the opposite direction. It is the ratio of the energy of a photon moving in the direction of va to the energy of a photon moving in the opposite direction. In general, N is an indication of the asymmetries in a body due to the body's absolute velocity.

Within *bodies* in the four reference frames of Fig. 9, the patterns of wave/particle energy being exchanged will be similarly asymmetrical along lines of absolute motion. When va=.9 ca, the asymmetry ratio is 19 as shown in Fig. 9 and as specified by Eq. (16). Nineteen times as many quanta of energy will be moving in the direction of va as are moving in the opposite direction. When va=.99 ca, the asymmetry ratio is 199 and when va=.999 ca, N=1999. Therefore, as the absolute velocity of a body approaches ca, the pattern of the body's internal energy becomes very

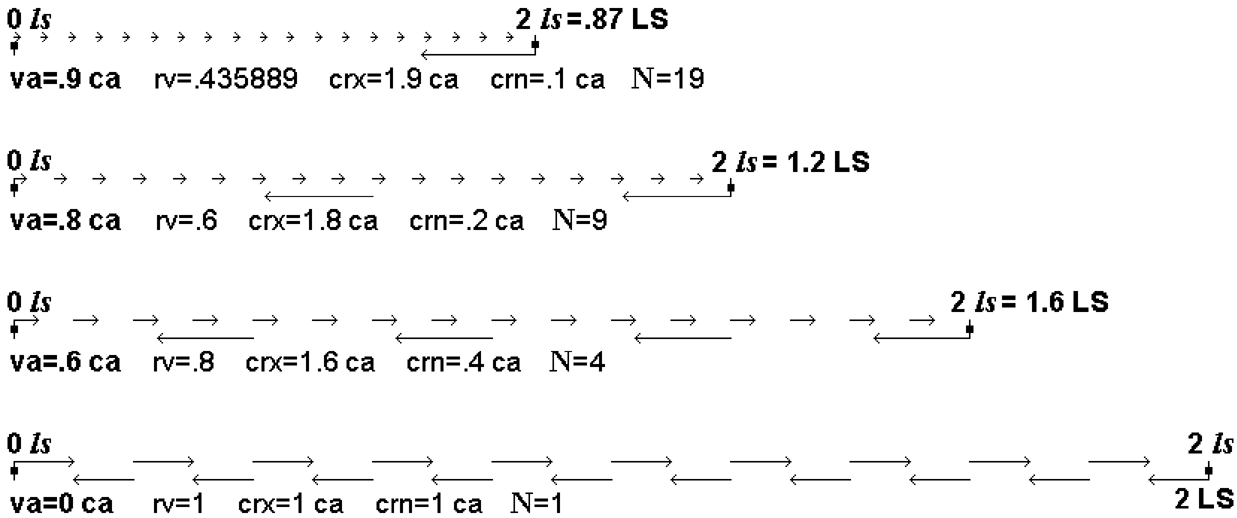


Figure 9. Twenty photons moving between two photon exchangers located 2 *ls* apart on the x axes of frames having velocities of 0 ca, .6 ca, .8 ca, and .9 ca in +x direction.

asymmetrical. Far more wave/particle quanta of energy are moving in the direction of the body's absolute motion than in the opposite direction, and these quanta have very high energies due to their Doppler blueshifts. Very little energy is moving in the opposite direction in the body or in the qm. Figure 9 and Eq. (15) indicate why a body cannot be accelerated to an absolute velocity of ca. The energy of the energy-carrying quanta moving in the direction of absolute motion would become infinite.

Figure 9 also indicates that a body's "inertia" is caused by the body's pattern of internal energy. Changing the pattern of internal energy in a body requires a force and work, regardless of the asymmetry of the pattern. The pattern of internal energy is analogous to a flywheel. Regardless of the speed of rotation or the direction of rotation of a flywheel, work is required to change the speed. Similarly, changing a body's velocity through the qm requires a force and work to change the pattern of internal energy of the body, whether the work makes the pattern more or less symmetrical or increases or decreases the internal energy of the body.

When we ride a bicycle on level ground it takes work to increase our speed because we must change the pattern of energy moving within our body. As our speed increases, the change in the pattern is very small but it takes considerable work due to the immense amount of energy in our body.

Newton's laws of motion

Physics textbooks now teach that Newton's laws of motion are not applicable for bodies moving at high speeds. It is true that Newton's second law of motion, expressed as $F=m\cdot a$, and the traditional equation for kinetic energy, $ke=m\cdot v^2/2$ do not reflect changes in the masses of bodies moving with high velocities. However with minor modifications these limitations of Newtonian mechanics can be removed.

When a body is moving with high absolute velocity (e.g. .99 ca, rv=.141) its internal energy is high relative to its at-rest energy, and a small change in the body's velocity results in a large change in the asymmetry and internal energy. As a result, more work is required for a given change in the body's velocity, and more force is required for a given acceleration. When a force (F) is accelerating a body, part of the force goes into changing the body's mass and part of the force goes into changing the body's velocity. The mass-changing force component (F_m) and the velocity-changing force component (F_v) depend on the body's absolute velocity va as follows.

$$\mathbf{F_m} = \mathbf{F} \cdot \mathbf{va^2} \tag{17}$$

$$\mathbf{F_v} = \mathbf{F} \cdot \left(\mathbf{1} - \mathbf{va^2}\right) \tag{18}$$

The body's acceleration a depends on the velocity-changing force component.

$$\mathbf{F_v} = \mathbf{m} \cdot a \tag{19}$$

Combining Eqs. (19), (18) and (4), Newton's second law of motion can be modified as follows to make it consistent with experimental results.

$$\mathbf{F} \cdot \mathbf{rv^2} = \mathbf{m} \cdot a \tag{20}$$

When a body is accelerated by a force F, the change in the body's kinetic energy ke is equal to the work done by the force during the change in the body's velocity. However, during the change in velocity, the body's mass changes as specified by Eqs. (4) and (15). As the body's mass changes, the force F on the body results in different accelerations of the body. Equations (20), (15), and (4) specify the body's acceleration in terms of the force and the body's mass and absolute velocity.

The work done by a force F which accelerates a body can be determined by dividing the acceleration process into small increments. For example, if a 1 kg mass is accelerated by a 1 newton force from va=0 to va=.6 ca (i.e. to va=$1.8 \cdot 10^8$ ma/sa), this process can be divided into 1 sa increments during which the force times the distance moved results in increments of work on the body. The sum of all the work increments equals the body's kinetic energy after acceleration, which is $2.25 \cdot 10^{16}$ joules or .25 kga. This is exactly the same ke as specified by Eqs. (14), (15), and (4).

The sum of the work increments is closely approximated by ke=$m \cdot v^2/2$ when va is small relative to ca. For example, accelerating a 1 kg mass from va=0 to va=$3 \cdot 10^6$ ma/sa (i.e. .01 ca, rv=0.99995) requires $4.50033 \cdot 10^{12}$ joules of work and the kinetic energy specified by ke=$m \cdot v^2/2$ is $4.50022 \cdot 10^{12}$ joules. The ratio of these energies is .999975. The ratio approaches .5 as the velocity va to which the 1 kg mass is accelerated approaches 1 ca. This is shown in the following alignment chart.

va (in units of ca)	.1	.6	.7	.8	.9	1
ratio $(m \cdot v^2/2) \div (m_o/rv)$	.9974	.9	.8570	.8	.7179	.5

Three hundred years ago there was no way for Newton to be aware of the relationship between a body's mass and its velocity. Surely Newton would want his laws of motion to agree with this relationship.

Acceleration and Gravity

Virtual force, mass, and acceleration

Figure 10 shows a 10 m x 10 m laboratory, which is located in a spaceship floating in deep space. The ship and lab have an absolute velocity of .6 ca in the +x direction. Observers(c) in the lab are verifying the validity of Newton's second law ($F=m \cdot a$) in their inertial frame. Their apparatus includes a bar B of negligible mass to which a force is applied at the center. Strings from the ends of the bar are attached to 1 kg masses, one string passing around a pulley P as shown. The "x mass" is accelerated along the lab's x wall and the "y mass" is accelerated along the y wall.

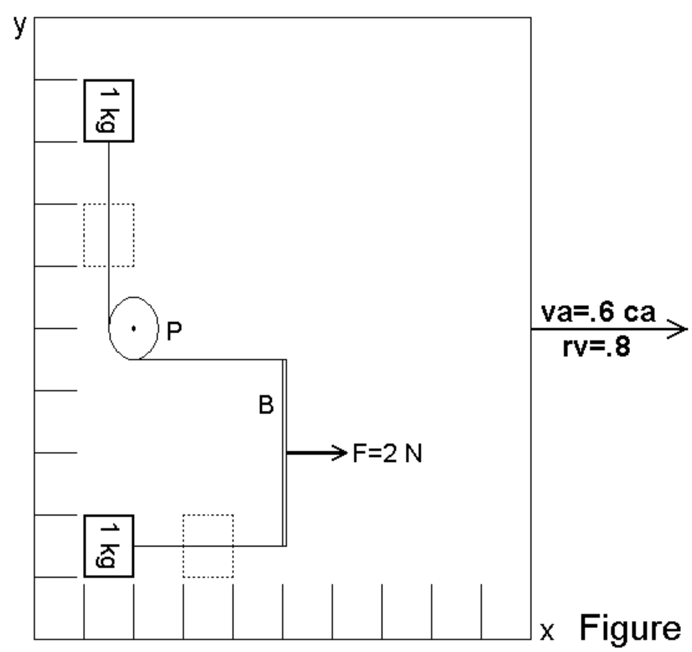


Figure 10.

To help explain the phenomena occurring in the lab, we need to introduce a unit of absolute force, the **absolute newton** (**Na**), **which is a 1 newton (N) force in an inertial frame at rest in the qm.** We will see that a virtual newton (N), like a virtual meter (m), is not a constant. It depends on its direction in its inertial frame.

The experiment starts when two stopwatches are started and a 2 newton force is applied to the bar. When the x mass has moved 2 m marks, one of the stopwatches is stopped, and when the y mass has moved 2 m marks the other stopwatch is stopped. Both stopwatches read 2 s, and the observers(c) conclude that Newton's second law of motion is valid in their lab. They observe correctly that each 1 kg mass is accelerated at 1 m/s^2 by a 1 N force, and that after 2 s each mass has a velocity of 2 m/s, and has moved 2 m at an average velocity of 1 m/s. F=m·a is observed to be valid in the lab because the units of force, mass, time, and distance in the lab are virtual units. The absolute phenomena responsible for the virtual phenomena are as follows.

Due to the .6 ca absolute velocity of the lab, the mass of each 1 kg mass is 1/rv or 1.25 kga according to Eqs. (4) and (15). The 2 N force on the bar is 2 Na and it causes a 1 Na force in the x direction on each string. The velocity-changing force component of the 1 Na force on the x mass is 1·rv^2 or .64 Na, and this force component results in an acceleration of (.64/1.25) or .512 ma/sa^2 according to Eq. (20). After 2.5 sa (2 s on the stopwatches) the x mass has a velocity of 1.28 ma/sa and has moved 1.6 ma (2 m marks) at an average velocity of .64 ma/sa.

The force of the string on the y mass is 1.25 Na because the pulley increases the force in the string by a factor of 1/rv, the ratio of the pulley's y-direction diameter to its x-direction diameter. In any inertial frame, 1 N along a line parallel to the frame's absolute velocity va is 1 Na, and 1 N along a line perpendicular to va is (1/rv) Na.

The velocity-changing force component of the 1.25 Na force on the y mass is rv^2·1.25 or .8 Na, and it results in an acceleration of (.8/1.25) or .64 ma/sa^2 according to Eq. (20). After 2.5 sa (2 s on the stopwatches) the y mass has a velocity of 1.6 ma/sa and has moved 2 ma (2 m marks) at an average velocity of .8 ma/sa. (Although the y mass moves 2 ma and the x mass moves only 1.6 ma, the bar does not tilt because the string moving around the pulley becomes shorter.) Therefore, the real phenomena occurring in Fig. 10 are not the virtual phenomena seen by observers(c) which seem to validate F=m·a in the lab's inertial frame.

This example shows how laws of physics can appear valid in all inertial frames if the observed, virtual phenomena are always consistent with the laws. Like F=m·a , the laws of electricity and magnetism and Maxwell's equations appear to correctly relate the virtual phenomena in all inertial frames even though, as in the above example, the virtual phenomena may be much different than the absolute phenomena responsible for the observations.

Gravity and physical change ratio rg

Newton's law of gravity specifies the **force of attraction** (**F**) between two bodies (e.g. between Earth and our body) in terms of **the masses of the two bodies** (**m$_1$**) and (**m$_2$**), the **distance** (ℓ) **between the centers of mass of the bodies**, and the **universal gravitation constant** (**G**) as follows.

$$\mathbf{F} = \frac{\mathbf{m_1 \cdot m_2 \cdot G}}{\ell^{\mathbf{2}}} \tag{21}$$

The cause of the apparent attractive force has been unclear and many have wondered why we feel pulled toward Earth. In the quantum medium view, the observed gravitational attraction between bodies is a consequence of the following premise.

> **Premise II:** Every large concentration of mass/energy (e.g. star) decreases the speed at which quanta of energy (e.g. photons) are propagated through the quantum medium in its vicinity.

Perhaps concentrations of mass/energy affect the electric permittivity and magnetic permeability of the qm, which would alter the speed of light. Or concentrations of mass/energy may emit a radiation into the qm which slows the speed of light through the medium, much as light is slowed by Earth's atmosphere, but to a much smaller degree. We will assume that massive bodies emit such photon-slowing radiation. Therefore, in the vicinity of a massive body **the speed at which quanta of energy are propagated through the qm (cag)** is less than ca.

The slowing of quanta of energy through the qm decreases the energy exchange rate in a reference frame or body, similar to the decrease in energy exchange rate cause by the velocity of a reference frame or body through the qm. As discussed previously, the ratio of a body's energy exchange rate when moving through the qm to its at-rest rate is equal to the body's physical change ratio, rv. Similarly, in a region of the qm affected by a concentration of mass/energy (e.g. Earth, sun), **the physical change ratio (rg) is the ratio of the energy exchange rate to the rate where the speed of light is ca**.

The physical change ratio rg for a location in the qm affected by a massive body is a function of the **mass** (**m**) of the massive body, the **distance** (ℓ) from the center of mass of the massive body, and the **gravitational constant** (**G**) as follows.

$$\mathbf{rg} = \frac{\ell}{\ell + (\mathbf{m} \cdot \mathbf{G})} \tag{22}$$

When distance ℓ is in LS units, G is $2.47 \cdot 10^{-36}$ $LS^3/kga \cdot sa^2$ (rather than $6.67 \cdot 10^{-11}$ $m^3/kg \cdot s^2$). Therefore, at Earth's surface, rg due to Earth's mass is approximately .999999999305 because Earth's mass is about $5.98 \cdot 10^{24}$ kga and Earth's radius is about .021266 LS.

When rg is close to 1 (as on Earth where rg due to the masses of Earth, sun and the rest of our galaxy is close to 1), rg is closely approximated by Eq. (23).

$$\mathbf{rg} \approx \mathbf{1} - \frac{\mathbf{m} \cdot \mathbf{G}}{\ell} \tag{23}$$

Even if Earth's mass were ten million times its present mass (and its volume unchanged), rg on Earth via Eq. (23) would be close to rg via Eq. (22)

(.99305 and .99310 respectively). Only in cases of exceptionally large masses combined with small distances (e.g. around a neutron star) does Eq. (23) not give good approximations of rg. Because Eq. (23) can yield rg<0, which is equivalent to qm environments where the speed of light and the rate of energy exchange are negative, it is not consistent with logic. Equation (22) does not predict the black holes and singularities that orthodox theory predicts. It predicts dark attractors that emit small amounts of weak radiation and cause gravitational lensing.

Gradients of rg and physical causes of gravity

Figure 11 shows a laboratory at rest in the qm one Earth radius away from a massive body of one Earth mass. The laboratory is 300 ma or 10^{-6} LS high as shown. The bottom of the lab is ℓ_1=.021266 LS from the massive body and the top of the lab is ℓ_2=(.021266 + 10^{-6}) LS from the massive body. Therefore, a gradient of rg exists in the lab.

Using Eq. (22) and the above values for ℓ_1, ℓ_2, m, and G, we find that rg at the bottom of the lab is $rg_{\ell 1}$=.9999999993054359 and rg at the top of the lab is $rg_{\ell 2}$=.9999999993054685. Throughout the lab, energy is exchanged between and within the atoms comprising the lab. Due to the gradient of rg between the bottom and top of the lab, the energy exchange in the lab is unbalanced. An atom at the bottom of the lab emits photons having a lower frequency and energy than the photons it would emit were it at the top of the lab.

This energy exchange imbalance throughout the lab along lines to the massive body will be represented by the imbalance in the energy exchanged between an atom at the bottom of the lab and an atom of the same element at the top of the lab. The energy of a photon emitted by an atom is a function of the emission frequency and Planck's constant as specified by Eq. (12). The emission frequencies of the photons emitted at the bottom and top of the lab in Fig. 11 are reduced in proportion to the physical change ratios, $rg_{\ell 1}$ and $rg_{\ell 2}$ because all processes are slowed in proportion to rg. Therefore, the **energy exchange imbalance (*deg*) caused by the gradient of rg** between the bottom and top of the lab is as follows.

$$deg = h \cdot f \cdot \left(\mathbf{rg}_{\ell \mathbf{2}} - \mathbf{rg}_{\ell \mathbf{1}}\right) \qquad (24)$$

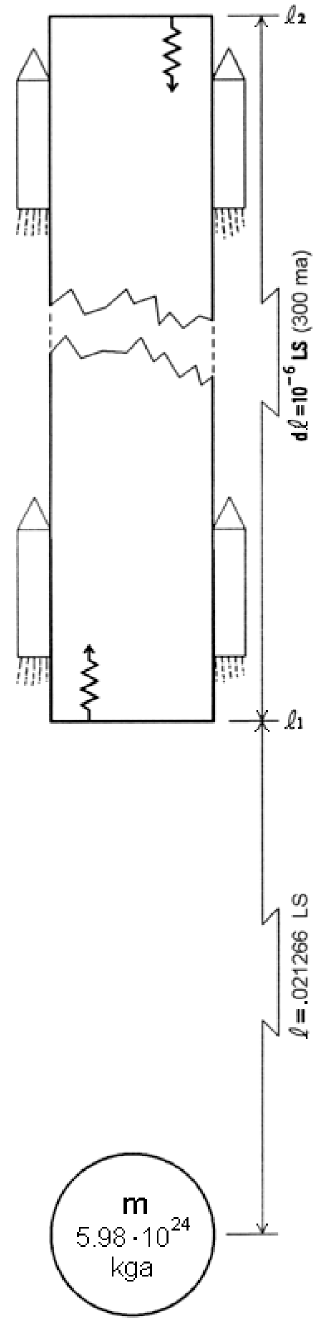


Figure 11. Lab with zero acceleration at rest in qm with gradient of photon-slowing radiation from m.

Entering the above values for rgℓ_1 and rgℓ_2 into Eq. (24), the energy exchange imbalance between the bottom and top of the lab is *deg* $= h \cdot f \cdot 3.26 \cdot 10^{-14}$ joules. The energy exchange imbalance throughout the lab results in a net force toward the massive body because the lab's atoms absorb more energy moving downward than moving upward.

As shown in Fig. 11, rocket engines exert a force on the lab which keeps the lab from accelerating toward the massive body. Without this force, the lab will have an acceleration of 9.8 ma/sa^2 or $3.26 \cdot 10^{-8}$ ca/sa toward the massive body. This is the acceleration a of a body falling to Earth, and it is specified by Eqs. (20) and (21), Newton's second law of motion and law of gravity. If we let m_1 be the body's mass, m_2 be Earth's mass, and rv=1, then $a = F/m_1$ from Eq. (20), and $F/m_1 = m_2 \cdot G/\ell^2$ from Eq. (21). Therefore, $a = m_2 \cdot G/\ell^2$ or $a = (5.98 \cdot 10^{24} \cdot 2.47 \cdot 10^{-36}/.021266^2)$ or $a = 3.26 \cdot 10^{-8}$ ca/sa.

A cause of gravity has been described where the apparent attraction of a body by Earth is the result of an imbalance in the exchange of quanta of energy within the body caused by a gradient in rg around Earth. A "gravitational force" per se is unnecessary, and the number of fundamental forces needed to describe nature is reduced to three. Many have wondered why the force of gravity is so weak compared with the other forces in nature and why the gravitational force is one of attraction only, as opposed to both the attractive and repulsive forces of electricity and magnetism. These are among many perplexing questions which the quantum medium view can answer.

Acceleration and faux gravity

Figure 12 shows a laboratory at rest in the qm far from any massive body. The lab is 300 ma or 10^{-6} LS long. At time ta=0 sa rockets on the lab begin exerting an upward force on the lab which causes an upward acceleration, a. At time ta=0 sa, when the absolute velocity of the lab is zero, an atom at the bottom of the lab emits a photon toward the top of the lab. The photon's velocity relative to the lab is 1 ca because the lab is at rest in the qm.

By the time the photon has traveled to where the top of the lab was at ta=0 sa, its velocity relative to the lab is equal to $(1 - a \cdot 10^{-6})$ ca. At this time, ta=10^{-6} sa, the top of the lab has moved upward a distance of $(a \cdot 10^{-12}/2)$ LS and the photon must travel another $(a \cdot 10^{-12}/2)$ sa to reach this location. By the time the photon reaches the top of the lab, its velocity relative to the lab is very nearly equal to $(1 - a \cdot 10^{-6} - a^2 \cdot 10^{-12}/2)$ ca and the photon has been redshifted relative to the lab.

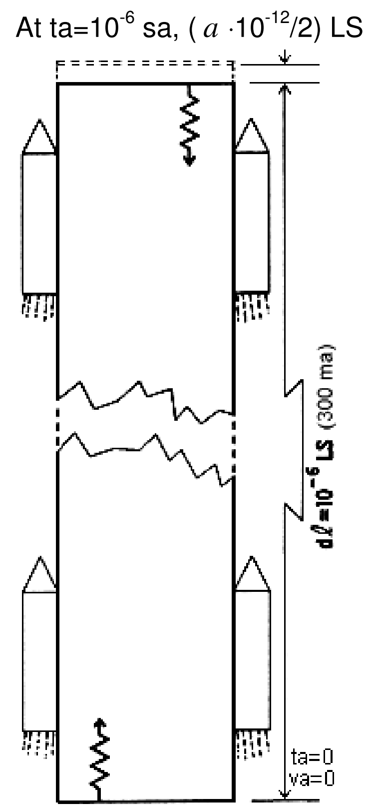


Figure 12. Lab at rest in qm (where rg=0) and accelerating at ta=0 sa.

Due to this Doppler redshift, when the photon is absorbed at the top of the lab, the energy that it transfers to the absorbing atom is less than the energy emitted by the atom at the bottom of the lab. Similarly, a photon emitted at the top of the lab is blueshifted relative to the lab by the time it reaches the bottom. These redshifts and blueshifts occur even if the velocity of the lab is not zero at time ta=0 and even if there is atomic motion of the emitting and absorbing atoms. The energy exchange imbalance, as photons transfer energy between the bottom and top of the lab, is a function of the magnitude of the red and blueshift. This **energy exchange imbalance** dea **caused by acceleration**, is a function of the acceleration a, the distance $d\ell$ between the bottom and top of the lab, the oscillation frequency of the photons f, and Planck's constant h as follows.

$$dea = h \cdot f \cdot \left(a \cdot d\ell + \frac{a^2 \cdot d\ell^2}{2} + ... \right) \quad (25)$$

If we let the acceleration a in Eq. (25) be the acceleration of the lab of Fig. 11 if the rockets are shut down ($3.26 \cdot 10^{-8}$ ca/sa) and $d\ell$ is 10^{-6} LS, then $dea = h \cdot f \cdot 3.26 \cdot 10^{-14}$ joules. This is the same energy exchange imbalance as occurs in Fig. 11 where $deg = h \cdot f \cdot 3.26 \cdot 10^{-14}$ joules according to Eq. (24) due to the gradient of rg in the laboratory. Because *deg*, the energy exchange imbalance in Fig. 11, is equal to dea, the energy exchange imbalance in Fig. 12, the force of the rockets on the lab in Fig. 11 must equal the rocket force on the lab in Fig. 12. Inside the labs the effect of the acceleration in Fig. 12 is the same as the effect of "gravity" in Fig. 11, which makes it appear to observers(c) that the phenomena are equivalent.

If the rockets in Fig. 11 are shut down, the energy exchange imbalance inside the lab due to the gradient of rg causes an acceleration of the lab sufficient to balance the energy exchange via Doppler shifts of the lab's wave/particle energy. According to the quantum medium view, an apple hanging on a tree has an internal energy exchange imbalance due to the gradient of rg caused by Earth's mass, and if Newton observed an apple falling to Earth, he was observing the balancing of the apple's internal energy exchange via the apple's acceleration.

Newton's bucket

Figure 13 shows an experiment, conducted by Newton, which involves somewhat mysterious results. Figure 13a is a cross section view of a bucket which contains water and is suspended by a cord so it is free to rotate around its centerline. To prepare for the experiment the bucket has been turned many revolutions around the centerline so the cord is twisted and exerts a torque on the bucket. The surface of the water is flat in Fig. 13a when the bucket is held motionless relative to Earth.

When the bucket is set in motion around its centerline so that the twisted cord contributes to this motion, the water gradually recedes from the middle of the bucket and rises up at the sides of the bucket creating a concave surface as shown in Fig. 13b. Why does this occur? This question was debated in the 1700's by G. Leibniz, L. Euler, I. Kant, and others. In the 1880's Ernst Mach wrote as follows.

> Newton's experiment with the rotating vessel of water simply informs us that the relative rotation of the water with respect to the sides of the vessel produces no noticeable centrifugal forces, but that such forces *are* produced by its relative motion with respect to the mass of the Earth and the other celestial bodies.

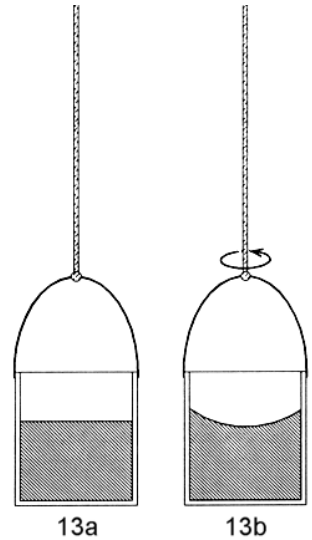


Figure 13.

In the quantum medium view, the concave surface of the water is the result of the acceleration of the water *in the quantum medium*, and it does not depend on the mass of "other celestial bodies." As described in connection with Fig. 12, the acceleration of a laboratory creates an imbalance in the energy exchanged between and within atoms. The acceleration results in an asymmetry of the Doppler shifting of the wave/particle carriers of energy in the lab. Atoms and their constituents are absorbing more energy coming from the direction of acceleration and less energy coming from the opposite direction. The result is a net force on the atoms in the direction opposite to the direction of acceleration.

Similarly, in Fig. 13b the atoms comprising the water have an acceleration toward the centerline of the bucket (regardless of the centerline's constant velocity through the qm), and this acceleration results in net forces on the atoms away from the centerline. The acceleration of the water is maximum at the walls of the bucket and zero at the centerline, resulting in a corresponding gradient of the acceleration forces on the atoms. It is logical that these forces should cause the water to move away from the centerline and create a concave surface so that the forces are offset by equal and opposite forces due to the gradient of water pressure due to the gradient of water depth.

Measurable Effects of rg Gradients

<u>Effects of rg gradients on the propagation of light</u>

In accordance with Premise II, light is slowed in the vicinity of a massive body, the speed of light being slower closer to the body. At any location in the qm, the speed of light cag is a function of rg as follows.

$$\mathbf{cag} = \mathbf{rg}^2 \tag{26}$$

The gradient of rg around a massive body is like a transparent sphere having an index of refraction that decreases with the distance from the massive body. On a galactic scale, the mass of our galaxy creates a gradient of rg in the qm, and on smaller scales the sun and Earth create spherically shaped gradients of rg in the qm according to Eq. (22). Although the masses of our galaxy and sun each have much more influence on rg at the surface of Earth than does Earth's mass, Earth's mass creates a much greater *gradient* of rg at Earth's surface, which is why we feel pulled toward the center of Earth rather than toward the sun or the center of our galaxy.

The gradients of rg around massive bodies cause the paths of light to bend, much as the path of a photon is caused to bend when it passes from air to water or through other materials where the index of refraction changes. Equation (27) in conjunction with Figure 14 specifies this bending.

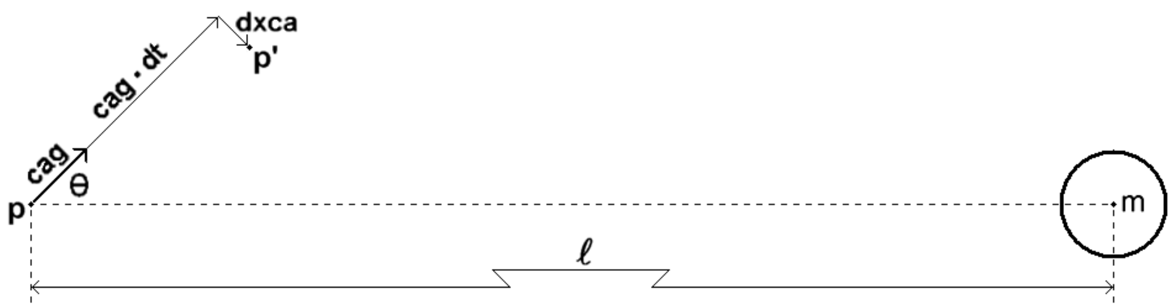


Figure 14. Incremental motion of photon p in gradient of rg due to mass m.

$$\mathbf{dxca} = \mathbf{dt}^2 \cdot \frac{\mathbf{1 - cag}}{\ell} \cdot \mathbf{sin\theta} \tag{27}$$

For example, during a **small time increment** (**dt**) sa, a photon p, which is a **distance** (ℓ) LS from a massive body of m kga, has a **velocity** (**cag**) specified by Eqs. (22) and (26). The photon moves a distance of (cag·dt) LS with an initial trajectory at an **angle** (**θ**) to a line to the massive body, as shown in Fig. 14. The photon also has a **component of motion** (**dxca**) specified by Eq. (27) at right angles to its initial trajectory and toward the massive body, as shown. These two components of motion specify the photon's location p' at the end of the time increment. A line from p through p' specifies the initial trajectory angle for the next time increment. Using this step-and-repeat process, a photon's motion through a gradient of rg in the qm can be computed.

Simple equations (22), (26), and (27) are consistent with experimental evidence that has been cited to support general relativity theory. We will compare consequences of these equations with the experimental evidence.

Slowing and bending of light through an rg gradient

In the mid-1960s, Irwin Shapiro and colleagues at MIT's Lincoln Laboratory measured the times for radar signals to travel to Venus and back to Earth. The round-trip travel time for the signals was about 1000 seconds when Venus was on the far side of the sun from Earth. Shapiro determined that the closer a signal's path was to the sun, the greater the slowing of the signals. When a round-trip signal passed within about 10 LS of the sun's center, the signal was delayed by about **170** microseconds and when a signal passed within about 120 LS of the sun, it was delayed about **80** microseconds. The time delays specified by Eqs. (22), (26), and (27) are **182** and **84** microseconds, in general agreement with experimental results.

The bending of the paths of photons due to the sun's mass has also been determined by observing stars and quasars which are seen to pass behind the sun as Earth orbits the sun. The first of these observations was made in 1919 by Arthur Eddington. The observed bending when a photon's path just grazes the sun's surface is **1.75** arcseconds, and the observed bending when the path comes within 78 LS of the sun's center is **.05** arcseconds. The bendings specified by Eqs. (22), (26), and (27) are **1.746** arcseconds and **.051** arcseconds.

Measured effect of rg on the energies at which photons are emitted

It was stated that photons emitted at the bottom of the laboratory in Fig. 11 have a lower frequency and energy than the photons emitted at the top of the lab. This is consistent with an experiment conducted at Harvard University in 1960 by R. Pound and G. Rebka, Jr. in which photons (gamma rays) were emitted at the bottom and at the top of a 22.57 m high apparatus. Photons emitted at the top were absorbed at the bottom and vice versa. The experiment showed that photons which had been emitted at the top had a higher frequency upon reaching the bottom than the photons which were emitted at the bottom. And photons which were emitted at the bottom had a lower frequency upon reaching the top than the photons emitted at the top.

These results are an important part of the experimental evidence supporting general relativity theory which attributes the difference in the frequencies between the top and bottom to a "gravitational redshift" of the photons traveling from bottom to top and "gravitational blueshift" of photons traveling from top to bottom.

In the quantum medium view, the frequencies of the photons do not change as they travel between the top and bottom of the apparatus. The photons emitted at the top have a higher frequency than the photons emitted at the bottom. The difference in emission frequencies of the photons is due to the differences in rg and energy exchange rate between the top and bottom. According to Eq. (22), a 22.57 ma change in elevation at the surface of Earth is equivalent to a change in rg of $2.45 \cdot 10^{-15}$. This agrees with the Pound-Rebka experiment where the measured differences between frequencies at the top and bottom of the apparatus were 2.5 parts in 10^{15}.

Photons moving up or down in the lab of Fig. 11 or in the lab at Harvard have small changes in velocity due to the small changes in rg in the qm. A change in cag does not change a photon's frequency and energy because the change in cag is due to a change in wavelength. A photon moving along a path of increasing rg in the qm has an increase in wavelength, but its frequency is constant at every point on the path. For example, imagine a photon as a wave ~ of length λ LS being propagated with velocity cag=.25 ca along a path where rg suddenly changes from .5 to 1. During the (λ/.25) sa it takes for the photon to pass the point of change in rg the front of the wave has a velocity of 1 ca while the rear of the wave has a velocity of .25 ca. This increases the length of the wave by a factor of 4, but the frequency (cag/λ) is not changed.

Effect of rg on clocks and bodies

Figure 15 shows a reference frame at rest in the qm. A huge mass of about $5 \cdot 10^{37}$ kga is located 500 LS from the origin in the −y direction. According to Eqs. (22) and (26), rg and cag in Fig. 15 are .8 and .64 ca. A round-trip light signal from the origin to the 1 LS location on the x axis takes (2/cag) sa or ($2/rg^2$) sa, similar to frame B in Fig. 3 where a round-trip light signal to the 1 LS (not 1 *ls*) location on the x axis takes ($2/rv^2$) sa. As in frame B in Fig. 3, the energy exchange rate in any body in the frame of Fig. 15 is proportional to the physical change ratio. All processes and clocks are slowed in proportion to rg. This is consistent with experimental evidence. An atomic clock at a 1500 m elevation on Earth runs .000005 s per year faster than a clock near sea level, reflecting the difference in rg.

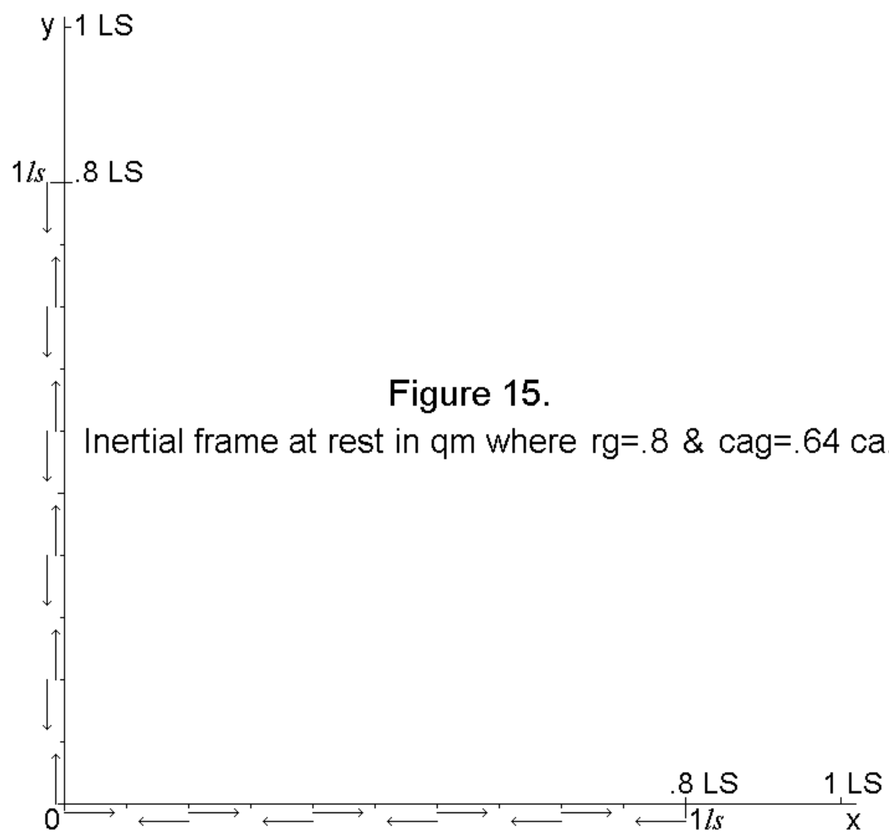


Figure 15.

Inertial frame at rest in qm where rg=.8 & cag=.64 ca.

The 1 *ls* locations in Fig. 15 are rg LS away from the origin of the frame because photons travel along the axes with a velocity rg^2 times ca and 1 s on a clock used to determine a 1 *ls* length is (1/rg) sa. Therefore, a 1 *ls* distance in the frame, or the length of a body in the frame, is only rg as large as it would be in a qm location where rg=1.

Previously we considered the effect of ***rv*** on the energies of photons moving between the origin and the 1 *ls* locations on the x and y axes of frames A and B in Fig. 8. We do the same for ***rg*** in Fig. 15 where photons are emitted every (.2/rg) sa rather than every .2 sa as in frame A of Fig. 8. These photons, traveling at rg^2 ca, take (1/rg) sa to reach their destination rg LS away. Consequently, the same number of photons are traveling along the axes of the reference frame in Fig. 15 as in frame A of Fig. 8 where rg=1. However, in Fig. 15 the photons have only rg times the rg=1 frequency and energy. Therefore, the energy (or equivalent mass) of a body in the frame of Fig. 15 is only rg as much as when the body is at rest in the qm where rg=1. Whereas a body's mass is inversely proportional to rv, it is proportional to rg. This indicates that huge concentrations of mass/energy also possess potential mass/energy that is released when the mass/energy becomes less concentrated (e.g. as our universe expands).

Summary and Conclusions

Ability to explain phenomena

The preceding pages show how the quantum medium view explains physical causes for a variety of perplexing phenomena. It answers the following questions for which answers have been elusive.

- What is causing the observed constant speed of light in every inertial frame?
- If the speed of light is constant in every frame, what can be causing the Doppler shift of a star's light when Earth's velocity changes toward or away from the star?
- What causes the observed change in the shape of a body when the observer's velocity is increased or decreased relative to the body?
- What causes a clock that makes a round trip to age less than a clock that does not make the trip?
- What causes the observed increase in the mass of a body when the body is accelerated to a high velocity relative to the observer?
- What causes a body to resist having its velocity changed (i.e. inertia)?
- What is the source of the huge energy contained in a body's mass?
- What causes the gravitational attraction between bodies?

The quantum medium permits clear, unambiguous answers for all these questions. The answers are found in the consequences of the two premises and the related equations, which specify characteristics of the medium. The primary consequences include the variable speed of light and the decrease in the rate of round-trip energy exchange in reference frames moving through the medium. These primary consequences of the medium result in secondary consequences including the asynchronization of clocks and the slowing of all processes in reference frames moving through the medium. The end result is different standards of time, distance, and mass in different reference frames, which leads to various perplexing observed phenomena and the above questions.

In addition to permitting plausible answers to these questions, the medium is a logical means for the propagation of light and for the variety of particles of mass/energy, as Maxwell and Dirac have shown. Further, the medium is consistent with evidence of a quantum vacuum and with the observed dipole pattern in the cosmic microwave background radiation. It is consistent with the null results of Michelson-Morley experiments, contrary to what students are now taught.

Principles for the advancement of science

If the goal of science is to understand nature, then the advancement of science can be defined as progress toward a better understanding of nature. The preceding pages suggest that the quantum medium view is a better understanding of nature. The likelihood of this view, or any other theory, being a good representation of nature is indicated by judging it according to logical criteria that helped advance science in the past.

Certainly a theory must agree with the related experimental evidence. The quantum medium view appears to agree with the evidence. It is in exact agreement with special relativity, which has been shown to be in agreement with a large body of experimental evidence. And it is in close agreement with evidence supporting general relativity. A theory must also rest on plausible assumptions, be self-consistent, and should not predict the impossible. The quantum medium view appears to meet these criteria.

It can be argued that nature can be described accurately without a light-propagating medium and that a simpler description of nature is better than one that is more complex. Perhaps the simplicity argument was used against the Copernican model, which required a concept more complex than the simple idea of all heavenly bodies moving around Earth. The simple geocentric idea ultimately resulted in a very complex theory. Similarly, the simple law of the constancy of the speed of light resulted in the complex theory of relativity and the need to combine space and time. The light-propagating medium, which the quantum medium view requires, may have already been shown to exist in the form of the quantum vacuum. Certainly the fact that the medium permits logical explanations for a wide variety of phenomena is reason for assuming its existence (much as it was reasonable to assume the existence of a physical means for passing characteristics from parents to children prior to the discovery of DNA).

If the goal of science is to understand nature, one would think that an essential criterion for judging scientific theories would be the ability to explain physical causes for phenomena. The Copernican model is better than the geocentric model because it identifies the physical causes for the observed motions of heavenly bodies, as opposed to Ptolemy's mathematical model which was consistent with observations but did not solve the mysteries of what causes the observations. The quantum medium view solves a variety of mysteries and it has significant implications for the advancement of science, *if* it is correct.

Therefore, one would think that those interested in the advancement of science would want to determine with greater certainty, whether or not it is correct. This is not necessarily the case. The advancement of science means different things to different scientists. To some it means the promotion and expansion of existing scientific knowledge as opposed to questioning and improving this knowledge. Many are certain that orthodox theory is correct and they are not interested in contrary thinking. A reviewer once rejected the quantum medium view on the basis that it is "contrary to 100 years of accepted physics." So far, it has not been found to be contrary to experimental evidence or logic.

Those who recognize how our civilization improved as our understanding of nature improved, must wonder that so many organizations teach ideas that are inconsistent with evidence discovered in recent decades and centuries. A great strength of good science is its ability to self-correct flawed ideas and thinking by constant questioning and self-examination. But when scientists become certain of their knowledge then science becomes more like an institution based on faith or desires, and the advancement of science is impeded.

Ultimately, the nature of science depends on the principles on which it is based and the criteria used to judge theories. People can make science what they want by selecting the principles and criteria they want. Judging Ptolemy's theory on its agreement with observations resulted in its success for over 1000 years. Similarly, the theory of relativity is sound according to this criterion, but its inability to explain physical causes for the observations indicates it is a misleading model of nature, as the preceding pages show.

Glossary of Terms and Symbols

absolute: as indicated by or determined by clocks, measuring rods, and observers in an inertial frame at rest in the qm or as determined by observers who allow for consequences of the qm.

at-rest: when a body or system is not moving through the qm.

[ ]: brackets specifying an event, as explained on page 18.

c: speed of light defined in accordance with orthodox theory, a constant approximately 300,000,000 m/s in all inertial frames.

ca: absolute speed of light through the qm devoid of impeding matter (e.g. air, water, glass) or nearby massive systems (e.g. stars, galaxies). This speed is a constant of nature.

cr: relative velocity of light. (This velocity of light, cr, *relative to a reference frame* moving through the qm is different in different directions.)

crn and **crx**: minimum and maximum speeds of light respectively in an inertial reference frame moving through the qm.

inertial reference frame (a.k.a. inertial frame, frame): An x, y, z, coordinate system which has a constant velocity and in which a body at rest remains at rest even when free to move in any direction.

kga: absolute kilogram. A 1 kg mass at rest in the qm where rg=1.

LS: absolute light second. Distance traveled by light moving with velocity ca for 1 sa. The standard unit of distance in the quantum medium view.

ls: virtual light second. Distance between two points in an inertial frame where a round-trip light signal between the two points takes 2 s according to clocks in the reference frame.

light postulate: The assumption that a photon moving through a remote region of the cosmos has the same speed relative to all bodies and all inertial frames regardless of their velocities.

m: meter. Length of a standard meter rod (which varies depending on its absolute velocity and its orientation relative to this velocity).

ma: absolute meter. (1 LS/300,000,000) or the length of a standard meter rod at rest in the qm where rg=1.

N: asymmetry ratio for a body or reference frame. (N=crx/crn)

Na: absolute newton. A 1 N force in an inertial frame at rest in qm.

observer(c): observer who assumes the speed of light is constant (in vacuum) in all inertial frames.

observer(cr): observer who assumes the speed of light is not constant in inertial frames moving through the qm.

orthodox physics theory: modern physics theory which includes the light postulate and conclusions of relativity theory.

qm: quantum medium. The medium through which light and other quanta of energy are propagated.

relativity theory: The special theory of relativity pertaining to phenomena in inertial reference frames and the general theory which includes phenomena involving accelerations and gravity.

rBC: virtual physical change ratio between frames B and C, equivalent to the gamma γ used in the transformation equations of special relativity.

rg: physical change ratio for a system due to the photon-slowing effects of large concentrations of mass/energy in the system's environment.

rv: physical change ratio for a system due to its velocity through the qm. Ratio of rate of round-trip energy exchange in system to the at-rest rate.

s: second. One second according to an atomic clock or other precise clock.

sa: absolute second. One second according to an atomic clock at rest in the qm where rg=1.

va: absolute velocity. Velocity of a body or reference frame through the qm.

vBa (or vCa, etc.): absolute velocity of frame B or body B.

vBC: virtual velocity of frame B relative to frame C.

vBCa: absolute velocity of frame B relative frame C.

virtual: not absolute due to distorted units of time, distance, and/or mass in the observer's reference frame, or due to other causes.

Appendix

Appendix I: About light (basic information)

Light is comprised of photons, which are quanta of electromagnetic energy having both wave-like and particle-like properties. The energy of a photon is directly proportional to the frequency of oscillation of the photon's electromagnetic field. Photons with low oscillation frequency have relatively low energy and vice versa. A photon's energy e is related to its oscillation frequency f by Planck's constant h as follows.

$$e = h \cdot f$$

Therefore, very high frequency photons such as gamma ray photons and X-ray photons have very high energies. Low frequency photons such as radio wave photons have relatively low energies.

The measured speed of light c in a vacuum is very close to 300,000,000 meters per second. The wavelength of light λ is equal to the speed of light c divided by the frequency f of the light ($\lambda = c/f$). Therefore, light with a frequency of 300,000,000 oscillations per second has a wavelength of 1 meter. The wavelengths of common electromagnetic radiation range from AM radio waves which are longer than a kilometer to gamma rays which are shorter than a billionth of a meter.

Visible light has a wavelength less than a millionth of a meter. In fact, the only electromagnetic radiation we can see is in the range of 400 billionths of a meter (violet light) to 700 billionths of a meter (red light). All other wavelengths have to be detected in other ways. For example we get sunburned from ultraviolet radiation and feel heat from infrared radiation. We use radios, TVs, garage door openers, and many other devices that can create and detect a wide variety of invisible electromagnetic radiation.

Atoms absorb and emit photons, and in doing so they change energy states. Atoms of different elements absorb and emit different photon energies and thus absorb and emit radiation having different frequencies, wavelengths and colors. Therefore, when different elements are heated and vaporize, they differ in their spectrums of emitted and absorbed radiation.

By analyzing the light coming from a star, it is possible to tell what kinds of atoms are present in the star. It is also possible to determine the relative motion between Earth and the star by comparing the observed frequency of the radiation of the star's elements with the known frequencies for the elements. (This is similar to an observer on a train determining his motion relative to a railroad-crossing bell by comparing the observed sound of the bell when the observer is aboard the train with the known sound of the bell when an observer is at rest next to the bell.)

Appendix II: Twins paradox of special relativity

It has been claimed by some that the Twins Paradox is not a problem for special relativity because it requires accelerating the traveling clock and thus removes it from the scope of special relativity which applies to bodies in constant velocity motion. Some even claim that it is the accelerations that are responsible for the slowing of the traveling clock. While it is true that accelerations can decrease the rates of physical processes, the accelerations involved in the Twins Paradox are not the cause of the slowing of the traveling clock predicted by special relativity.

Let us assume that a traveling clock rapidly accelerates to velocity v relative to a stay-at-home clock and then travels for a time before it rapidly accelerates in the opposite direction and returns home with an equal and opposite relative velocity. If the accelerations were responsible for the slowing, then the slowing would be independent of the travel time or distance traveled. This is not what special relativity says. It predicts that doubling the traveling time and distance traveled will double the amount that the traveling clock lags the stay-at-home clock after the round trip.

We can eliminate the confusion due to the accelerations by imagining a clock relay experiment as shown in Figure A. No accelerations are involved in this experiment. The figure shows the situation at the halfway point of the experiment. It shows how the experiment will appear to observers in the frames of the three clocks involved. We will first consider what is observed in frame B, the frame of the stay-at-home clock (center diagram). The stay-at-home clock is located at the origin of frame B and is represented by a black square. Only the x axis of B is shown. The two legs of a round trip to the Bx=60 *ls* location are made by two clocks, clock C1 and clock C2, which are also represented by black squares. Distance marks are shown every 10 *ls* along the x axes. Clock C1 is located at Cx=0 on inertial frame C1 which has a constant velocity vC1B=+.6 c along the x axis of frame B, as shown. When clock C1 was next to clock Bx=0, both clocks read 0 s, and when clock C1 is next to clock Bx=60, as shown in Fig. A, it reads 80 s and clock Bx=60 reads 100 s. The time observed in B required for clock C1 to travel from the origin of B to the 60 *ls* location is 100 s because the velocity of C1 along B is vC1B=+.6 c. The time for the first leg of the trip according to clock C1 is 80 s. Therefore, all observers in B observe clock C1 advance only .8 times as much as the clocks on B.

As clock C1 passes clock Bx=60 reading 100 s, clock C2 is also momentarily at this location and the observer traveling with clock C2 sets her clock to read 80 s, as displayed by clock C1 and as shown in Fig. A. Clock C2 travels on toward Bx=0 with a velocity vC2B=−.6 c, and it passes clock Bx=0 reading 200 s when clock C2 reads 160 s. Therefore, in accordance with special relativity, all observers on B will see that the time for the round trip relay is 200 s according to clocks in B and 160 s according to the traveling clocks. But observers traveling with the clocks will disagree, as shown in the top and bottom diagrams of Fig. A.

The observer traveling with clock C1 will observe that clock Bx=0 runs slower than clock C1 and that when clock C1 reads 80 s clock Bx=0 reads 64 s (bottom diagram). Therefore, according to the observers on frame C1 the clocks on B advanced only 64 s during the first leg of the trip.

Similarly, the observers on frame C2 observe that clock Bx=0 runs slower than clock C2 and that when clock C2 reads 80 s clock Bx=0 reads 136 s (top diagram). Therefore, when clock C2 arrives at clock Bx=0 reading 200 s, the observers on frame C2 conclude that clock Bx=0 advanced only (200−136) or 64 s during the second leg of the trip.

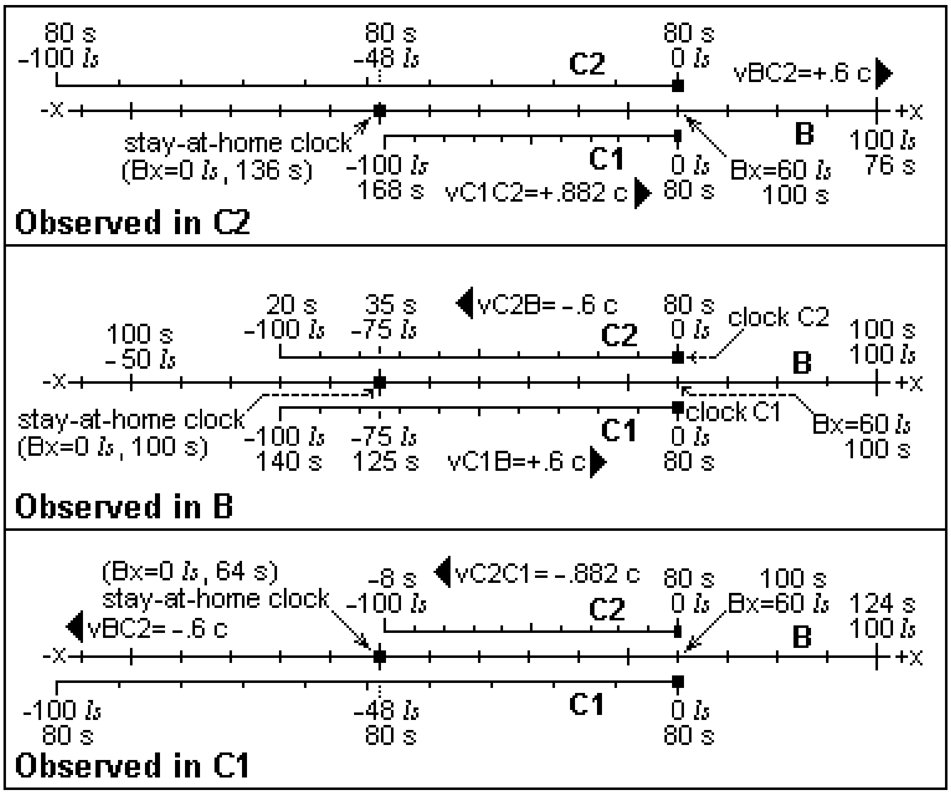


Figure A. Meeting of clocks C1 & C2 as observed in frame B (middle), frame C1 (bottom), frame C2 (top).

Therefore, according to every observer on frames C1 and C2, the stay-at-home clock at Bx=0 was running slower than his or her clock during the leg of the trip in which their clock was involved. But during the other leg of the trip, in which their clock was not involved, they observed that the stay-at-home clock was running faster than the traveling clock and that this resulted in the total time for the round trip according to the stay-at-home clock being more than the total time according to the traveling clocks.

The quantum medium view shows that the Twins Paradox is the result of asynchronized clocks, different standards of time and distance in different inertial frames and the observers' belief that the speed of light is constant in all inertial frames. It is not the result of accelerations. It is logical that the Twins Paradox has been a source of confusion because it involves causes which orthodox theory does not recognize.

Appendix III: Derivation of Equation (5)

Mathematical relationships developed by Lorentz relate the observed relative velocity and the observed changes in bodies moving relative to the observer. The equations are part of special relativity theory. According to the quantum medium view, the equations for transforming observations on one body directly into observations on another body bypass the underlying phenomena occurring in the qm that are responsible for the observed, virtual phenomena.

It is an interesting consequence of the qm that observers moving relative to one another agree on their relative velocity. We will investigate the causes of this agreement.

The observers in frame C in Fig. 6 determine the velocity of frame B relative to frame C (vBC) by determining a distance traveled by B through C and the time duration required to travel this distance.

$$\text{vBC} = \frac{\text{observed distance traveled in C}}{\text{observed time duration in C}} \tag{A-1}$$

For convenience, we will let the observed distance traveled through C be from Cx=0 to Cx=1 or a distance of 1 *ls*. Therefore the numerator in Eq. (A-1) becomes 1.

The observed time duration will be the time displayed on clock Cx=1 when a location in B (e.g. Bx=0) arrives at Cx=1 minus the time displayed on clock Cx=0 when the location in B was at Cx=0. This *observed* time duration is equal to the actual time duration times the physical change ratio for C (rvC) plus the asynchronization between clocks Cx=0 and Cx=1.

$$\text{observed time duration in C} = \left(\frac{\text{rvC}}{\text{vBa} - \text{vCa}} \cdot \text{rvC}\right) - \text{vCa} \tag{A-2}$$

The actual time duration is the actual distance traveled along C (which is rvC as shown in Eq. A-2) divided by the absolute velocity of B relative to C (which is vBa–vCa as shown). Note that in Fig. 6 vCa is a negative. The actual time duration is multiplied by rvC to get the time duration according to a clock in C. And the asynchronization between clock Cx=0 and Cx=1 is vCa according to the asynchronization RULE.

Therefore, substituting the 1 *ls* observed distance traveled and the observed time duration of Eq. (A-2) into Eq. (A-1), we get the following.

$$\text{vBC} = \frac{1}{\dfrac{\text{rvC}^2}{\text{vBa} - \text{vCa}} - \text{vCa}} = \frac{\text{vBa} - \text{vCa}}{\text{rvC}^2 - \text{vBa} \cdot \text{vCa} + \text{vCa}^2} = \frac{\text{vBa} - \text{vCa}}{\text{rvC}^2 - \text{vBa} \cdot \text{vCa} + 1 - \text{rvC}^2}$$

From Eq. (4) we know that $\text{vCa}^2 = 1 - \text{rvC}^2$, and we can see that the rvC^2 terms add to zero and that we are left with Eq. (5). We can also arrive at Eq. (5) by using distances and times as observed in frame B.

Appendix IV: Test for a light-propagating medium

In Figure 3, observers in frames A and B can use portable clocks to determine if light is propagated through a medium or if light has the same constant speed in all inertial frames. For example, let a portable clock be located at Ax=0 *ls* and an identical clock be located at Ax=1 *ls* and let these clocks be virtually synchronized by observers who will be traveling with the clocks. Because the clocks are virtually synchronized in frame A, they are absolutely synchronized. Then let the clocks be accelerated in the +x direction at the same time according to clocks in A and with the same accelerations and decelerations, as observed in A, into a frame M which has a velocity relative to A that is observed to be .1 c.

In frame M the clocks will continue to be absolutely synchronized because nothing occurred that would cause one clock to advance either more or less than the other clock. Each clock started and stopped accelerating at the same times on the clock and the clocks experienced the same acceleration and deceleration. The absolute distance between the clocks will continue to be 1 LS. However, because crx and crn in frame M are 1.1 ca and .9 ca respectively, the observers with the clocks will observe that the clocks are approximately .1 s out of sync.

According to the light postulate and orthodox physics theory, there is no reason for the clocks to appear out of sync because the speed of light between the clocks in frame M is the same as in frame A and because there is no cause for either clock to advance more or advance less than the other.

If this portable clock test is conducted in frame B, the observed test result will be the same, although the absolute phenomena that occur during the test will be much different.

Atomic clock technology and supersonic flight technology make it possible to conduct a similar test on Earth. If two portable clocks are located 1000 km apart and are virtually synchronized on Earth and then accelerated at the same time by supersonic aircraft to a velocity of 1000 m/s (≈Mach 3) relative to Earth, in the frame of the aircraft the clocks will be observed to be $1.1 \cdot 10^{-8}$ s out of sync if light is propagated through a medium. This is a time duration that can be measured by portable atomic clocks.

The rates and resulting asynchronization of the portable clocks are affected by aircraft locations, accelerations, velocities, and altitudes, and the test results will depend on sufficient control of these variables.

Whether or not this test confirms the existence of a quantum medium is debatable because it can be argued that relativity theory can predict the clock asynchronization observed in the frame of the moving aircraft. As with other tests, relativity theory is able to predict the test results but is unable to explain the physical causes of the results. The quantum medium view clearly explains the causes of this test result, namely, the changes in the speed of light between the clocks due to the change in absolute velocity of the aircraft and clocks.