COMMENTARY

Distinguishing Absolute True Time from Relative Time: Consistency of Quantum Mechanics and Relativity

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Funding: No specific funding was received for this work.

Potential competing interests: No potential competing interests to declare.

Abstract

The notion that time 'dilates' for observers or detectors in motion is widely published, and the use of a time dilation factor has led to several generalizations that are accepted but are problematic. Here the relative velocity between light rings emanating from a source, and the position of that source, as functions of time are diagrammed for a theoretic ideal source/detector system moving at half-light speed. The true distances traveled by light ring photons are the product of time and speed **c** in each respective direction, but the relative distance accumulated between ring edges and the source/detector results from the fixed speed of photons from their initial source positions plus the distance traveled by the detector while the rings enlarge. The widely used time dilation factor for moving detectors or objects in motion results from computing distances incorrectly. This finding requires correcting relativistic Physics notions regarding time, space, and velocity, and refutes the argument that motion creates mass. It is clear that Newton's laws of Physics, quantum mechanics, and true postulates of special relativity are consistent when correctly applied.

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Introduction

Light is massless electromagnetic energy consisting of quanta of photons with electric **E** and magnetic **B** field sets that oscillate sinusoidally in time while tracing out wave patterns in space. The speed of light from its own instantaneous position in space derived by Maxwell, given by $\mathbf{c} = \mathbf{E}/\mathbf{B} = 1/\sqrt{eu}$[1], has been abundantly confirmed, by Hertz using $\mathbf{c} = f\lambda$, by Michelson using $\mathbf{c} = \mathbf{d}/t$, and by inserting measured values for e and u in the above formula, where all agree to high 6 digit accuracy[2]. The formula for light speed was derived without need to consider the velocity of the source, and instead **c** represents light speed with respect to its own instantaneous position in space, wherever that may be, independent of the velocity of the source or an observer or detector. The fixed intrinsic speed that light must have to exist, determined by

the rapidity with which changing electric **E** fields induce changing magnetic **B** fields and vice versa, is the central postulate of special relativity.

Single photon travel paths for light to pass moving rods[3], and two dimensional systems of light travel between source and detector in lateral moving light sources, are used in attempts to use light detectors as time measuring devices[1][3][4][5][6][7]. The assumption that light speed must always be fixed at **c** has led to the notions that even relative velocity between a light front and a moving detector must somehow remain magnitude **c**, and thus that time must 'dilate' for observers or detectors in motion[3][4][5][6][7]. It has been assumed that time itself must differ for a given single event for observers in relative motion. This now has been adequately disproven, as described in numerous publications from 1963 to the present[8][9][10]. Here, the analysis is extended to systems where light rings of photons emanate from a moving source, to delineate true from relative time for a light event. As first written by Sir Isaac Newton, true time for any single event is absolute[11], while measurements of time are relative and differ from true time due to perceptual or methodologic error.

Methods

Light speed from its own instantaneous position in space is fixed at **c** in any particular medium, and photons from light sources can form spheres in three dimensional space. Diagrams were drawn of a plane of light rings from a source, each produced sequentially in time while the source undergoes motion along the horizon. Flashes of light are assumed to be produced instantaneously from the source at a particular position in time, so that each ring emanates at speed **c** in all directions uniformly from that original position. Instantaneous stoppage of movement for the source to produce each ring is assumed, to avoid consideration of the effect of synchronous aberration, where photons produced from lateral moving sources angle travel with a lateral velocity component of the source. This avoids the unnecessary complication of asymmetric ring shapes that would actually be produced from continuously moving sources that is beyond the scope of the present study. A vertical rod connecting the source at the bottom end to an attached detector at the top end is shown at corresponding positions in time. This system helps to distinguish between the actual true propagation distance traveled by photons, in a given time interval, from the physical distance between the source and detector, or between a ring of photons and the detector in a shifted position. Vector quantities are shown in boldface.

Results/Discussion

Diagrams of light rings emanating from a lateral moving source are shown in Figure 1. Any ring enlarges as time progresses with radii all increasing at light speed **c**. The lateral moving source/detector system also moves horizontally while the rings expand in space. The circles progressively increase in radii because the photons forming these circles were produced from flashes at various source positions in time, each ring assumed to emanate from an instantaneously halted source position that would produce symmetric-shaped spheres. The flashes are produced instantaneously so as not to appreciably affect the overall rapid average velocity of the source.

The left circle is the largest circle because it was formed before the subsequent circles at later times. The top figure at time t_1 represents the light source at the bottom tip of a vertical rod of height **H**, where a light ring of photons forms in an initial flash. The second figure at time t_2 shows the first ring enlarged in size while the light source has moved laterally and a second flash ring forms. The dark circle at the top of the stick is the light detector, and at t_2 the first ring of light has not yet reached it. At time t_3, the first ring is large enough to reach the detector when the third ring forms. The bottom figure shows the arrangement of rings seen in Figure 1 after four rings from four flashes have been produced. Note the first ring has passed the detector and the second ring now reaches it.

All radii of the circles are a magnitude equal to the actual distance traveled by photons making the particular ring. The largest circle on the left consists of photons that all have traveled radial distance labeled **R**. The source also traveled from its original position at the center of the largest circle to its final position after four flashes of rings formed. The true time for light to first arrive at the detector is time $t_3 = \mathbf{R}/\mathbf{c}$, the time interval between the time at which the first ring was formed $t = 0$, and the time t_3 that it arrives at the detector.

The line below the lower figure is drawn from the initial flash point for the largest circle to the lateral position the source and detector are located at the final time t_4. This arrow does not represent the actual path of any photon of the first formed ring because the ring began at the point where the source was previously located and at the time the ring arrives at the detector t_3 the horizontal traveling photon already had passed the source position at the bottom of the rod. Thus all photons have not only intrinsic light speed **c** with respect to their own instantaneous positions in space, but also relative velocity with respect to the moving source. That is, if the source had remained stationary at the center of the circle, the distance between the source and the ring would be **R**, but since the source moves, the distance is other than **R**. The total accumulated distance a photon travels with respect to a moving source depends on the velocity of that source. The time taken for a photon to arrive at the left edge of the first, large circle is **R**/**c** where **R** is the distance the photons in the first ring actually traveled from the source when at left, to its position when the detector has coincidentally moved to the position at the time the ring arrives. The time for any photon to reach its final position in the first formed ring is indeed **R**/**c**, since **R** is the actual path the photons have traveled. The time cannot be correctly computed from the distance between the flash at t_1 to the source at t_4 or from the distance between the final position of photons in the ring and the source, or any other mistaken photon path. Note that the frequency of the light rings is higher in the direction of source motion and lower in the opposite direction. For light continuously emitted from a moving source, photons have higher frequency and shorter wavelength when propagating in the direction of motion, and lower frequency and longer when propagating in the opposite direction of motion of the source. Indeed, light from the side of the sun rotating toward earth is higher frequency and lower wavelength than light from the receding side, while light speed remains fixed at **c** regardless.

There are many ways that true time can be incorrectly computed. The often published method to attempt to prove that time ‘dilates due to motion’ is assuming that the moving observer sees the photon travel only distance H so that the computed time would be H/**c**. This is false and would be the time only if the rod were stationary of course. As seen here, this ‘dilated time’ is merely the amount of error in computing time, made by an observer moving with the source/detector who wrongly assumes the physical distance between the source and detector was an actual travel path that light followed.

The time dilation formula for a moving observer of a light ray traveling oblique to the direction of motion of the source (the 2 dimensional case here) is published as $\Delta t = \Delta t_0/(1 - \mathbf{v}^2/\mathbf{c}^2)^{1/2}$ [1][4][5][6][7]. These authors argue that Δt is the difference in time for a light event when observed by a moving observer compared to the time Δt_0 computed by a stationary observer. Notice that, as in the example using rings, Δt is merely the error in computing time made by the moving observer who assumes the travel path was distance **H** rather than the true path length **R**.

The true time at which the photon ring first arrives at the detector when the third ring has formed may be obtained from $(\mathbf{ct})^2 = (\mathbf{v}t)^2 + \mathbf{H}^2$ where **v** is the horizontal velocity of the source/detector and $\mathbf{R} = \mathbf{c}t$ is the radius of the first ring at the time ($t = t_3$) when the ring intercepts the detector. Thus $t = \mathbf{H}/(\mathbf{c}^2 - \mathbf{v}^2)^{1/2}$. Note if the source is not moving, $\mathbf{v} = 0$ and $t = \mathbf{H}/\mathbf{c}$ as expected and if $\mathbf{v} \geq \mathbf{c}$ the detector is not reached by the light.

For $\mathbf{v} = (1/2)\,\mathbf{c}$, $t = 2\mathbf{H}/(\sqrt{3}\mathbf{c})$. If each increment of time were 3.33 ns, then the photon rings enlarge by $\mathbf{R} = \mathbf{c}t = 2.99792458 \times 10^8$ m/s x 3.34×10^{-9} s) = 1 meter between successive rings. In 6.68 ns, the source/detector has moved laterally $\mathbf{d} = (1/2)\,\mathbf{c}t = 1$ meter while the first ring has enlarged to a radius of $\mathbf{R} = \mathbf{c}t = 2$ meters upon reaching the detector. In the example, the height of the rod is $\mathbf{H} = (2^2 - 1^2)^{½} = \sqrt{3}$ meters. The time for the first ring to reach the detector on the rod, $t_3 = \mathbf{R}/\mathbf{c} = 6.68$ ns is computed correctly by the stationary observer seeing the true light path.

The time computed by a moving observer who assumes the light merely traveled length **H** is a factor of $\sqrt{3}/2$ times less than the true actual time, at 5.77 ns. This is indeed the time computed by the "time dilation" formula above where $\Delta t = (6.68 \times 10^{-9})/(1 - (3/4)\,\mathbf{c}^2)^{1/2} = 5.77$ ns. True time for this event is 6.68 ns, and the different time computed by the moving observer is a perceptual error, as classified early by Isaac Newton in 1714. Perceptual errors in relativity do not alter true time for any event[11]. True time for any event is independent of the motional states of observers who do not control the event. The notions that twins have different ages, or that simultaneous events are not simultaneous, due to relative motion, are of no physical significance. In fact, if true time could be two different magnitudes for the same event, then this would violate the first postulate of special relativity which states that the magnitudes of physical parameters for a system must be the same regardless of the state of motion of a reference frame. Indeed, time progresses at its own rate and does not depend on clocks, on matter, gravity, etc. to exist. Time existed long before the material universe ever did.

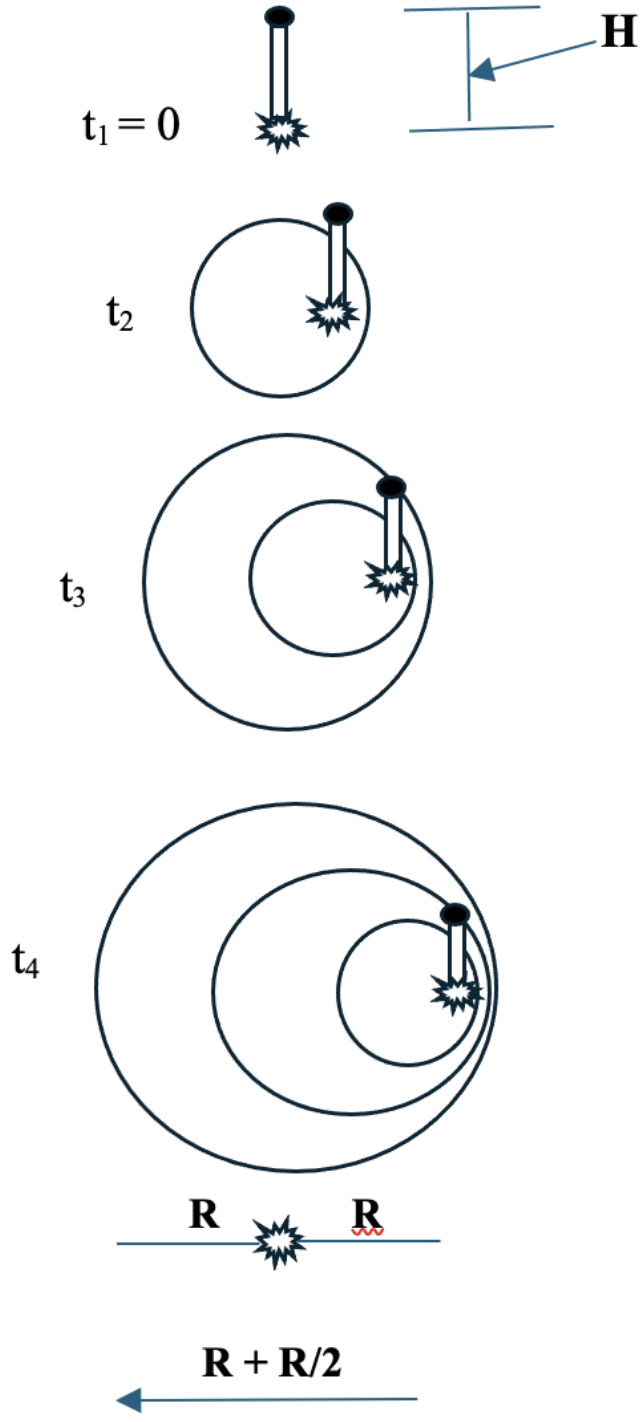

Figure 1. The time dependent expansion of rings of light emanating from a moving light source. The source is at the bottom of a vertical rod which moves to the right at speed **v** = (½) **c**. As time progresses, light rings appear sequentially from the source at its various positions, and all spread from their respective points of origin at intrinsic speed **c**. A detector is shown as a black ball at the top of the rod. In the top figure, the first ring has formed at time $t_1 = 0$. At t_2, two rings from two flashes are present. At t_3, three rings have been produced by the source, and the first ring has now reached the detector. At t_4, four rings have

appeared, where the largest first ring has now passed the detector, and the second ring now reaches it. Two positions at which the ring from the first flash exist at t_4 are shown with equal length lines representing the paths of photons traveling to the right and to the left at speed **c** from the first flash position to the final location. The longer bottom arrow drawn from the final position of the source on the right, all the way to the final position of the first ring on its left, is not the path any photon has taken but is instead the net distance accumulated, by the light front **R,** and also by the detector **R**/2 at the final time t_4.

Again, the problem is that an observer riding with the source could be tricked into thinking that the light that arrived at the detector traveled only distance **H** along the rod, and that the time computed would be given by t = **H**/**c**. This is false because the true distance the light traveled to arrive at the detector is **R**, and is not merely the height of the rod **H**. The claim that time 'dilates' due to observer or detector motion is simply mistaken even though this notion is widely published by otherwise very reputable sources. Many other possible ways to compute time incorrectly exist. It would be false to compute time as (**R** + **R**/2)/**c** because no photon in the first ring traveled this distance in the system. The photons in the first ring all traveled distance labeled **R**, while the source also moved a distance (1/2)**c**t = **R**/2.

The usual modern procedure to "prove" time dilation due to motion uses a two dimensional figure of a theoretical rocket ship or light box with height **H** moving laterally with velocity **v**, where light leaves a source and travels up and down inside[1][4][5][6]. A stationary observer on the ground sees the actual true distance the photon travels and computes time correctly. A moving observer inside the box or ship senses or perceives that light only travels the height of the ship or box and back, computes time incorrectly. The listed references claim it is a correct time for the moving observer because that is what that observer would perceive as being true. The difference in time computed by the moving and stationary observers of the event, namely t = **H**/**c** - **H**/(**c**^{2} – **v**^{2})**,** is therefore merely the error in computing time that the moving observer can make because of a perception error. It is not actual slowing of the rate that time progresses. These extended from the original 1905 description in one dimension[3] where the time for light to pass a receding rod of length **L** was assumed to be **L**/c because a moving observer would presume the length of the rod is the actual travel path for light, the same mistake described in the present report. The true time for the one dimensional case of course may be computed from **c**t = L + **v**t where **v** is the rod velocity, because the relative velocity between the light front and the moving rod is given by **c** + **v** [3], all while light itself retains fixed intrinsic speed **c**.

Correcting special relativity theory

Newton wrote early about relativity[11], stating that true time for any event is absolute while all measurements of time are relative and subject to error, whether methodologic or perceptual. Note that time existed long before humans invented clocks to measure it, and thus the rate that time progresses does not depend on clocks.

The formula for true time for the theoretic system is known here where a perfect vacuum is assumed, with constant vector velocity **c** for all photons having magnitude **c** only in the propagation direction for each. **c** is properly treated as the vector

quantity it is, rather than the simple scalar magnitude it can also be. The relativistic Pythagorean time dilation formula described above has been broadly applied to measurements of length, time, mass, and even to biologic properties[1][3][4][5][6][7]. Because of the results of the present analysis, this requires comment.

Simultaneity

The common claim[1][4][6][7] that “two events which are simultaneous to one observer are not necessarily simultaneous to another observer” is not true. If an observer moves away from the midpoint between two light simultaneous flashes, the observer will detect the flashes at different times, but the events are nevertheless simultaneous. Simultaneity of events is not dependent on motion of an observer or detector that does not control the events.

Measured Time

The claim[1][3][4][5][6] that “clocks moving relative to an observer are measured by that observer to run more slowly as compared to clocks at rest” is incorrect. The operation of various clocks can be affected by motion or by gravity, temperature, humidity, and other environmental factors, but not all clocks are equally affected by these variables. GPS clocks use internal EM radiation and are affected by gravity and motion differently than pendulum clocks or other clocks. True time is attempted to be measured with any clock, but all such measurements are relative and subject to error and are never perfect or able to determine exact true time for any event with zero error. True time for any event does not depend on, and is not affected by, motion of clocks, observers or detectors that do not control the event.

Twin ‘paradox’

The claim[1][4] that a “traveling twin returns to earth having aged less than the earth twin” is false. The age of twins is the same as long as they exist, where age is the true time elapsed since their birth. Again, true age is approximately measured, but nevertheless is at any time the same for twins born at the same particular point in time. All entities in the universe, that exist, exist together at any instant in time and progress together in time, as time progresses. Tissue growth, general biochemical metabolism, and aging rates are not directly affected by motion. Diagrams that attempt to prove the paradox on paper typically re-do the original 1905 tactic where it was thought that the time required for light to pass a rod of length **L** receding from the light at velocity**v** would be t = **L**/**c** for a moving observer but t = **L**/(**c - v**) for a stationary observer. **L**/**c** is only the time if the rod could be made stationary.**L**/**c** is not the actual time even though the moving observer on the rod senses that light only traveled distance **L**. It traveled distance **L + v**t. If it only moved **L**, it would not even pass the receding rod. The stationary observer, who sees the total path the light actually travels, computes the correct time. The moving observer is simply wrong. The Pythagorean time dilation factor has always merely computed the amount of error when time is measured by the deceived moving observer, compared to the stationary correct observer.

Many argue that atomic clocks that read differently at fast velocity also proves that twins moving fast will age more slowly.

But time existed long before clocks ever did, and time is not regulated by any clock. A deviant reading on an atomic clock is due to error from its own velocity and other factors, not because time slowed its own rate for the atomic clock that moved faster. Atomic clocks are notorious for having their operation be affected by the velocity of the device, and this is in part due to the fact that light with its fixed speed with respect to its own coordinate in space needs to travel a greater distance round trip inside a faster-moving clock. If one holds atomic clocks in both hands, after a period of time, the two clocks will read differently, where one arm moved differently than the other arm. The arms however do not have different ages.

‘Time dilation’ of muons

The claim that time dilation due to motion[6][7] explains why muons in the atmosphere have longer decay half-lives than in the laboratory is false. Muons in the atmosphere, like embers waved in the air, last longer perhaps due to environmental conditions and certainly do not prove that true time itself dilates due to motion, as originally mentioned theoretically in 1905.

‘Length contraction’

The claim[1][4][6] that “the length of an object is measured to be shorter when it is moving relative to the observer than when it is at rest” is misleading. The object’s true length is not shorter, but if it is measured inaccurately due to perceptual error from rapid relativistic motion, the results will be different than the true length. Any claim that the true length is itself actually shortened due to motion, as though matter disappears from the object or that the object becomes thicker or more dense, or that matter can be created or destroyed by motion alone, is false.

‘Relativistic velocity addition’

It has been argued that because light speed derived by Maxwell for a photon speeding from any instantaneous coordinate in space is fixed at magnitude **c**, that even the relative velocity between a light front and a moving object having velocity**v** with respect to its own instantaneous velocity is unable to exceed magnitude **c**, that is, $\mathbf{c} + \mathbf{v} \leq \mathbf{c}$. It is presumed by many that light intrinsic speed is not only fixed but also cannot be exceeded. The usual formula for relativistic velocity addition is given by $(\mathbf{u} + \mathbf{v})/(1 + \mathbf{uv}/\mathbf{c}^2)$ where a time dilation factor is introduced to prevent exceeding velocity**c** for two added velocities. This argument is nonsensical since the formula falsely presumes that time itself ‘dilates’ due to motion. Note that for two light beams where $\mathbf{u} = 0.5\mathbf{c}$ and $\mathbf{v} = 0.5\mathbf{c}$ the formula does not produce **c** but rather 0.8**c** The relativistic velocity addition procedure has been adequately disproven by Arthur Otis[8]. A lit candle produces photons that travel at speed **c** West and speed **c** East. The relative velocity between them is 2**c** (not 0.67**c**). The rate that distance is accumulated by the beams together is 2c.

It must be noted that the speed of light, or any object, with respect to stationary space is not affected by motion of an

observer that does not control it. A car with speedometer reading 30 mph is not determined by an observer. An observer can run away, at velocity **v** with respect to the ground, from the car, but the car speed still remains 30 mph. The relative velocity between the car and observer though is 30 + **v**. The earth orbits at 30 km/s with respect to the sun, but has a velocity with respect to itself, or an object on earth, of zero, while still retaining speed 30 km/s with respect to the sun. And the total velocity of the earth with respect to stationary space is not known (due to galaxy rotation, etc). The special feature that light has in special relativity is that light total velocity with respect to stationary space IS known, at magnitude **c**. And the relative velocity between a light front and a moving observer having velocity**v** with respect to space is**c** + **v**, all while intrinsic light speed remains **c** of course.

‘Relativistic mass’

The claim[1][4][7] that “the mass of an object is measured to be greater as its speed increases” is also misleading and complex. The idea, that the mass of an object truly is, not justly indirectly measured to be, dependent on its velocity, stems from the use of the original Pythagorean time dilation relativistic factor $(1 - v^2/c^2)^{1/2}$ when computing the theoretic time involved in particle collisions[7]. Assuming such ‘dilation’ of time by a moving mass m was true required that momentum m**v** would only be conserved if the mass were also relativistic given by $m = m_0/(1 - \mathbf{v}^2/\mathbf{c}^2)^{1/2}$, where m_0 is its rest mass. This has been followed by presumed experimental confirmation and is widely recognized as a basic formula of Physics[4]. It is important to emphasize that in such derivations of ‘relativistic mass’, the assumption is first made that the total energy of a particle is the sum of its rest energy $m_0\mathbf{c}^2$ and its motional kinetic energy K, where $E = m_0\mathbf{c}^2 + K = m_0c^2 + m\mathbf{v}^2/2$[4][6]. Therefore the conclusion that mass itself changes when an energy change occurs is a violation of logic known as a logical inconsistency. It is not possible that kinetic energy can be simply represented by $m\mathbf{v}^2/2$ if mass were to change with velocity. And the assumption that all energy is mass energy, so that E here represents total energy, is not rational since many other forms of energy exist. And energy is affected by temperature and gravitational potential which are not included in the above formula. Any object of mass m has more energy at a high temperature, or if it is elevated in a gravitational field, but does not contain more mass in these conditions.

As far as ‘confirmation’ of ‘relativistic mass,’ the mass of rapidly moving objects can be measured improperly or inaccurately, or can be an implied or computed mass, rather than necessarily an actual physical mass. The inertia and kinetic energy both steeply increase for particles in rapid motion[6], but true physical mass is not altered by changes in velocity, as though matter can be created or destroyed by motion itself. For example, miniscule physical particles such as electrons energized to near light speed have not only increased translational velocity, inertia, and kinetic energy independent of changes in mass, but, from quantum mechanical principles, also have spin energy and oscillation or vibrational energy while propagating with wave-like characteristics. Increases in observed energy with increasing translational velocity appears to impressively follow the Lorentz formula for relativistic energy as a function of a fraction of light speed **c**[6], but this does not prove that mass itself is actually created by increased motion. The Pythagorean relativistic term might cause agreement between observed and theoretic energies for other reasons, such as vibrational oscillations perpendicular to the propagation directional velocity. There is no convincing proof that electrons accelerated to

near light speed **c** at the Stanford Linear Accelerator Center (SLAC) become larger in size, or more dense. or heavier particles, and instead this is a theoretic argument. If mass creation could occur due to increased velocity, the currently reached speed of 0.999999992**c**[12] at SLAC would cause the electron mass to be 4.3 times larger than the mass of a proton and 7,900 times the known mass of an electron. It would be invalid to refer to such presumed particles as electrons. The particles at SLAC remain electrons and indeed are used to produce X-rays[12]. Accelerating protons do not produce X-rays.

From quantum mechanics considerations, the deBroglie wavelength for an energized electron traveling at 0.9**c** would be given by $\lambda = h/(m\mathbf{v}) = 2.70 \times 10^{-12}$ m wavelength which is in the gamma ray portion of the EM spectrum. In both natural and artificial systems, electrons have not been found to be energized to exceed light speed **c**. These observations confirm the special relativity theorem that material objects, even miniscule electrons at 9.1×10^{-31} kg, cannot be accelerated, while remaining intact electrons, to exceed light speed **c**[6]. Energized electrons at the SLAC closely approached light speed**c** without reaching it. Likewise, **e**lectrons in natural radioactive elements that undergo electron capture (a reverse of beta decay as in tritium ^{3}H) have been computed to travel at near light speed**c** at the time of collision with the protonic nucleus to form a neutron[13]. Since electrons in these systems propagate with wavelike characteristics, the total energy would be not only proportional to the square of the translational velocity **v** but also to the oscillation frequency h**c**/λ. So increases in total energy cannot be claimed as proof that it is mass that is created with increases in velocity.

At the SLAC, the Stanford positron electron accelerating ring (SPEAR) houses electrons and positrons traveling in opposite directions that cause collisions and annihilation of the electron into EM radiation[14]. The magnitude of mass annihilation energy converted into light energy would equal, from the relativistic formula $E = m\mathbf{c}^2$, 8.19×10^{-14} Joules. In theory, this amount of EM energy could exist as one high energy gamma ray with frequency, from E = hf, 1.23×10^{20} Hz and a wavelength, from **c** = fλ, of 2.43×10^{-12} m, or 250,000 photons of visible light with a frequency of 4.92×10^{14} Hz, or a combination of various frequencies. The production of various frequencies of light from nuclear explosions is well known.

Accelerating electrons produce EM radiation, and rapidly stopping electrons produces X-rays. It is instructive to consider also the possibility that electron mass could theoretically be annihilated into EM energy. Indeed, the early first description of the latent energy that any mass m contains, as $E = mc^2$ by DePretto[15], considered the conversion of mass into massless EM energy having final speed **c**. Moreover, electron-positron annihilation has been described. Considering this possibility, the deBroglie wavelength for an electron reaching essentially speed **c** would also be, as expected from λ = h/m**c**, 2.43×10^{-12} m as above. Arthur Compton first argued that this distance**d** for the highest energy gamma ray of light might represent the diameter of an individual electron[16], but today this length is recognized as between the proton diameter of about 1.7×10^{-15} m and the hydrogen atom diameter of about 37×10^{12} m. An electron oscillating over this distance at speed **c** would require a time t = **d**/**c** = 8.11×10^{-21} s per oscillation period, which again is a frequency, from f = 1/t, of 1.23×10^{20} Hz. It must be noted that the gamma photon energy theoretically able to be produced as electrons approach light speed **c** before annihilation from quantum mechanics considerations, and from relativity considerations for latent mass energy $E = m\mathbf{c}^2$, and from the Newtonian definition of velocity t = **d**/**c**, all produce the same result. The energy of electrons with deBroglie wavelengths for speeds less than **c** is lower than this, which perhaps reflects that for any such

conversion into EM radiation, the electron must be energized to speed **c** before annihilation, where the oscillation frequency of the electron is the same as the oscillation frequency for a gamma ray photon. Indeed, electrons in ground state orbitals of hydrogen have a significant fraction of speed **c** but are not naturally annihilated, and instead it is high energy nuclear reactions that are associated with annihilation of matter.

The opposite notion, that mass can actually be created by motion, has led to confusion not only in Physics but in Chemistry, where it has been argued that all chemical reactions having changes in energy must somehow also involve changes in mass. There are many forms of energy other than mass energy, including heat, light, kinetic, potential, and chemical bond energies. Lighting a match causes the production of heat energy from the rearrangement of atomic bonds, with corresponding changes in bond energy between reactants and products that explain the heat involved, all while mass is conserved in the reaction[17]. Mass conservation holds for all reactions other than nuclear transformations, where mass may be annihilated in accordance with $E = m\mathbf{c}^2$. In any event, the fallacy of using the relativistic term to compute time, used to deduce relativistic mass, does not require a complete explanation for the term correcting apparent energies observed at relativistic speeds.

Fission and fusion nuclear reactions do involve heat energy converted from mass loss of course, but the widespread claim that “for any change in the energy of an object, there is a corresponding change in mass”[4] is not always correct. For example, the earth does not repeatedly gain mass as it approaches perigee at its fastest orbital velocity and lose mass at apogee. Electrons in ground state orbitals at rapid velocity do not have more mass than electrons in outer orbitals at lower velocity. The concept of mass creation due to motion alone has caused a major upheaval in scientific thought even though the assumption that time dilation is real, on which it is based, is incorrect, as noted here.

Reconciling Quantum Mechanics, Relativity, and Newton’s Laws of Physics

The idea that Newton’s laws of motion are somehow wrong or defective for relativistic speeds needs to be analyzed. The inability to energize particles such as electrons to faster than light speed **c,** which is believed to be central to special relativity theory, may be due to the likelihood that an assemblage of such particles might begin to be annihilated into massless EM energy at such high speeds, where Newton’s law $\mathbf{F} = m\mathbf{a}$ remains correct, but merely does not apply since EM radiation has no mass. It is not physically possible to accelerate particles of mass near light speed **c** with an applied vector physical force **F** in perfect alignment with the directional velocity**v** the particles have in various directions, while acting over extremely large distances as the particles vibrate but remain intact during the energization. The wave function treatment used to derive the orbital cloud probability regions for the hydrogen atomic electron employ Newton’s third law of Physics since centripetal electrostatic force and centrifugal reactive force are opposite where $mv^2/\mathbf{r} = kq^2/\mathbf{r}^2$ at any instant in time. The electrostatic force continuously attracts the electron in a radial direction causing the oscillations in velocity, kinetic and potential energy as a function of radial distance **r** from the nucleus[6][13].

It is possible to derive the formula from these considerations due to conservation of momentum, where, at near light speed, a particle momentum $m\mathbf{v}$ would approximate $m\mathbf{c}$**.** At its conversion, the magnitude of momentum would equal the

energetic but massless momentum of light, recognized at E/**c**, so: E/**c** = m**c** and E = m$\mathbf{c}^2$.

The often stated idea that quantum mechanics and special relativity are 'contradictory,' and 'cannot both be true,' is simplistic. It is claimed that the relativistic factor that would be zero at a velocity equal to **c** suggests that mass at that speed would be infinite. Since the 'time dilation' factor reported here is erroneous, this is not the case. In fact, *it is quantum mechanical considerations that may explain the axiom of relativity, that electrons in vacuum are not able to be accelerated to propagation speed **c** which is limiting for normal matter*. The computed deBroglie wavelengths of electrons in the hydrogen atom not only accurately represent the circumferences of spherical orbital cloud probability regions in the atom, but also here demonstrates the equal wavelengths, frequencies, and energies of material matter at approximately speed **c** with these quantities for massless radiation. There are no oscillation frequencies greater than gamma in the EM spectrum for light, and energizing electrons more than in electron capture, or at the SLAC or other comparable system, could therefore theoretically cause electrons to be annihilated into EM radiation, which then propagates at speed **c** but no longer involves intact physical mass. It is not that mass would need to be infinite that prevents achieving speed **c** by a particle with mass, but rather that light is the only known entity that travels at the speed of light, which has no mass and instead is EM photon energy hf which contains no term for mass of course since, again, light has no mass.

Momentum is conserved in collisions, and as seen here, in the theoretic transformation of mass energy as well. It is evident that at light speed **c,** the electron mass energy is the same magnitude as the energy of a theoretically produced gamma photon. So it appears that both momentum and energy would be conserved in such a transformation. This is reasonable since this is not a collision where momentum, but not necessarily energy, is conserved. It is a transformation of one form of energy into another. Such transformations are known in thermodynamics where mechanical energy is converted into heat energy. Understand though that the equal magnitudes of energy do not imply congruence in these cases. The energy is the same magnitude but different in form. Heat energy is different than mechanical energy even though the magnitude of each may be the same. Likewise, mass is not light, and light is not mass even though the two forms of energy may theoretically interconvert. The notion, since E = m$\mathbf{c}^2$ and m = E/$\mathbf{c}^2$, that this "proves" that light has mass is improper. Instead, the relation computes how much mass one would need in kg to have latent mass energy that would equal the magnitude of Joules of energy in a sample of massless light. *Not only does quantum mechanics confirm the true original postulates of special relativity, but these postulates likewise support principles of quantum mechanics.* The fact that speed **c** is not exceeded by matter is consistent with the most probable velocity of the hydrogen electron as a function of radial distance from the nucleus, where speed **c** computed from quantum formula is not exceeded even at the close proton-electron contact distance in electron capture[13].

Conclusions

The original postulates of the special theory of relativity have been validated experimentally and theoretically.**I.** The speed of light is fixed in any particular medium, regardless of how fast the light source or observer may be moving, and **II.** Physical characteristics of a system are not affected by constant relative velocity of a frame of reference. Moreover, normal physical matter with physical mass cannot be accelerated to reach or exceed light speed **c**. Only light propagates

at light speed. However, extrapolations of these points are typically unreal and mistaken. The analysis presented here should help to explain the original error made in 1905 when the relativistic time dilation factor was first proposed, and the unfortunate effects this has had in scientific disciplines ever since. Although time, length, velocity, and mass can be computed or measured with error, the true magnitudes for these variables for any particular system are absolute, each single valued, which returns us to the exquisite descriptions of relativity by Isaac Newton published in 1714[11].

Statements and Declarations

Acknowledgments

Students at Palomar College are acknowledged for useful discussions, and giants of science in history are honored for describing the true aspects of the nature of time, light, matter, and space.

Disclaimer

Statements in this report may be considered controversial by many and thus are not necessarily the views of Palomar Community College or its staff. The late Dr. Stansbury, San Marcos Urgent Care, San Marcos, CA is thanked for not only rescuing me from severe lethal pneumonia but also for describing his desire to be a theoretical Physicist until it was necessary to accept ‘time dilation’ and other related theories as facts, that caused his switch to the medical profession. My Christian friend David Smith at the University of California, San Diego 58 years ago is acknowledged for critical comments on theoretical Physics.

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