THE THEORY OF DISTANCE-TIME

(A quantum theory of space and time that is more accurate than special relativity and where distance is equal to a period of time according to the equation $D = cT$.)

By Keith Maxwell Hardy

ABSTRACT

Defining space and time in a manner that agrees more with an observer who measures distance and time with particles, I create a quantum theory of space and time which is more accurate than the special theory of relativity. This new theory, called distance-time theory, predicts the following quantum principles: Heisenberg's uncertainty principle, the probabilistic location of a particle, and the collapse of this probability once a particle is observed. These principles are derived mostly independent of traditional quantum theory, and they are intrinsic properties of time and space in distance-time theory. However, special relativity theory always gives a particle's exact location and speed. This relativistic result disagrees with the quantum principles previously discussed, but it agrees with classical physics. Special relativity theory is a classical theory, while distance-time theory is a quantum theory. Nevertheless, distance-time theory still predicts proven special relativistic results, and there are novel testable predictions made by distance-time theory. The most notable predictions are those regarding the speed of quantum tunneling and certain characteristics of light. Also, distance-time theory defines distance as equivalent to a time period according to the equation $D = cT$.

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1. INTRODUCTION

1.1. Introduction

When the creators of classical science and mathematics defined space and time, they had to predict all experiences related to time and space in their environment. These experiences included measurements with rods (rulers) and clocks, plus the motion of bodies relative to each other. Also, each body was defined within a Galilean reference frame which postulated that all laws governing these bodies are relative to their reference frames. This principle of the relativeness of laws to a reference frame was reaffirmed in Einstein's first postulate of the special theory of relativity [1–5]. However, what made Einstein's special theory of relativity different from classical theory was his second postulate, which states that light has a constant speed relative to any reference frame. In order to satisfy this second postulate, Einstein augmented classical physics, and this resulted in special relativity theory. Although most of the special relativity theory is impeccable, its weak point is that it is an augmentation of the past. Einstein preserved archaic principles of classical space and time in special relativity. These archaic principles include not equating time to a scalar distance, the definition of time and space without using particles, the infinite speed of space, a fourth dimension for the time axis, and the concept of a mass defining matter. (I later replace mass with the concept of a rest momentum, which is very similar to the idea of a mass.) Furthermore, special relativity gives a particle's exact location and speed, which contradicts Heisenberg's uncertainty principle [6–9]. And, probabilistic wave theory for matter cannot be predicted from special relativity. Consequently, special relativity is a classical theory but not a quantum theory.

In this article, I create a new theory, one that is a quantum theory of time and space, but not a classical theory of time and space. In doing this, however, I must still predict the results of classical and relativity theories that have been experimentally proven to be accurate. As a result, I must predict rod and clock measurements, the relative motion of bodies, Einstein's first and second postulates of special relativity, other verified relativistic results, and three dimensions. (Three dimensions are the only number of dimensions verified to exist. Distance-time theory only uses three dimensions. Generally, new theories of space and time have more dimensions though not less than those of special relativity, which has four.) However, in these traditional theories of relativity and classical physics, some principles are not experimentally verified; rather, they are assumed. I do not predict some of these principles in this article. Instead, I derive novel principles in this new theory of time and space. Since I predict experimentally proven results of special relativity in this theory, and derive different principles and results in areas where special relativity is not verified, I am presenting a theory of time and space which is more accurate than special relativity theory.

In chapter 3 of this article, I create a new approach to time and distance that contrasts with the traditional approaches of classical and relativity theories. Although, traditionally, distance and time have been treated as not equal, all measurements of distance and time require that particles move across a distance in a period of time. Therefore, distance and time are not measured independent of each other but are always measured together in nature. The premise that distance and time are combined in nature is the distance-time premise.

Traditional theories, on the other hand, define time and space independent from particle motion, allowing for their definition of a time not equal to a scalar distance. Consequently, they do not satisfy the distance-time premise. Yet, in nature, the distance-time premise is always obeyed because space and time cannot be measured without particle motion. Rod measurements obey the distance-time premise. Light particles that move from one end of a rod to the other end must cross a quantity of distance and time. These light particles allow an observer to see the rod extended out, thus allowing an observer to measure with the rod. As a result, rod measurements obey the distance-time premise. If I were to measure the distance from the earth to the moon, I could use a light beam or possibly a rocket. However, the light beam and rocket are made of particles which travel a distance and a time together; therefore, I would not measure distance as being separate from time, thus satisfying the distance-time premise.

To make a measurement, clocks also require that any particle move across a distance in a period of time. The internal workings of any clock require electron or sprocket motion. Consequently, clocks do not measure time as being separate from distance, and they obey the distance-time premise. Since all measurements of distance and time always obey the distance-time premise, I create, in chapter 3 of this article, a three-dimensional manifold in which distance and time are combined and defined with particle measurement by an observer. Furthermore, Einstein's postulate of the constancy of the speed of light in a vacuum can be predicted in three dimensions, if a distance, D, is equal to a period of time, T, multiplied by the speed of light in a vacuum, c. Therefore, I combine distance to time in this three-dimensional manifold so that $D = cT$. I call this union of distance and time "distance-time". Using this approach, I satisfy the distance-time premise and derive the experimentally proven results of classical and special relativity theories in chapters 3 and 5 of this article. I derive clock and rod measurements, the motion of bodies relative to each other, the observation of a three-dimensional space, and the experimentally verified predictions of Einstein's special theory of relativity. There are some predictions that result from this new theory of distance-time, and these predictions contrast with those of traditional theories. The following statements contain a brief listing of most of these new predictions: (1) distance is equivalent to time; (2) space has a finite speed equal to the speed of light in a vacuum; (3) space contracts to an infinitesimal point at a single point of time; (4) there is a structure of time and space with only three dimensions; (5) there is a structure of time and space that agrees with Heisenberg's uncertainty principle and the probabilistic position of a matter-wave; (6) matter possesses a scalar rest momentum instead of a mass; (7) there are predictions about the behavior of light particles; and (8) there is a space and time structure that discusses the speed of quantum tunneling. The minimum requirement to be a quantum time and space theory is that it agree with elementary quantum theory. Since Heisenberg's uncertainty principle and the probabilistic position of a matter-wave agree with distance-time theory, this theory is essentially a quantum theory of space and time. This is a major reason for creating distance-time theory and it contrasts with special relativity, which is actually a classical theory. The fact that distance-time theory agrees with elementary quantum principles does not mean that distance-time theory is a form of relativistic quantum mechanics. Relativistic quantum mechanics is essentially applying relativity to quantum theory. In contrast, distance-time theory is not about applying relativity to quantum theory. Instead, it is a novel structure of time and space with intrinsic quantum characteristics, and it makes new predictions not found elsewhere.

Next, I briefly explore the finite speed of space, as well as a space that is contracted to an infinitesimal point. In chapter 3 of this article, I define a distance-time manifold and delineate unique characteristics of its space. An example of the latter is that space has a finite speed in a distance-time manifold. This is totally different from special relativity theory in which space occurs at an infinite speed, due to the fact that the distance in relativity occurs perpendicular to the time axis at a single point of time. This result contradicts with nature's behavior. In nature, time and distance can only be observed via a particle, and no particle traversing time and distance can exceed speed *c*. Therefore, distance cannot occur faster than speed *c* relative to an observer. In distance-time theory, however, distance and time are defined via particles and are combined so that distance occurs over a period of time. Therefore, distance occurs at a finite speed. I often refer to this characteristic as the finite speed of space, as space has distance defined throughout it. In the universe, this means that the gap (distance) between an observer and any object occurs at a finite speed. Also since the gap has a finite speed, zero distance occurs at an infinite speed between the observer and any object. Since zero distance occurs at infinite speeds, space is infinitesimal at the single point of time of the present (the now) relative to the observer. This characteristic of space is totally different from any characteristic of space in special relativity, for in special relativity, space occurs infinitely fast and is never infinitesimal relative to the observer.

In chapter 5 of this article, I define a perspective of space and time for light traveling in a vacuum and show that light disobeys the principle of causality. This behavior of light is not derived in relativity theory. Also, I predict that photons can interact with each other only under certain circumstances. Although I do not derive a perspective of space and time for light directly out of reference frames for matter, I do define the perspective of space and time for light based on principles of distance-time theory that I define for reference frames of matter.

In chapter 6 of this article, I define quantum tunneling as something that happens via an infinitesimal space. Although distance-time theory predicts that faster-than-light travel across a space is impossible, it also predicts that faster-than-light travel via an infinitesimal space is possible. Therefore, I predict faster-than-light speeds for particles tunneling via an infinitesimal space, and I give a solution to causality paradoxes that may be caused by these tunneling particles. This is not done in relativity theory nor in classical space and time theory.

To understand this theory, one must have an understanding of Einstein's special theory of relativity, and an understanding of elementary quantum theory. Distance-time theory delves into time and space using a distance-time metric in a Euclidean manifold. Therefore, it should not be compared to the theory of general relativity.

Overall, the relationship between distance-time theory to the special theory of relativity is best portrayed in Figure 1. This figure displays two circles. The smaller is included within the larger one. The larger circle's area includes special relativistic results plus predictions only found in distance-time theory. Everything enclosed within the larger circle is predictable from distance-time theory. The smaller circle's area represents only verified predictions made by the special theory of relativity.

I have not attempted to create any theory of gravity with this theory. I believe that any new theory of gravity should be approached by probing deeper into quantum field theory, which I have not done in this article.

2. PREPARATION OF PERSPECTIVE

2.1. The distance-time premise

The distance-time premise is that distance and time are joined together in nature, possessing dual characteristics of distance and time. This premise contrasts with traditional views which do not equate time with a scalar distance. The premise of distance-time may be proven wrong if distance or time can be measured independently. However, if any measurement is accomplished by particle motion, an independent distance or time measurement has not been achieved, as particles travel across distance and time jointly.

The rod (ruler) measurement has been traditionally seen as a measurement of distance separate from time. However, the location of every part of the rod is communicated by photons that traverse distance and time. Therefore, rod measurements are dependent on particle motion. They are not a measurement of distance separate from time. Furthermore, the difference between locations of physical bodies is always communicated by particle motion across distance and time. For instance, if I try to determine the difference of position between the earth's and the moon's surfaces, I may use a light beam or rocket. Yet, both are groups of particles which cross distance and time and move between the earth and the moon. Therefore, I would not achieve measurements of distance independent of time. Consequently, all measurements of distance by an observer in nature are made across a period of time.

Traditionally, the clock measurement has also been seen as a measurement of time separate from distance. However, clocks use particle motion in order to measure. The traditional clock has spindles which sweep across the face of the clock, crossing time and distance together. Also, a digital electronic clock requires electrons to move across time and distance jointly. These clocks do not achieve measurements of time independent of distance.

In the previous examples, measurements of distance or time, which are independent of each other, were not achieved. Therefore, the distance-time premise remains valid. However, traditional theories, such as relativity, do not use particles to define distance and time, and they do not satisfy the distance-time premise; instead, they always separate time from distance.

In chapter 3, I define a structure of time and space so that an observer placed in this manifold would literally measure distance and time the same as would be done in nature. Consequently, an observer in this manifold would literally have the same perspective of time and distance as an observer in nature would have via particles, with distance and time combined.

2.2. Distance-time theory's unique idea of space

Sometimes when scientists come upon a new idea, they try to develop the best terminology to describe their idea. In comparing the difference of how space is defined between special relativity and this new theory, I coined the two phrases: the “finite speed of space” versus the “infinite speed of space”. I make the following scenario, scenario one, the simplest situation. Two people are at rest in the same reference frame, and all forces are negligible. One of them takes out a large ruler to measure the distance between them. How fast does that ruler exist between them? In special relativity, that ruler exists infinitely fast between them. In other words, at any given moment of time, that ruler exists in the gap between them. I would like to see anyone prove the assumption that special relativity has just made. This assumption has never been verified, and I claim in this theory that it can never be verified because it is wrong. There are some special relativity books that do discuss that the ruler does exist infinitely fast between those two people in scenario one. [1] These books are correct in their understanding of special relativity. Nonetheless, it is only an assumption that special relativity makes. (If I am correct about the existence of space in nature, this assumption is wrong.) In special relativity, this gap, or distance that the ruler occupies, is a part of the same reference frame at rest relative to both persons in this scenario, and this gap exists at each given moment of time relative to them. In other words, this gap occurs infinitely fast, or another description is that the gap exists at a single point of time according to special relativity. Hence, with both of them at rest in their shared reference frame, the time axis in special relativity is defined as being perpendicular to the three space axes. Therefore, in special relativity, space is still defined as being separate from the time axis. A person can make a point about relativity claiming that it does bring time and space together in a manner that classical theory never did. Nonetheless, within my own reference frame, I still would measure space separate from time. It is only when there is a difference of velocity between two observers that one's measurement of distance relative to the other is not simultaneous according to special relativity—not when they are both at rest.

Now, in scenario two, a person (Victor) has a constant velocity relative to me. According to special relativity, I should see Victor's measurement of distance contract in the direction he is moving relative to me. In other words, I would indirectly—not directly—measure his distance as existing nonsimultaneously. In special relativity all space that I can directly measure occurs simultaneously relative to me. This includes the space that Victor is moving through relative to me. The idea is that a person's space exists only relative to that person—not relative to me. In scenario two, it is by Victor's direct measurement of space that I can indirectly determine that his space is nonsimultaneous relative to me. The reason for all space being simultaneous relative to me is that in my reference frame all space exists according to my measurements, which is done simultaneously or at a single point of time relative to me. Hence, in special relativity, directly measurable space can only exist simultaneously relative to the observer who is directly measuring it. Furthermore, in scenario two, the nonsimultaneity of space only exists indirectly to me through Victor's measurement but never directly through my measurement. Since all points of space that I can directly measure in my reference frame exist simultaneously, the existence of space is infinitely fast relative to me. This infinite speed of space does not exist in distance-time theory, which is just the reverse.

In contrast, distance-time theory asserts something very different. In a distance-time manifold, distance divided by a quantity of time is equal to the speed *c*, which is the speed of light in a vacuum. There is a constant scalar relationship between distance and time. To explain its meaning, I use scenario one of two people being at rest in the same inertial reference frame. They again place a ruler between themselves. However, this time the ruler does not exist right now between them; nor does the gap exist between them right now, according to the distance-time equation ($D/T = c$). Therefore, this gap between them only exists over a period of time, which totally contradicts special relativity's assumption of the infinite speed of space or simultaneity of space. Furthermore, one cannot even imagine a gap (distance) existing right now between two people as special relativity portrays in people's minds. In distance-time theory, all that should be imagined existing at a single point of time is an infinitesimal space, which is a point space. Distance can only be directly measured and perceived as existing nonsimultaneously (over a period of time) in distance-time theory, whereas in special relativity distance could only be directly measured as existing simultaneously. The concept of a finite speed of space is very difficult for the human mind to literally visualize, as the human mind is limited by what it can imagine. It is easier to just interpret the distance-time equation ($D/T = c$). This equation means that the distance D exists over a period of time, T, at a rate of c, which is the speed of light in a vacuum. In scenario one, the ruler and the space the ruler occupies would literally exist between two persons as fast as they could determine the ruler's existence via particles. And, the speed c is the fastest speed that can be measured.

2.3. The finite speed of space

In our everyday experience, all distance and time can only be observed via particles. In nature, therefore, no distance or time can occur relative to an observer any faster than it can be communicated to that observer. Naturally, I do not discount the possibility that one might think that distance could occur faster than an observer could measure. Nevertheless, the distance would still not exist relative to the observer any faster than the observer could measure it. Also, in our environment, all that is real to an observer is only that which an observer can detect. Thus, in our natural surroundings, neither distance nor time occurs relative to an observer any faster than it can be communicated to that observer. Since no particle moves faster than speed c across space relative to an observer in the universe, no distance can be defined as occurring faster than speed c in the universe. This contradicts the special theory of relativity. In special relativity, distance is perpendicular to the time axis and it occurs at a single point of time. Consequently, all space in special relativity occurs infinitely fast. This result disagrees with nature and the distance-time theory, which I further illustrate in the next paragraph.

I imagine two brothers, Nathan and Steve, tossing a ball between each other. Nathan wishes to determine the speed at which the gap (distance) occurs between him and Steve. Using light beams and subtracting out the time it takes for the light beam to travel between him and Steve, he synchronizes his watch with Steve's. Next, he tosses the ball as fast as he can towards Steve and measures the time it takes the ball to travel from him to Steve. After dividing the distance that the ball travels by the period of time it travels, he derives the velocity of the ball. This proves that there is a distance occurring between him and Steve at least as fast as the velocity of the ball. Nathan realizes that the fastest way he can measure the speed at which the distance occurs between the two of them would be to shine a light between him and Steve. This light is assumed to be traveling in a vacuum. Since all that is real in nature, relative to the Nathan and Steve, is that which is detectable by them, the gap between them cannot occur any faster than speed *c* relative to them. This result totally disagrees with special relativity theory. In the latter theory, both Steve and Nathan can be placed in space a distance apart at a single point of time relative to each other. Consequently, the distance between each other would occur infinitely fast relative to either one. This allows both brothers to be located a distance apart faster than they could measure each other's location with a particle. In distance-time theory, however, distance is combined with time and is only defined via particles. Consequently, in distance-time theory, distance occurs over the period of time a particle travels. Therefore, the gap between Nathan and Steve can only happen as fast as Nathan or Steve could measure with a particle.

This result agrees with our actual everyday experience. In our natural environment, no object can have a location relative to an observer until that observer detects the object's location via a particle. Thus, the gap between an observer and any object cannot occur any faster than can be measured with a particle. Therefore, distance cannot be perceived to occur infinitely fast in nature and in distance-time theory. Since distance is defined throughout the three dimensions of space, the speed of space has a finite speed no faster than speed *c* in distance-time theory and in our everyday environment. Only an infinitesimal space can be perceived to occur at infinite speed in distance-time theory and our everyday environment. In other words, relative to Nathan or Steve, the distance between them at a single point of time of the present (the now) has not yet occurred, and thus, the gap between them is shrunk to zero in distance-time theory and nature.

In sections 3.8 and 3.10, I delineate more about the finite speed of space and about an infinitely quick, infinitesimal space as I delve into the characteristics of the distance-time manifold. Also, since some may assume that the concept of a finite speed of space refers to the concept of an expanding universe, I must emphatically declare that this reasoning is completely without merit. (See section 3.9.)

2.4. Visualizing the finite speed of space within the human mind

To fully appreciate the concept of a finite speed of space, one must first realize that within the model construction of relativity and classical theories space is assumed to be infinitely fast. It may seem to some people that an observer at the origin of a coordinate frame can record the light signals he gets on his retina, apply his assumption about light propagation being at speed *c*, and infer space-time coordinates for the sources that sent him the signals. In that way, he can come up with space-time coordinates that have a finite difference in space but no difference in time. The underlined part is an assumption that traditional theories make about the speed at which the distance (gap) occurs between coordinates. These theories are assume that the distance between coordinates is occurring at an instant ("no difference in time"). Consequently, the distance is assumed to be occurring at an infinite speed. However, it is not necessary to assume that distance occurs infinitely fast, since there is absolutely no physical evidence that supports the concept of an infinite speed of space.

The problem with seeing the assumptions people make is that people often are not aware they are making them. The human mind is limited in what it can visualize. For instance, I cannot literally imagine four dimensions. In my mind, I can only visualize three dimensions. To work in four dimensions, scientists use the mathematics created in three dimensions and then extend this mathematics to both imagine and work with an extra dimension. Therefore, these scientists never directly visualize four dimensions. They only use the mathematics for four dimensions. Summarizing, one cannot literally visualize a space of finite speed. The simple reason for this is that not only does the human mind visualize solely three dimensions, but the human mind also only imagines a space which is infinitely fast. In other words, a whole space that is always there (happening at an instant) is what our minds solely visualize. As a result, it is quite easy to assume that space is infinitely fast without realizing one has made this assumption.

To perceive the concept of a finite speed of space, I need to rely primarily on mathematics. Within distance-time theory, I define distance as being equivalent to time, according to the equation $D = cT$. Rearranging this equation, I derive $D/T = c$. I interpret this latter arrangement to mean that the rate of distance occurring per period of time is equal to speed c. In the model construction of distance-time theory, therefore, distance happens over a period of time and at a speed c. Distance does not happen at an instant within distance-time theory.

It is extremely difficult for the human mind to perceive distance not occurring between two coordinates at an infinite speed, since every model construction of space and time I try to conceptualize is embedded within a space of infinite speed as pictured in my mind. As a result, I can be easily fooled. The way to deal with the dilemma of this erroneous picture of space in my mind is to mainly rely on the mathematical interpretation I have postulated.

As I discussed earlier, within the construction model of distance-time theory, distance is defined as not occurring instantaneously between locations in space. At an infinite speed (a single point of time), therefore, I define distance as contracted to an infinitesimal point between all locations in space (an infinitesimal space). Distance is essentially an abstract concept that represents the magnitude of the difference between distinct coordinates in space. Since the distance occurring between coordinates at an infinite speed is contracted to zero, there is no distinction between coordinates at any single point of time. In other words, there is zero distance between different coordinate locations at an instantaneous speed. Space as people normally experience it should not be conceptualized to exist at a single point of time. Only a space that has contracted to an infinitesimal point should be pictured as existing at an infinite speed. The space I live within everyday exists solely at a finite speed, but never does this space that I always see happen at an infinite speed. Space has not occurred yet at speeds faster than speed *c*, which is the speed of space. Some people may be perplexed about how there could be an infinitesimal space existing at any instant of time. For instance, how could the human body exist within a space that has contracted to a single point? The human body would exist only within a space of finite speed. As a result, all the actions and reactions transpiring within the body could not happen any faster than speed *c*.

Since a four-dimensional space-time continuum in general relativity theory assumes that space is infinitely fast, an infinitesimal space existing at an infinite speed cannot be derived from the theory of general relativity. Therefore, this infinitesimal space is an independent idea from the concept of a singularity found in general relativity theory. (I answer questions regarding an infinitesimal space in sections 3.10 thru 3.13.)

2.5. A major motivation for the creation of distance-time theory

I claim that distance-time theory is a more accurate theory than the theory of special relativity. This assertion should not be seen as a direct challenge to special relativity theory. In reality, the idea of distance-time is a direct challenge to the four-dimensional space-time continuum, the latter of which is far more similar to the classical space and time theory than it is to the distance-time theory. The four-dimensional space-time continuum and classical theory of space and time always give an exact location and speed of a particle. Thus, they do not agree with Heisenberg's uncertainty principle and do not predict the probabilistic location of a particle. Also, the minimum requirement to be a quantum theory of time and space is that it agree with elementary quantum theory principles. Consequently, the four-dimensional space-time continuum is not a quantum structure but a classical structure. In contrast, the distance-time theory agrees with Heisenberg's uncertainty principle and predicts that particles will have a probabilistic location until their positions are measured by an observer. Then the probabilistic location of the particle collapses to a smaller region where the amplitude of the wave exists relative to the observer, which is also predicted by distance-time theory. It is important to note that the structure of time and space, found within distance-time theory, possesses these quantum properties mostly without relying on quantum theory. The principles of quantum theory are for the most part only discussed as a reference point for predictions made by distance-time theory. These characteristics of distance-time theory are significant, and they lead me to conclude that distance-time theory agrees more with elementary quantum theory than with the classical theory of space and time.

Therefore, the theory presented in this article is not a classical theory but a quantum theory. Furthermore, quantum theory by itself is not a structure of time and space, yet it does make inferences about time and space. Both Heisenberg's uncertainty principle and the probabilistic location of a particle are essentially laws stating the relationship of a particle to space and time. These laws about a particle's relationship to space and time are significant! Yet, special relativity does not predict these laws. On the other hand, distance-time theory does predict these laws. This prediction of quantum laws does not mean that distance-time theory is a form of relativistic quantum mechanics. Relativistic quantum mechanics is essentially applying relativity to quantum theory. In contrast, distance-time theory is not about applying relativity to quantum theory. Instead, it is about a novel structure of time and space with intrinsic quantum characteristics, and it makes new predictions not found elsewhere.

In later sections, I define distance and time in distance-time theory as continuous. However, since quantum mechanics does not predict that distance and time necessarily come in quantified amounts, a quantum theory of time and space may define time and space as continuous. In chapters 3 and 4 of this article, I describe further the relationship of distance-time theory and quantum theory. Although distance-time theory is a quantum theory and as such a direct challenge to the four-dimensional space-time continuum, it still predicts the experimentally proven results of special relativity. Furthermore, since it does predict quantum and special relativistic results, it may, in fact, be a more accurate theory of time and space than the theory of special relativity.

Another important item is the search for a quantum theory of gravity. Since modern gravitational theories rely on a warping of space and time, it is important that a quantum theory of space and time be found, if a quantum theory of gravity is ever to be realized.

2.6. New testable predictions only made by distance-time theory

To separate distance-time from special relativity and quantum theory, distance-time theory must make predictions which neither special relativity nor quantum theory can make. One such prediction is the speed of quantum tunneling. The speed of quantum tunneling is given by Eq. 27, which states that quantum tunneling cannot occur slower than speed c. Along with this prediction, I give solutions to causality paradoxes for tunneling faster than light. Furthermore, I define rules of time and space for light that predict that photons only influence each other under certain conditions. These conditions I describe in chapter 5, which deals with a photonic distance-time. Moreover, in that chapter, I predict that the law of cause and effect does not apply to the photon. Since distance-time theory makes predictions not made elsewhere, it is a new theory.

3. DISTANCE-TIME THEORY

3.1. Distance-time

Distance and time have traditionally been treated as being not equal. In this article, however, I combine distance with time to create distance-time. I start by defining a time line with a time coordinate, t. These points of t are defined as points of existence. In the case of $t_2 > t_1$, there is the period of time $t_2 - t_1 = T$. Next, I define distance as having a positive and negative direction in the same manner as time. Then, in the same direction as time, I superimpose distance on this time line so that for D, distance, divided by c, a constant, there is an equivalent T, a period of time. I call time lines with distance superimposed on them “distance-time lines”. This relationship, $D/c = T$, I call the “distance-time equation”. Distance-time is measured in either distance units or time units, and it possesses the characteristics of distance and time.

3.2. Eventons

All motion in nature is given by an object moving relative to an observer. In this paper, I use a particle moving relative to an observer to represent the motion of distance-time relative to an observer. It is the motion of the particle that is important—not the particle itself.

In a three-dimensional coordinate system with X, Y, and Z axes, I place fictitious particles which I call *eventons*. I use these eventons to define distance and time in the coordinate system. An eventon's presence at any coordinate in the coordinate system defines a point of distance-time occurring at that coordinate. An eventon's presence at a coordinate is what I refer to as an “event”. Once an eventon leaves a coordinate, that coordinate is defined no longer at the event at which it was previously defined when the eventon was at that coordinate. While an eventon moves in the coordinate system, new events are defined by the eventon at each coordinate that the eventon contacts. These new events occur successively in only a positive direction and they define a distance-time line. A distance-time line defined by an eventon traveling in a coordinate system is an event line for that eventon. Since the event line for an eventon is a distance-time line, an eventon defines distance and time occurring along its path at a ratio of $D/T = c$. The eventon can only be at one event of its event line at a single point of time, relative to an observer in the coordinate system. Therefore, the only event an eventon defines at a single point of time is at the coordinate of the eventon's location. The rest of the event line is not defined relative to an observer at the same point of time. Consequently, any length is defined across a period of time and not at a single point in time. Therefore, relative to an observer, the X, Y, and Z axes would always be defined across a period of time and not at a single point of time. This contrasts with relativity theory in which, relative to an observer, the X, Y, and Z axes are defined at a single point of time. Also, I propose that eventons may pass through each other. I stress that an eventon is only a representation of distance-time's motion in a manifold. An eventon's event line is distance-time.

Eventons are like photons only in that they both have speed *c*. Eventons possess neither energy nor momentum, and they are not electromagnetic waves. Furthermore, they are not virtual and have no spin. Their only function is to represent distance-time, and they may not even exist. Nonetheless, they are important because they give one an easy visualization of distance-time.

The most basic definition of a particle is not that it has a spin, momentum, energy, or field. The most basic theoretical view of a particle is that it occupies a small region. This is only theoretical. In practice, one cannot detect the presence of a particle in a location unless it does more than occupy a small location. Using this most basic theoretical view, we see that eventons are fictitious point particles.

3.3. Distance-time manifold

I define a three-dimensional distance-time manifold as a three-dimensional coordinate system with *X*, *Y*, and *Z* axes, and there is neither distance nor time, except that which is defined by eventons. An indefinite number of eventons present at the same coordinate is a single event at that coordinate. These eventons move along every possible continuous path in both directions, linking coordinates. A photon possesses an eventon which moves along with the photon in the same direction and path. Regardless of an eventon's path or direction, the eventon defines positive amounts of distance-time within the coordinate system.

I imagine two eventons traveling a straight path between two locations, *A* and *B*. Both eventons move in opposite directions to each other, and they both begin their journeys at time t_1 and end them at t_2. Relative to an observer at *A*, *B* is located a negative distance into the past $(t_1 - t_2)$ and a positive distance into the future $(t_2 - t_1)$, even though both eventons move in a positive direction across distance-time relative to the observer. Thus, the observer could only measure a positive distance between points *A* and *B* regardless of their directions. This example shows that the event line of an eventon defined in the coordinate system is defined only by a distinct eventon. In order to measure this distance-time, it must be done via this eventon. Otherwise, it is not defined relative to an observer.

Within a distance-time manifold, the shortest amount of distance-time an eventon crosses, along a continuous path going from one coordinate, (x_1, y_1, z_1) to another (x_2, y_2, z_2), is given in distance units by the distance-time Euclidean metric function

$$D = cT = \sqrt{\left[x_2 - x_1\right]^2 + \left[y_2 - y_1\right]^2 + \left[z_2 + z_1\right]^2}\ . \qquad (1)$$

Consequently, any particle in a distance-time manifold, moving straight from (x_1, y_1, z_1) to (x_2, y_2, z_2), must cross the distance-time defined by Eq. (1). This, also, includes particles with speeds slower than c, as I demonstrate in the subsequent section, 3.18. The distance-time premise is satisfied with Eq. (1). Since eventons cross a distance per period of time at a constant ratio c, relative to an observer in this manifold, they have a constant speed c.

Similarly, since the distance along each coordinate axis is defined across a period of time, the coordinate axes cannot be imagined at a single point of time but only across a period of time relative to an observer. The only location that can be imagined in the now is where the observer is located, and this is relative only to the observer. Hence, a distance-time manifold cannot be imagined to exist at a single point of time, but an observer can imagine a distance-time manifold across the period of time that the eventons travel. This description is actually how an observer experiences distance in nature across a period of time.

3.4. Scalar coordinate

The time coordinate t is defined as a scalar coordinate within the three dimensions represented by the X, Y, and Z axes, and the difference between distinct points of t is still measured in time units. Henceforth, I call the (x, y, z) coordinates "vector coordinates" "to distinguish between them and the scalar coordinate t. The increasing of t represents eventons moving in a positive direction across distance-time. Therefore, if $t_2 > t_1$,

$$D = cT = c\left(t_2 - t_1\right). \tag{2}$$

In the special case of when an eventon moves along a continuous path across the shortest amount of distance-time between two distinct vector coordinates, I use the Euclidean distance-time metric function of

$$c\Delta t = \sqrt{\left(\Delta x\right)^2 + \left(\Delta y\right)^2 + \left(\Delta z\right)^2}\,. \tag{3}$$

3.5. Rest speed

I contend that an eventon, A, crosses a constant amount of distance-time before it returns to a vector coordinate P. Since an eventon's event line defines distance-time within a distance-time manifold, A, being located at point t, defines P to be at point t when A is at P. I further contend that the distance-time is infinitesimal between the contacts that A makes with P; therefore, P moves across continuous scalar points of t, while A moves across scalar points of t. The point of time occurring at P is the present moment for any observer at P. Because the distance-time occurring at P is defined with an eventon, the speed of distance-time occurring at P is speed c relative to the coordinate system. This speed across distance-time at point P is called the rest speed at point P. All particles of matter in a distance-time manifold are defined as possessing eventons that move in every possible path. As a result, there is an eventon moving in a similar path to that of *A* at every particle of matter. Within a distance-time manifold, therefore, all matter flows through points of *t* and possesses a rest speed *c* across distance-time. Since a coordinate system only exists relative to an observer's definition, the vector coordinate system is defined relative to an observer's point in time, too. Consequently, a coordinate system flows through points of *t* with an observer. This does not mean, however, that the coordinate system is at the same point of time as the observer; it only means that it flows through time with the observer. At every single point of present time relative to the observer, the coordinate axes would still be extended out across different points of time as measured by the observer via particles. To summarize, these axes flow through time with the observer, even though they are extended out across different points of time from the observer's point of time.

3.6. Distinct sets of events for every point t

At t_1, I define a distinct set of eventons at a vector coordinate *P*, defining an event at *P*. A number of these eventons follow paths that contact point *P*, only once making the event at t_1 and *P* unique. Since *P* can be any vector coordinate in a distance-time manifold at t_1, a unique set of events occurs throughout the distance-time manifold. While a distance-time manifold flows through points of *t*, it therefore flows through distinct sets of events.

3.7. Motion

The concept of motion (change) is an independent concept from the concepts of time and space. Motion is defined in the traditional classical and relativity theories of time and space by defining points of time to happen at a finite rate in space. In these traditional theories, the finite speed of time is not quantified in and relative to a reference frame. Another perspective on the speed of time in these traditional theories is to perceive space moving to different points on the time axis at a finite speed and in a positive direction along the time axis. However, if time is not given a finite speed, space is stuck at a single point of time, and the motion of bodies in space is impossible. Hence, the concept of motion is added to the concept of time so that points of time occur at a finite rate in space. Although motion is a concept independent from the concepts of space and time, time and space quantify motion. When an object moves across a quantity of distance in a period of time, the motion of the object is quantified, and, as a result, the object has a specific speed.

To delineate motion into the distance-time manifold, I give the eventon movement across a distance-time line. The ratio of distance to time crossed by the eventon quantifies the motion of the eventon but does not cause motion of the eventon. In the relationship between the eventon and a distance-time line, the motion of the eventon must be defined as a separate concept because motion is an independent concept from the concept of distance-time. If the eventon were not defined as changing location on the distance-time line, the eventon would be stagnant at a single point on the distance-time line. However, I define the eventon as moving in a positive direction along its event line. Since the ratio of distance to time crossed by an eventon crossing its event line is a constant $D/T = c$, the speed of the eventon is quantified to be a constant speed c relative to the coordinate system within the distance-time manifold. Thus, the speed c is intrinsic to the distance-time manifold, and all other speeds smaller than c are fractions of it.

3.8. The finite speed of space and the inverse speed of time

In the classical and relativity theories, the time axis is defined perpendicular to the three dimensions of space. This space is defined as moving at a finite rate to different points of time on the time axis. Therefore, points of time appear at a finite rate in space. Since the axes of space are defined as perpendicular to the time axis, all points of space occur simultaneously with respect to each other. Hence, the distance between any of these points of space happens at a single point of time and infinitely fast. However, in distance-time theory, distance occurs across a period of time, making distance finitely fast. In other words, each distinct point of a distance happens at a distinct point of time. What this means is that as points of time occur, points of distance occur with them.

As I stated previously, in a distance-time manifold, each observer has a rest speed c across distance-time because the rate of an eventon defining distance-time is speed $D/T = c$. Also, while these observers are flowing across distance-time at rest speed $D/T = c$, distance-time is occurring at speed $D/T = c$ between vector coordinates, which happens when measured by an observer with photons in a vacuum. Relative to this observer, therefore, the rate of distance occurring per period of time in any direction is speed $D/T = c$, and the rate of time occurring across distance is the inverse speed $T/D = 1/c$. A distance with speed c defined between two objects means that the gap between these objects occurs at a speed c, not infinitely fast. Consequently, consecutive points of distance occur with consecutive points of time in either direction between vector coordinates when a photon travels in either direction between these coordinates.

Points of distance and time can only be defined as occurring when defined as occurring with a particle. Photons in a vacuum are used to measure the speed at which distance occurs because photons in a vacuum move at the same speed as eventons relative to an observer. Since a space is distance defined in three dimensions and since distance has a speed c, I often refer to the speed of space as speed c in distance-time theory. Also, since vector coordinates are defined within a space of finite speed, they also occur at a speed c relative to an observer. This concept of the speed of space having a speed c is in contrast to relativity and classical theories, which defines space as occurring at an infinite speed.

3.9. The finite speed of space versus the expansion of the universe

When I discuss the finite speed of space, some readers may conclude that I am referring to the expansion of the universe. However, this could not be more erroneous! The finite speed of space does not refer to the expansion of space between objects. To further illustrate this, I place a man in a room facing a stationary wall. Relative to this man, the wall is located at a period of time and at a distance away from him. The finite speed of space essentially means that the consecutive points of distance between the man and the wall occur with consecutive points of time as measured by the man through the use of light particles. Therefore, the wall would occur at a distance and a period of time away from the man. This means that the gap between the man and the wall happens at a finite speed because it occurs over a period of time. Obviously, this does not mean that the gap is expanding and the wall is moving away from the man. Instead, it means that the stationary wall would occur with its surrounding space a distance and a period of time away from the man. Since the expansion of the universe actually refers to galaxies moving away from each other, it is obviously a different concept from the finite speed of space. Nevertheless, there may be a connection between the speed of space and the expansion of the universe even though space of speed c is not the same idea as an expanding universe.

3.10. A here-now

Since space has a speed c in distance-time theory, principles requiring a space and time, such as influence at a distance, Heisenberg's uncertainty principle, momentum, and energy, are redefined in a space which occurs at speed c in a distance-time manifold. Consequently, in distance-time theory, the speed of measuring the location or speed of a particle is at a speed c or slower, and any influence across a distance must occur at speed c or slower. On the other hand, in Einstein's relativity theory, the uncertainty principle, influence at a distance, energy, and momentum are defined in a space of infinite speed. Space has this finite speed because time is integrated into it. Any structure of time and space needs to describe space in the future, past, and present. A here-now is space in the present, and it is a point space. A here-now is where at a single point of time there is no difference between locations in space.

Since distance occurs at speed c in a distance-time manifold, at a single point of time, t, only an infinitesimal point of distance occurs between any two distinct vector coordinates. Therefore, at every point of time, distance contracts to zero, an infinitesimal point, between different vector coordinates and results in an infinitesimal space. This means that within a distance-time manifold every vector coordinate at the single point t, the present in time, is located here and now relative to any vector coordinate. Consequently, any particle in a distance-time manifold experiences all other particles in this manifold here and now. I call this infinitesimal space at time now a “here-now”. A here-now contrasts with

Einstein's special relativity theory, which assumes that there is an infinitely fast space at the single point of time happening now relative to an observer [1–5]. This point space is infinitely quick because it happens at a single point of time. Also, since a four-dimensional space-time continuum in general relativity theory assumes that space is infinitely fast, a here-now cannot be derived from the theory of general relativity. Therefore, a here-now is an independent concept from the concept of a singularity found in general relativity theory.

Some readers may still be troubled with an entire space that contracts to a single point. I compare the relationship between space and a point of space to an analogy about the relationship of light and darkness. Darkness is essentially the lack of light. Similarly, a point space is the lack of distance within space. Where there is a zero amount of light, there is darkness. When there is zero distance occurring in any direction of space, there is no difference between vector coordinates in space. Thus, all vector coordinates in space define the same location. In other words, a single point of space occurs when zero distance happens at an infinite speed between any vector coordinates.

Distance is only defined within the difference between points of time, but not the here-now, which is only defined at a single point of time. However, both distance-time and the here-now still happen in the same manifold. This seems contradictory. How can both occur in the same manifold? In section 3.6, I illustrated that a here-now at a point of time is distinct because of the distinct set of events it possesses. Therefore, there is a difference between each here-now, which is measurable by the distance-time each eventon traverses between each here-now. Thus, distance can only exist in the difference between points of time, and the here-now can exist only at a single point of time.

One should not think that within a here-now there is zero distance divided by zero time. Instead, within a here-now, there actually exists an infinitesimal point of distance-time. As a consequence, one could only divide an infinitesimal point of distance by an infinitesimal point of time, which would still result in a constant ratio c.

How does one define the concept of zero? It would be easier to define zero in a quantified model of something but not in a continuum of something. In the quantified model of something, that something at its smallest comes in bits. In this type of model, I can simply count the quantity of the bits. If there are no bits, the quantity is zero bits. A continuum is different. What is the concept of zero in a continuum model of something? It is difficult to count the quantity of something that is continuous. When can I count or measure zero of a continuous something? I can say that that continuous something is an infinitesimal. If I use the concept of an infinitesimal, I can state that no matter how small of that continuous something you can measure or count, a zero amount of it is less than that. Distance-time is continuous. A here-now is zero distance-time. The best way to look at a here-now of distance-time is that of an infinitesimal distance-time.

Although the existence of space is communicated to observers by particles with finite speed, it is generally assumed that space exists at a single point of time. One cannot prove, however, that space does exist at a single point of time. To give an example of this, I define a man as standing a distance from a wall. The man wants to prove that there is a gap between him and the wall at the single point of time happening now. In other words, he wishes to prove that space is infinitely quick. The man first bounces a ball off the wall and measures the period of time between the moment the ball leaves and the moment it returns. Although this proves the existence of space between the man and the wall, it does not prove that this space is infinitely quick. The man also realizes that the fastest way he can determine that the wall is a distance away is to measure the distance with a light beam traveling in a vacuum. The difference in time it takes the light to travel between the man and the wall proves that there is a gap occurring between the man and the wall and that this gap occurs at least as fast as the speed of light in a vacuum. However, the man realizes that no object travels faster than the speed of light in a vacuum. Thus, he is unable to prove (measure) that space is infinitely quick. If an observer cannot detect something, that something cannot be defined relative to an observer. In other words, relative to an observer, all that is real is that which is observable. In retrospect, it is erroneous to define an infinitely quick space relative to an observer. Yet, the special theory of relativity does exactly that. In distance-time theory, on the other hand, the gap between the man and the wall does not exist at a single point of time. Therefore, the gap shrinks to zero at a single point of time and the wall is located here-now relative to the man.

To think that all the energy that is in a space is collapsed into a point creating infinite energy would be a wrong view of a here-now. In a here-now, there is zero distance-time and zero frequency-wavelength. As a result, there would also be zero energy in a here-now. Indeed, all principles in physics I discussed earlier, notably Heisenberg's uncertainty principle, influence at a distance, momentum, and energy, seemingly conflict with the here-now because these principles need a space and time in which to be defined. Yet, I reiterate that principles needing a space are not defined as happening at a single point of time. Instead, they are defined across a period of time in a space of speed c. Therefore, they do not conflict with the here-now principle, which is only defined at the single point of time happening in the present relative to an observer. Any structure of time and space needs to describe space in the future, past, and present. A here-now is space in the present, and it is a point space. It is necessary in this article.

3.11. A here-now never overlaps space

A here-now and space only occur relative to an observer. A here-now only happens at the point of time in the present relative to an observer. As a consequence, all other here-nows in the past or future do not exist relative to the observer. On the other hand, relative to an observer, space happens over a period of time into the past or future. In other words, space happens over a period, which is the difference between the present point of time and a point of time in the past or future. Therefore, relative to an observer, space never happens at the single point of time of the present. As a consequence, space and a here-now never occur at the same point of time; nor do they ever overlap relative to an observer. Therefore, any object observed in a space at a point of time, *t*, in the past could not be located here-now, relative to the observer, at the same point of time, *t*.

3.12. The effect of two distinct incidents on each other

One question about a point space may trouble some readers. If a space is located at a single point of space at the point of time happening now, how can the force and momentum of a car wreck keep separate from me as I watch television two miles away at the time of the wreck? These two incidents occur at a finite speed and only in a space of finite speed. In general, the laws of physics governing actions and reactions occur in a space of finite speed. (There are possible exceptions to this rule, one of which I discuss in chapter 6 on quantum tunneling.) Since the force and momentum in the car wreck happen in a space of finite speed, they do not occur here-now relative to me. Therefore, the force and momentum in the car wreck happen two miles away and have no effect on my watching television. The solution that I have given to the paradox of the car wreck may be applied to many problems that readers have with the concept of a point space. For instance, how can the human body function in a point space? The answer is that all the reactions within the human body occur within a space of finite speed and not within a point.

A second question may also surface. How can a particle be located within an infinitely fast point space and be measured to have a specific location within a space of finite speed? I best answer this question in section 6.1 of this article, which focuses on the probabilistic location of a particle.

3.13. Measuring a distance between two distinct locations at the same point of time relative to me

Let's for a moment imagine that I am standing in the middle of a room exactly halfway between two opposing walls which I call *A* and *B*. I simultaneously emit two photons in opposite directions. One bounces off wall *A* and returns to me. The other bounces off wall *B* and returns to me. Since both left me simultaneously, they will both arrive at their respective walls at the same exact time. Hence, I would measure a distance between two walls which coexist at a single point of time, relative to me. How could this result occur, if, at a single point of time, a point space exists? It must be remembered that space is defined relative to an observer and via particles, so the only point space existing relative to me at a given moment is in my now, and not in my future or past. However, relative to me, these two walls coexist at a different point of time from my now and are a distance from me in opposite directions. The only way I could measure a wall in the present time (the now), relative to me, is for me to be at the same point in space as the wall. However, if I were located at either wall, *A* or *B*, I could not measure both walls happening at the same point of time and a distance apart from each other. Instead, I would always measure them existing at different points of time and at a distance apart.

3.14. Rod and clock measurements

Traditionally, all measuring rods (rulers) are calibrated to distance units, and all clocks are calibrated to time units. Nevertheless, rods and clocks measure distance-time. Rods measure the distance-time that any object must move across, going straight from one vector coordinate to another. The quantity of distance-time between vector coordinates is defined by the metric function given in Eqs. (1) and (3). Clocks, however, measure the magnitude of distance-time that the entire manifold moves across with its rest velocity. Using the distance-time equation, $D = cT$, I could divide rod measurements by c to get the time measured by a rod, or I could multiply clock measurements by c to get the scalar distance measurement of clocks. However, rod and clock measurements are not necessarily equated because they can measure independently from each other. Consequently, a rod measurement divided by a clock measurement can equal any speed, though not necessarily speed c. The distance-time equation only states that distance is equivalent to time, and not that a rod measurement is equal to a clock measurement. However, the magnitude of a rod measurement is equal to a clock measurement when a rod and clock measure the distance-time traversed by the same photon traveling at speed c.

3.15. The speed of rod measurements

In Einstein's relativity theory, the rod measurement was assumed to be infinitely quick because space was defined as infinitely fast [1–5]. Nevertheless, no object travels faster than the speed of light in a vacuum; therefore, I have no object by which to measure the speed of the rod measurement at speeds faster than that of light in a vacuum. Despite these circumstances, I could measure the minimum possible speed at which the rod measurement occurs. Placing a rod in a vacuum, I could measure the difference in time that a photon travels from one end of the rod to the other. This measurement would determine that speed c is the minimum possible speed, though not necessarily the actual speed, and that one end of the rod occurs a distance away relative to the other end. Nevertheless, I could merely validate the minimum possible speed of the rod measurement, and the relativistic view of an infinitely quick rod measurement would remain only an assumption.

In contrast to this relativistic view, the determinable minimum possible speed c of the rod measurement is the speed of the rod measurement in distance-time theory because that is the speed of distance in distance-time theory. I send a photon on a straight path along a rod measurement. The path, direction, and speed of the photon and the distance-time traversed by it between the rod ends are the rod measurements. As a result, the rod end that it encounters first occurs first, and the rod end that it encounters last occurs last.

To further illustrate these concepts, I create a thought experiment. In my imagination, I send a photon along a rod in a vacuum, and I place an observer at both ends of the rod. Relative to the observer at the rod end that encounters the photon last, the other rod end occurs at a negative distance-time away. Relative to the observer at the rod end that encounters the photon first, the other rod end occurs at a positive distance-time away. Since a different photon could be traveling the same path but in an opposite direction, the order of which rod end occurs first or last would depend on which photon is being observed.

3.16. Dilation of distance-time

In Figure 2, I place point *P* at $(x_1, 0)$, point *Q* at $(0, y_1)$, and point *O* at $(0, 0)$, which is the origin. In this figure, an eventon travels straight from *P* to Q, crossing

$$PQ = \sqrt{\left[x_1 - 0\right]^2 + \left[y_1 - 0\right]^2}\,. \tag{4}$$

PQ is the distance-time given in distance units. In order for this eventon to travel from *P* to *Q*, it must cross

$$PO = \left[x_1 - 0\right], \tag{5}$$

and

$$QO = \left[y_1 - 0\right]. \tag{6}$$

PO is the distance-time parallel to the *X* axis, and QO is the distance-time parallel to the *Y* axis. Therefore, this eventon traveling straight from *P* to *Q* crosses *PQ* distance-time, while crossing *PO* distance-time parallel to the *X* axis and *QO* distance-time parallel to the *Y* axis. Using Eqs. (4), (5), and (6), I derive

$$PO \le PQ \tag{7}$$

and

$$QO \le PQ\,. \tag{8}$$

As a result, *PO* and *QO* are dilated along the path that the eventon takes between *P* and *Q* when *PO* and *QO* are smaller than *PQ*.

PO and *QO* dilated between *P* and *Q* occur slower than speed *c*. Dividing *PQ* by *c*, I change *PQ* from distance units to time units, *T*. Since *PO* distance-time and *QO* distance-time occur in a period of time *T*, I divide Eqs. (7) and (8) by *T*, which gives

$$c = \frac{PQ}{T} \geq \frac{PO}{T} \tag{9}$$

and

$$c = \frac{PQ}{T} \geq \frac{QO}{T}. \tag{10}$$

Both Eqs. (9) and (10) show that the distance in *PO* and *QO*, dilated between *P* and *Q*, have a speed smaller than or equal to *c*. If in Figure 2 I send a different eventon traveling straight between *P* and *O* or *Q* and *O*, it travels at speed *c*; therefore, actual distance occurs at speed *c* between P and O as well as between *Q* and *O*. However, the *PO* and *QO* distances in Eqs. (5) and (6) are dilated between *P* and *Q*, and are only parallel to the *X* and *Y* axes in Figure 2. They do not necessarily lie on the *X* and *Y* axes. According to Eq. (9), *PO* has a speed *c* if *PO* = *PQ*. According to Eqs. (4) through (6), this only occurs when *QO* equals zero distance, making *PO* the actual distance occurring between *P* and *O*. Also, *QO* has speed *c* and is the actual distance-time between *Q* and *O* when *PO* equals zero distance.

3.17. Visible space

Visible space is the space an observer sees. Since light particles crossing distance-time give an observer a special view, I derive a three-dimensional view of space by placing an observer in a distance-time manifold.

In this section on visible space, I assume that light is traveling in a vacuum. In Figure 3, an observer stands a distance from the broadside of a wall. Also, in Figure 3, I place points *P, Q*, and *O* from Figure 2 such that the observer is at point *Q*, and on the wall's surface lie points *P* and *O*. Light beams travel a straight path in Figure 3 from *P* to *Q* and from *O* to *Q*. The observer at *Q* sees that the light that travels from *P* to *Q* crosses *PO* distance parallel to the wall's surface. Because the path from *Q* to *O* is perpendicular to the wall, the observer sees that the light that travels from *O* to *Q* does not cross any distance parallel to the wall's surface. Therefore, the observer sees *P* extended out from *O* a distance of *PO*. Since *P* can be any point on the wall's surface, the observer sees the entire wall's surface extended out, a distance in any direction on the wall's surface from *O*, when the light rays reflected off of the wall's surface reach the observer.

The fraction of distance in *PQ* parallel to the straight path between *Q* and *O* is *QO* distance. Since *P* can be any point on the wall's surface, every light ray from the wall's surface reaching the observer must traverse *QO* distance parallel to the straight path between *Q* and *O*. Thus, the observer sees the wall's surface a depth of *QO* distance away and in the past.

I make the plane represented by the wall's surface infinitely large, and I make the distance *QO* any possible distance in any direction from the observer and perpendicular to the wall's surface. The point *P* can now be any point within the three-dimensional distance-time manifold, and the observer sees a three-dimensional space in the past. However, the distances within this visible space do not always travel as fast as actual space at speed *c*. Visible space is only the space that an observer sees. It is not necessarily the actual space, which has a speed *c*. According to Eq. (9), the distance of *PO* that the observer sees on the wall's surface has a speed smaller than or equal to *c*. The observer only sees the actual distance PO occur at speed *c* if the observer is located at point *O*, making *QO* equal to zero distance and *PQ* = *PO*. However, if the observer is at a distance away from *O*, the distance that the observer sees between P and O is dilated along the path between *P* and *Q*, and is slower than speed *c*. Hence, visible space has a speed smaller than or equal to the speed of actual space.

3.18. Reference frame motion with speeds slower than c

Objects given a location in a traditional space are stagnant if no provision for the motion of these objects across space is defined. Therefore, the traditional view of a space requires a fourth dimension of time. In this view of space and time, or *space-time*, space moves across the fourth axis of time. Each distinct point of time is a distinct point of existence for space. At a given point of time, an object can exist at a different location in space compared to previous or later locations in space. This ability of relocation at different points of existence allows an object to move in space while space moves across the time axis. In distance-time theory, however, there is no fourth axis of time with a space extended out, separate from the time axis. Instead, in distance-time theory, motion is defined by eventon motion occurring at speed *c* relative to a reference frame at rest. A reference frame is a coordinate system that is a reference for a perspective. Any motion of another reference frame at velocity *v*, relative to the reference frame at rest, is a part of this motion of eventons at speed *c*. Therefore, relative to the reference frame at rest, a fraction of the distance-time (in the speed c) of these eventons goes into the velocity *v* of the other reference frame. This relationship of *c* to *v* is in contrast to traditional theories of space and time, which do not view all velocities *v* as only fractions of a whole number *c*. Since both reference frames share the same eventons, the same eventons define distance and time for both of these frames. As a result, the distance-time in *v* (the speed of the moving frame) is subtracted out of the distance-time of the moving frame relative to the reference frame at rest. However, the distance-time relative to the reference frame at rest does not have distance-time subtracted out. Using the *S* and *S′* reference frame, I illustrate in Figure 4 the relative motion of one reference frame to another.

In Figure 4, *S′* has a velocity *v* in the positive *X* axis direction. The *X* and *X'* axes, as well as the *Y* and *Y'* axes, lie parallel. The *S* clock is at the *S* origin, and the S' clock is at the S' origin. At the *S* and *S′* clock measurements of *t = 0* and *t′* = *0*, the *S* and S' origins coincide with eventon *A*. Relative to *S, S′* moves from (*0, 0*) at *t = 0* to (*x, 0*) at *t* = *t*, and eventon *A* moves straight from (*0, 0*) at *t* =

0 to (*x, y*) at *t = t*. However, relative to the *S′* frame, this eventon *A* moves from (*0′,0*') at *t′ = 0* to (*0′, y′*) at *t′ = t′*, which is straight along the *Y′* axis. Also, rod measurements within the *S* frame give

$$D'' = cT'' = \left(x - 0\right) \tag{11}$$

and

$$D' = cT' = \left(y - 0\right). \tag{12}$$

In Figure 4, the distance-time that eventon *A* crosses between (*0, 0*) and (*x, y*), in time period of (*t − 0*), is given by the distance-time Euclidean metric function, which is

$$ct = \sqrt{x^2 + y^2}\ . \tag{13}$$

However, the amount of *ct* parallel to the *X* and *Y* axes are given by Eqs. (11) and (12), and they are dilated across ct. Thus, eventon *A* crosses *D″* distance in t time parallel to the *X* axis. Also, parallel to the *Y* axis, eventon *A* crosses *D*' distance in *t* time. The speed of eventon *A* parallel to the *X* axis is

$$v = \frac{D''}{t} = \frac{x}{t}. \tag{14}$$

The speed of eventon *A* parallel to the *Y* axis is

$$u = \frac{D'}{t} = \frac{y}{t}. \tag{15}$$

The ratio of distance to time in which an eventon crosses is always *c*. Thus, Eqs. (14) and (15) are not distance-time metric functions. Instead, relative to *S,* they are only rod measurements taken along the *X* and *Y* axes and divided by the *S* clock measurement, which gives partial velocities *v* and *u* of the total velocity *c*. Dividing Eq. (13) by t and combining the result with Eqs. (14) and (15) produces

$$c^2 = v^2 + u^2, \tag{16}$$

the relationship between the total and partial speeds of eventon *A*. Combining Eqs. (11) and (14), I arrive at

$$D'' = cT'' = ct\left(\frac{v}{c}\right). \tag{17}$$

Combining Eqs. (12), (15), and (16) yields

$$D' = cT' = ct\sqrt{1 - \frac{v^2}{c^2}}\ . \tag{18}$$

Both Eqs. (17) and (18) give D'' and D' as fractions of ct. Since D' and D'' are crossed by eventon *A* while eventon *A* crosses *ct*, D' and D'' are dilated, according to Eqs. (17) and (18), across *ct*.

Relative to the *S* frame, the *S′* frame moves with velocity *v* along the *X* axis. The distance-time crossed by this velocity *v* along the *X* axis is defined in Eq. (14) to be the distance-time $D'' = cT''$, which is the part of *ct* that occurs parallel to the X axis in Figure 4. This distance-time in *v* does not occur relative to *S′*. Only in the *S* frame does it occur as a fraction of *ct* distance-time. Relative to *S*, eventon *A* travels across $D' = cT'$ parallel to the *Y* and *Y′* axes and inside *S′*. $D'' = cT''$ is the distance-time in the rest speed, *u*, of *S′* relative to *S*. Combining Eqs. (11), (12), and (13), I derive

$$\left(D'\right)^2 = \left(ct\right)^2 - \left(D''\right)^2. \tag{19}$$

Similar to Eqs. (19) and (18), the distance-time in *v*, which is $D'' = cT''$, is subtracted out of the total distance-time *ct*, which eventon *A* crosses in *S*. This leaves $D' = cT'$ distance-time within *S′* relative to *S*. Although other eventons have different paths from eventon *A*'s event line, relative to *S*, all the paths of eventons within *S′* still have the distance-time in *v* subtracted out according to Eqs. (19) and (18), leaving the distance-time in rest speed *u*, which is $D' = cT'$. I used eventon *A*'s event line in Figure 4 because with this event line the relationships are apparent between the distance-times in speeds *c*, *v*, and *u*. The distance-time in *v* is the difference between *S* and *S′* reference frames relative to *S*. Consequently, $D'' = cT''$ is the difference between the here-nows of the *S* and *S′* reference frames. The events in $D'' = cT''$, therefore, are located here-now relative to the *S′* reference frames. However, these events are still dilated across $D = cT$ relative to the *S* reference frame. Since both *u* and *v* are dilated across *cT*, they both are slower than *c*. This is the reason that allows velocities of *v* that are slower than *c* in a distance-time manifold.

It is now appropriate to examine a second event line in Figure 4 defined by an eventon *B*. I place eventon *B* in Figure 4 traveling in a positive direction along the *X* and *X′* axes. At $t = 0$ and $t' = 0$, *B* coincides with the origins of *S* and *S′*. According to the metric function, within the *S* frame, *B* crosses

$$x = ct \tag{20}$$

quantity of distance-time, and within the *S′* frame, *B* crosses

$$x' = ct' \tag{21}$$

quantity of distance-time. Using Eq. (20) for substitution into Eq. (17), I arrive at

$$D'' = \frac{xv}{c}. \tag{22}$$

Dividing Eq. (22) by *c*, I change Eq. (22) into time units, getting

$$T'' = \frac{xv}{c^2} \text{ .} \qquad (23)$$

In Eqs. (22) and (23), $D'' = cT''$ (which is distance-time in the velocity v) is dilated along the X axis relative to the S frame. Since $D'' = cT''$ is the difference between distance-time occurring within S and S' relative to S, Eqs. (22) and (23) give this difference of $D'' = cT''$ along the X axis in terms of x. In order to put Eqs. (22) and (23) in terms of x', I substitute x' for x and $-v$ for v, since S is moving in a $-X'$ axis direction relative to S'. These substitutions give

$$D'' = -x'\frac{v}{c} \qquad (24)$$

and

$$T'' = -x'\frac{v}{c^2} \text{ .} \qquad (25)$$

Both Eqs. (24) and (25) give the difference of $D'' = cT''$ in velocity $-v$ between S and S' along the X' axis in terms of x'. I use Eqs. (22) through (25) at a later point in the article.

Since $D'' = cT''$ is the difference in distance-time between the S and S' frames, it is also the difference between the various sets of events occurring here-now in the S and S' frames. Consequently, for every distinct reference frame, there is a distinct set of events occurring here-now in that frame. Any of the Eqs. (22) through (25) can be used to describe the difference between the here-nows of the S and S' frames. I give a clearer description of this after I have derived a few more equations. I next substitute the distance-time of x in Eq. (20) into ct of Eq. (18), deriving

$$D' = x\sqrt{1-\frac{v^2}{c^2}} \text{ .} \qquad (26)$$

In Eq. (26), $D' = cT'$ is the distance along the X' axis in the S' frame which is contracted relative to S.

3.19. Speed limit

Distance-time theory offers two explanations not found in relativity theory regarding how speeds faster than speed c cannot be attained by particles crossing distance and time. The first reason is that space travels at speed c. Therefore, at speeds faster than c, space has not happened yet; thus, there is no space to travel across. The second explanation proposes that c is the only speed intrinsic to the structure of distance and time in the universe. All other speeds possess only a part of the speed c according to Eq. (16). Consequently, the maximum speed that v can be is c according to Eq. (16).

3.20. A perspective of a three-dimensional distance-time manifold

A three-dimensional distance-time manifold has an indefinite number of eventons moving along all possible paths and directions at every vector coordinate. Relative to any observer, a reference frame within this manifold possesses distance and time according to how distance and time is traversed by eventons. Whatever periods of time the eventons move across, relative to the observer, the reference frame are defined across those periods of time, too. The distance that the eventons cross along their paths relative to an observer is the distance occurring along that path in that reference. The motion of the eventons is intrinsic to the distance-time manifold, and the speeds of matter that are slower than c are part of the motion of these eventons. Hence, these speeds of matter, which are smaller than c in and relative to a reference frame, are fractions of the speed that the eventons experience in and relative to that reference frame. In essence, all experiences of time, distance, and motion in and relative to an observer's reference frame are given by the eventons. Therefore, a reference frame is essentially all the time and space that eventons traverse relative to an observer. This perception of a reference frame is a proper perception of a distance-time manifold. In summation, the distance-time manifold is a three-dimensional space, and this space has a finite speed because time is integrated into it. The way that time is integrated into it is by using the distance-time equation. Time is never on a fourth axis that is in some way curled up. The manifold is strictly three-dimensional. Essentially, it is the most classic and basic understanding of a manifold. Euclid would be proud. The only differences are the distance-time metric function and how it is interpreted. Of course, this gives strange consequences. Nonetheless, these consequences are directly related to the distance-time metric function's meaning.

How do I describe a point in this kind of dynamic manifold? The eventons are entering and exiting every point of a three-dimensional manifold. This entering and exiting of eventons moving in all directions I call an “event” or an “event point”.

3.21. Relative motion's effect on rod and clock measurements

Since I define events as existing at every vector coordinate independent of light or matter, eventons make up an ocean. In this ocean of eventons reside all particles of matter, light, and their respective reference frames of motion. The movement of the eventons gives a rest speed to all particles (except light, which does not have a rest speed) and allows for the speed of one particle relative to another. Of course, eventons only represent distance-time. As an actual particle, they may not exist. There are two types of measurements of distance-time: the clock measurement which measures the magnitude of distance-time, and the ruler measurement, which is a vector measurement. The latter is a vectorial measurement because eventons travel along the ruler in opposite directions. As a result, depending upon which direction one measures with the ruler, an eventon is moving in that direction.

A person experiences a rest speed across distance-time relative to an observer. If this person has a constant speed relative to an observer, the observer observes that this person gets his or her relative motion via the same eventons that gave him or her an individual rest speed. Therefore, some of the distance-time that is in this person's rest speed has now gone into his or her relative motion. There are two points I need to make. First, the rest speed comes from the magnitude of the distance-time that eventons traverse. Second, this rest speed gives clocks their measurements. Also, the magnitude of the vectorial distance travelled by the same eventons gives ruler measurements. Therefore, when some distance-time is removed from the eventons giving the rest speed for a person with a relative motion, this person's distance-time should be effected relative to an observer. Hence, the person's clock and ruler measurements will be effected in the same manner.

In sum, all matter exists within an ocean of eventons, and they give us and all other objects all experiences of time and distance. This includes clock and ruler measurements as well as objects' relative motions. Relative motion, as well as clock and ruler measurements, relies on the same eventons for distance-time. As a result, there is distance-time in the motion of an object, and this distance-time should be subtracted from the clock and ruler measurements of this moving object relative to an observer at rest.

3.22. Perceiving the distance-time idea

In special relativity, $E = mc^2$. This equation means that energy is equal to mass. Sometimes it is referred to as mass-energy. This does not mean that mass is multiplied by energy. (In chapter 4, I derive the mass-energy equation from the distance-time equation. In other words, $E = mc^2$, because $D = cT$, which I later show in chapter 4.) Similar to the mass-energy idea, in distance-time theory, distance is equal to time. This does not mean that distance is multiplied by time as well. In distance-time theory, I rely on the distance-time equation. D means a length. T means a period of time. Also, c is the speed of light in a vacuum. Only c and D can be a vector. T is always a scalar. This means it is only the magnitude of distance that is equal to the period-of-time. It is this scalar relationship that must always be satisfied. When I use a ruler to measure a distance, I use $D/c = T$ to derive the time in the ruler measurement. According to this equation, if I divide the distance by the c, I get the time in the distance-time measured by the ruler. Wouldn't I get the inverse time, and shouldn't I use $D/T = c$? Time is often used inversely in physics. If I were to talk about the time it took for me to go from point *A* to point *B*, I would refer to the time in conversation, not to the distance, too. However, in reality, the actual time is in the denominator of the equation that gave the speed. I would use $D = cT$ to derive the scalar distance in a clock measurement. If I am not calculating time from distance or distance from time, I primarily use equation $D/T = c$. This equation helps me appreciate the distance-time idea. Distance-time is a speed from which I can derive distance and time measurements. The best way to imagine distance-time in a three-dimensional manifold is to imagine something with speed c like an eventon. After all, distance-time does possess a real speed relative to matter.

3.23. Time is never a vector

The equivalency of distance to time is a scalar and constant relationship because time is never a vector. Distance and velocity can be vectors—not time. This means there is no vector energy either. Also, there are no three dimensions of time, and time cannot be used to create analogous geometric ideas like area or volume.

3.24. The classical fourth dimension

All that is needed to know about time and distance in this theory is given by eventons in the manifold. The distance-time manifold is kinetic—not static. Events continuously happen within this manifold. Why insist on four dimensions? The fourth dimension has never been proven to exist. Time as a fourth dimension comes from the classical idea of time on an axis separated from the three dimensions of space. Who invented that classical idea, and why should I accept it as a fundamental truth about the universe? Was it Descartes who invented the classical structure of space and time? All that the relativists did was adapt this classical structure to satisfy relativistic results such as the following: the speed of light in a vacuum is constant. In so doing, relativists created a four-dimensional space-time continuum. The only reason people accept the fourth dimension is because they have developed that model into their theories, and of course there are some very good theories that are four-dimensional. Just because ideas work in a four-dimensional space-time continuum does not mean that there are necessarily four dimensions. Nevertheless, space-time is very classical in its approach, and I do not trust it.

4. DERIVATION OF SPECIAL RELATIVITY

4.1. The necessity of deriving special relativistic results

Any new theory claiming to be more accurate than the old theory must predict the old theories' verified results. The special relativistic predictions derived here are not new. However, these predictions are derived from a distance-time manifold. Therefore, a different perspective is given to these special relativistic results. In this chapter, I prepare the reader for a photonic distance-time.

4.2. The second postulate of special relativity

Einstein's second postulate of special relativity theory is that any particle traveling at speed c has a constant speed relative to any reference frame [1–5]. This postulate is satisfied by the distance-time Euclidean metric function, Eq. (3). According to this function, the ratio of time to distance is always a constant c relative to any reference frame. Therefore, within a prime reference frame, the amount of distance per time an eventon crosses is Eq. (3) with all prime variables. Within a nonprime reference frame, different from the prime frame, the amount of distance per time is Eq. (3) again, but this time all variables are nonprime. Consequently, the rate of the distance per period of time an eventon crosses is a constant speed c relative to the prime and nonprime reference frames. This is Einstein's second postulate of special relativity: that any particle at speed c has a constant speed relative to any reference frame [1–5]. Therefore, the distance-time Euclidean metric function satisfies Einstein's second postulate of special theory of relativity.

4.3. The first postulate of special relativity

I next derive Einstein's first postulate of special relativity. Since relative to any reference frame, eventons have a constant speed c, the clocks relative to any reference frame have a constant speed c. This constant clock speed for a reference frame I call the "proper clock speed." Therefore, the amount of time measured by a proper clock measurement of any reference frame is constant. Also, the relationship between rod measurements and clock measurements for an eventon moving in a straight path in and relative to a reference frame is given by Eq. (3). Consequently, a rod measurement relative to a reference frame is also constant. I call this rod measurement the proper rod measurement. If all physical laws relative to any reference frame were defined to be based only upon the proper clock and rod measurements, all physical laws would be constant relative to any reference frame, since clock and rod measurements of any frame are constant. This is equivalent to Einstein's first postulate of special relativity, which states that the laws of physics are constant relative to any reference frame [1–5]. I am assuming that Newton's first two laws of motion hold within the reference frames that I am using to derive Einstein's postulates of special relativity; therefore, the Euclidean distance-time metric function holds within these reference frames.

I could put in this article the same type of clock synchronization scenario as found in any book about special relativity. Instead, I state that I synchronize clocks in a similar manner and that there is no need to delineate the method of clock synchronization any further.

4.4. Relativistic kinematics

To derive the relativistic equations found in Einstein's special relativity theory, I use Figure 4 and Eqs. (11) through (25). (Eqs. (11) through (25) come from Figure 4.) In Figure 4, relative to the S reference frame, Eq. (18) gives the relationship between the distance-time in the rest speeds of S' and S frames. Converting Eq. (18) to time units, I arrive at

$$t = \frac{t'}{\sqrt{1-\frac{v^2}{c^2}}}, \tag{27}$$

which is Einstein's time-dilation equation [1–5]. However, Eq. (18) [the origin of Eq. (27)] compares the magnitude of distance-times occurring in the S' to that of S. It is not a general transformation of S' coordinates to S coordinates. Also, Eq. (18) was derived from the clock measurements of Figure 4. Since the clocks were only located at the S and S' origins in Figure 4, Eq. (27) transfers only the clock measurement at the S' origin to the clock measurement at the S origin. It is assumed that the clocks within the S and S' frames are synchronized by a traditional method of synchronization. Since v and $-v$ lie parallel to the X and X' axes, there is a difference in the clock measurements between the x and x' coordinates according to Eqs. (22) through (25) because there is nonsimultaneity of the synchronized clocks along the relative to the S frame. To derive the Lorentz transformation equations, I first subtract out the distance-time in $-v$ from t', which gives $t' - T''$. (The distance-time in $-v$ is the difference in distance-time between the x and x' coordinates relative to the primed reference frame.) Since I am transferring from t' to t, I subtract the left side of Eq. (25) from t', and this results in

$$t' + x'\frac{v}{c^2} = t' - T''. \tag{28}$$

Secondly, in Eq. (27), I replace t' with Eq. (28). This results in

$$t = \frac{t' + x'\frac{v}{c^2}}{\sqrt{1-\frac{v^2}{c^2}}}. \tag{29}$$

Lorentz's clock transformation equation for transforming clock measurements in S' to S is in Eq. (29) [1–5].

The Y' axis is perpendicular to the X' axis. Therefore, according to Eq. (29), the difference between points on the Y' axis has no effect on time measurement. However, clock measurements on the Y' axis would still be dilated according to Eq. (27).

I next derive the equation to transform the y' coordinate to the y coordinate. Eventon A in Figure 4 travels from $(0, 0)$ at $t = 0$ to (x, y) at $t = t$ in S, and from $(0', 0')$ at $t' = 0$ to $(0', y')$ at $t' = t'$ in S'. Therefore, according to the distance-time metric, I have Eq. (13) in S, and I have

$$ct' = y' \tag{30}$$

in S'. According to Eq. (14), eventon A crosses vt distance-time in the positive X axis direction. Using Eq. (14), I substitute vt for x in Eq. (13). Then, I solve for y to get

$$y = ct\sqrt{1-\frac{v^2}{c^2}}\,. \tag{31}$$

Combining Eqs. (27), (30), and (31), I solve for y and y', which results in

$$y = y'\,. \tag{32}$$

The transformation equation between the y and y' coordinates is given by Eq. (32). The same results can be derived for the z and z' coordinates.

I next derive the transformation equation that transforms the x' and t' coordinates to the x coordinate. Again I use eventon B to give the distance-time metric Eqs. (20) and (21), for the X and X' axes. Using Eqs. (20) and (21) to substitute for t', x', and t in Eq. (29), I change Eq. (29) from time units to distance units and derive

$$x = \frac{x' + vt'}{\sqrt{1-\frac{v^2}{c^2}}}\,. \tag{33}$$

Lorentz's transformation equation, which transforms the x' and t' coordinates to x is given by Eq. (33) [1–5]. Employing similar methods to those I have already used, I can derive Lorentz's transformation equations, which are

$$t' = \frac{t - \frac{xv}{c^2}}{\sqrt{1-\frac{v^2}{c^2}}} \tag{34}$$

and

$$x' = \frac{x - vt}{\sqrt{1 - \frac{v^2}{c^2}}}. \tag{35}$$

Finally, I turn to the subject of length contraction. The scalar coordinate is different from the vector coordinates. The scalar coordinate is what the clock measures. I give the following scenario. Relative to an observer, there are two clocks. Relative to this observer, clock *R* is at rest, and clock *S* has a speed. To start, they are both at the same time $t = 0$. Later, clock *R* has measured more time than clock *S*. In other words, relative to the observer, clock *R* is at $t = A$, and clock *S* is at $t = B$, where $A > B$. However, the *S* clock is at *B* at the same time that the *R* clock is at *A* relative to the observer. This means that in the same period of time it took the *R* clock to go from *0* to *A*, the *S* clock went from *0* to *B*. From the observer's perspective, therefore, the *S* clock measured less time than the *R* clock. The observer sees the start times of both clocks simultaneously, and he sees the end times of both clocks simultaneously. Consequently, the *S* clock period of time must span the period of the *R* clock's time. In conclusion, the smaller amount of distance-time measured by the S clock must be dilated—not contracted—relative to the observer. However, this is the result for the scalar coordinate *t* only—not for the vector coordinates. In Figure 4, eventon *B* travels across less distance-time in the *S′* frame than it traverses in the *S* frame. The relationship between the distance eventon *B* traverses in the two reference frames is given by Eq. (26). Since the eventon is moving along the *X* and *X′* axes, its location is given by vector coordinates, not scalar coordinates. Relative to an observer in the *S* frame, eventon *B* begins at a coordinate that moves in the *S′* frame but not in the *S* frame. Consequently, when the eventon arrives at the end coordinates, the starting coordinates of the *S* and *S′* are now at different locations. This causes an observer in the *S* frame to determine that eventon *B* traverses less distance-time in the *S′* frame. Unlike the distance-time in the scalar coordinate, the distance-time in the *S′* frame does not extend across the distance-time in the *S* frame. As a result, according to an observer in frame *S*, the lesser distance-time must be contracted—not dilated—given by Eq. (26), which is the length-contraction equation found in special relativity.

4.5. A matter-wave at rest

I define matter as a wave with a frequency *f* and a wavelength *w*, and I refer to matter as a "matter-wave." I place a matter-wave in the S' reference frame of Figure 4. Relative to *S′*, the matter-wave cycles at a rest speed *c* across distance-time. Since the matter-wave cycles across distance-time, I divide the wavelength of the matter-wave by *c* to change distance units to time units. This results in a corresponding frequency to the wavelength. Therefore, the matter-wave has a frequency-wavelength analogous to distance-time. I treat S' as the source for the matter-wave. The source emits *N* cycles of the matter-wave across the proper clock measurement *ct*. Earlier, I derived the proper clock measurement to be constant relative to both *S* and *S'*. The frequency-wavelength of the matter-wave is

$$w_o = \frac{ct}{N} = \frac{c}{f_o}. \tag{36}$$

I next adapt De Broglie's equations to be used for the matter-wave [6–9]. In this use of De Broglie's equations, which are

$$E_o = hf_o \tag{37}$$

and

$$P_o = \frac{h}{w_o}, \tag{38}$$

the rest frequency is multiplied by Planck's constant, and the rest wavelength is divided into Planck's constant. This results in the rest energy momentum of a matter-wave. Combining Eqs. (36), (35), and (38), I find that the rest momentum-energy equation can be derived:

$$E_o = P_o c. \tag{39}$$

The rest velocity *c* multiplied by proportionality factor *m* is equal to the rest momentum. Therefore,

$$P_o = mc. \tag{40}$$

The proportionality factor *m* must be determined distinctly for each matter-wave. Combining Eqs. (39) and (40), I find that the Einstein's mass-energy equation can be derived:

$$E_o = mc^2. \tag{41}$$

Eq. 41 is for a body at rest [1–5].

The concept of a rest momentum is very similar to the idea of a mass. The only difference is that, in distance-time theory, mass always has a speed. In other words, even if a mass is at rest relative to an observer, it still has a rest speed. Therefore, it is not only a mass; instead, it is a mass with a scalar rest speed, and it has a scalar rest momentum. In distance-time theory, time does not exist without distance. In other words, matter cannot exist without a scalar rest or vectorial relative speed. I have not eliminated the idea of a mass from physics because mass can still be used in this theory. However, I contend that I have made a slightly different concept other than mass with the idea of a rest momentum. Classical theory gave matter a speed across the time axis, which was similar but not the same, because this speed was also not across distance.

4.6. Doppler effect of matter

In Eq. (16), *v* represents *S′* frame's velocity relative to *S*, and *u* represents the rest speed within *S′* relative to *S*. The relationship between *v* and *u* in Eq. (16) equals a constant *c*. Therefore, relative to *S*, the matter-wave placed at rest in *S′* of Figure 4 has a velocity *v* in the positive direction of the *X* axis, a rest speed *u*, and a total constant speed *c*. Although De Broglie used Eqs. (37) and (38), his description of matter as a wave had only a varying velocity *v*; however, my description gives a constant total speed *c* with varying partial speeds of *v* and *u*. Using Eq. (19), I create, in Figure 5, a mnemonic device which represents the distance-time crossed by the matter-wave relative to *S*. In this figure, *ct* is the total distance-time that the matter-wave crosses and is the event line for the matter-wave. *D′* is the distance-time in the rest speed, *u*, of the matter-wave relative to *S*. *D″* is the distance-time the source (*S′* reference frame) with the matter-wave crosses in the velocity *v* relative to *S*. While the source moves across *D″*, relative to *S*, it emits *N* cycles of matter-wave across *D′*. This gives a wavelength for the matter-wave, relative to *S*, of

$$w = \frac{D'}{N}\,. \tag{42}$$

I use Eqs. (42) and (36) for substitutions into Eq. (18) to get

$$w_o = \frac{w}{\sqrt{1-\frac{v^2}{c^2}}}\,. \tag{43}$$

In Eq. (43) the wavelength *w* is shorter than the wavelength w_o. This is caused by the source moving in approximately the same direction as the matter-wave, thereby causing a Doppler effect. Dividing Eq. (43) by *c*, I change Eq. (43) from distance units to time units and derive

$$f = \frac{f_o}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{c}{w}\,. \tag{44}$$

Because of the Doppler effect, the frequency of the particle wave is increased to *f* according to Eq. (44).

In Eqs. (43) and (44), I relate the original frequency-wavelength, $f_o w_o = c$, relative to *S′* to the total frequency-wavelength, $fw = c$, relative to *S*. I next relate $f_o w_o = c$ to $f' w' = c$, which is the frequency-wavelength in the rest speed *u* of the matter-wave within *S′*, relative to *S*. Relative to *S*, the fraction of the distance-time in rest speed *u* is *D′*. According to Eq. (18), *D′* is dilated across *ct*, which is the total distance-time the matter-wave crosses relative to *S*. (Equation 18 is being used as a fraction found within the total distance-time, which is *ct*. Hence, across *ct*, *D′* is dilated—not contracted.) Therefore, the wavelength *w′*, in the rest speed *u*, is also dilated out from *w* to the same extent that *D′* is dilated in Eq. (18). In Eq. (18), I replace *ct* with *w′* and *D′* with *w*. Combining this result with Eqs. (43) and (44), I derive $w_o = w'$ and $f_o = f'$. Therefore, the frequency-wavelength of the matter-wave in the rest speed *u* relative to *S* is equal to the original frequency-wavelength of the matter-wave relative to *S′*.

I next derive the relationship between $wf = c$ and $w''f'' = c$, which is the frequency-wavelength of the matter-wave in *v* relative to *S*. According to Eq. (17), the fraction of *ct* in *v*, *D″*, is dilated across *ct*. Therefore, *w″* is also dilated compared to *w* according to Eq. (17). Replacing *ct* with *w″* and *D″* with *w* in Eq. (17), I derive

$$w = w''\frac{v}{c}. \tag{45}$$

Changing the distance units in *w″* and *w* to time units by dividing by *c*, I change Eq. (45) to frequency units, resulting in

$$f'' = f\frac{v}{c} \tag{46}$$

Using Eqs. (37), (38), (40), and (41), along with Eqs. (43) and (44), I derive the following:

$$P = \frac{P_o}{\sqrt{1-\frac{v^2}{c^2}}}, \tag{47}$$

$$E = \frac{E_o}{\sqrt{1-\frac{v^2}{c^2}}}, \tag{48}$$

$$P = \frac{mc}{\sqrt{1-\frac{v^2}{c^2}}}, \tag{49}$$

and

$$E = \frac{mc^2}{\sqrt{1-\frac{v^2}{c^2}}}. \tag{50}$$

Both Eqs. (47) and (48) give the relationship between the total momentum-energy, $E = Pc$, of the matter-wave relative to *S* and the energy-momentum of the matter-wave at rest, $E_o = P_o c$, relative to S'. Einstein's relativistic equation between the rest energy E_o and the total energy E of a body of matter is given by Eq. (48) [1–5]. Eq. (50) gives the total energy, E. Dividing Eq. (49) by c and equating the result to M, I produce the following result:

$$M = \frac{m}{\sqrt{1 - \frac{v^2}{c^2}}} . \tag{51}$$

This is Einstein's relativistic equation, which relates the rest mass, m, to total mass, M, of a body of matter [1–5]. In distance-time theory, the scalar rest momentum, P_o, is compared to the total momentum, P, in Eq. (47).

Next, I multiply Planck's constant, h, by Eq. (46). This results in

$$E'' = E\frac{v}{c} . \tag{52}$$

Changing the time units to distance units in Eq. (52), I divide both sides of this equation by c to get

$$P'' = P\frac{v}{c} . \tag{53}$$

$E'' = P''c$ is the momentum-energy of the matter-wave in the velocity v. Using Eqs. (52) and (53) to substitute for P and E in Eqs. (47) through (50), I derive the following:

$$P'' = P_o \frac{v}{c\sqrt{1 - \frac{v^2}{c^2}}} , \tag{54}$$

$$E'' = E_o \frac{v}{c\sqrt{1 - \frac{v^2}{c^2}}} , \tag{55}$$

$$P'' = \frac{mv}{\sqrt{1 - \frac{v^2}{c^2}}} , \tag{56}$$

and

$$E'' = \frac{mvc}{\sqrt{1 - \frac{v^2}{c^2}}} . \tag{57}$$

Within Einstein's relativity theory, Eq. (56) is found [1–5]. However, Eqs. (54), (55), and (57) are not found in relativity because P_o, the scalar rest momentum, and *E″* are not a part of relativity. Since *E″* = *hf″* and *P″* = *h/w″*, Eqs. (56) and (57) can be altered to

$$w'' = h\frac{\sqrt{1-\frac{v^2}{c^2}}}{mv} \tag{58}$$

and

$$f'' = \frac{mvc}{h\sqrt{1-\frac{v^2}{c^2}}}\ . \tag{59}$$

The wavelength in the velocity *v* of the matter-wave is given by Eq. (58), and it agrees with Einstein's special relativity theory and De Broglie's wave theory for matter [6–9].

4.7. Different here-nows for different reference frames

As I previously discussed, all events at every coordinate are located here-now for a single clock point, *t*, relative to a reference frame. However, different reference frames experience different sets of events here-now. I use Eq. (34), derived from Figure 4, to examine the relationship of here-nows between the different reference frames of S and S'.

In Eq. (34), I define *v* to be constant while examining the three variables *x*, *t*, and *t′*. As I pointed out earlier, each point of *t* and *t′* represents distinct sets of events located here-now relative to the *S* and *S′* frames, respectively. (See section 3.6.) Also, $x(v/c^2)$ in Eq. (34) is the fraction of distance-time that is in the velocity *v* of the *S′* frame, relative to the *S* frame of Figure 4. Eq. (34) subtracts the events in $x(v/c^2)$ out of the set of events located here-now in the *S* frame, represented by *t*, to get the set of events located here-now in the S' frame, represented by *t′*. To see this more clearly, I hold *t′* constant in Eq. (34) and vary *x*, which then varies $x(v/c^2)$. Since *t′* is constant, *t* must vary with $x(v/c^2)$. Since the single point *t′* represents one here-now in the *S′* frame, all the events in $x(v/c^2)$ are happening here-now at *t′* relative to the *S′* frame. However, $x(v/c^2)$ are the events in the velocity *v* relative to *S* and are not happening here-now relative to *S*. Therefore, the difference between the here-nows of the *S* and *S′* frames are the events in $x(v/c^2)$, located here-now relative to the *S′* frame but not to the *S* frame. Consequently, the *S′* frame cannot measure its own velocity *v*. The velocity −*v* of *S* relative to *S′* is a different velocity, which the *S′* frame can measure. Summing it up, we see that the events in the distance-time of the velocity, *v*, of a particle are located here-now, relative to that particle, and the particle cannot measure its own velocity. However, relative to an observer who sees the particle moving with the velocity *v*, these events do not occur here-now but are in the distance-time line of velocity *v*.

4.8. Does matter have a memory?

In the preceding section, I stated that the events, in the velocity, *v,* of a body of matter, happen here-now relative to the body. Nevertheless, relative to a body, the events in their rest velocity never happen here-now. This means that, events happening between objects in space and time occur within the events of a body's rest velocity and not within its velocity, *v*. To further illustrate, I give the following example. Imagine a ball having a velocity, *v* relative to an observer standing next to a wall. The observer and the wall would also have a velocity −*v* relative to the ball. At a point in time, the ball hits the wall and bounces back. Since the ball striking the wall can occur in the future, while not in the now relative to the ball, the ball striking the wall is not an event occurring in the velocity, *v* of the ball. Thus, it must be occurring in the rest velocity of the ball. (In other words, striking the wall does not occur here-now relative to the ball.) Consequently, the ball would not know ahead of time that it will strike the wall, and the ball will not have a memory of hitting the wall. From this we can conclude that matter does not have a memory of events.

4.9. What about a light cone?

Distance-time theory is theoretically very different from special relativity theory. There is no light cone separating timelike intervals from spacelike intervals. I could discuss how vector coordinates, in distance-time theory, have a direction and act similarly to spacelike intervals in special relativity; however, vector coordinates and spacelike intervals are not the same because one cannot separate distance from time in distance-time theory. Hence, there can be no spacelike intervals different from timelike intervals in distance-time theory. I could also discuss how scalar coordinates seem to behave similarly to timelike intervals; however, scalar coordinates also cannot represent time without distance. As a consequence, the idea of a light cone separating timelike from spacelike intervals does not apply to distance-time theory. At best, I may derive an analogue to the light cone. These differences plus other differences previously discussed show that distance-time theory is theoretically very different from special relativity. It is a mistake to think these two theories are not very different ideas.

5. PHOTONIC DISTANCE-TIME

5.1. Nonmatter reference frames traveling at speed c

Since a body of matter cannot travel at speed *c*, a person cannot have a perspective from a reference frame traveling at speed *c* relative to any other body of matter. However, since light travels at speed *c*, there is no physical law prohibiting a person from imagining how a photon experiences time and space.

One must first read section 4.7 on different here-nows for different reference frames to understand a photonic distance-time. I now turn to a definition of a photon's perspective of space and time by analyzing the theoretical difference between the *S* and *S′* frames when *S′* has a velocity *c* relative to *S*. Since the momentum-energy of matter reaches infinity as matter reaches speed *c*, according to Eqs. (47) through (49), any reference frame containing matter cannot travel at a speed *c* relative to another reference frame. However, for a reference frame void of matter, the only limitations for its velocity, relative to another reference frame, are imposed by eventon motion, which represents all motion. Since eventons possess speed *c*, relative to a reference frame, the maximum speed for another reference frame, void of matter, is speed *c*.

Equation (34) is derived from Figure 4, which uses reference frames *S* and *S′*. These reference frames may be void of matter. I use this equation to analyze reference frame S' traveling at speed *c* relative to the *S* frame. I rearrange Eq. (34) to

$$t - x\frac{v}{c^2} = t'\sqrt{1-\frac{v^2}{c^2}}\ , \qquad (60)$$

and equate *v* to *c*, which yields

$$t - \frac{x}{c} = 0\,. \qquad (61)$$

This shows that relative to the *S* frame, the *S′* frame with speed *c* possesses zero clock speed; therefore, relative to the *S* frame, the *S′* frame experiences in the distance-time of its speed *c* a single set of events located here-now. Along the *X* axis the events in this single set of events are given by *x/c* in Eq. (61). All other events located in this single set are on all axes parallel to the *X* axis and are also given by *x/c* of Eq. (61). However, relative to the *S′* frame, the ratio of distance to time is still *D′* = *cT′*. Therefore, theoretically *S′* would still experience a clock motion, and eventons would still travel at speed *c* relative to *S′*. Consequently, relative to itself, *S′* would experience not one, but many sets of events here-now. However, this is not the case for the photon. Moreover, I don't consider a reference for the photon, but instead I discuss a photonic distance-time.

5.2. Photonic distance-time

I now define the physics for the space and time of a photon traveling at speed *c* within a distance-time manifold. Throughout chapter 5, the photon is assumed to be traveling in a vacuum. I define space and time for a photon so that it can be placed compatibly into a distance-time manifold. Therefore, I define the distance-time similar to, but not the same as, the *S′* reference frame with speed *c* relative to *S*. The distance-time for the photon does not possess a rest speed. Instead, I define the photon to have only a velocity *c* relative to matter. This is different from the relationship between *S* and *S′* of Figure 4. Because even when *S′* has a velocity *c*, relative to *S*, *S′* still has a rest speed *c* relative to itself. Here, however, I do not give the photon a rest speed relative to itself or any reference frame. Therefore, the only distance-time a photon moves along is its event line relative to matter. Since the photon does not possess a rest speed, it experiences only one set of events here-now.

According to Eq. (61), the here-now of *S′* includes the distance-time line in *S* of *x/c*. Hence, I define the past negative distance, $-(D = cT)$, and the future positive distance, $D = cT$, of a photon's event line, relative to matter, to happen here-now relative to the photon. The photon should not be able to distinguish the difference between its past, present, or future. Therefore, relative to an observer, the principle of cause and effect ceases to be valid for the photon. I further delineate this with an example. Relative to an observer, a photon passes through an event *A* and later an event *B*. If the photon makes a decision, at event *A,* that is dependent on its decision at event *B*, it would break the law of causality relative to the observer. However, relative to the photon, events *A* and *B* occur here-now. Consequently, in this scenario, the law of causality would not be broken relative to the photon. Any phenomenon satisfying this scenario would be evidence for the photonic distance-time defined in this article.

If a communication occurs between two photons strictly by means of their presence here-now relative to each other, that communication occurs infinitely quickly. Matter's reference frame is different from light's perspective of space and time. For matter any point on a clock is a different here-now. Consider that there are eventons moving in all different directions at each vector coordinate point at every moment. This means, as these eventons move around, a different set of events are happening at every given moment. Thus, a different here-now exists at every point of time for matter. This is not the case for light. With light, there is only one here-now. The only distance-time light traverses is in its relative motion to an observer. Light does not traverse any rest distance-time; therefore, it cannot have any clock measuring time at rest relative to a photon. This clock would be frozen at a single instant of time. What allows the photon's wave to wave if there is no time occurring relative to the photon? The wave waves across the distance-time that the photon traverses relative to an observer. *A* photon only experiences a single here-now. The following examples illustrate these principles.

In Figure 6, photon *O* is located at the origin of a reference frame for matter. Photon *O* is moving in a straight line along the positive *X* axis direction. All the events occurring a *D = cT* in front of *O,* in the positive distance-time of photon *O,* and a *–(D = cT)* behind *O,* in the negative distance-time of photon *O,* occur here-now relative to photon *O*. Perpendicular to photon *O*'s event line on the *X* axis are the *Y* and *Z* axes. The *Z* axis is perpendicular to the plane of the sheet of article. In Figure 6, event A, occurring at point *(x, y, z,)*, happens here-now relative to photon *O*, if, at *(x, 0 ,0)*, an event *B* occurs here-now relative to both photon *O* and event *A*. Events *A* and *B* occur here-now relative to photon *O* if at time *t = x/c*, events *A* and *B* occur, and at time *t = 0,* photon *O* is at the origin. In Figure 6, the time measurements are taken with a clock in the reference frame for a body of matter.

In Figure 7, I describe the following four events happening at *t = 0* relative to a reference frame for matter: photon *A* occurring at point *A*; photon *G* occurring at point *G*; photon *O* occurring at the origin; and photon *B* occurring at point *B*. All four photons, *A*, *B*, *O*, and *G*, are moving along event lines that are parallel to the *X* axis. Photons *A*, *O*, and *G* are moving in a positive *x* direction, and photon *B* is moving in a negative *x* direction. Points *A*, *O*, and *B* are located at different locations on the *Y* axis. Points *G* and *O* are on different locations of the *X* axis, and they are in different here-nows. All events occurring here-now relative to photon *A* occur here-now relative to photon *O*. Consequently, *A* and *O* have the same here-now. The event of photon *G*, at point *G*, does not occur here-now relative to photon *B*, and vice versa. The here-now of photons *A* and *O* are separate from the here-now of photon *G* by the distance-time between point *G* and the origin. Therefore, photon *G* does not interact with photons *A* and *O*, unless there is a field between the different here-nows. Only the event of photon *B* occurring at point *B* is located here-now relative to photons *A* and *O*, and only the events of photons *A* and *O* occurring at points *A* and *O* are here-now relative to photon *B*. All other events within the here-now of photons *A* and *O* do not coincide within the here-now of photon *B*, and all other events within the here-now of photon *B* do not coincide within the here-now of photons *A* and *O*.

What, in terms of distance-time, exists perpendicular to the event line for a photon? (See Figure 8.) In Figure 8, the *X*, *Y* plane is perpendicular to the photon's velocity, and the photon has a velocity in the positive *Z* axis direction. The part of the coordinate system that is perpendicular to the photonic event line is similar to matter's reference frame. In Figure 8, the *X*, *Y* plane is a two-dimensional space with a here-now that is infinitely fast and with a distance-time of speed *c*. Nevertheless, the photon experiences distance-time differently than matter does. Therefore, the photon experiences this two-dimensional space with finite speed differently than matter experiences its three-dimensional space with finite speed. Perpendicular to the velocity of the photon, this distance-time travels out from the point for the location of the photon as fast as the photon is moving away from its current point of existence. Therefore, the photon does not experience distance-time moving away from it perpendicular to its event line. In other words, the photon is never at rest while a space of speed *c* moves out from it. One noteworthy issue is that a matter-wave's amplitude exists in the interplay between a here-now and a space of finite speed. (See chapter 6.) Since the amplitude of light is perpendicular to its velocity, this amplitude also exists in the interplay between a here-now and a space of finite speed; however, the here-now and space of finite speed are two-dimensional.

A photon's distance-time is not predicted by classical and relativity theories; it is, instead, only predicted by distance-time theory. Consequently, all predictions of photon behavior, as laid out in this theory of a photon's distance-time, are found exclusively in distance-time theory. This is an important difference between distance-time theory and special relativity theory. Any particle within a structure of time and space should posses a relationship to that time and space or else it cannot be within that structure of time and space, and a photon's distance-time defines a relationship between light, time, and space. Furthermore, in nature, we have only observed three dimensions in which both light and matter particles reside. Since my space and time structure is only three-dimensional and all particles of light and matter posses a kinematical structure, I have defined a structure of time and space that is totally inclusive of all particles that exist within it. I did not state that a photon would have a rest frame the same as matter. Relative to matter (an observer), photons do not have a rest frame. This theory states that relative to the photon, the photon has a rest frame, but it is an unusual frame. Humans cannot possess this rest frame. However, we can imagine a photon's experience in this frame.

5.3. The global here-now

The eventon is only like a photon in that it shares the photonic perspective of space and time. After all, the eventon does travel at speed *c*. Also, every eventon in the ocean of eventons makes up all events in a distance-time manifold. Moreover, all distance throughout all space and all periods of time throughout all time are represented by this ocean of eventons. Every eventon, like a photon, experiences all future, past, and present together in the present, and possesses only a single here-now. The idea of a global here-now is the total sum of all eventons' perspectives of space and time. Since every eventon experiences all of its events in a single here-now, the sum or total rules of space and time of all eventons would be that all events throughout all space and time exist here-now. This global sum of all the eventons' distance-time is what I call the global here-now. One might ask whether this global here-now has any relation to the primordial point universe that existed before the Big Bang that started the known universe. I can only guess. It is possible that that primordial point universe still exists, and it is best understood as this global here-now in which our universe currently resides. However, I really have not extended this theory too much in the direction of cosmology. Since an observer is matter, an observer does not have this perspective. Instead, all time and distance are extended out relative to any observer.

6. PROBABILITY AND TRAVEL VIA A HERE-NOW

6.1. The probability of a particle's location

There is the space of finite speed and the infinitely fast point space in distance-time theory. These two things do not overlap because one happens instantaneously and the other happens over a period of time. However, they share the same coordinate system. Hence, they share the same particles in that coordinate system. In a point space, a particle is at every location, and in space, a particle has a single location only. How is this apparent paradox to be resolved? After all, these particles are in an infinitely fast point space and they are in a space that travels at speed *c*. (It should be noted that a space of finite speed is where an observer detects the location of a particle.) This paradox must be resolved by means of a probability. A particle has a possibility via a point space at being located at any coordinate when its location is defined in a space, as space gives a unique position to particles. However, all the other possibilities collapse once a particular position for the particle is given in a space of finite speed. There is one problem. Space continuously defines the location of a particle. Therefore, the probability is always collapsed. There is one last thing to add: elementary particles should be wave sources—not particles, as viewed classically. (In this theory, however, I often use the term “particle” interchangeably with “matter-wave”. A matter-wave is assumed to be the basic wave found in quantum theory.)

Before I proceed any further, I propose my “theory of quantum wave sources”. In this theory, I state that a particle is best understood to be a wave source, and according to Huygens' principle, an indefinite number of point-wave sources can make up a wave. (See my “Theory of Quantum Wave Sources” [11].) In quantum wave source theory, quanta are understood not to be particles but waves made up of an indefinite number of point-wave sources. Furthermore, the smaller the region that these quantum waves inhabit, the more they behave like point-wave sources. Theoretically, if a wave was restricted to a single point, this wave would be represented by a single point-wave source. However, a wave is not restricted to a single location like a particle in space rather, it always spreads out and forms a wave in space like it does in a medium.

I now make a couple of statements and I elaborate on each of them. Then I formulate the result that combining these statements allows. Statement one is that a point-wave source located in a distance-time manifold is located in a point space at a single point of time in the present. Another perspective of this statement is that a point-wave source is at all possible locations in the universe at the point of time in the present, because at this point of time, all vector coordinate locations are at a single point. At first glance, this perspective seems to contrast with an observer's measurement. Any object is not found at all points of the universe by an observer, but rather, it is found at a specific location in space when its location is measured. However, an observer never measures infinitely quickly, nor within a here-now, because a person always measures with a particle that travels at a finite speed. Statement two is that a space of finite speed gives a specific location to objects. As a result, a space of finite speed requires that a point-wave source form a wave in a specific region, and outside that region that the wave's amplitude be negligible. (For further discussion of waves sources in a hypothetical three-dimensional medium, see my “Theory of Quantum Wave Sources” [11].*)* According to the rules for waves in my hypothetical quantum medium, waves should have a minimum diameter of ½ a wavelength and be continuous and smooth. (I assume there are no obstructions in the medium that might constrain a wave into a smaller region.) The next question is how a point-wave source in a hypothetical medium constructs a wave. Looking at traditional waves for a clue, I know that a point-wave source can be divided to create an indefinite number of point-wave sources from which a wave is constructed. An example of this happens when a wave front emerges and spreads out from the originating point-wave source. Naturally, more of the original point-wave source would be located where this wave would have a higher amplitude, and less of the original wave source would be located where the wave had a smaller amplitude. Therefore, in a traditional medium, the amplitude of the wave at a specific point represents the amount that the original point-wave source went into that point of the wave. I now have two principles that I need to satisfy. The first is that via a here-now, a point-wave source is in contact with every vector coordinate, and it has a possibility to be at any place when its location is detected in space. The second is that point-waves sources are located in the wave they create, and this wave's location is measurable in space. Summarizing, in an infinitely fast point space, we see that point-wave source is at every location, and in a space of finite speed, a point-wave source has a location only within the region where its waving. How is this to be resolved? I resolve this through the statement that a point-wave has a possibility, via an infinitely fast point space, of being found anywhere there is amplitude for its wave in a space of finite speed. Now, I make one further statement. The amplitude of the wave at a specific point represents the amount of the original point-wave source that went into that point of the wave. I merge all previous statements into the idea that the possibility of a point-wave source to be detected at a location is related to the amplitude of the wave at that location. This hypothesis satisfies all statements. As a result, a quantum wave is constructed by point-wave sources (like traditional waves), but the amplitudes of these point-wave sources are representative of the probability of locating the original point-wave source at that spot. Of course, from this original point-wave source come all the point-wave sources that construct the quantum wave. The hypothesis I made in this paragraph agrees with quantum theory. [5, 6]

The wave in space is created by a point-wave source that has a possibility of being located, via a here-now, in different locations in a space. Hence, if a point-wave is not found in a location, there is no possibility of it being located, via a here-now, in that area. As a consequence, the possibility of it being located in that region collapses. The entire wave does not collapse, but the possibility of the point-wave source being found in that area collapses. Therefore, the wave in that area is collapsed.

In taking this new approach, I find that the probability intrinsic to a distance-time manifold is now related to the amplitude at each point of a wave, which leads me to this next question: Is there still a possibility of a point-wave source being found anywhere in the universe? The answer depends on how the wave is structured. It is possible to create a wave with essentially a minimum ½ a wavelength and with a negligible amplitude throughout the rest of the universe. Consequently, outside of that ½ wavelength of the wave, there would still be a possibility of finding the point-wave source from this wave anywhere in the universe, however unlikely.

Of course, an observer is still dependent on measuring via particles to get a more exact location of a point-wave source. This agrees with Heisenberg's uncertainty principle, which states that an observer is limited on the accuracy of his or her measurement because he or she is limited by the particles being used for measuring [6–9]. The point-wave source is located where there is an amplitude for the wave, and the measurement can be as narrow as possibly allowed by the wavelength of the particle used for the measuring and at any point of the wave. By using this new approach, I see that this theory of distance-time comes more in line with verified results of elementary quantum theory [6–9]. To be more specific, it agrees with Heisenberg's uncertainty principle, which Einstein's special relativity could never proclaim.

In distance-time theory, I do not describe the characteristics of a wave packet or any other type of wave. I am stating, however, that the idea that a matter-wave's location is given by measuring with a particle, which would not travel faster than speed *c*. Also, the manifold does not give a pinpoint location for the matter-wave, but via a here-now, it gives different locations for a point-wave source, which creates a wave in space because point-wave sources always combine to create a wave. In other words, for more exact information about the matter-wave, I am reliant on measuring a matter-wave with the particle. This is different from special relativity, which always gives the exact location in time and space along with an exact velocity. Since the time, space, and velocity, are given exactly without relying on particle measurement, the energy and momentum would also be exact, with no uncertainty. On the other hand, distance-time theory would be totally dependent on measuring with particles for more exact information about time position, space location, and velocity. As a consequence, energy and momentum would also be uncertain. Distance-time theory agrees with the uncertainty found in elementary quantum theory. I do not derive Heisenberg's uncertainty equations because this theory does not predict a wave. Instead, it predicts possibilities for a point-wave source's location because of the interplay of a point space and a space of finite speed. Because there is a possibility of finding the location of a matter-wave, there should be a probability and an uncertainty associated with it. I only relate the wave found in quantum theory to this probability and uncertainty.

I further delineate the relationship between a here-now and a space with the following example. Using particles with speed $v \leq c$, an observer detects a point-wave source's location in a small region. Relative to the observer, who is existing at time t_1, this detected point-wave source exists at a specific region in space and at a time, t_0, in the past. However, when this observer also existed in the past at points of time $t < t_0$, the point-wave source at t was located here-now relative to the observer, and this point-wave source was in contact with all the vector coordinates coexisting at t.

Consequently, the point-wave source at t could make the transition from the here-now (the here-now relative to the observer at t) to any possible position in a space where the amplitude of the wave exists in space. Relative to the observer, this position would exist at time t, and this space could be measured via any particle with speed $v \le c$ by the same observer who would then be existing between times t_0 and t_1. Therefore, since this point-wave source's position was not measured during this period of time between t_0 and t_1, the point-wave source, at time t, would possess a probabilistic location anywhere in the amplitude of the wave in space relative to the observer. However, when the point-wave source acquires a small region of amplitude, at time t_0, in the space measured by the same observer who is now at time t_1, this point-wave source has no other probabilistic position in that space besides that narrow region, since all positions outside that narrow region for the amplitude have collapsed. As a result, the probability of the point-wave source's location collapses to a small region relative to the observer at time t_1.

The possibility of a point-wave source being found anywhere its wave amplitude existed before its location is detected in a narrow region, and the collapsing of these possibilities outside this small region after the point-wave source's location is detected, agrees with elementary quantum theory [6–9]. It is noteworthy that these results are not derived using the traditional methods of quantum theory, and they are not found in special relativity. However, they are inherent to the space and time structure within distance-time theory

Distance-time theory predicts that a point-wave source has a greater possibility of being found where the amplitude of the wave is greater. To find the exact probability of locating a point-wave source in space, I would have to use Max Born's probabilistic mathematics found in elementary quantum mechanics. I do not predict Born's probabilistic mathematics from distance-time theory. However, I do claim that a point-wave source has a probabilistic location which happens via a here-now. The consequences of this claim are discussed in the rest of the sections of chapter 6.

Finally, it is noteworthy, that the amplitude of the wave for matter exists where there is interplay between an infinitely fast space and a space of finite speed. This is true for the amplitude of a photon, too. (See chapter 5.)

6.2. Travel via a here-now

One of the more unique ideas in distance-time theory is the idea of a here-now. The here-now is the point of time that is now and is the point of space that is here. All vector coordinates *(x, y, z)* exist in a here-now at a given point of time. What if an object could travel via a here-now where there were no difference between locations in space at a single point of time? What would travel via a here-now look like or resemble? These are some of the questions I now address.

Within the reference frame of an observer, Joe, a here-now exists everywhere at a single point of time. Since it exists at a single point of time, it is instantaneously at every vector coordinate relative to Joe. Therefore, relative to him, travel via the here-now in his reference frame is instantaneous. However, according to section 4.7, there are different here-nows for different reference frames. The difference between Joe's here-now and the other reference frames' here-nows are the events in $x(v/c^2)$, which come from Eq. 23. (I am assuming other reference frames are moving in the positive *X* axis direction relative to observer Joe, and that x represents the distance from the origin. Hence, *x* is actually *[x – 0]*.) These events in $x(v/c^2)$ are located here-now in the other frame but not in Joe's frame. A particle traveling through a here-now in a different reference frame from Joe's frame would travel infinitely fast in that different frame but not relative to Joe. The reason is that relative to Joe, the here-how of a frame different from his own happens across a time of $x(v/c^2)$; therefore, travel via the here-now of this different reference frame would also travel across the time, $x(v/c^2)$, relative to the observer. Since there are different reference frames, there are different here-nows from Joe's perspective. This distance-time difference between Joe's reference frame and different frames of reference is zero along the *Y* and *Z* axes, positive in the positive *X* axis direction, and negative in the negative *X* axis direction. In other words, a particle would go back in time if it travelled via a here-now in the negative *X* axis direction.

Next, I discuss the range of all the possible here-nows to each reference frame relative to my observer Joe. These ranges include all the reference frames for matter of all speeds, and the range boundaries include the speed *c*. According to photonic distance-time in this article, a single photon possesses a single here-now within a distance-time manifold. Moreover, the photon has a speed *c*. This information coupled with the discussion in the preceding paragraph gives a range of times for travel via a here-now. Relative to my observer Joe, these times range from x/c all the way down to a zero time and all the way to the negative time of $-x/c$. As a result there are many different here-nows that a particle could traverse. Nonetheless, any particle traversing through a here-now would never travel slower than speed *c*. It would always travel faster than or equal to *c* because *v* is smaller than or equal to *c* in $x(v/c^2)$. Therefore, having faster-than-light speeds is one characteristic an observer can look for to determine if a particle went through a here-now. This is not the case within a space of finite speed. Speeds faster than speed *c* are not attainable in a distance-time manifold. In section 3.10, I discussed how there is no distance-time, energy, momentum, or force within a here-now. These only exist within distance-time. Therefore, barriers have no force to stop a particle. Thus, barrier penetration is another sign of travel via a here-now. According to section 6.1, there is a probability relationship between a here-now and a space of finite speed. Consequently, there should be a probability characteristic associated with travel via a here-now. All three properties of faster than speed *c*, barrier penetration, and a probability are not associated with any form of travel in physics beside quantum tunneling.

The velocity of a particle is independent of its position, for if this were not the case, Heisenberg's uncertainty principle would be violated. The idea of the interplay between a here-now and the finite speed of space gives the probabilistic position of a particle. As a result, traveling via a here-now has to do with the probabilistic laws governing a particle's position—not its velocity. Consequently, a particle, independent of its velocity in any reference frame, can travel via the here-now of any reference frame. It may travel across a here-now and $x(v/c^2)$ distance-time, which is the difference between its reference frame and the reference frame's here-now that the particle is traversing. In other words, a particle has a position (or moving position) in all reference frames, which allows it to be in contact with every here-now or a here-now plus $x(v/c^2)$ for each reference frame.

I never claim that I can predict exact mathematical probabilities. However, there must be some sort of probability associated with the possibility of a point-wave source's location. This probability has already been calculated in basic quantum theory. All I state is that this probability happens via a point space. Then I give the range of speeds. Of course, this method deriving probability eventually needs to be developed further. Maybe, there is a more correct way that can eventually be developed based on the method for deriving probability in this paper.

I am very limited in my discussion about travel via a here-now because distance-time theory gives a limited understanding of it. I can only discuss it based on the information I have with regard to distance-time theory.

6.3. The causality paradoxes' solution for travel via a here-now

In section 5.3, I discussed the global here-now. The global here-now possesses all events throughout all space and time. All these events in the global here-now exist here-now relative to the sum of all eventons' rules for space and time, which is the global here-now. In other words, there are no differences between any events within a global here-now. Therefore, a series of events cancel if that series of events leads to an outcome event that prevents the first event of that series from happening. This means that within a global here-now, the beginning event and the outcome event happen together. This allows the outcome event to prevent the beginning event from occurring if a causality paradox occurs in this series of events. Essentially, the outcome event cancels the first event, as they both happen together. Hence, within a global here-now, all series of events cancel that produce a causality paradox. Consequently, I will never be able to travel into the past and kill my grandfather before he marries my grandmother. In this series of events, killing my grandfather cancels my birth, which in turn cancels me from traveling into the past. All these events happen together in a global here-now. This allows the series of events beginning with me traveling into the past to be cancelled as I kill my grandfather. A path of events through a here-now that would allow me to cause a causality paradox never occurs. Travel via here-now only can happen when there is no causality paradox or any other impossible outcome. Relative to my observer Joe, it would seem that the cosmos knew ahead of time that traveling via a here-now into the past would cause a causality paradox. This resolves all potential causality paradoxes.

6.4. The speed of quantum tunneling

According to Einstein, speeds faster than light were impossible because causality paradoxes could occur. As previously discussed, no causality paradoxes occur because of faster-than-light travel via a here-now. This last point is unique to distance-time theory. At this point I delve into faster-than-light travel via a here-now. Whenever a particle travels via the here-now of a distinct reference frame between any two points in that frame, it travels across zero distance and time between these two points and relative to that specific reference frame. Since it crosses a zero period of time in this frame, relative to this frame, it travels infinitely quickly between these two points. However, relative to a different reference frame, it would travel across a quantity of distance-time.

From Figure 4, I derive Eq. (23), which gives the difference in time units, T'', between the S and S' reference frames, relative to an observer in the S reference frame. Altering Eq. (23) gives

$$\frac{d}{T''}=\frac{c^2}{v}. \qquad (62)$$

In Eq. (62), v is the velocity of S' relative to S, and d is the distance in the S frame spanned by T'' relative to S. According to Eq. (62), a particle tunneling through a barrier in the same direction as v will travel across d (distance) in T'' (period of time) with velocity c^2/v relative to the S frame. Since $c \geq v$, the particle will always move equal to or faster than the speed of light in a vacuum. Since I do not know what determines v, I cannot predict the time it takes for a particle to tunnel through a barrier based on the width of the barrier. If the particle moves faster than light via a here-now in the opposite direction of v, it will traverse a negative period of time, $-T''$, relative to S. For this reason, Einstein declared speeds faster than light impossible, thus preventing time travel into the past and any causality paradoxes which may arise. However, I have already give the resolution for that possibility.

6.5. What is waving?

Quantum theory only gives the rules of a quantum wave, but it does not tell us what is waving. What is it that is being disturbed that acts like a wave? Distance-time theory does not tell us either what is waving. However, distance-time theory does tell us that the wave exists in the interplay between a point space and a space of finite speed. This at least tells us something extra about the nature of the wave, assuming that distance-time theory is correct.

7. DISCUSSION

7.1. Concluding Discussion

I stated in the introduction that most of Einstein's theory of special relativity is impeccable. However, Einstein created special relativity by augmenting classical physics to satisfy his postulate of the constancy of the speed of light in a vacuum. Although his postulate is correct, his augmentation of classical physics retains archaic principles that are wrong, and these principles are the weak points of special relativity. These archaic principles include the infinite speed of space, the separation of space and time, and the concept of a mass for matter. Also, special relativity does not agree with Heisenberg's uncertainty principle and does not predict the probabilistic location of a particle of matter. This is true for classical theory as well. Furthermore, the minimum requirements to be a quantum time and space theory is that it agree with the elementary principles of quantum theory. Therefore, special relativity is not a quantum theory of time and space; in reality, it is a classical theory. To eradicate these archaic principles and predict elementary quantum principles from a structure or space and time, I did not augment the past. Instead, I invented a new theory of time and space.

In creating a new theory of time and space, I had to predict the experimentally verified results of previous successful theories of time and space. What I did was derive classical and relativistic verified results: I predicted rod and clock measurements, the motion of bodies relative to each other, Einstein's two postulates of special relativity, and relativistic kinematics and dynamics. However, in order for this theory to be distinct, it also had to make new predictions that were not made in these previous theories. In this new theory, I predicted a finite speed for space, a here-now, the equivalency of time to distance, and the definition of time and space that agree more with the measurement of particles, the rest momentum-energy for matter, the photon's perspective of space and time, the laws of cause and effect governing the photon, and the speeds for quantum tunneling via an infinitesimal space. In addition, Heisenberg's uncertainty principle and the probabilistic position of a matter-wave have been shown to agree with distance-time theory. Since Heisenberg's uncertainty principle and the probabilistic position of a matter-wave agree with distance-time theory, it seems only logical to conclude that distance-time theory is a quantum theory of space and time. These predictions, which I have just listed, were not made in traditional theories of time and space. The relationship between distance-time theory to the special theory of relativity is best portrayed in Figure 1. This figure displays two circles. The smaller circle is included within the larger one. The larger circle's area represents the predictions of distance-time theory. These predictions include special relativistic results plus predictions only found in distance-time theory. The smaller circle's area represents only verified predictions made by the special theory of relativity.

I believe that, one of the most unique elements of distance-time theory is that it is a structure of time and space which predicts elementary quantum principles mostly independent of quantum mechanics. (First, I derive the quantum principles in this article from a distance-time manifold. Second, I refer to elementary quantum mechanics as a reference.) Quantum mechanics by itself is not a structure of time and space, yet it does make inferences about time and space. Both Heisenberg's uncertainty principle and the probabilistic location of a particle are essentially laws stating the relationship of a particle to space and time. These laws about a particle's relationship to space and time are significant! Yet, special relativity does not predict such laws. On the other hand, distance-time theory does predict these laws. This does not mean that distance-time theory is a form of relativistic quantum mechanics. Relativistic quantum mechanics is essentially applying relativity to quantum theory. In contrast, distance-time theory is not about applying relativity to quantum theory. Instead, it is about a new structure of time and space with intrinsic quantum characteristics, and it makes new predictions not found elsewhere.

There are other characteristics of distance-time theory, which separate it from special relativity. In the remainder of this article, I elaborate on the relationship between matter, antimatter, light, and distance-time theory. I use the phrases "matter mechanics," "antimatter mechanics," and "photon mechanics" to refer to all laws that govern matter, antimatter, and light, respectively. Toward the end of the explanation, I hypothesize about the relationship between matter, antimatter, and photon mechanics. I begin by analyzing the destruction and creation of matter, antimatter, and light.

When a particle of matter emits light, a portion of the mass of the particle of matter is destroyed and light is created, according to Einstein's Equation $E = mc^2$. [1–5] When matter absorbs light, matter is created and light is destroyed according to the equation I just put forth. Considering these phenomena, I pose two questions. First, what happens to matter mechanics once matter transforms to the state of light? Second, what happens to photon mechanics once light becomes matter?

In another phenomenon, called “pair annihilation”, a particle of matter and its corresponding antiparticle of antimatter annihilate each other, thereby creating light [10]. A phenomenon believed to exist, which is a reversal of “pair annihilation”, is known as pair production. This is defined here as the creation of matter and antimatter out of pure light [10]. If the same light from a pair annihilation were captured and used in a pair production, the particle and antiparticle created in the pair production would still obey the same mechanics that the particle and antiparticle obeyed before pair annihilation. Therefore, matter and antimatter mechanics are not created arbitrarily when light transforms to the states of matter and antimatter, and matter and antimatter mechanics must have been preserved in some unrecognizable form in photon mechanics. Hence, once the light transforms back to matter and antimatter, the mechanics of matter and antimatter reemerge.

At this point, I analyze a couple of examples of the transformation between a matter mechanics and a photon mechanics, using distance-time theory. In distance-time theory, relative to matter, the photon crosses a distance per period of time at a rate of $D/T = c$. Since, relative to matter, the photon, traveling in a vacuum along its event line, moves as fast as eventons, the photon experiences only one set of events here-now, including its own event line, which is the path of the photon relative to matter. On the other hand, if the photon, through some unknown process, comes to rest, it could easily be contacted many times with a distinct eventon. As a result, the photon would experience a rest speed across distance-time, as is the case with matter, and it would experience its own event line expanded out, not located here-now, and this would be similar to matter. The sets of events located here-now to the photon would be the same set of events located here-now to a body of matter at rest with the photon. The photon, at rest in a reference frame for matter, would experience time and space the same as matter in that reference frame. Hence, this illustrates how a matter kinematics can be derived from a photon kinematics. This is in contrast to special relativity, where this cannot be shown, as there are no rules given for a photon's distance-time defined in special relativity.

In this next example, I discuss the conservation of momentum-energy in the transformation between the states of light and matter. In distance-time theory, light and matter possess momentum-energy. Therefore, in the transformation between matter mechanics and photon mechanics, momentum-energy is unaltered in the state of light or matter. This is not the case in special relativity theory, where matter possesses a mass-energy. Therefore, the momentum-energy of light is perceived to have altered to mass-energy, according to relativity. Since no altering of momentum-energy is necessary in distance-time theory, matter and photon mechanics are more similar in distance-time theory than they are in special relativity theory.

In the last two examples, I have shown how characteristics of light and matter can be preserved in the transference between light and matter in distance-time theory. Again, I reiterate that this is not the case in special relativity theory. As I indicated previously, matter can be created out of light and vice versa. Nevertheless, this does not mean that light possesses the same characteristics as matter. For instance, light does not possess an electric charge, whereas matter does. Still, in the earlier hypothetical scenario where I concluded that matter and antimatter mechanics are conserved in an unrecognizable form in a photon mechanics, I propose the following hypothesis: matter and antimatter mechanics can be derived from a photon mechanics and vice versa. As a result, the characteristic of an electric charge can be derived from a photon mechanics. According to my hypothesis, this occurs even though the photon does not possess an electric charge. In order for matter mechanics to be derived from photon mechanics, the process that transforms light to matter and matter to light needs to be fully understood. Because this process is unknown, I have not derived a photon's distance-time directly out of matter mechanics in this article. Instead, I have merely defined a photon's distance-time as compatibly placed in a reference frame for matter by using distance-time theory.

Physics began with the classical structure of space and time. In this model, time was not a fourth dimension. It was an axis that was added to the three dimensions of space to allow for the movement of things. All classical theories were developed using this structure. The classical space and time model evolved into the space-time continuum. In this model, the time axis is a fourth dimension. All physics theories were developed using this model. However, one question still remains: Is there any direct way to test for any dimension beyond three? So far, the answer has been no. If there are only three dimensions, ultimately all theories are going to have to find ways to agree with only three dimensions. The best theories in classical physics have been based on the space and time model. The best theories of the twentieth century have been based on the space-time continuum model. I strongly believe that the best theories of the future will be three-dimensional, which is the only number of dimensions proven to exist.

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Figure 1

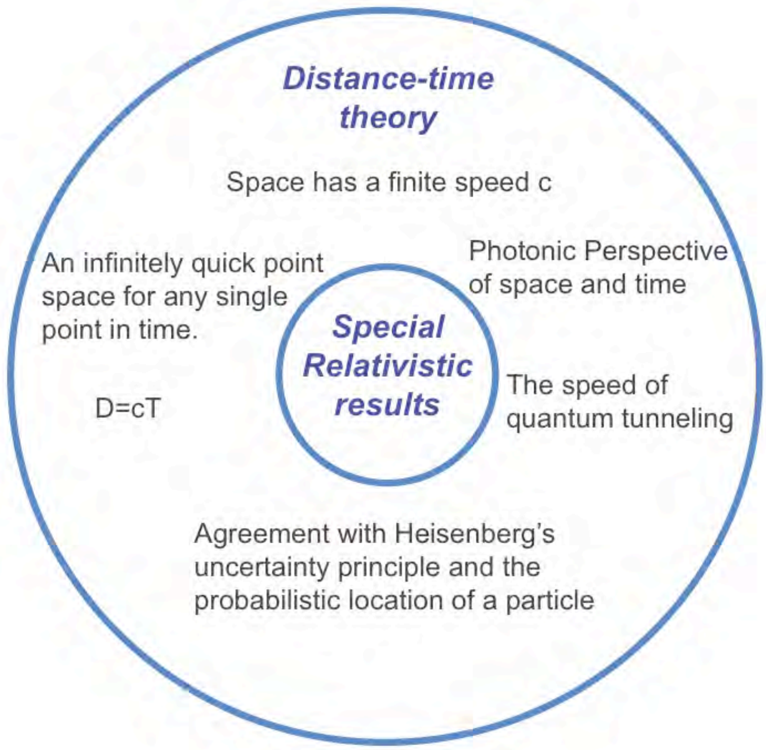

Figure 1. The area in the inner circle represents the place where special relativity is applicable. The area in the larger circle, including the area in the inner circle, represents the place where distance-time theory is applicable. The area in the larger circle but not inside the inner circle represents the place where only distance-time theory is applicable.

Figure 2

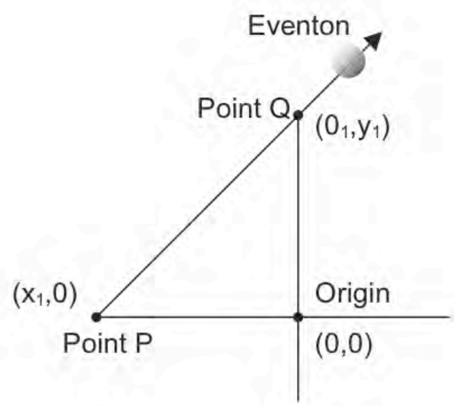

Figure 2. The line segment *PQ* is a part of the eventon's event line. The distance-time in *PQ* parallel to the *X* and *Y* axes is stretched out between points *P* and *Q* and occurs at speeds smaller than or equal to speed *c*.

Figure 3

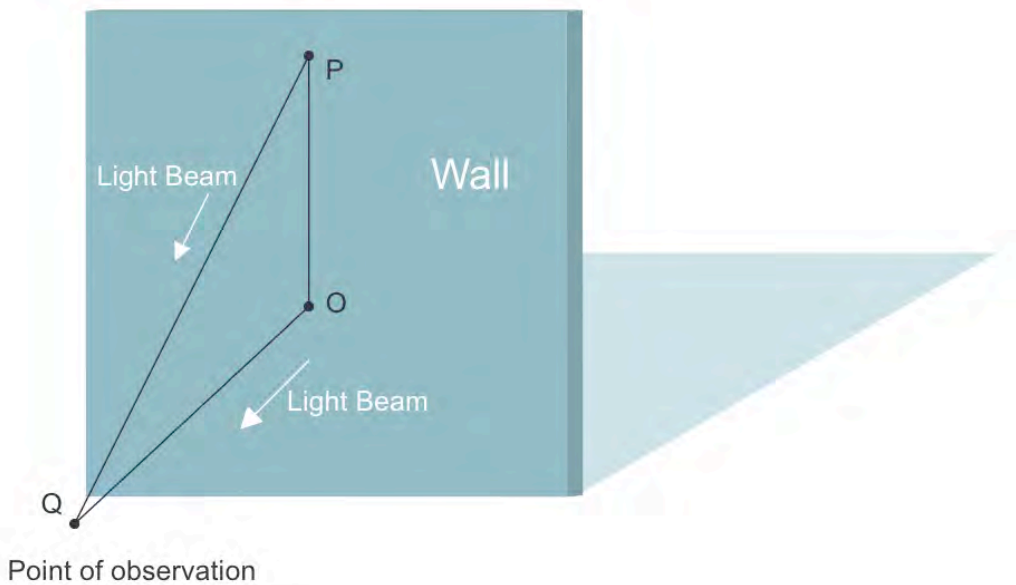

Figure 3. The line segment *QO* is perpendicular to the wall's surface. The observer at *Q* sees that the light traveling from *O* to *Q* does not move across distance-time parallel to the wall's surface. However, the observer sees that the light going from *P* to *Q* does cross *PO* distance-time parallel to the wall's surface. Consequently, at the distance of *PO*, *P* is separated from *O* relative to the observer.

Figure 4

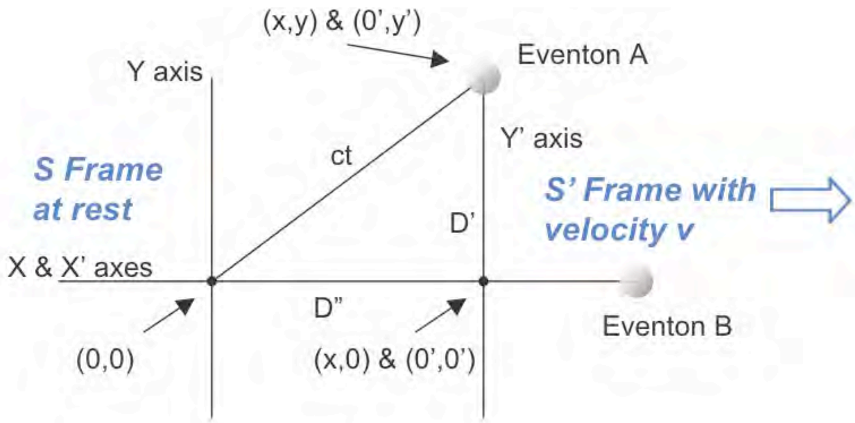

Figure 4. The S' reference frame has a velocity v in the positive X axis direction, and the S reference frame is at rest. At $t = 0$, the S origin, S' origin, eventon A, and eventon B all coincide. Eventon A moves on a straight path, crossing ct distance from ($0, 0$) to point (x, y) relative to S; and eventon A moves along the Y' axis, crossing D' distance from ($0', 0'$) to ($0', y'$) relative to S'. Eventon B moves along the X' axis, crossing D' distance relative to S'.

Figure 5

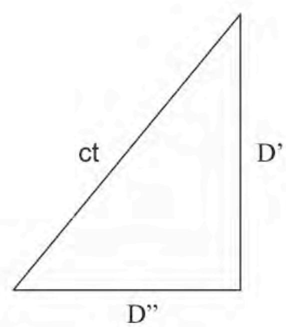

Figure 5. The above mnemonic device shows the relationship between the distance-times *D''*, *D', and ct* of a body of matter with *v* velocity. *D'', D'*, and *ct* are the distance-times in the relative velocity *v,* rest speed *u*, and total speed *c,* respectively.

Figure 6

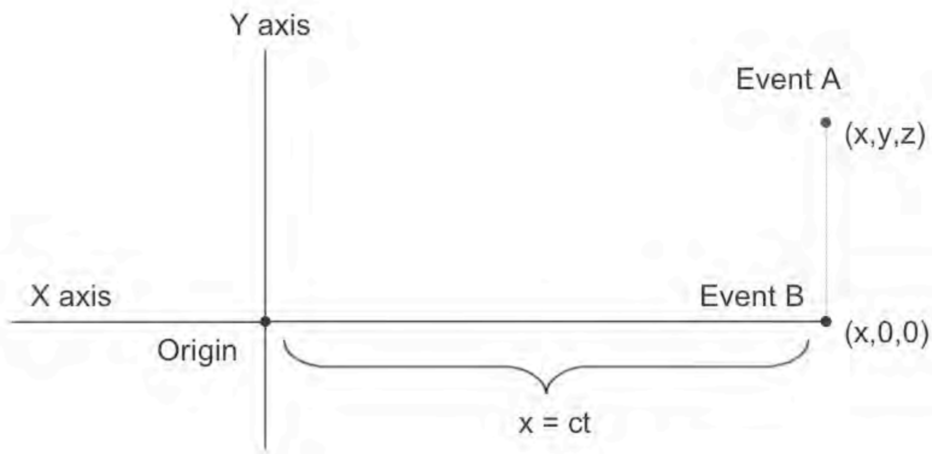

Figure 6. A photon *O* at the origin at $t = 0$ is moving along the *X* axis in a positive direction. Events *A* and *B* occur $x = ct$ distance-time away at coordinates (x, y, z) and $(x, 0, 0)$, respectively. These events occur here-now, at any point of time, with photon *O,* since they both occur at $x = ct$.

Figure 7

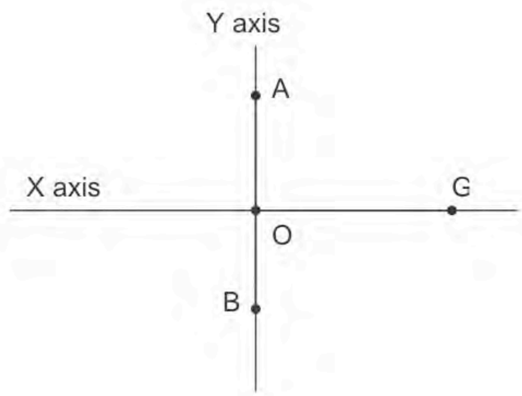

Figure 7. Each point, *A*, *O*, *B*, and *G*, in a reference frame for matter, represents a distinct photon at that location at a single point of time. Photons A, *O*, and *G* are moving in a positive *X* axis direction, while photon *B* is moving in a negative *X* axis direction. Photons *A* and *O* do not exist relative to *G* and visa versa. The event lines of photons *A* and *O* occur here-now relative to each other. Photon *B* is located here-now relative to photons *A* and *O* only when *B* is on the *Y* axis with *A* and *O*.

Figure 8

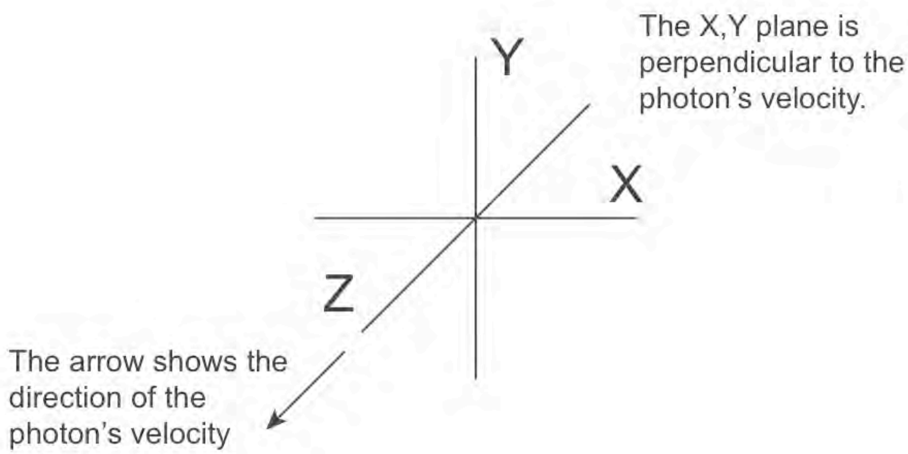

Figure 8. In Figure 8, the *X*, *Y* plane is perpendicular to the photon's velocity, and the photon has a velocity in the positive *Z* axis direction. The part of the coordinate system that is perpendicular to the photonic event line is similar to matter's reference frame. In Figure 8, the *X*, *Y* plane is a two-dimensional space that has an infinitely fast here-now and has a distance-time with a speed *c*.