A Practical Perspective – it's about time.

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Abstract

The purpose of this essay is to present a perspective on the meaning of "time"– a perspective that was once considered obvious but now has become a subject of debate. If time is something that was created along with the rest of the universe in the big bang, then it is fair to ask the question, "what happened before the beginning of time". In this paper, by treating time as a measure of motion, relations in quantum physics and relativistic physics can be integrated into a single model that makes practical sense of the particle-wave duality, the transformation of future into past, the reason that the speed of light is not relative to its source, and the Schrodinger wave equation. Finally, it provides a practical basis for studying the holographic nature of physical reality and the field of consciousness.

Introduction

There have been a lot of books, chapters and articles published about the meaning of time. Whether they are written by physicists, mathematicians or philosophers, most (except perhaps those based on process philosophy of Alfred North Whitehead) are based on the assumption that time is one-dimensional, whereas space is three. That seems to be the right answer because it takes three coordinates to describe a position in space and only one coordinate of time. And in all practical applications, that's fine. It works to predict motion in 3-D space, which is what we usually care about. The problem is that it hides the nature of time itself. And folding 1-D time up with 3-D space as a 4-D manifold as in the Minkowski formalism creates more questions than answers about the nature of time.

It may not even seem practical to ask "what is time" but some physicist, like Lee Smolin, consider it "the single most important problem facing science as we probe more deeply into the fundamentals of the universe." (Smolin, 2013) The practical answer that I hope to support in this paper is that time is nothing more than a measure of motion. I don't claim this as an original idea by any means. In fact, it is more of a reminder that this is what we were told in the introductory section of Physics 101. Any motion that consistently repeats itself can be used as a clock. Time is a scale of motion that has been standardized for use as a denominator. It is used to *denominate* other measures of motion and that is what makes it seem to be different – to have a different meaning. This is in contrast to Smolin's answer (that "Embracing time [as real] means believing that reality consists only of what's real in each moment of time"), which may be true but is as impractical as the notion that time is a persistent illusion, as Einstein and many others have said. In his 1999 book, *The End of Time*, Julian Barbour said, "Time does not exist. All that exists are things that change. What we call time is – in classical physics at least – simply a complex of rules that govern the change." (Barbour, p. Loc 2327) But that is not practical either. Time *does* exist, not as a complex of rules, but as a very simple tool. Newton was the tool-maker and the tool was used for nearly 300 years to advance physics to the point that we now realize the limits of its usefulness.

Back when Newton proclaimed time to be absolute and independent, before linear time was engrained in everyone's mind, it was considered by most to be a *philosophical blunder*. Isaac Barrow, Newton's predecessor, explained in his "Geometrical Lectures", published in 1735:

> *"Time is commonly regarded as a measure of motion, and… consequently differences of motion (swifter, slower, accelerated, retarded) are defined by assuming time is known; and therefore the quantity of time is not determined by motion but the quantity of motion by time: for nothing prevents time and motion from rendering each other mutual aid in this respect. Clearly, just as we measure space, first by some magnitude, and learn how much it is, later judging other congruent magnitudes by space; so we first reckon time from some motion and afterwards judge other motions by it; which is plainly nothing else than to compare some motions with others by the mediation of time; just as by the mediation of space we investigate the relations of magnitudes with each other." (Burtt, 2003, p. 158)*

It's true that nothing prevents time and motion from rendering each other mutual aid, but considering time to be fundamental creates the question that no one seems to be able to answer; what is time? *Clearly*, as Barrow said, time is just "reckoned" from some motion – a repetitive motion such as the sun, moon, stars, sands through an hourglass and eventually an international standard measured by the decay of radioactive isotopes. The standard was then "minted" as the approved *denomination* (the literal denominator in the equation for motion) to be used as a scale to judge other motions.

The more accurate and precise our time standard became, the more real and independent it seemed to be. And as the science advanced, the math got more and more complicated until it formed an intellectual trap. It's a trap because only those who are smart enough to learn the enormous complexities of advanced math and physics can speak the language, but the language itself is based on the use of time as we know it. So those who speak do not know and those who know do not speak.

Spacetime

Spacetime, or the space-time continuum, is an idea that most people credit to Einstein. But it was actually a mathematician named Hermann Minkowski, who presented it. Einstein even credited him in his book, *Relativity, The Special and the General Theory*:

> *"the world of physical phenomena which was briefly called "world" by Minkowski is naturally four dimensional in the space-time sense."*
> (Einstein, 1952)

In fact, before Einstein started using it he called Minkowski's approach "superfluous learnedness" and said, "since the mathematicians have invaded the relativity theory, I do not understand it myself any more." (Minkowski, p. 2) But he decided to use the concept because it provided an invariant and the laws of physics must be invariant regardless of the observers' state of motion. However, he said, "space-time does not claim its existence on its own, but only as a structural quality of the field." (Einstein, 1952, p. 155)

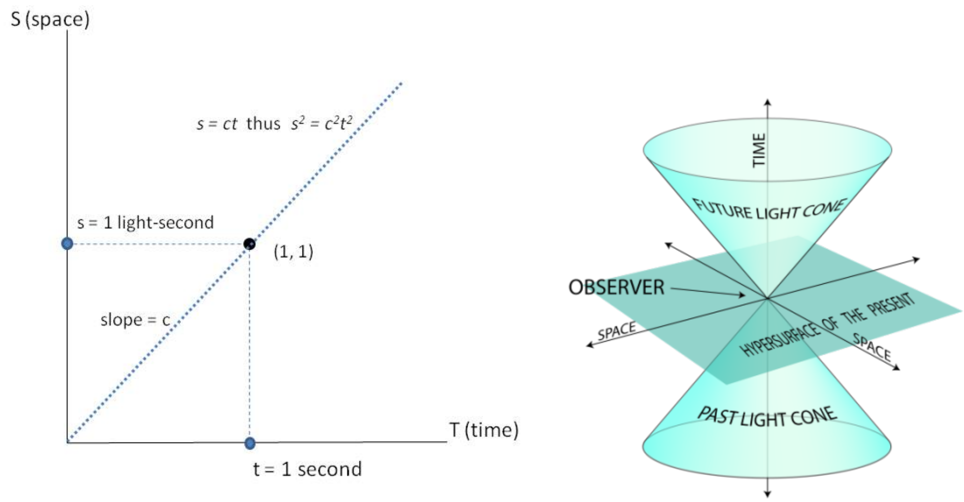
In a recent article published in Scientific American, entitled "What is Spacetime," George Musser said

> *"People have always taken space for granted. It is just emptiness, after all—a backdrop to everything else. Time, likewise, simply ticks on incessantly. But if physicists have learned anything from the long slog to unify their theories, it is that space and time form a system of such staggering complexity that it may defy our most ardent efforts to understand". (Musser, 2018)*

My goal is to show that it is the math that is complicated, not spacetime. The reason that the math is so complicated is that the four-dimensional spacetime equation itself is lopsided; it defines spacetime as a mixture: 3 parts space and 1 part time. But doesn't this definition create a forgone conclusion and force the interpretation to be lopsided as well? It's like a balloon animal, made from a single balloon that is twisted up into a figure. The real trouble with physics is that most people are trying to figure out how to make it smooth (unified) by adding more twists.

The problem with the Minkowski model

The Minkowski four-dimensional space-time (ST) formalism is used to illustrate spacetime as a continuum. I'll briefly describe a few points, beginning with the Minkowski diagram of space (S) versus time (T) in Figure 1a. We imagine a flash of light that expands spherically outward in space ($S = s^2 = x^2+y^2+z^2$) at the speed of light $S = CT$ or $s^2 = c^2t^2$, represented by the diagonal line (with $C = c^2 = 1$ in "natural units") from the origin.



a. b.

Figure 1 (a) A normalized plot of space vs. time that illustrates the point that light travels one unit of distance (light-second) in one unit of time (second)

(b) Minkowski's time vs. space diagram is normally shown with time as the verticle axis and space as a horizontal plane. The time axis is mirrored to include the past as negative time and the future as positive time. However there is no representation of direction in space since 3D space is represented as a 2D "hypersurface of the present".

Note that I use upper case S and T to mean the modulus or absolute value of space and time, where $S = s^2$ and $T = t^2$ which are both positive[i]. Lower case *s* then represents the radius (one dimension) of the light sphere and therefore, the distance that the surface of the sphere travels in a given amount of time, also as one dimension - lower case *t*. In Figure 1b the axes are rotated just to show the Minkowski diagram as it is normally presented. Keep in mind that $s = ct$ represents the radius as a single dimension that increases with time as a single dimension. But Minkowski treats time as if it is actually one-dimensional so he uses *t*, which is $\pm\sqrt{T}$ and claims, *a priori*, that the negative axis represents the past. Then he tries to represent 3D space on the same diagram, but 3D space cannot be represented as three dimensional in the diagram, so it is portrayed as a "hypersurface" (a major problem with this model in my opinion). The intersection of the time axis with this "hypersurface" is said to represent an event, i.e. the present. A "light cone" is formed by revolving the line, (the diagonal in Figure 1a) that connects the origin with the point (1, 1), around the T axis to represent the limit of causality.

Next, the equation ($s^2 = c^2t^2$) is expanded on one side to give ($x^2+y^2+z^2 = c^2t^2$) and rearranged to give the four-dimensional spacetime vector (or tensor): $x^2+y^2+z^2 - t^2 =$

0, with $c = 1$. No physicist or mathematician would blink an eye when they saw the equation that describes a spherical expansion of light ($s^2 = c^2t^2$), written as ($x^2+y^2+z^2 = c^2t^2$). It is mathematically correct, because the equation for a sphere is $S = s^2 = x^2+y^2+z^2$ and everyone knows that time is one dimension. Right? Wrong. If we are to reevaluate the fundamental meaning of time, we cannot apply the assumption that time is one-dimensional while space is three. The variables *s* and *t* represent the radius, not the entire sphere. If the term for radius is unfolded to represent space, then time must be also, which simply means that motion (and thus time) flows in all directions.

There is certainly an advantage to unfolding space as $s^2 = x^2+y^2+z^2$: it fits our perception of 3D space, making the model seem intuitive. But the problem with unfolding one side of an equation without doing the same to the other (leaving it "enfolded" as David Bohm might say (Bohm, 1980)) is that it creates an artificial asymmetry – a lopsided perspective that complicates the math, requiring parameterization in terms of hyperbolic functions (Jackson, 1975, p. 517). The result is a transformed coordinate system that must be calibrated by using the original ($c^2\Delta t^2 + \Delta x^2 = n^2$) to mark increments on the distorted axes. (Penha & Rothenstein, 2007).

There is also a problem with mirroring the time axis to represent the past as *negative time.* That is how it has always been done because the past is conceptually the opposite of the future. It seems to agree with our sense of past, present and future as we experience time, but it centers on zero as the reference, which introduces a singularity. That's because there is no such thing as zero time or zero space. The point, $t = 0$ means the start time or reference time, not the magnitude, whereas coordinates on the *S-T* graph represent increments, i.e. magnitudes. So representing $t = 0$ and $s = 0$ on the graph incorrectly represents zero time and zero space.

The alternative approach presented below, as the Space-Time-Motion (STM) model, is to interpret space and time as vectors – conformal projections of motion (M) as a third perpendicular axis so that S = M x T. The origin of the graph (where the S and T axes appear to cross), then means zero *motion* - the "at-rest" state (which will apply to the quantum model). The first increment on either scale represents a unit of measurement (i.e. the reference point with magnitude of one, $s = 1$ and $t = 1$). This change in interpretation will reveal the quantum model, the domain hidden within the relativistic framework between zero and the first unit of measurement on either axis S or T.

In calculus, it is the limit as $t \to 0$, the infinitesimal region that is infinitely close to the origin but not quite there. Outside of that region we represent motion as the slope of the diagonal line, but as we approach zero relative motion we lose the bits necessary to represent information, i.e.

$$\lim_{t\to 0} \frac{s(t)}{t} = \lim_{t\to 0} \frac{t}{t} = 1. \quad (1)$$

So instead, that region must be represented as a unit circle with a radius of one infinitesimal unit and a circumference of 2π, which is Planck's constant in natural units.

So $E = hf = 2\pi\left(\frac{1}{t}\right)$ is simply a transform function; it transforms the linear scale (a differentiated domain with orthogonal bases) into a polar coordinate system (a domain that integrates the bases into the same circumference yet pointed in opposite directions). And the mathematical model of a circle is a wave function that fits the quantum model of a particle as follows:

$$\text{One unit of space, } s = \int \frac{1}{s} ds = \ln(s) -> s = e^s,$$
$$\text{in one unit of time, } t = \int \frac{1}{t} dt = \ln(t) -> t = e^t,$$
$$\text{produces } {}^{s}/_{t} = {}^{e^s}/_{e^t} = e^{s-t} .$$

Normalizing *s* and *t* (which just means scaling them to one unit: wavelength, λ and period, *T*) with $k = \frac{2\pi}{\lambda}$ and $\omega = \frac{2\pi}{T}$ makes them cyclical to model repetition of events,

$$\psi = e^{(ks-\omega t)}, \tag{2}$$

which is a classical wave and graphically represented as a phase vector or "phasor". It can be shown that the free-particle Schrödinger equation is simply a partially evaluated classical wave equation[ii], with de Broglie relations inserted and the imaginary symbol *i*, used as a spinor to represent the function as a phasor, which is a complex vector[iii]. (Hestenes, 2003)

The Space-Time-Motion (STM) Model

The STM model uses the same idea of a light flash at some position, s_0 and time, t_0 expanding in a sphere as ($s^2 = c^2t^2$), but neither side of the equation is unfolded. The squared terms represent space as a whole and time as a whole (moduli), which are symbolized by upper case $S = s^2$ and $T = t^2$. The first important result of this is that $s^2 = c^2t^2$ can be written as

$$S = Tc^2. \tag{3}$$

In this form, the equation means that ***space and time are equivalent*** – not the same, but *equivalent* – in exactly the same way that $E = mc^2$ means that *energy and mass are equivalent*. They are equivalent because they are two different ways of representing the same phenomenon. They are simply different scales for the same *process*[iv]. Equation (3) suggests that time ($T = t^2$), is transformed into units of space ($S = s^2$) just as energy is transformed into mass. The term c^2 is simply the factor that relates the units of measurement.

Graphically, $S = CT$ is a line on the *S*-*T* plane through the origin with a slope of *C*, the same as in Figure 1a above, which represents the motion of a spherical wave front. In contrast to the Minkowski diagram, the STM model considers change (both *S* and *T*) to be positive (a modulus, an absolute value) so there are no negative axes. Just as the radius of a sphere (lower case *s*) is a positive *measure* from the center outward to the surface of a sphere, positive S values represent outward-directed motion of the entire surface in space (s^2). Similarly, positive T values represent "outward-directed" change in time, i.e. the future. The "arrow of time" simply means that regardless of which direction motion happens in 3D space, once movement or any event happens, it can never "un-happen". In other words, the information in every event does not just go away. It becomes something – it becomes part of the particle (discussed below). That is not evident in the Minkowski model because it is hidden in the singularity, at the point of reflection, where the positive is mirrored as negative.

Mathematically, it is not incorrect to use negative variables[v], such as $-s$ and $-t$ because the magnitudes of $S = (-s)^2 = s^2$ and $T = (-t)^2 = t^2$ give the same result. So it seems to make sense to use the negative as the opposite direction in time, but this mirror-image method hides the region at the point of reflection, where the quantum model applies. For the STM model, positive *s* and positive *t* mean radially outward from the flash point of the light. And the opposite of radially outward is radially inward. Knowing that the energy of a quantum particle, such as a photon, is directly proportional to frequency, which is the inverse, or opposite of time, it makes more sense to use $1/t$ to represent the past. And $1/s$ then represents radially inward.

Therefore, rather than using the negative reflection, the STM diagram superimposes an axis representing the inverse of time, so the region between the zero-motion point and "1" (one unit of measurement where $t = \frac{1}{t} = 1$) on the T axis represents the past, the inverse of the future as shown in Figure 2. The measurement event effectively inverts or "enfolds" what was the future (potentiality) into the past (actuality) and transforms t into $\frac{1}{t} = f_t$ or temporal frequency (an actual particle with energy $E = hf$). On the S axis, the region between the zero-motion point and "1" corresponds to inner space, beneath the apparent surface of the sphere, as a wave number $({}^{1}/_{\lambda})$ or spatial frequency $({}^{1}/_{s} = f_s)$, a concept commonly used in medical physics referring to image quality (Bushberg, p. 269ff) as well as optics, referring to the gratings of a hologram (Guenther, 1990, p. 469ff). Small objects correspond to higher spatial frequencies. In particle physics, smaller, higher-energy particles correspond to higher temporal as well as spatial frequencies.

What appears to be the intersection of the two axes is neither zero time nor zero space, so the axes can't be thought of as intersecting. The zero point is simply a reference point that represents the zero-motion-perspective or at-rest state. This is the realm of time-independent quantum mechanics. The "at-rest state" refers to the particle's perspective of itself, i.e. its position in space ("Here" using the *S* axis) in relation to a clock's position in time ("Now" using the *T* axis).

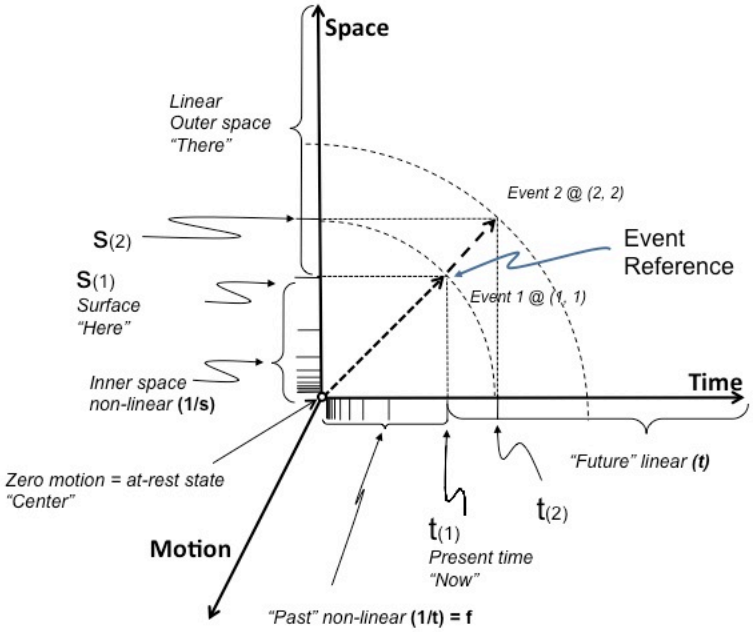


Figure 2 **Event Reference from the at-rest perspective of the flash bulb. A light bulb flashes at some time before t1 sending a spherical wave outward toward S1. *Event 1* (at position 1 and time 1) represents the measurement of the light at radius s1 (1 light-second) in 1 second. Every event that comes before *Event 1* (the "past") is thus represented as a point closer to the origin. Event 2 represents the radius and time that the sphere will be in the future.**

According to Huygens-Fresnel principle, every point on a wave front can be considered a point source of a spherical wave. But imagine this point source as the center of a quantum particle. The at-rest state is represented by the particle's own frame of reference (as if the particle was the center of the universe). It is also the frame of reference for the light sphere, which is moving radially outward. From light's perspective, the particle is at its center and if it could see its own surface it would not appear to be expanding or moving. It would appear to itself to be a particle – a photon – a time-independent quantum function, a unit of energy that does not change with time. It perceives itself as a constant size and sees the "source particle" shrinking, collapsing into its center. This "observation" is represented in Figure 2 as Event 1, say at 1 second after the flash where $s^2 = 1$. It sees itself at a given moment, which is shown as the "event reference" s_1 and t_1.

The event reference represents the observation as "now", where $t = \frac{1}{t} = 1 = t^2$. So at this point, the value of measured t is equal to the concept of "time as a whole" ($t^2 = T$), which is why we tend to think of t and T as being the same. It is common to say that a measurement collapses the wave function, but this model shows that it actually collapses time (to "Now") so that it appears to be one-dimensional. Regardless of what happens in the "outside world", where the moving frame experiences the flow of time, each time the photon observes itself (say Event 2 in Figure 2) it looks the same, so *the model has to reset* to show that Event 2 has become the new event reference. Nothing happens to the particle. It's the model that collapses. As mentioned above, it inverts or enfolds what was perceived to be the future (t - potentiality, looking outward) into its reflection, i.e. the past, where $\frac{1}{t} = f_t$, frequency of vibrations (actuality, looking inward) – and what it perceives to be its physical form in space at $s = \frac{1}{s} = f_s = 1$.

Graphically, the particle is represented as a superposition of state vectors and points in the "direction" (in Hilbert space) of motion (the diagonal with slope = 1). A spatial measurement is represented as a projection of a vector that reaches (1, c) onto the S axis, which is a Lorentz-magnification of the phase vector (phasor) shown in Figure 3. Note that because the slope of the composite vector is *c*, the magnitude on the vertical axis is $({}^{c}/_{\lambda})$. Multiplying both axes, $({}^{c}/_{\lambda})$ and f, by Planck's constant *h,* the *S* vs *T* plot becomes $({}^{hc}/_{\lambda})$ vs hf, de Broglie relations for energy.

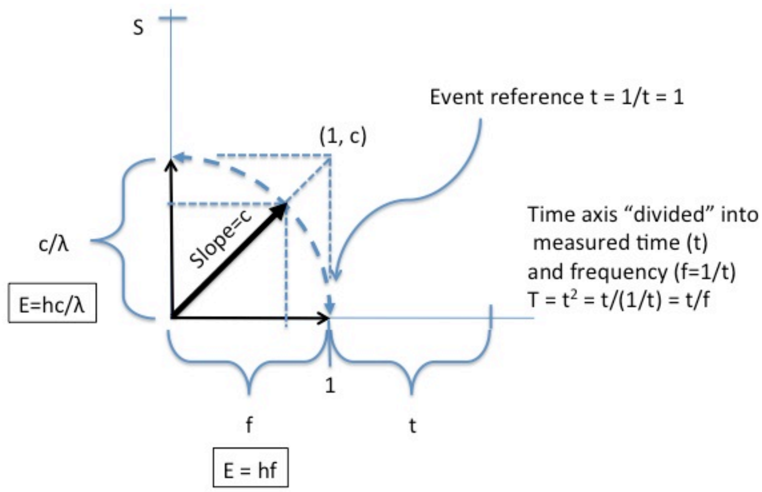


Figure 3 Time axis divided into measureable time, t, and frequency (f). The energy state of a particle is represented as the inverse domain scaled to Planck's constant E=hf

The resulting diagram is a composite representation of two domains: the inverse, quantum domain interposed in the first increment of the linear, relativistic domain. In fact, the triangle formed by the diagonal (with $E = hf = mc^2$) is used in a mnemonic device in the Fundamentals of Physics text as shown in Figure 4 (Halliday, Resnick, & Walker, 1993, p. 1122)

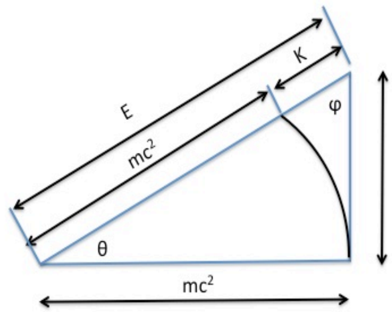


Figure 4 A relational triangle offered as a mnemonic device to help with remembering the relativistic relations among the total energy, rest energy, kinetic energy and momentum. (Halliday, Resnick, & Walker, 1993) The arc in the figure is meant to illustrate that the magnitude of mc^2 on the hypotenuse is the same as that on the horizontal leg, regardless of the angle θ. It can be shown that the angles θ and φ are related to $\beta = \frac{v}{c}$ and γ as $\sin(\theta) = \beta$ and $\sin(\varphi) = 1/\gamma$

Since $E_o = hf = mc^2$ the horizontal leg of this triangle (in Figure 4) can be represented on the STM diagram as shown in Figure 5. This puts the vertical leg parallel to the S axis and the hypotenuse extends out to the "moving frame" to represent the total energy of a quantum particle or a photon in its own rest frame as seen from the moving frame. The vertical leg then represents inverse space as the de Broglie wavelength or spatial frequency, because $E_o = pc = \frac{hc}{\lambda}$, in agreement with Figure 3.

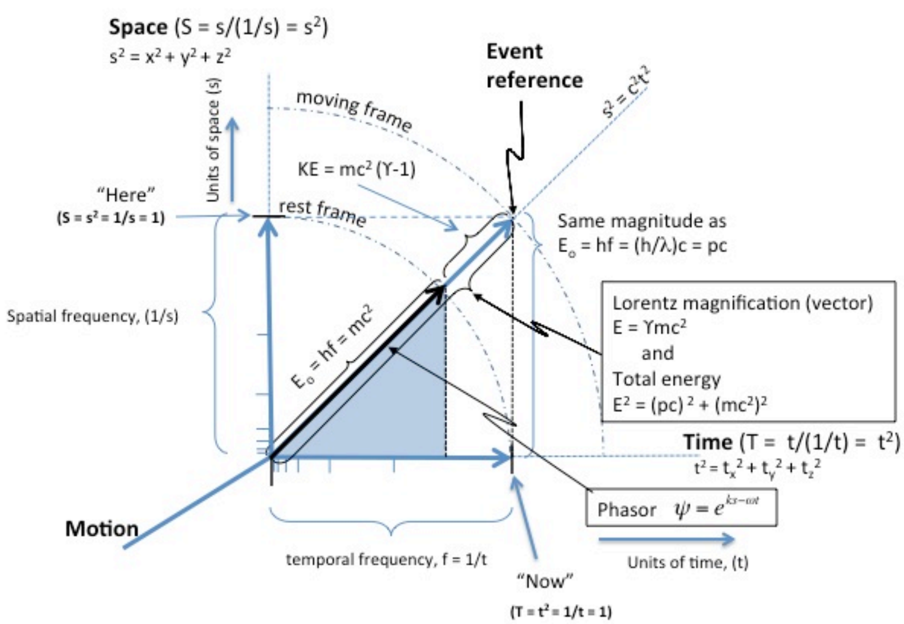


Figure 5 Space-Time-Motion (STM) model. By superimposing the frequency domain over the time domain, the STM model shows the relationships between quantum energy, relativistic energy, and total energy. The interposed quantum domain (polar coordinate system) shows to superposition of the two quantum states as a phase vector (phasor), which gives rise to the quantum wave function.

The smaller triangle in Figure 5 (rest frame) and the larger triangle (moving frame) are similar right isosceles triangles. Geometrically, the horizontal and vertical legs of the larger triangle have the same magnitude, E_o, as the hypotenuse of the smaller one (the semi-circular dashed lines are drawn to show this: $E_o = mc^2$ for the horizontal and $E_o = pc$ for the vertical). The Pythagorean theorem gives total energy:

$$E^2 = (pc)^2 + (mc^2)^2. \tag{4}$$

The larger hypotenuse represents total energy, $E = mc^2 + KE$ where KE is the relativistic kinetic energy. It is a Lorentz magnification of the smaller hypotenuse, so $E = \gamma mc^2 = mc^2 + KE$. Solving for KE,

$$KE = mc^2(\gamma - 1). \tag{5}$$

where

$$\gamma^2 = c^2/(c^2 - v^2) = \frac{1}{\left(1 - \frac{v^2}{c^2}\right)} \tag{6}$$

is the Lorentz factor, which can also be gleaned from the STM diagram, as shown in Figure 6.

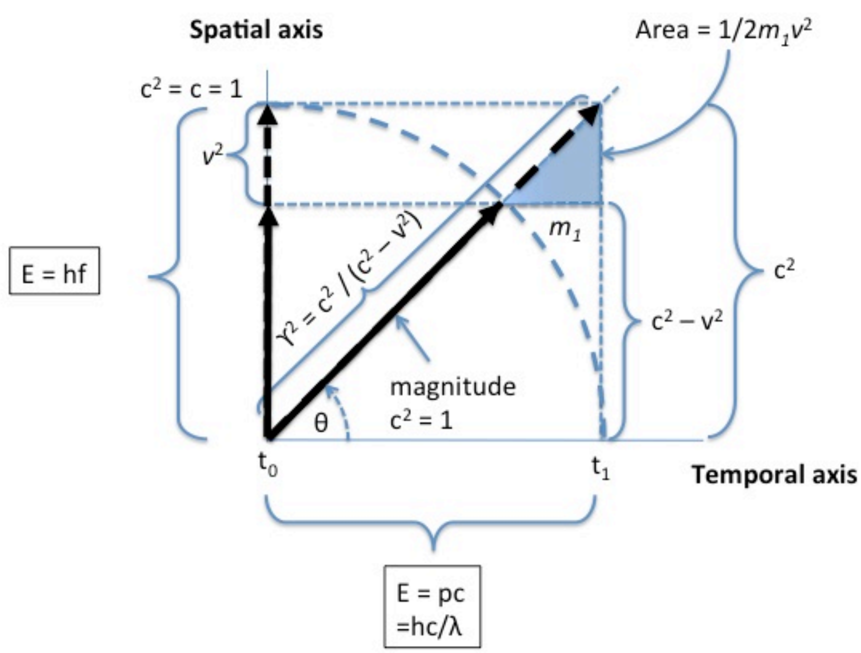


Figure 6 The Lorentz factor is a magnification factor that results from using scalar quantities (s/t) to set the scale for a vector quantity (c). The composite vector is magnified to $c^2\gamma^2$. In this case $c^2 = 1$. If m_1 represents a unit mass, then the area of the small triangle represents kinetic energy of that mass.

The Lorentz factor squared γ^2 is a scaling factor $c^2/(c^2 - v^2)$, which is simply the relative magnitude of scales for a particle at rest, c as compared to the same particle as seen from the moving reference frame, with relative motion, v. It describes the distortion (contraction) caused by perceiving the image of a particle at rest from the moving reference frame and vice versa.

The practicality of the STM model

Is it practical to think of "past" time as the inverse of future time? My short answer of course is yes. What does not make sense is the idea of negative time. The use of numbers to represent time is the same as the use of numbers to represent objects or units of measurement. Objects and measures are numbered for the purpose of counting them. The number we assign does not represent the object. It represents a quantity. Negative represents a deficit or removal operation and you cannot remove time. Therefore the inverse operation is more appropriate to model the transformation that occurs after an observation transform energy into a wave function. Imagine a pulse of light traveling directly toward a quantum particle. Let's say it is 1 light-year away. Using a standard clock we say it will take 1 year to reach a point at which we stop the clock to define the interaction (event reference) with the particle. It makes perfect sense to use positive time and say that it is going to take 1 year (future tense) to travel the distance, but once it does, we now say that it travelled 1 light-year within that year. "Within that year" means per year and "per year" means inverse year, so it makes perfect sense to use the inverse when referring to the past. Then you might argue that this also applies when speaking of the future, by saying the next pulse is going to travel 1 light-year per year, but that refers to motion, not the future. Once you have observed it, it has happened, and the motion form of energy becomes the particle. The interaction is done. Now there is energy, information contained within the particle, which can be quantified by frequency. Potentiality has transformed into actuality.

The STM model provides a sensible explanation of quantum mechanics that is more practical than the Copenhagen interpretation. Graphically, the relativistic vector, which is projected outside of the quantum domain, is transformed into a phasor in the quantum polar domain. This also provides a practical interpretation of David Bohm's terminology (Bohm, 1980) referring to "enfolded" and "unfolded" order. We consider energy to be a process of unfolding events, but the events themselves become enfolded into quantum particles with each observation event. The diagonal vector in Figure 6 represents the projection of motion into the future. At the event reference, (at the point where $t = 1$ is reset to $t = 0$), time is enfolded or collapsed so graphically the vector is projected onto the S axis to equal the phasor magnitude. Yet the phasor, which is diagonal at $t = 0$ so that $ks = \omega t$ in equation (2), is different in phase so this gives it the appearance of spin. Therefore, what was the projected future is enfolded into the past at each observation event. Visually, we see it as a projection onto the space axis "unfolded" into a 3-D particle at a given location.

The STM model also makes sense of the speed of light being constant regardless of the speed of its source. Imagine you are that expanding sphere of light and you perceive yourself as a particle at rest. Now suppose that you flash a light. You would see light that seemed to be moving radially away from you at a constant speed. If I then come whizzing by you and flash my light bulb just as I meet you, and you measured the speed of my light sphere, you would not measure the sum of my speed and the speed of my light. It would be the same speed as the light that flashed from your bulb. That just doesn't make sense if the light photons are actually moving. According to the STM model, if you look at the problem from the perspective of the light, from its at-rest frame, it makes perfect sense. Light, whether it comes from my bulb or yours, is a disturbance in the field that does not move. When I flashed my bulb, you and I were at practically the same position. It appears to you to radiate out in all directions, but from the light sphere's perspective, it is not expanding; you and I are collapsing into its center. So the reason the speed of light is constant is because it is the real, fundamental constant – the only thing that is *not* moving. In a sense, it is not the speed of light expanding that we measure; it is the speed of darkness receding.

Continued research

The magnification or contraction discussed above is evident in nature. If we call the legs of the small triangle a (labeled c^2 in Figure 6), and the legs of the large triangle $a + b$ (labeled $c^2 - v^2$ in Figure 6), then the Lorentz factor is $\frac{a+b}{a}$, which is the definition of the "golden ratio", Φ, where $\Phi = \frac{a+b}{a} = \frac{a}{b}$. This condition identifies a threshold that may be related to the fine structure constant and threshold energy requirements of the photoelectric effect. These relations are the subjects of continued research[vi].

This perspective may also provide a practical model for understanding consciousness. With the transformation of darkness (the lack of information) into light (information) we become enlightened. As a quantum particle, I can be mathematically described as a wave function. And when I observe myself in motion relative to my surroundings, I define event references. I experience change as the passage of time and appear to have a definite, constant form in three-dimensional space. But when I observe the world around me, I am not observing myself. I'm projecting my awareness outward in space and time. So in essence, my wave function expands. I seem to be "out there" at one with my surroundings. I immediately correct myself, lest I lose my identity, and collapse back to my own, personal-event reference "here" and "now" and reflect inward toward my memory of my previous self. In physics it is very useful to model light as traveling from the source, reflecting off of objects and hitting the detector. But that model must be inverted if it is really the wave function of my body that is expanding and collapsing with each observation. What's wrong with saying that, as a collection of quantum particles, I expand (call me awareness) and collapse drawing in information that I perceive as light. Of course I also get information from the contrast between light and what appears to be dark. So in order to include both light and dark, it is better to refer to "*the field*" of vibrations. As Einstein said, "The field thus becomes an irreducible element of physical description." (Einstein, 1952, p. 150)

As I said, when any event happens, it can never “un-happen”. The information in every event does not just go away. So what happens to it? Don’t we carry information-storage molecules in every cell of our bodies? I propose that the information becomes an integral part of every cell. We know that DNA molecules contain all the information necessary to form, nourish, reproduce and heal the cell, but do we know where the information came from in the first place? And is the genetic code fixed for a particular organism or does it evolve so we can adapt?

If information from events around us collapses into and becomes part of the cells of our bodies, then every cell of a particular body would have nearly the exact same information, but a slightly different perspective than every other cell depending on its location and function in the body. It seems to agree with Karl Pribram’s “Holographic Hypothesis of Brain Function” (Pribram, 1984) to explain why memories cannot be eradicated by removing individual parts of the brain. This could be tested if there is a sensitive enough instrument to detect the minute differences, by using PCR[vii] to multiply DNA molecules from different parts of the body.

Finally, the STM model also helps to understand how physical form can be considered a holographic projection without having to refer to some black hole or the outer surface of the universe. (Suskind, 1995) Physical form is the manifestation or perception we observe (and measure) when motion separates the field into four base pairs (*s* and 1/s); (*t* and 1/t)[viii]. Each pair of inverses move in opposite fashions; as t increases, 1/t decreases so one moves outward as a quantum particle wave function and the other moves inward as the collapse of the same (and thus coherent) wave function modulated with information. However, the two domains are out of phase with each other. The vector represents the conformal projection and the phasor represents the reflection (in the past). So the boundary of every particle, transformed by the phase difference between the linear domain and the inverse quantum domain, is effectively the *holographic interference pattern* forming the apparent surface of the volume in space. This is the subject of continued research.[ix]

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Notes

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[i] "Any circle can be described uniquely by giving three points, but many different sets of three points give the same circle: the correspondence is many-to-one. However, circles are uniquely parameterized by giving their center and radius: this is two real parameters and one positive real
https://en.wikipedia.org/wiki/Moduli_space

[ii] This is also an exercise problem #2.7 in Michael A Morrison's text, Understanding Quantum Physics, pg 48

[iii] In Geometric (Clifford) Algebra, i is called a spinor that acts as a rotation operator to rotate an axis by 90°. Spinors are also used in quantum mechanics to operate on complex multi-dimensional tensors. It may be more complete to say it represents a "flipper-spinor" since $\left(i = \frac{i^2}{i} = -\frac{1}{i}\right)$.

[iv] The fact that the word "process" can be used as both verb and noun form is germane. The verb form of process refers to an action of change and the noun refers to an object such as a bony protrusion (e. g. spinal process). Perhaps it would be appropriate to call a quantum particle a "quantum process." This is much like the process philosophy of Alfred North Whitehead.

[v] Actually, "negative number" is a misnomer. Numbers are positive quantities. The negative sign is an operator that means something, like a deficit or removal of the quantity that the number quantified.

[vi] Report: "The Holomorphic Quantum Theory, Parts 1-4" at http://vixra.org/author/theodore_j_st_john

[vii] Polymerase chain reaction (PCR) is a technique used in molecular biology to amplify a single copy or a few copies of a segment of DNA across several orders of magnitude,

generating thousands to millions of copies of a particular DNA sequence. https://en.wikipedia.org/wiki/Polymerase_chain_reaction

viii This may also be related to the base pairs that make up DNA molecules.

ix Report: "The Holomorphic Process: Understanding the Holographic Nature of Reality as a Metamorphic Process" at http://vixra.org/author/theodore_j_st_john