The Holomorphic Quantum.

A Systems Approach to Understanding the Nature of Reality

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Abstract

Quantum Mechanics is appropriately named because it is mostly about the mechanics of working out probability problems as they apply to the mysterious effect of measurement that makes energy present as quantum particle-waves. It is easy to visualize a quantum particle but there seems to be no way to visualize a "probability wave" so there has never been a clear interpretation of what quantum physics tells us – or should tell us – about the underlying essence of reality. Fortunately, a new approach was discovered and proven to work in biology that threats the mystery of life like a locking system and provides not only the key, but also the keyhole and the direction in which to turn it.

In this paper the systems approach is introduced, including some background information on the history of how the systems approach integrated elements of substance philosophy with process philosophy and has become a powerful tool for use in science. Here, it is applied to physics and used to represent the transformation of implicit energy into an explicit space-time quantum domain superimposed on a relativistic time-space background. These two "products" are then correlated with two of four blocks in a basic control-system diagram (input and output) commonly used in control-systems engineering. (The four blocks are input, transfer function, output and feedback function) Because they are explicit, they can be drawn explicitly on the space versus time plot as a *map* of motion. We emphasize that this is a map – an *explicit projection* of an *implicit function* (in this case, a plot of space versus time is a projection of the variance we call motion) represented as an implicit domain (a perpendicular dimension). We recognizing that a feedback function is equivalent to and therefore *implies* a back-projection or reflection back "up" into that "implicate order." These two implicit functions (projection and

reflection) are then correlated with the transfer function and feedback function in the control system.

> *If I had an hour to solve a problem and my life depended on the solution, I would spend the first 55 minutes determining the proper question to ask, for once I know the proper question, I could solve the problem in less than five minutes.*
> *– Albert Einstein, (1879 - 1955)*

> *I have had a lifetime to solve the problem of understanding the underlying essence of reality and spent 55 years determining the proper question. I feel that I found the right question and solved the problem. Now, at the age of 60, I am still trying to spell it out as plainly as I can with the limited power of the English language supplemented by the language of science.*
> *– Theodore J. St. John (1960 – present)*

The motion function is related to the probability wave by the statistics name – the "variance" of a statistical distribution – and we point out that each axis of the space-time domain is scaled by standard "deviations," which define the explicit scales. Because a standard deviation is the square root of a variance, the square space that maps as a relativistic scalar plot (a standard Cartesian coordinate system) of space versus time or "space-time" actually represents one of two *square roots* of the implicit variance we call motion. Thus our measurements of this domain keep us *rooted* in physical reality. However, this coordinate system is shown to be just the root – one part of a "whole system" that includes a non-physical implicit feedback function. The feedback function is correlated with the "reflection" of the explicit domain, i.e. inverse-space and inverse-time, presented as a phase space called time-space and represented as a unit of spatial frequency versus temporal frequency.

These frequency representations are shown to be the two well-known equations for quantum energy from quantum mechanics and they are used to identify energy-space as "the quantum domain" inside of, or superimposed on the background "relativistic domain," which is a scalar space These two domains are then shown to be coupled at the point where both scales are equal to "1". As a whole, and in the language of quantum field theory, this model is a graphical representation of an energy-momentum tensor and as a visual model, it provides a clear conceptual interpretation of complexity theory, in which reality is expressed as the superposition of a self-organizing control system that convolves with a dissipative open system or "sea of disorder" and transforms it into physical units of order.

This approach reveals that the question about the beginning of time is a question fallacy, by revealing the equivalence of space and time as $S = Tc^2$, and presents it geometrically to be the exact same relation as the mass-energy equivalence equation $E = mc^2$. The model also reveals that quantized energy projects as a *characteristic* and allows one to visualize the solution to the particle-wave duality "problem" as being a change in perspective. It's the change in perspective that makes the particle-like property and wave-like property appear as "emergent" – analogous to what would appear when one visualizes an object from two different perspectives – *at rest* with respect to one's own body yet *in motion* relative to some other "moving" body.

The approach also reveals how the transfer function and feedback function act to transform matter, adding the fourth component (the Controller) and making it a complete control system: a self-organizing, self-sensing system that can see itself explicitly and reflect upon itself implicitly. How that correlates with living systems becomes obvious.

Introduction

A systems view of physics

This presentation makes use of a new perspective in science called a "systems view of reality" (Capra and Luisi, The Systems View of Life, A Unifying Vision 2014) to present a working process model that will help in understanding physics, including quantum and relativistic mechanics. Most people are aware that the discovery of quantum physics around 1900 marked the beginning of a scientific revolution, but many do not know much about some real breakthroughs that began in the early 1960s with the discovery that there is order in chaos, or to say it another way, the order that we see in our world emerges out of disorder. The breakthrough was in the discovery that systems with feedback, whether it is a physical connection or just the atmospheric surroundings, is the key component that allows any system to find its own order. This discovery led to a breakthrough in mathematics with the formulation of complexity theory, technically known as "nonlinear dynamics" in the 1960s and 1970s. During the 1980s and 1990s, complexity theory was welcomed into the biological sciences and "the strong interest in nonlinear phenomena generated a whole series of new and powerful theoretical models that have dramatically increased our understanding of many key characteristics of life." (Capra and Luisi, The Systems View of Life, A Unifying Vision 2014, Pg. 12)

For the first time in history since the advent of Newtonian physics, serious scientists have broken free of the restrictions that forbid discussion and consideration of metaphysical ideas and have since discovered that this new degree of freedom has resulted in meta-science – a science that is beyond modern science – a very scientific approach to understanding meta-phenomena like metabolism and metamorphoses. It is currently being used to develop cybernetics, artificial intelligence and in cognitive science research, providing breakthroughs in the understanding of consciousness. This essay presents a meta-scientific model, called the holomorphic quantum systems model that uses feedback from these areas and applies this *systems approach* to reshape the way we look at physics.

What we call "modern physics" (Anderson 1982) usually refers to the conceptual developments of the twentieth century in contrast to "classical physics," which includes all physics that was conceived prior to 1900. Modern physics did not render classical physics obsolete, out-of-touch or even old-fashioned. In fact, most of the problems of our everyday world can still be solved with classical physics. At the time when quantum phenomena were discovered, it was just the newest thing that physicists wanted to understand. Unfortunately, after 100 years of work, there is still a significant problem with understanding it.

The Copenhagen interpretation of quantum physics has been, and still is the most widely accepted explanation of quantum phenomena. Treating the quantum wave function as a probability wave is mathematically simple, accurate and very useful, so there doesn't seem to be a need to fix it. However, in a recent study on the effectiveness of teaching and learning quantum mechanics, it was found that there are significant misconceptions and a variety of mixed interpretations of quantum concepts. (Krijten-Lewerissa, et al. 2017) The study also concluded that the most effective teaching methods placed emphasis upon visualization and conceptual understanding, and that this approach has made it possible to introduce quantum mechanics at an earlier stage. But visualization means "the formation of a mental image of something," so if the concept that you are trying to understand has no form, it is impossible to visualize without using analogies that have form. The challenge for the teacher is to give it form because when they do, they create the classical misconceptions. The systems view provides a solution as a *meta-form*, i.e. a metaphor.

Mathematicians may be perfectly comfortable visualizing quantum phenomena as groups of matrices, but that is very unsatisfying to some, especially at the undergraduate level. So rather than trying to visualize the quantum, or memorize matrices, some teachers have us settle for visualizing a series of mysterious boxes, even the meat grinder analogy (Morrison 1990, Pg. 5) that have inputs and outputs, ignoring what happens inside the boxes. This is a little more satisfying because, even though they don't fully understand the quantum, or what goes on inside the box, they understand that it is a ***process***.

The *new way* of thinking about reality in terms of feedback systems has gotten the attention of many mainstream physicists, including the author of this paper. In fact, the very notion of this new information getting one's attention and serving to modify the way one thinks about an old concept, is an illustration of a feedback system at work. Normally the feedback in a system mixes with the input to produce a modified output signal, and that is what usually happens in research; a new output is just an addition or slight modification to the current branch of science. However, in some systems, there comes a time when the system reaches a critical point and requires a shift, like the paradigm shift that gave birth to modern physics. Likewise, the systems way of thinking requires a shift in the way we think about reality. This perspective is a strategic point of view that transcends the space-time and time-space domains, making this a scientific treatise on metaphysics – emphasizing that "meta" means *beyond,* not mysterious, esoteric, pseudo or woowoo.

The primary characteristic feature of systems thinking is that rather than thinking of smaller substances as fundamental bases or constituents of reality, it focuses on *process* as the *basis* for substance. Once the systems approach (as applied to quantum phenomena) is understood, other "theories" and specialized branches of physics can be seen in the same light. The same approach may then be applied to them, and *the different way of looking at physics* will change physics as a whole[i] from a substance-based philosophy to a systems-based philosophy.

Substance philosophy was the basis for mechanistic science; it focused on static physical properties of matter and was used to build the structure and establish all branches in "the tree" of science. About the same time that quantum physics arrived on the scene, *Process Philosophy*, which focuses on the physics of *becoming* as opposed to the physics of *being,* took its place and played its new, albeit minor role in forming "the tree." It is a new role, but not a new philosophy. Process philosophy stems back in history as far as substance philosophy to include the pre-Socratic philosopher Heraclitus of Ephesus (c. 535 – c. 475 BC). In the early twentieth century, it was applied to mathematics by Alfred North Whitehead and Bertrand Russell in their seminal book *Principia Mathematica*, and extended to the natural sciences by Whitehead in his book *Process and Reality*. (Whitehead 1929) However, it still had more of a teleological spin to it and remained separated from mainstream science.

On the other hand, application of process philosophy to life eventually made its way into the mainstream (Eastman and Keeton 2004) and began to revolutionize biological science. (Varela and Maturana 1972/1980) In the early 1900s the structure of Biology had been established, thanks to the mechanistic substance philosophy, and provided the means for understanding structures and functions of biological cells' subunits. Biological units had been studied in parallel, but biologists recognized that this approach failed to provide any explanation for how those functions were coordinated or integrated into the functioning of a cell as a whole. Then when these systems and subsystems were viewed as parts of a common *process*, they were seen as multilevel structures – systems within systems. The transformation of the process from a lower-level system to a higher level was seen to result in morphism – a change in physical form. "Process morphology" then refers to the notion that living structures such as leaves of plants do not *have* processes, they *are* processes. They recognized how the process of morphism was a type of self-organization and the school of thought that became known as "organicism" or "organismic biology" focused on organization and organizing relations.

The shape of things to come

Researchers noted that processes, which emerge at higher levels, were the same as underlying processes yet the emergent *properties* were different than the properties known to exist at lower levels. This clearly suggests that the process is more fundamental than the substance, as philosopher C. D. Broad (1887-1971) had explained in the early 1920s when he coined the term "emergent properties." This idea was not very relevant to physics because in physics, a property is considered to be static, i.e. the unchanging characteristic that defines a substance, *not* something that can emerge, or disappear. That is what is changing in the minds of the new systems-minded physicists. What used to be considered a fundamental property is now considered a phase characteristic, which is something that is common to biology, psychology and even teleology, where characteristic is seen as a "character role." So if we were to identify a *paradigm shift* between "old physics" (to include both classical physics and modern physics) and the new physics of wholeness, this would be it.

Quantum physics recognizes the fact that energy changes its role (particle or wave) depending on how *the observer* takes a measurement, so the observer must be included as another character. Furthermore, the observer can also change his character role from operational (or tactical, down in the weeds of chaos) to strategic (elevated, bird's eye view from where islands of order can be seen). These two are more like *functional* roles than supporting roles. As the systems approach continues to *prove itself* in other applications, physicists have begun to see the common threats and patterns, and recognize that the same patterns are evident in other sub branches of physics. Upon reflection, more common patterns will be seen and it will become clear that the same phenomena had been given different names simply because they were not understood when they were named and that seemed to hide the underlying process. Some things in physics, like units (Newtons of force, Coulombs of charge), or spaces (like Cartesian or Hilbert space) were named after the person who formulated the theory, and thus the names have nothing to do with the process.

As the *inner workings of the process* are understood and validated and the same characteristics of the process are seen in other areas of science, it is really just a matter of *translating* from that model to the others and from one branch of science to another. Rather than resisting the idea of a changing property of matter, a physicist can see it, not as a contradiction, but as a change in the *implied meaning* of the word that was previously used. Rather than thinking of the fundamental properties of matter as being static or eternal, we can think of them as "emergent properties" – an explicit product of an implicit process.

What is meant by the *inner workings of the process,* in the first line of the paragraph above? Is there a single inner process that works in every living process – a "mono-process" that all processes can be reduced to that will correlate with the fundamental properties expressed as the standard model of particle physics? In order to answer these questions, we will need to distinguish between a process and the *products* of a process. A process is implicit whereas the products are explicit units that capture the process "in a nutshell"; they are explicit component models of the process. Regardless of what scale we are talking about, from quantum particles, to regular life-sized objects that obey the laws of classical physics, physical systems are explicit *models* that express (like a metaphor) the same mono-process, which will be presented in the next section.

An explicit model of a system

The trick to expressing something implicit as a set of explicit steps is to choose the right names for the steps. The right names are names that express the implicit *action* as explicit *things* that appear or emerge at explicit locations. That way, we express (action) an expression (thing) as a model. The standard model used in engineering for a control system – what we could call a "mono-process" – is shown in Figure 1, where input, output, controller and feedback are the standard explicit names (things) used for the inner workings (actions) at each location. (Ogata 1970, Pg. 4) The symbols *explicitly* identify each function and imply or *implicitly express* what the function is doing (explicitly represented by arrows) and where it is located in the process (presented by the process yet re-presented by words, names, lines and blocks). Together these descriptions reveal a dualistic nature (implicit and explicit) and "character" of the system as a whole is explicitly identified in its own box, named "Function."

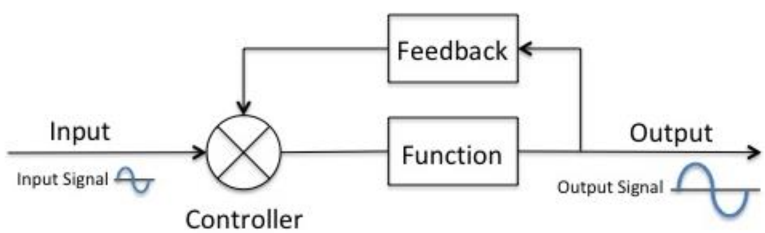


Figure 1 Block diagram of a simple closed-loop system

The process of drawing Figure 1 involved "scribing" the static lines and shapes and then "de-scribing" using dynamic words to express the *character roles* that the process requires. It is easier to describe "the function" when it is expressed by an electronic system or control "circuit" because there, it is called a "signal" and it is easy to imagine a vibrational pattern or modulated wave passing through and around an electronic circuit. As an observer, looking at it and reading the description, you the reader implicitly "connected" with the system at "the output" and "the signal" was effectively transmitted, transformed and translated into your mind. If you were one who read the first version of this presentation and gave the author feedback "signals," then you would fit in the *feedback* block of the system that created this thesis and helped give it its current emergent characteristics.

"The character" of something is equivalent to an explicit property – the static form of its "characteristics" – and the name or label "scribes" *where* it is in the system. What it *does* is the implicit, dynamic function – equivalent to momentum in physics. The process makes the signal appear to change its *character role in the system* depending on how and where one looks at it in the system. Thus "the output" is exactly the same *signal* as "the input" with the same directional *attitude*, but it has a new "emergent character" (as if the same signal plays another role in a different location).

In Figure 1, the output signal is drawn to show a higher degree of amplitude, and we don't consider amplitude to be a different "property" in physics. On the other hand, if the output of this system is connected to the input of another and the higher degree of amplitude reaches a critical point that is characteristic of that system, then the output of the whole will change and appear as a new "emergent property." Now if we follow this logic "downward" or "inward" to the quantum level, where the "inner workings of the process" are purely implicit (vibrations), we can see how this process would account for all of the slightly different characteristics of elementary quantum particles. Then, as the process produces an upward cascade or "bubbling" of new emergent properties, it can account for the periodic structure of the table of elements and all of the different properties of matter, as suggested by Cahill. (Cahill 2005)

Three components (input, output and feedback) were all that was needed to make a closed-loop system, but the feedback has to "feed" the input, which is a function. Or we could say that the input line has to accept or even "eat" the feedback and this is the function of the fourth component labeled "Controller" in Figure 1. At the quantum level we call this controller a "quantum operator" and the "transfer function" component is correlates with the "quantum wave function".

The fact that there is a physical reality for us to even talk about means that the quantum system is already "up and running." We are physically part of the system, our bodies being made up of the explicit "output" particles that play the tactical role as operators. And we are implicitly part of the system, our minds being able to look down at the circuit from the elevated strategic perspective and analyze it *as if* we were explicit components, separate from yet implicitly connected via signals fed back to us as Controllers from a higher dimension. In the literature referenced by Capra and Luisi, this is referred to as downward causation.

The systems approach allows us to distinguish living organisms from non-living matter by referring to this feedback link as its own controller. Non-living refers to the organized patterns of energy that are components within a larger system and actively being maintained in static equilibrium by interacting with each other from the outside. We think of this as an open system, and it appears to be in *static* equilibrium because we cannot actually see the activity or the feedback without zooming in and looking beneath the surface of what *appears* to be the static boundary. Quantum physicists have done that so even though we can't see it, we know that what we call non-living matter is still a projection of the quantum process. It is simply the most elementary level and lacks the self-controller. We call living matter "organisms" because they (we) are able take action that will affect our own organization, to self-organize (called "autopoiesis"), self-adapt and even self-destruct. At this level, the feedback and controller serve to *form* and *inform* the system and equilibrium is called homeostasis.

The systems approach also allows us to distinguish between organisms that are *self-conscious* and those that are just *conscious*. Once an organism is "born" or the system is "up and running" – differentiated from the parent and "projected" as a self-organizing system, it has a property that lower systems lack. That property correlates with what we call consciousness. It's what puts the "self" in self-organizing. It can form itself and reform itself to maintain its structure, *acting* in self-interest and *reacting* to outside interactions, but it cannot rise above its own plane to see its "insides" and therefore cannot *in-form* itself. In other words, it is conscious but not self-conscious, i.e. conscious of its own consciousness. In order to be self-conscious, it would need for a new, parallel output signal to emerge as an implicit feedback network that serves as a reflective property, a mirror image of itself that could provide a higher perspective and *inform* itself from the higher dimension.

As we mentioned, these ideas have been serving to advance biology and cognitive science. There are plenty of manmade systems that could serve as metaphors, like an electronic transceiver circuit, but there are also natural systems that are even better. We could say that the ideas have been fermenting and need to be distilled and expressed in the *spirit* (like alcohol) of both classical and quantum physics. One systems-minded physicist goes even further out on a limb and refers to ancient mystery teachings and expresses the mystery in terms of the alchemical process of transformation. (Bullard 2012) The new "systems science" intentionally makes use of many metaphors. This is because *metaphors are models* that allow one to express the *spirit* (the implicit free-space connection) of the underlying process rather than focusing on the physical substance or branch of science being used as an explicit model. This allows us to extend our basic concepts, initially embodied by physical matter, into abstract theoretical domains. Metaphorically speaking, substance philosophy provides *the lock and key* and process philosophy provides *the keyhole and direction* in which to turn the key. Both are *necessary* to unlock the mysteries of the universe.

Organization

As a whole, presentation of the system approach is organized into four parts, to express four fundamental functions in the process. These functions were expressed in the previous section as 1) Input, 2) Transfer Function, 3), Feedback and 4) Output. Recall that "Controller" is not included, because it is considered a higher-level function that emerges at the next level. The four functions have been previously described as steps, expressed as 1) separation, 2) projection, 3) reflection, and 4) reintegration[ii] and the process model was called the "Holomorphic Process Model". (St.John 2018)

The holomorphic process terminology can be applied to the previous section of this paper by saying that it (the section itself) represented a "separation" from the current mainstream or modern way of thinking about physics and a "projection" of the new systems way of thinking. The next section of this presentation will play the role of *reflection* (the third step of the holomorphic process); we will reflect on the old, using an explicit graph to visually represent the relationships between space, time and motion. In this reflection, we point out the distortions caused by thinking in terms of unity rather than wholeness. “Unity” in physics is expressed as a “singularity” and will be called “the zero-point problem” here. We will eliminate the problem by *reintegrating* (the fourth step of the holomorphic process) the variables space and time and refer them back to motion as the higher dimension. We will also reintegrate quantum mechanics with probability theory by reflecting on terms from statistics correlating “variables” in each physics dimension with *variances* and recognize that variables were actually units of standard deviation, separated by how they appeared from different perspectives and thus projected or expressed differently and given different names.

Next, we will reintegrate the two expressions (variance as a whole and variables as measurable units) as a composite diagram to present motion as a projection of energy in the time-space and space-time. This composite diagram will

1. demonstrate space-time equivalence as $\boldsymbol{S = Tc^2}$: exactly the same relation as $\boldsymbol{E = mc^2}$
2. make the zero-point problem a non-issue (no singularity) yet allow for an understanding of zero-point energy,
3. reveal the relativistic equations for energy of a quantum particle as two components (state vectors) of a quantum wave function (a composite space-time vector).
4. allow one to visualize the particle-wave duality as a *duality in perspective* of a non-dualistic or undifferentiated whole, the same as you can visualize an object both at rest yet simultaneously in motion with respect to a moving reference,
5. re-present the background (free-space and objects in time-space) as being an integral part of the whole *system*, giving *the observer* the potential or *power*

to see it as either a stationary object (particulate form) or as an integral part of the entire universe (system form), and

6. provide a structural framework for representing the quantum particle as a holographic image that takes form as a spherical standing wave – "an island of order in a sea of disorder." (Capra and Luisi, The Systems View of Life, A Unifying Vision 2014, Pg. 116 & 160)

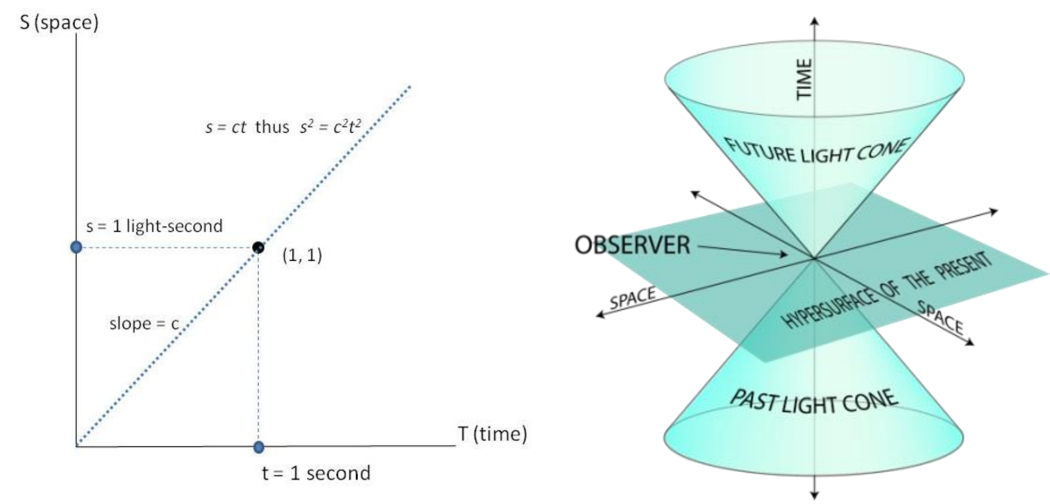
The Space-Time-Motion Diagram

Reflecting on Minkowski space-time

To set up the visual model, we begin with a graph of the variable (or *variance*) we call space ($S = s^2$) versus *the variance* we call time ($T = t^2$) as in Figure 2a. The only difference between Figure 2a and the old, standard Cartesian map is that we recognize space and time as implicit variances rather than explicit variable measurements, which in the language of statistics would be called standard deviations. We imagine a flash of light at the origin that expands spherically outward in space ($S = s^2 = x^2 + y^2 + z^2$) at the speed of light $s^2 = c^2 t^2$. Thus $S = CT$ is represented by the diagonal line (with $C = c^2 = 1$ in "natural units") from the origin. So when the clock ticks 1 time unit, (a *coordinate point* on the T axis), the plot of the function must be moved out on the diagonal to correlate with the movement of the surface of the light sphere to 1 "light unit". This point can also be projected to a coordinate on the S axis as a *reflection* of outward motion in space.

In mathematical language, upper case S and T would be called the *modulus* of space and the *modulus* of time, where $S = s^2$ and $T = t^2$ are "square spaces" meaning that they require at least 2 dimensions to describe them. Therefore the plane as a whole represents a 4-dimensional domain. The S is the variance we call "space" and we see it as it exists in time, so technically, we should call it "time-space." The T is the variance we call "time" and is correlated with this particular use of the word "space", so technically we should call it *space-time*. We will explain what is meant by "this particular use of the word space" below.

Some readers may be familiar with the Minkowski spacetime (ST) formalism, which was explicitly named by mathematician Hermann Minkowski (1864-1909) and used by Albert Einstein (1879-1955) to illustrate this newly conceived concept of "spacetime" as a four-dimensional continuum. However, it was presented as a model before the importance of the systems approach was realized, so there was no reason to differentiate between time-space and space-time. Calling it "spacetime" was just an attempt to *reunify* space and time rather than *reintegrating* them as a whole, despite the fact that it required a four-dimensional expression. Now that the systems way of thinking has proved itself in other areas of science, and demonstrated the importance of understanding that the whole is greater than the sum of its parts, it is important for the physics branch of science to accept the feedback and be willing to adapt its language and reform to the new perspective.



a. b.

Figure 2 **(a) A plot in natural units (c=1) of space vs. time that illustrates that a light-unit travels or "varies" 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 represent the past as negative time and the future as positive time. However the ability to visualize the relations with this graph has failed since space is represented as a 2D "hypersurface of the present".**

Time-space versus phase-space

We will return to Figure 2a and 2b, but first we need to understand the reason that it is important to differentiate between space-time and time-space. Firstly, the term "time-space" specifies a *type* of space. This is important to realize because there are different types of spaces other than "this particular use of the word space". For example "phase-space" refers to an explicit representation of a system that forms an organized pattern. It's a phase because a particular pattern or property relates it to a characteristic *phase*. There is no *fundamental* difference between time-space and phase-space, so we shouldn't think in terms of some mysterious parallel universe. It's all the same "free-space" in reality, but in practice, and as an expression of information, the *type* expresses the difference, and it's *the difference that makes a difference* in our understanding of the phenomena they represent. Time-space is what we would normally use to plot some measurable deviation with respect to standard clock-time. Phase-space is used to plot a variance that happens in cycles in order to analyze if something changes after a certain number of cycles or at certain *critical* values of another variance like amplitude. Rather than using time as the horizontal axis, time is used along with angular frequency to scale the angle. The space is then presented as a phase-space diagram.

A phase-space diagram is also called a "phasor diagram" and is commonly used in engineering, but not generally in physics. A "phasor," or phase vector, represents a wave of constant amplitude (A) and two rotating phasors of length A (one for spatial measurement and the other for temporal measurement) point out from the origin like the hands of a clock with both hands the same length. They are usually shown as a single vector because they start at the same angle, corresponding to $\Delta s = 0$ and $\Delta t = 0$.

We should also discuss different kinds of time, but since units of time are explicit expressions of implicit concepts like change, motion, etc. it cannot be visualized as anything other than a "point," so time is expressed as "a point in time." We ignore the fact that something is happening between each tick of the clock even though we know that clocks are based on cycles. We could call it "*blank*-time" and then fill in the blank to specify the chosen cycle, but instead we call it *space*-time. If we used a pendulum we could use of a unit of "pendulum-time": the pendulum swings down from an initial height, where it had zero velocity and maximum negative angle, to a low-point where it has maximum velocity and zero angle, and then up to the opposite-side to its a stopping point, where it again has zero velocity. If we then plot velocity (positive or negative) versus angle (positive or negative) and scale each axis appropriately, we would produce a circular trajectory in phase-space, which would describe the pendulum's state of motion completely.

Phase-space diagrams project time explicitly as a shaped unit of motion. Generic time-space (or clock-space) projects time explicitly as a circular-shaped unit of motion; a circular clock is just like a pendulum that goes all the way around. If we turn that last statement around, we could say that space-time projects motion (or vibration) explicitly as a shaped unit of time, which implies that <u>a particle in space is a *shaped unit of time-space*</u> whose size is determined by the frequency of vibration. If one understands Fourier analysis or even FM radio signals, this also implies that complex molecular shapes can be expressed as frequency-modulated spherical waves. That is exactly how quantum numbers were determined and used to reform the modern version of the periodic table of elements. With that in mind, it is easy to envision physical reality in terms of information content and the shape of particles to have *intension* in the same sense that words express *intention*.

Variance re-presented in phase-space

We can now return to Figure 2a and re-present it as a phase space. As we have mentioned, light is a variance and though we are in the habit of saying that light travels through space and time, it is equally correct to say that it *varies* in the form of space-time and time-space. As variances, $S = s^2$ and $T = t^2$ are always positive, and neither are directly measurable. It was also mentioned that a variance is represented as a square space and therefore, a *measurement* is the square-root of the variance, which is the standard deviation. In the square time-space, $S = s^2$, lower case s represents the standardized unit of deviation from the origin, i.e. the *spatial radius* of the light sphere and therefore, the distance that the surface of the sphere travels or varies outward in *time-space form* for a given amount of space-time. Thus 1 unit of light represents the variance we call motion of 1 unit in space-time form (1 light-year) per unit of time-space form (1 year). And the unit of time (year) cancels because it is expressed in both the numerator and denominator of the ratio. It is just a dummy variable "unfolded" like a jack-knife (alluding to David Bohm's term of "enfolded" in the implicate order (Bohm 1980)) and used like a balanced-scale measuring tool to express the implicit nature of motion referenced to our standard clock-time-space.

Likewise, the same amount of positive standardized deviation in square space-time, $T = t^2$, is lower case *t*. This unit represents the *temporal* radius of the same light-sphere that correlates with a given amount of time-space. Like all standard deviations, both scales are positive, but if we were physically standing with the light bulb when it flashed and were interested in using either of these standard measuring tools, we would simply unfold them, *pretend* that we were the center of the universe by setting $t = 0$ and $s = 0$, arbitrarily assign polarity to the axes and then flash the light and measure how it momentarily *separates* itself (divides itself into our perception of quantum-sized space-time units).

In Figure 2b as compared to Figure 2a, the axes are rotated (time is vertical and space horizontal) to show the Minkowski diagram as it is normally presented. It is important to emphasize that the relation $s = ct$ as it is normally expressed represents the radius as a single dimension in space that increases with time, also as a single dimension. Minkowski treated time in the classical manner, as if it is actually one-dimensional – independent of space – so he used *t*, which is $\pm\sqrt{T}$ and claimed (*a priori*) that the negative (polarized) axis represents the "past". This was the conventional wisdom of the time. Then he represented 3D space unconventionally as *two-dimensional* on the same diagram, portrayed as a "hypersurface of the present" – a square-space. It wouldn't have made sense to polarize those axes, so he didn't. There may not be any rule against that for mathematicians, but for physics it *disables* the model in that it prevents us from visualizing the relations with angles. It was already out of balance, and acted like a warped mirror or broken record. In other words, the Minkowski diagram was broken and no longer a *working* model.

Points in this "Minkowski-space" correspond to events in spacetime and there is one light-cone associated with every single event. The intersection of the time axis with the "hypersurface" represent a special event, i.e. the present "now" at $t = 0$ and it creates the zero point problem – a singularity. It is purely a mathematical problem because motion is a variance in space Δs divided by a variance in time Δt and the expression $t = 0$, which should actually be written as $\Delta t = 0$, specifically suggests that there is no variance in time at that point. So the definition itself doesn't work at that position in time-space.

Next in his explanation of spacetime, the equation ($s^2 = c^2t^2$) was expanded on one side to give ($x^2+y^2+z^2 = c^2t^2$) and rearranged to give the four-dimensional spacetime manifold $x^2+y^2+z^2 - t^2 = 0$, with $c = 1$. No physicist or mathematician would blink an eye at 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 even if we don't know what time really is, "everyone knows" that time *must be treated* as one scalar dimension. So time is treated as the forth element of a "quaternion."

Progress in mathematical physics from there required even more abstract algebra and got so hairy that physicists and mathematicians failed to see eye-to-eye. In fact, there was a long period in history when the physics and math departments quit talking to each other[iii]. Physicists with "common sense" couldn't challenge the wild new implications of the math and there was no place in the academic world for a hybrid mathematician/physicist even up to the 1970s. (Gleick 1987, Pg. 66) Eventually, certain mathematicians began calling themselves "mathematical physicists" and used the power of computer modeling to convince academia (and organizations that provided funding for research) that the images they generated were real. So now, challenging them is a financial issue. However, some scientists have begun to challenge them. Jim Baggott, for example with his book, *Farewell to reality. How Modern Physics Has Betrayed the Search for Scientific Truth* (Baggott 2013) and Lee Smolin, a physicist who sent out a plea for help in his book, *The*

Trouble With Physics saying that this generation has failed to make any significant contribution to science or society. (Smolin 2006)

The trouble, I submit, is that they are still thinking of time as an independent entity. There are several different opinions about what that "entity" we call time might be (Barbour 1999) (Burtt 2003) (Hawking 1990) (Smolin 2013)[iv] rather than what it *means* or *implies*, but in classrooms it is still treated classically – as a mysterious "thing" that somehow mixes with space to give us spacetime. The solution to the problem proposed here is this; rather than trying to answer the question, "What is time?" we change the question to "What is the *meaning* of the word time?" And the answer is, as we already expressed, it means we have a tool that we can unfold and use to express reality and thereby increase our level of knowledge and expand our *time-space sphere* of knowledge.

Reflecting on the symmetry of space and time

Interpreting time in terms of cyclic units is not a new idea. In fact, we have actually come full circle if one considers that cyclic time, based on the cycles of the sun and moon, is the original and most obvious approach. According to philosopher E. A. Burtt, in the days of Newton the treatment of time as an independent entity was considered by many to be a philosophical blunder. In *Metaphysical Foundations of Modern Science* (Burtt 2003), Burtt said:

> *"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."*

If time is a measure of motion, you cannot treat time as one-dimensional while treating space as three. Motion in space ***is*** motion in time and vice versa (like sand through an hour glass or the cyclic motion of the sun or a pendulum). They are equivalent yet different characteristics of the same abstract essence. If the expression for time-space (radius of the sphere) is unfolded to represent three orthogonal dimensions, then the same must be done for space-time. In equation format this is $s^2 = x^2+y^2+z^2 = c^2(t_x^2 + t_y^2 + t_z^2)$. If not, then they both must be kept enfolded[v]. Writing the equation $s^2 = c^2t^2$ as

$$\boldsymbol{S = Tc^2} \tag{1}$$

means that space and time are equivalent, just as

$$\boldsymbol{E = Mc^2} \tag{2}$$

means that energy and mass are equivalent. The term c^2 is just the conversion factor that comes from arbitrary units of measurement (meters, miles, seconds, years, etc). In natural units, it is just 1.0 light unit.

Looking at things from a different perspective, consider the "inverse problem," i.e. the multiplicative inverse of the equation $s = ct$, that is, $\frac{1}{t} = c\frac{1}{s}$. In terms of frequency, which is another name for a variance that is more akin to "motion", this is

$$f_t = cf_s \tag{3}$$

where $\frac{1}{t} = f_t$ is temporal frequency and $\frac{1}{s} = f_s$ is spatial frequency. In essence, frequency is *the reflection* in both space and time. Notice how the subscripts specify the *type* of frequency we are talking about giving them similar *intension* as time-space and space-time without having to express them as a pair of opposites, which was necessary in the separation phase, when motion was separated and projected onto the two-dimensional map. Frequency is therefore a back-projection into the same *third conceptual dimension* as motion through which the other two can be reflected and reintegrated.

When plotted on a space-time diagram, as shown in Figure 3, the line with slope (c) represents the exact same line as in Figure 2a. In both cases, it represents a conformal projection of the three-dimensional variance (energy in the motion domain) onto the two-dimensional plane separated into a *quantum domain* and *relativistic domain*. Because we understand that this third dimension is an integral part of the model as a whole, we call it the Space-Time-Motion (STM) diagram.

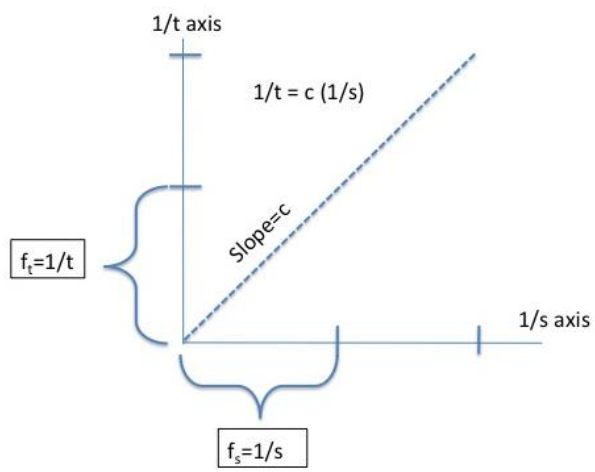


Figure 3 The Inverse Problem: Inverse time versus inverse space $\frac{1}{t} = c\frac{1}{s}$, is the same as temporal frequency versus spatial frequency or $f_t = cf_s$.

Notice that other than zero, which represents no variance, no energy and therefore nothingness, there is one and only one point on either axis that correlates with both domains and is numerically equal; that is at the first increment, i.e. 1 unit. That is where we would have said that the two domains are *coupled* when we looked at them as being separate "entities" from our previously separated point of view.

Coupled domains

Normally when we make graphs, like S vs. T we are taught to represent them as perpendicular axes and connect i.e. *couple* them by intersecting them where they are numerically equal to zero. We call it "the origin" and it is just a reference point, but if zero represents "nothing" in either domain, then this suggests that there is nothing there in either domain to couple them. Nothing means no "thing" and since all things are projections of energy, it would be more appropriate to call that point the "zero-point-energy reference". It's "the nothing" that got captured or encapsulated by "the something" that became a quantum energy or frequency domain. In the light of this new perspective, what we were really doing with a Cartesian plot of space versus time was treating the quantum domain as if it were an infinitesimal circle to use as a "trick" for solving the problem, by pretending we could stop time and define $t = 0$ and then ignoring it. If we needed a measure of motion at an explicit "quantum moment" in time, we would pull out the trick, differentiate the function and get instantaneous velocity as the output. That trick is a standard procedure in Calculus: take the limit as *t approaches* zero, i.e. we take the derivative.

In terms of the systems approach, we can consider velocity to be the product of two coupled systems. It's the *product* of the system, i.e. multiplication, because it is produced by the spatial motion system, which produces an output variance of (Δs) coupled with a temporal motion system whose output variance is $\left(\frac{1}{\Delta t}\right)$. We would say that "the output" or "the derivative" of motion is *derived from* this interaction as a product that is expressed at the output of the combined system. Then it is rescaled and represented by a symbol (v or c) and projected onto the conformal map in the *shape* of a diagonal line (the diagonal line in Figure 3).

This could be expressed in terms of quantum mechanics as follows: the wave function is operated on by the "energy operator" and then transferred or transformed by the eigenfunction to its time-space form as a quantum unit of instantaneous time-space energy ($E_s = hf_s$). (Since we haven't yet introduced the concept of time, it is expressed as a time-independent state by the time-independent Schrodinger equation). We *could* represent this explicit function as a plane with E_s as the vertical axis and f_s as the horizontal axis, but what would be the use? It would be a static and meaningless picture. It has the potential to *work* as a model of energy (recall that energy is defined as the ability to do work), but in order for it to *actually work* we also need to represent time. Time is not an illusion; it is the dynamic expression of action that gives life to the static expression, which is lame without it.

In quantum mechanics, time is introduced by a "time-evolution operator," which, after some complex mathematical manipulations in Dirac notation, turns out to be the same as the Hamiltonian representing the total energy of the system (Goswami 1992, Pg. 126-128). The result is the time-dependent form of the Schrodinger equation, which is the quantum wave function that lends itself to being "collapsed" into an instantaneous space-time form: in other words, a quantum unit of energy expressed in a unit of space-time. Here we will use the expression ($E_t = hf_t$) to represent the space-time form of energy and superimpose a plane of space-time energy over the time-space energy plane already discussed. Then we remove the subscripts that distinguish energy as being spatial versus temporal and the result is shown as the STM diagram in Figure 4.

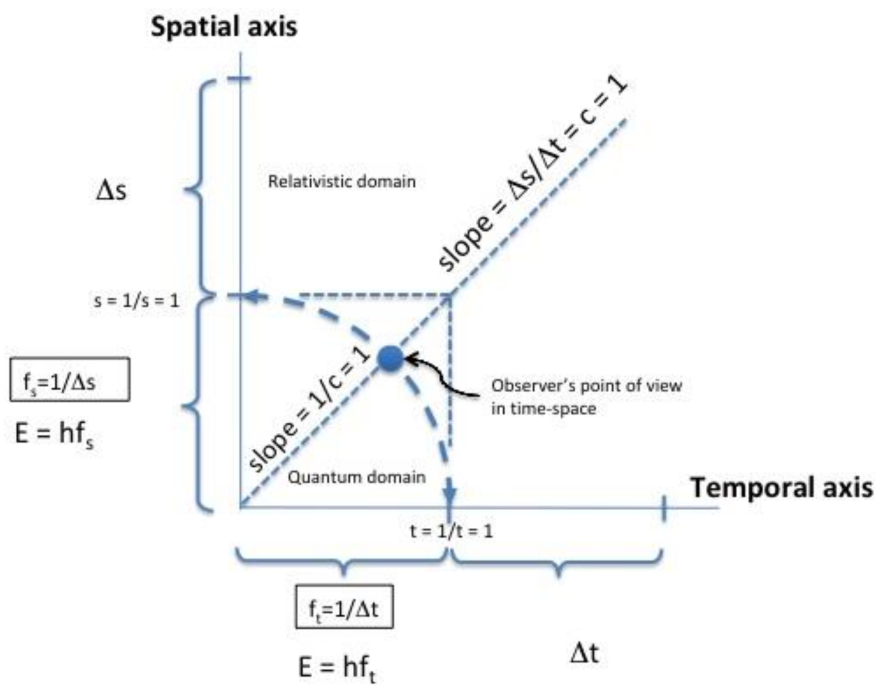


Figure 4 The inverse temporal domain scaled by Planck's constant is the energy of a quantum unit.

In this form the STM diagram represents reality as a self-organizing control system with a dashed circular shape drawn to represent an implicit boundary that *has the potential* to separate the quantum domain from the relativistic domain. In quantum mechanics, we call that a "potential well." This can be compared to the system diagram shown in Figure 1. The background relativistic plane is the open system into which "output" energy flows but then implicitly feeds back to the "input" due to the fact that the quantum domain is an integral part of and therefore superimposed on the background plane. That portion of the background ("behind" the quantum domain) correlates with the feedback branch in Figure 1. Thus we have accounted for an input, output and feedback branch. So what parts of Figure 4 correlate with "controller" and "function?"

Recall that we said that the two domains are *coupled* at the points on the axes marked as 1 unit. If we use the same sized scale as the two axes and mark a point at 1 unit radially outward on the diagonal line, this point would couple the point where motion = 1 in the elevated dimension, to the plane. We (the observer looking down from the elevated domain of motion) could then move our perspective down to that point. From that point of view, we could look either inward toward the quantum domain or outward toward the relativistic domain. That boundary between a quantum particle and the outside world is where the feedback from the outside mixes with the information that previously organized into the particle. That is the point that we can correlate with "Controller" in the control system diagram.

The function of the transfer function

The "Function" block is the transfer function, which is an implicit function of both space and time so it cannot be drawn explicitly on the map. Mathematically, an explicit equation is one that expresses one variable in terms of another, like $y = 2x$ or $y = x^2 + 1$. In each case, the y is an explicit function of x and is therefore often written as $y = f(x)$. An *implicit* function of x and y, call it M, would be written $M(x, y) = 0$ for example. In this case, M stands for motion and the implicit equation for space and time from the discussion above was $M(s, t) = s^2 - c^2t^2 = 0$. In the ST plane, this *implies* or *points at* the origin because any set of numbers that we substitute for s and t must combine to give zero in order to solve the equation. If $c = 1$, then the set of solutions are all of the points where s and t are the same number, which when plotted in the plane would be a line of dots at (1,1), (2,2), (3,3) … These are points on the diagonal line, but they do not include the regions in between the points and they are not separated by the same amount as the points on the two axes, so it is stretched with respect to the standard deviations and the first point on the diagonal line does not correlate with the point that is coupled from above in the motion domain.

In effect, the equation refers to the origin (the singularity that equals 0) *as if it was real*, i.e. really something rather than nothing, but the points that are *real solutions* to the equation *imply* the line. In other words, the line exists as a variance in the implicate order, and the dots produce a sort of shadow on the plane. The line itself must be formed (the implicit must be transformed or explicated) by the system. This transformation can be seen by representing $M(s,t)$ in phase space where s still represents linear space but c represents actual variance and explicitly drawn as a phasor with magnitude (c) and angular velocity (ω), as shown in Figure 5. In effect, it forms a "droplet of light" (labeled inner space) on a dark outer space background.

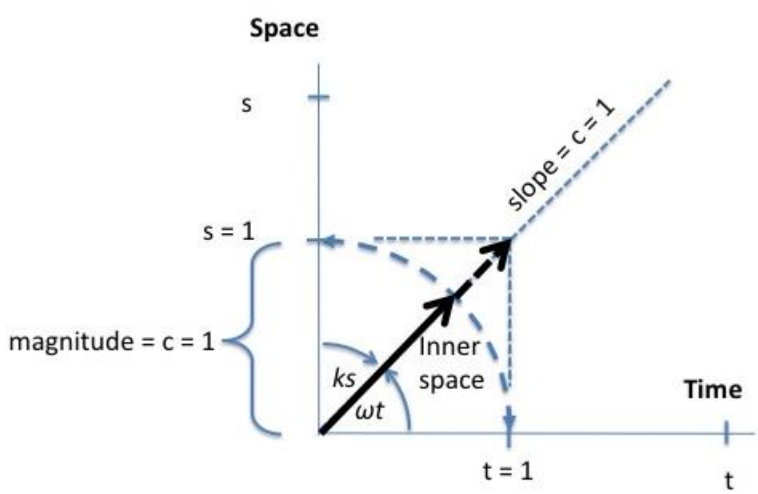


Figure 5 Variance of motion from the higher implicit domain projected "down" onto the two-dimensional space-time plane as a phasor that rotates with an angular frequency ω. Because $kr - \omega t = 0$, the phasor must be conceptually separated into two phasors rotating in opposite directions.

In that way, $M(s,t)$ represents the exact same circle as the quantum domain except now, the c represents the initial slope and also represents the radius like a wire that couples the input to the output in Figure 1. Not only does the speed of light refer to the linear motion, it also refers to non-linear, spinning motion of this droplet of light, which it *momentarily* separated from the background field. As a unit of space-time, “momentarily” means quantum moments in time, but if a physical particle in space is a *shaped unit of time-space*, spun out of nothingness, then momentarily means that it projects as a unit of *momentum*.

Notice also that the region shown back in Figure 4 between the circular quantum domain and the point (1, 1) is in that implicit zone between explicit singular dots. One dashed line, representing the implicit equation $M(s,t) = 1$ at $s = 0$, is drawn vertically up from the “event reference” we call “now” at $t = \frac{1}{t} = 1$ and another one is drawn horizontally over from “here” at $s = \frac{1}{s} = 1$. The region enclosed by the quantum domain and these lines (call it a quantum gap) is shown in Figure 5 as a dashed arrow as a hybrid phasor/linear vector, which represents a potential particle (like an electron cloud). This region would correspond to the energy gap between electron orbitals in the atomic model. In the system model, it is the “Function” block, where the implicit transfer function fits.

The transfer function is the implicit characteristic equation, but it can be transformed into an explicit (analytical) function simply by integrating the function and thus reintegrating the quantum domain back into the relativistic domain. In control system engineering, the quantum unit is expressed by the exponential equation e^{-st}, where here the letter s was chosen by the engineer who wrote the textbook to represent a complex number. If we use this to represent it as frequency, we would use ω, so this is the same as a radial wave in space (scaled as r) expressed as $e^{kr-\omega t}$ at $r = 0$, which has a magnitude of 1. This is multiplied by the input signal, $f(t)$, and the product is integrated from 0 to infinity. As a whole, this interal equation is called the Laplace transform, $\mathcal{L}(f)$. We can use this to illustrate how a numerical representation of a quantum unit, which has not been differentiated into a system of units, can be integrated into the system. We simply take the Laplace transform of 1 and we get

$$\mathcal{L}(f(t) = 1) = \int_0^{\infty} f(t)e^{-\omega t}dt = -\frac{1}{\omega}e^{-\omega t}|_0^{\infty} = \frac{1}{\omega} = \frac{1}{1/t} = t\ .$$

Then, we can get the model "up and running" by naming the first integrated quantum unit "a" and taking the Laplace transform to get

$$\mathcal{L}(e^{at}) = \frac{1}{\omega - a}.$$

This shifts the reference point from the origin out to the event reference (the first t unit). We could repeat this operation to produce a logistic equation in complexity theory using the same input function and then simply multiply the two Laplace transformed functions together analytically to get a new product. In order to then reintegrate the product back into the background, we take the inverse Laplace transform. If, instead of using the Laplace transform, we wanted to do this operation using functions of time, we could do it stepwise as an iterative logistic equation or use the convolution integral. Note that the word convolution provides a direct implication from the math of physics to the words in anthropology. If this systems approach is applied to the growth, adaptations and transformations of living organisms, then it implies that the theory of evolution should be renamed the **theory of convolution**. And in cognitive science, we should refer to the convolution of consciousness.

This model can also be used to better understand phase transformations including those in chemistry and the natural changes we call seasons. If we consider seasons to be phases, the expression of high-order moments in space-time, they can be correlated with high-order moments in time-space (complex particles with momentum). By modeling each particle in the standard model of particle physics as a character in the systems model, and determining the appropriate transformed equation, we could model any element, chemical compound or complex system using an electronic circuit as a meta-form. There are well-known correlations between mechanical characteristics, (such as friction, inertia, and heat capacity) and electrical component characteristics, (as resistance, inductance and capacitance). The goal would be to model the entire Gaia-sphere as an integrated system to include transfer functions for subsystems that may have a substantial effect on the weather, which would represent the feedback block. Even a simple electronic harmonic oscillator uses feedback to produce a cyclic output that can be separated into four sub-phases. Because the variances in an electronic signal disappear immediately, non-physical functions would be modeled as signals. Physics characteristic are those that have momentum and contribute to the inductive nature of the system. The capacitive characteristic of mass is expressed by the concept that physical particles are units of time-space, meaning that they store information, exactly like a capacitor stores energy as charge, but also like a computer chip stores a tremendous amount of memory. It is beyond the scope of this presentation to elaborate, but I, the author, suspect that the human consciousness will be found to have the dominant transfer function and therefore a very large effect on the climate, even more so than things like carbon emissions.

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According to Capra and Luisi, although the study of consciousness became established as a broad, interdisciplinary field of study in the 1990s, as of 2014, there was still "a bewildering variety of approaches to the study of consciousness by quantum physicists, biologists, cognitive scientists, and philosophers." (Capra and Luisi 2014, Pg. 259) If we apply the STM model to the mind-body system, we can identify the body with the quantum domain, the self with "the observer" as the "Controller" and another self (Carl Jung's "shadow" self as in, "I see myself fitting in this model") as a seemingly separate, implicit mind or spiritual being. As the mind-body system *moves* through the process of life, both linearly (motion) and non-linearly (emotion), information from within the system is output into the world and it, along with other information from the outside world is fed back to the input. It convolves with and transforms the system, storing information by modifying the transfer function (physical adaptation) and expanding the mind. Eventually, it reaches a critical point and the mind experiences a quantum leap to the next level, changing both the physical and psychological characteristics. The “shadow” changes to a “persona” – a new *character role* to fit the new level of maturity with greater *power* to shape his or her self and the surrounding world.

How the model works to separate force from power

There is little or no mention of power in introductory quantum mechanics textbooks. Why should there be? There is really no need to discuss power because, if everything is made of energy, that is what we need to focus on – quantum energy states. We need to know all about the different states of energy because we want to know what we can do with them. What can we do? We can build stuff, and we can make stuff work for us. Once we build stuff then *making it work for us* <u>*is*</u> *power*. Isn’t that reality the purpose of science as a business? Power is a dynamic expression of how we *use* energy, and that is not really of interest in basic quantum mechanics. In physics, power is the amount of energy expended per unit time and that’s a fact, but it is just one way to look at it. Power is also about the amount of energy *stored* per unit time, but we never think of it that way. We only think about the end product – the static unit that got stored, like in a battery, and again that is what we call energy.

Despite what was just said about it not being of interest, power is included in a very technical book, *Quantum Field Theory,* written by the celebrated physicist Michio Kaku. After a discussion about energy-momentum tensors, power is introduced with a single sentence, in which he states that the energy-momentum tensor is “recognized as the energy density and the Poynting vector.” (Kaku 1993, Pg. 102) A Poynting vector is the name for an expression of power as a spatial variance[vi]. However, the only reason it was introduced was to use it as a confirmation: “the energy-momentum tensor is a physically acceptable quantity and compatible with gauge invariance.” Then Kaku dives back into the weeds of relativistic quantum mechanics.

One reason we point this out here is also to serve as a confirmation: the STM diagram can also be correlated with power because it represents an energy-momentum tensor. We can see this by rewriting the spatial energy expression $E = hf_s$ as $E = pc$, where $p = \frac{h}{\lambda}$ is the momentum. Thus, even without understanding the complexities of QFT we can interpret STM diagram – the superposition of the temporal expression of energy with the spatial expression of momentum – as energy density or power. The classical definition of power, as energy per unit time can also be derived from it by interpreting the diagram as the time-space form of energy (E) divided by its instantaneous space-time form, i.e. a quantum unit of time (t); thus $P = \frac{E}{t}$.

So what? Why is this important to know? Because it tells us that even the tiniest vibrations of information energy that comes from the outside of us as physical systems and is fed back into our mind-body systems is stored, not as potential energy, but as potential power in the form of knowledge. Everyone knows that *knowledge is power*. We do not use the term "potential power" anywhere in physics or engineering, perhaps because it would be considered redundant; the word "potential" is from the Latin *potentia*, which already *means* "power." It describes something or someone that has the power to become something. It is important for quantum particles to *be* something, but it is more important for us to understand that they can *do* something and *become* something else. It is also important to understand what they can become. Then, because we understand the process, we understand that what they become is just another phase of *being* and we want to know what they can become in the next phase of the process. Notice I said we *want* to know *what* they can become, but that may not be possible based on our current *power* to comprehend, so in order to increase that power, we *need* to know how to increase our power. Tragically, we humans, who are the embodiment of quantum power, who know that we are becoming something whole – something that is greater than the sum of our parts – have a very bad habit of using and burning up our power through the use of force.

There is an excellent book written by David R. Hawkins called *Power vs. Force* that focuses on the difference in terms of human behavior. (Hawkins 2002) We can see the difference between power and force in the STM diagram, starting with power. We look at the plane of energy as it is scaled by or "divided by" the scale units of the horizontal axis and recognize this temporal axis itself represents energy divided by time as a conformal map of power onto a single line.

Force is also represented in the STM diagram. If we do the same conformal projection of energy onto the vertical spatial axis we can see that the axis represents *energy divided by distance* and that is the classic definition of force, $F = \frac{E}{d}$. Force correlates with the static form of action at the output of a system that potentially pushes and pulls in the relativistic domain. It doesn't actually move anything because once motion starts, it's no longer force; it's energy that is being *expended* in the form of motion. It's the product of the system and that product is "units of motion" called space. Whatever forces something to move is transforming its stored energy into actual units of space and that simply contributes to the expansion of the universe (the relativistic domain). Thankfully, it is not entirely wasted energy because it generates vibrations that act as feedback, so it's all-good. The part of it that is in the form of random chaotic patterns serves to create the huge variety of swirling, twisted bifurcations that we can see in the Mandelbrot plots called fractals.

Power is the energy that is stored inside the boundaries of the organized as silhouettes framed by chaos that we can see "popping up" as we zoom into a Mandelbrot plot. Those organized patterns are literally created by the chaotic framework, so it is apparent that chaos is a "necessary evil." The framework or structure of reality is what creates the closed system and the power that is stored within those patterns forms the transfer functions that allow the self-control system to emerge. When the controller forms, it has the power to choose whether to store more energy implicitly or to use it to build and fortify the explicit framework. In the physical form, some of the power *must* be used as output in order to interact with the outside world and to generate feedback, which we think of as dissipated energy, but the part that is not dissipated maintains and increases self-order. As part of the greater system, it can use power to change the outside world *with or without* the use of force. *In mass*, ($E = mc^2$) it has the power to destroy its entire world with nuclear-powered force, but in time, ($S = Tc^2$) it grows to realize that it has the same power *en masse* to create a new world.

Conclusion

Correspondence between the STM model and other expressions in physics and chemistry that have been proven in both classical and modern versions gives the model itself its power. Working with the model gives the user more power of understanding and the ability to *reflect* on all of the other forms of expression that have been proven in science. The STM model works to represent self-actualization in both physical and mental processes. Capra and Luisi include a discussion about how the systems approach is helping cognitive science and work continues on correlating system "output" products with terms used in modern physics. In terms of nuclear physics, the stored power correlates with the inner forces (nuclear and chemical binding energy, also expressed as strong force, weak force, nuclear force and electromagnetic force in the standard model of particle physics).

We already understand the holomorphic system approach because it serves to power processes identified by many different names in many different branches of science and engineering. So it will not be very difficult to recognize it and understand its tremendous value as a basic crystalizing structure upon which we can rebuild our world. Simply knowing that the organized pattern is all around us will not serve to fortify it. What we now need are engineers to establish a new vocation, which is called "Holomorphic Engineering." That is the subject of a new book being reviewed and soon to be published on Amazon entitled (T. J. StJohn 2021).

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[i] It's been said that when you change the way you look at things, the things you look at change. It's all about perspective.

[ii] Note that the fourth step was called "reunification" in the reference. Reintegration is used here to refer explicitly to the mathematical process of integration in Calculus and to emphasize that the higher level needs to be thought of in terms of wholeness rather than a singularity, which is what unification or unity implies.

[iii] There was a "long divorce" between physics and math; see *A struggle for the soul of theoretical physics* at https://www.nature.com/articles/d41586-019-01171-0

[iv] Physicist Lee Smolin considers *the time problem* to be "the single most important problem facing science as we probe more deeply into the fundamentals of the universe." (Smolin, Time Reborn: From the Crisis in Physics to the Future of the Universe 2013)

- Newton's idea of absolute time and space –as independent and separate aspects of objective reality, and not dependent on physical events or on each other and independent of any perceiver – was superseded by Einstein who showed that a single event does not happen simultaneously to two observers moving relative to each other. So in relativistic physics, time is considered one of four dimensions of spacetime. But in quantum physics, position and time are considered separate, independent quantities. (Morrison 1990, 58)

- Physicist 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 1999, Loc 2327)
- Stephen Hawking stated that time exists, but is comprised of a real and imaginary component. "Imaginary time is indistinguishable from directions in space." Thermodynamic and cosmological time are real – they describe the increase in entropy of the universe, which started with the big bang and provide the arrow of time that points in the same direction as the expanding universe. (Hawking 1990, 143-155)
- And Lee Smolin says that time is real. "Embracing time [as real] means believing that reality consists only of what's real in each moment of time. Whatever is real in our universe is real in a moment of time, which is one of a succession of moments." (Smolin, Time Reborn: From the Crisis in Physics to the Future of the Universe 2013, Loc 80)

[v] Terms like implicit, explicit, unfolded and enfolded, were first presented by physicist David Bohm in his book, *Wholeness and the Implicate Order*

[vi] It is just a happy coincidence that the name Poynting sounds like "pointing" because as a vector, it actually points in a particular direction.