THE THEORY OF QUANTUM WAVE SOURCES:

The foundation to constructs of all elementary particles

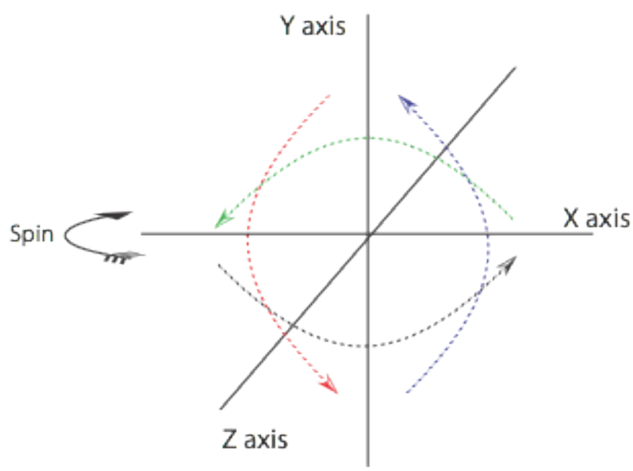
By

Keith Maxwell Hardy

The Author of “The Theory of Distance-Time”

Website: www.quantumtheorys.com

Email: keithmhardy@gmail.com



ABSTRACT

I replace the Copenhagen Interpretation of quantum mechanics with the Wave Source Interpretation, which I give now. When a quantum wave’s location is observed in a small area, it collapses to a transversal wave source. If this small region is three-dimensional, then the quantum wave would act like a three-dimensional transversal wave source. The three-dimensional transversal wave source has characteristics that parallel leptons’ and hadrons’ characteristics. These properties are derived from the wave sources in this paper without relying on quantum theory. I claim that elementary particles have wave sources as their foundational structure.

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Part 1: INTRODUCTION

1.1. Introduction

Pondering elementary concepts in quantum theory, I troubled with some intriguing questions. The first was about the Copenhagen interpretation of the double-slit experiment. According to the Copenhagen interpretation, a quantum wave collapses to a particle when its location is detected [1–5]. I was bothered by the question of what causes the particle to turn back into a wave. Does it become a wave again only after a certain time? Does some sort of collision or interaction cause it to start acting like a wave again? On the other hand, does an observer's type of measurement determine if the quantum will be a particle or a wave? Clearly, the Copenhagen interpretation is insufficient in fully dealing with these types of questions.

Another question was about the description of the electron as a wave packet. This description essentially gives the inner construct for the electron and for other elementary particles [1–5]. Such a description does explain the basic wavelike behaviors of quanta. However, can it explain their quantified spins? No, it cannot. Can it explain the Pauli exclusion principle? No, it cannot. There are other elementary particle characteristics which this clearly insufficient construct for the electron cannot explain. In trying to resolve these questions and others, I eventually derived deeper quantum principles and a new structure for elementary particles, which I discuss in this article. (The Pauli exclusion principle states that no two identical particles that are fermions can reside in the same spot. When this is attempted in nature, they very strongly repel each other [1, 2, 4]).

In elementary quantum theory books, quantum waves have never been treated like disturbances in a medium and for a good reason. According to elementary quantum theory, an electron sometimes acts like a wave and sometimes like a particle. This is the previously discussed Copenhagen interpretation. Since traditional mediums in nature do not propagate waves that sometimes behave like particles, no medium for quanta was successful enough to make it into quantum books. However, in this article, I challenge the Copenhagen interpretation by replacing it with the wave source interpretation. Before I do this, I present abstract concepts which act as rules for wave behavior in a three-dimensional medium. These rules I extract from elementary particle behavior and from analysis of traditional mediums in nature. I present these rules in Table 1; they are essentially the characteristics of a three-dimensional quantum medium. Hence, they represent the abstract idea of a medium. These rules do not represent any kind of physical substance that propagates waves, such as air, water, or string. Since there are no physical constraints found in a traditional medium, the rules and their results can come out quite different and even strange compared to traditional waves. Nonetheless, I use these rules mostly to create standing waves, which are essentially wave sources within this work.

All mediums, whether they are one-, two-, or three-dimensional, possess wave fronts that move in a particular direction. These wave fronts are constructed out of an infinite number of point-wave sources. Furthermore, all waves in a medium can be constructed out of point-wave sources. The cosmic medium I present here is three-dimensional. Like all mediums, every disturbance within the medium is best understood in terms of its components. It was first noted by Christian Huygens, a Dutch physicist, that these components are point-wave sources [6]. I will show that in the medium I create, there are essentially two types of wave sources: indeed, one type paralleling fermions' behavior and another type paralleling bosons' behavior. (See Figure 1, which is located on the first page of the last twelve pages of this document. The last twelve pages are where all the figures for this article are located. They are placed in order, 1 through 12.) In this article, I show that point-wave sources at a central origin where waves that are being emitted in all directions act like fermions, and point-wave sources that construct a wave front which moves in one direction act like bosons. There are other possible constructs. In my cosmic medium, waves can be bosons or fermions, or a mixture of both. (I contend that all waves within any medium are one of the two types of point-wave sources discussed in Figure 1, or a mixture of the two.) Also in this article, an even number integer spin is a boson spin, and an odd number integer spin is a fermion spin. Of course, I could divide them both by 2 and get an integer spin for bosons and a ½ odd number spin for fermions. In traditional physics, the spin for bosons and fermions is an integer spin and a ½ odd number spin, respectively [7, 8].

I make a crucial leap from my wave source interpretation of quantum theory. In Section 7 of my earlier article, "The Theory of Distance-Time", I stated the following hypothesis: "Matter and antimatter mechanics can be derived from photon mechanics and vice versa*."* [9]. This meant that if all the laws of photon mechanics and of matter mechanics were fully understood, then one could be derived out of the other [9]. (For a further delineation on this, see the discussion section in my theory of distance-time [9].) I further illustrate this hypothesis in the current article. By using the wave source interpretation of quantum theory and the hypothesis that matter mechanics can be derived out of a photon mechanics, I am led to a conclusion about the structure of elementary particles—that when a light wave is captured into a small three-dimensional region, it becomes a three-dimensional wave source. Since all quantum waves are transversal, this wave source is a three-dimensional transversal wave source. However, in nature there are three-dimensional longitudinal wave sources, and there are no three-dimensional transversal wave sources. Nonetheless, the rules I create for a cosmic quantum medium do allow for this kind of wave source to exist.

I now summarize the objectives of this work. Essentially I create rules that govern wave behavior in a three-dimensional quantum medium. Next I challenge the Copenhagen interpretation of quantum theory with the wave source interpretation. From these first two steps, I construct a structure for elementary particles, i.e., quarks, leptons, and hadrons. What I do is create a construct for fermions that parallels the fermion-quantified spin and predicts the Pauli exclusion principle. Also, in my theory, photons necessarily have a boson spin, and the spin's axis is parallel to the direction of its velocity, which agrees with traditional theory [10]. In the light of this construct for fermions, it becomes obvious that something like the nuclear strong and weak forces ought to exist along with the force when two identical particles that are fermions interfere with and repel each other. This last force comes from the Pauli exclusion principle. I briefly discuss the relationship of these forces later in the article.

The prerequisites for understanding this article are elementary quantum theory, classical wave theory, and my theory of distance-time. This theory of distance-time is only required for Part 4. A rudimentary background in particle physics is not required but is helpful. This article is mostly a work dealing with elementary quantum principles. Nonetheless, in breaking through these most basic principles, I have surprisingly derived an inner structure for elementary particles.

In particle physics, particles do not have an inner structure in a traditional manner. What are traditional inner structures? Traditionally, a structure of an object in physics was a model where smaller bits of matter were the constituents of a larger object. These smaller bits of matter were placed in some sort of pattern that was the structure of the larger object. For an example, a crystal lattice is made up of a plethora of molecules in an array pattern. This is the structure of the crystal. The basic structure of the hydrogen atom had a proton at the nucleus, with an electron in an orbital. Both of those examples followed the traditional idea of a structure with smaller bits of matter in a pattern or a design making a larger object. I admit that in the traditional understanding there is no inner structure to these elementary particles, because there are no smaller bits of matter making up a bigger object. Instead, the inner structure of elementary particles is waves that mesh or interfere according to the pattern of the three-dimensional transversal wave source. Since this is a pattern or design of waves, I consider it an inner structure for elementary particles.

Part 2: RULES FOR QUANTUM WAVE SOURCES

2.1. Introduction to Part 2

The idea that I propose is to create a three-dimensional medium without an actual substance that propagates waves. This theory has a simple theme at its foundation. Traditional waves are vibrations in a medium. Hence, this theme is about analyzing rules of how waves truly act in a medium. Then, I analyze quantum waves, looking for and conjecturing about parallel rules of behavior. Some of these new rules may seem strange at first. I use this new set of rules to represent a hypothetical three-dimensional quantum medium. To start, I must ask: How do vibrations in classical mediums act? These classical mediums were derived from observations in nature.

Pondering the waves in traditional mediums of nature, I came upon four interesting concepts. First, vibrations interfere with each other. Second, the wave vibrates from its top crest point to its corresponding bottom trough point along a straight line that passes through the center of the wave. In other words, a wave on a string must wave between two extreme points, each on the opposite side of the string from each other. All waves on that string could be created from the additions of that simple motion. A third characteristic was discovered by Huygens and is called Huygens' principle [6]. Huygens' principle essentially states that a wave front is made up of an indefinite number of point-wave sources, and any part of this wave front when isolated to a small enough area will act like a wave source. A fourth characteristic is that waves within a natural medium (air, water, string) are smooth and continuous. Therefore, I can draw a line from wave to wave without encountering corners or breaks along the line. It is true that I could mathematically create waves with corners or breaks. Even so, within natural mediums, waves are smooth and continuous.

I intend to keep this work simple by not pursuing precepts that add complexity. As a result, I do not discuss waves being transmitted between two different mediums, as such a topic is not relevant to this analysis.

To create a medium without an actual substance that propagates waves, I will use abstract ideas taken from traditional mediums. Furthermore, I will analyze quantum particles' behavior. From both of these sources, I derive rules that apply to the behavior of quantum waves. It is these new abstract rules I will use to represent my three-dimensional quantum medium. Since I am not proposing any physical medium for quantum waves, this hypothetical quantum medium will have characteristics that are not found in physical mediums.

2.2. The Rules of the Cosmic Quantum Medium

How can there be a medium without a substance? I admit, it is strange. The only way to deal with such a possibility is to approach it abstractly. What are the abstract ideas that are a part of any medium regardless of what the substance or lack of substance for that medium? This is one thing I did in creating a cosmic medium. In other words, I asked, What characteristics do waves possess in any medium? For example, there has to be a vibration; therefore, I created a rule for vibration. For another example, there has to be wave interference; hence, I created a rule for wave interference. This was the general idea. These are just abstract rules that any wave in any medium must possess, or it is not a medium. The second thing I did was to augment these abstract rules so that they would predict elementary particle behaviors. Essentially, I derived these rules by analyzing traditional mediums and quantum wave behavior. They are postulates. Some of these rules are self-evident. The self-evident rules can be easily observed by watching traditional mediums. The other rules came from deriving the three-dimensional transversal wave source.

As previously delineated, this is a three-dimensional medium. There are many principles about waves I don't bring up here because I feel it is unnecessary to delve into these in this current article. My main intent is to give the crucial rules that make a quantum medium feasible. What follows are the rules that will guide me in constructing the waves within my hypothetical medium. These rules give me the tools to create only foundational structures for elementary particles (electrons, protons, photons, quarks, etc.). I do not make any specific particle structure. Furthermore, because I have a structure for these particles, I have a better understanding for their behavior. In Table 1, I delineate these rules, which I use throughout the article.

Table 1. Rules for Waves in a Quantum Medium
1. Waves with no measurable differences can interfere with each other. This means that two waves can interfere if they are measured to be identical. Also, since waves that cannot be measured have no measurable differences, they can interfere.
2. Waves that are traveling in opposite directions to each other interfere with a reverse amplitude relative to each other. Consequently, if two waves are moving in opposite directions to each other, they will interfere constructively if their amplitudes are the opposite (one a crest and the other a trough.) If both amplitudes are the same, they would cancel each other. Since direction in the medium affects amplitude, a standing wave is assigned a direction, too.
3. There is an attractive force between waves that interfere constructively. There is a repulsive force between waves that interfere destructively.
4. Waves vibrate so that there are opposite points of amplitude at ½ a wavelength apart. These two opposing points of a wave happen at opposing sides of the center of the wave within any space.
5. All waves within the quantum medium when located collapse—not to a particle—but to a new wave located within the region it was detected. If this region is small enough, the wave would act like a wave source. This replaces the Copenhagen interpretation of quantum theory.
6. All waves within the quantum medium are smooth and continuous. All waves that interfere add up in a smooth and continuous fashion.
7. All waves are always transversal waves.
8. The medium is three-dimensional. Wave sources spread out three-dimensionally. They have a three-dimensional structure and they interfere three-dimensionally.
9. Along the direction that a wave cycles, standing waves must exist in quantities of ½ wavelengths where there are no obstructions in the medium. Hence, the smallest region it could exist within the quantum medium is ½ a wavelength.

2.3. A Discussion of the Quantum Medium Rules

Rule 1 is based on the idea of interference between identical particles in quantum theory. In quantum theory, any two identical fermions that interfere with each other repel. The opposite holds true for bosons. However, if quantum particles are not identical, they will not interfere [1, 2, 5, 6]. This can be reinterpreted to mean that quantum waves that have no measurable differences will interfere. As a consequence, I could take waves that are constituents of a complete wave and have them interfere because they exist within a quantum wave and are not measurable. Since they attract together to form a whole wave, they must be bosons. In other words, bosons are used to construct fermions. Rule 2 is a new concept created for quantum wave source theory. It was created so that a three-dimensional transversal wave source could exist. Three-dimensional transversal wave sources cannot exist without this rule. For more information about rule 2, see section 3.8. Rule 3 is related to the interferences of waves within the quantum theory. In quantum theory, bosons attract when they interfere [1, 2, 5, 6]. I took an intuitive leap with my imagination and realized that waves exist where they add to each other, but there can be no waves where they cancel each other out. This is essentially Rule 3 restated; it allows me to make waves from boson-wave building-blocks, and these waves I create can add up constructively or destructively. Indeed, some constructs behave like fermions. Rule 4 is the rule of vibration. In all mediums, waves have a vibration, and waves in the quantum medium are no different. Generally, there are opposite extreme points in the cycle of a wave. In other words, trough and crest points always occur in the cycling of a wave. This rule results in photons having a boson spin, as I later show. Rule 5 is essentially Huygens' principle. It is important because it explains the two-slit experiment for quantum particles. Hence, the rule demystifies elementary quantum theory somewhat. Instead of a quantum sometimes acting like a wave or sometimes like a particle, it always acts like a wave. This wave may not behave exactly like waves that I am familiar with in natural mediums such as air or water. Nevertheless, the wave source interpretation of the two-slit experiment does allow me to interpret a quantum's behavior more like a disturbance in a medium than does the Copenhagen interpretation. Furthermore, it leads to a construct for elementary particles. Indeed, if any photon wave front is confined in a small enough volume, it should act like a wave source. This is a very important idea that I will use to help build a fermion later. Much of section 3 discusses Rule 5 and its consequences. Rule 6 is a definition for all waves in any continuous medium. Rule 7 further elaborates on the basic nature of the waves within the quantum medium. Within quantum theory, light is treated as a transversal wave. Even matter is considered a wave packet of transversal waves. Rule 8 deals with the three-dimensional characteristic of the medium. It was very important that I keep the medium three-dimensional. By doing so, it forced me to understand what a three-dimensional transversal wave source behaves like. Rule 9 addresses the fact that a wave only exists where there is amplitude, and there is no amplitude at the edge of a wave at ½ a wavelength in diameter. All these principles are discussed with respect to both fermion and boson wave constructs within the cosmic quantum medium.

As stated earlier, I am not proposing any physical medium for quantum waves. As a result, this quantum medium has characteristics that are not found in physical mediums. For example, a real substance or physical medium could not have amplitudes that reverse with direction. As a result, some of my abstract rules could not exist in a medium with an actual substance. Therefore, they are described as abstract rules for my quantum medium.

Lastly, the rules in Table 1 could be interpreted as quantum rules for motion. I could have included in Table 1 the idea of the Doppler effect of matter, which I delineate in my theory of distance-time [9]. Had I done so inertia would have been included into the quantum rules for motion presented in that table. However, inertia is not really discussed in this article and is therefore not included in the table.

Part 3: QUANTUM WAVE SOURCES

3.1. Introduction to Part 3

Traditionally the Copenhagen interpretation has been used to understand the double-slit experiment for quantum theory. Here, however, I apply Huygens' principle to quantum theory and create what I call the wave source interpretation of the double-slit experiment for quantum theory. Huygens' principle essentially states that a wave front is made up of an indefinite number of point-wave sources, and any part of this wave front when isolated to a small enough area will act like a wave source. In quantum theory, a wave front for an electron represents all possible locations of that electron particle. When I measure the location of an electron in its wave front, I essentially dissect a small part of its wave front from its other possible locations. According to Huygens' principle, this small section of the electron wave front is best understood as a wave source—not simply a particle. Using this method, I can predict all verified results of the Copenhagen interpretation, plus more.

In this section, I treat a wave source as the originating wave of other waves. I also develop Huygens' principle so that all the added up point-wave sources of a wave front equal the original point-wave source of that wave front. Furthermore, I briefly discuss the concept of a compound wave source which starts to exist when two wave sources overlap. I discuss how this corresponds to hadrons' behavior (i.e., the nuclear strong force). Finally, I create a new abstract structure that I call a three-dimensional transversal wave source. I show that the behavior of a three-dimensional transversal wave source parallels fermions' behavior. To be more specific, this new structure has a quantified odd number integer spin and obeys the Pauli exclusion principle. These results are predicted strictly out of this new structure I create without reliance on known particle physics. I only use the traditional particle physics as a reference. (In this article, an even integer spin is a boson spin and an odd number integer spin is a fermion spin. Of course, I could divide them both by 2 and get an integer spin for bosons and ½ odd number spin for fermions [7, 8].)

3.2. The Wave Source Interpretation

Traditionally, quantum theory has interpreted the double-slit experiment as being a result of the wave particle duality behavior of a quantum. This is generally referred to as the Copenhagen interpretation of the double-slit experiment. However, here I use the wave source interpretation to get very similar results when applied to the double-slit experiment. This new wave source interpretation comes from applying Huygens' principle to quantum theory. When this new interpretation is developed, a deeper quantum theory is created because a structure for elementary particles emerges. For now, I need to delineate the double-slit experiment. Using this experiment, I can then compare the wave source interpretation with the Copenhagen interpretation. Although the wave source interpretation is not the same as the Copenhagen interpretation, it is still very similar.

Huygens' principle is central to understanding this new interpretation for the double-slit experiment. This principle essentially treats all wave fronts in a medium as if they were made out of an innumerable amount of pointlike wave sources [6].

Consequently, any narrow section of a wave front behaves like a wave source. This must be considered to have a proper interpretation of the double-slit experiment.

I use a single electron going through two slits in a barrier as an example. In a quantum mechanics test, an electron is shot towards a barrier with two slits. (For simplicity, I treat the electron as a small series of wave fronts hitting the barrier.) Then this electron, acting like a wave, passes simultaneously through two slits in the barrier. One slit I will call 1, the other 2. On the other side of the barrier, the electron wave exits these slits as two new wave sources. From these wave sources, two new small series of wave fronts emerge. These expand and interfere with each other. Hence, a wave-interference pattern results. According to the Copenhagen interpretation, however, the electron wave will collapse to that of a particle if its location is determined. Hence, it would momentarily be a single particle that has a specific location. As a consequence, this electron detected exiting slit 1 could not exit slit 2 as well. The type of detection device does not matter as long as it detects particles adequately. Therefore, the interference pattern on the other side of the barrier would collapse.

The wave source interpretation produces a similar result with a different interpretation. The difference is that the electron never collapses—even momentarily—to being a particle. Instead it collapses to a new wave source. In other words, if an electron's location is determined to be within a narrow region, then the wave acts as if it has encountered a single-slit barrier. Thus, the electron wave can only pass through this single narrow region and exit the other side as a single new wave source. Consider the following example. An electron wave passes through two narrow slits (called 1 and 2) in a barrier. Shortly after the electron wave emerges, it gives off a photon. This photon is detected by observers, and it is determined by these observers that the electron wave is located in a narrow region near the exit of slit 2. Thus, the electron wave collapses to a new wave source a small moment after exiting slit 2. To be more explicit, the electron is now only located in this narrow region where it was detected. It will emerge from this narrow region, like a wave emerging from a slit in a barrier, as a new wave source. The closeness of the electron wave to slit 2 and the narrowness of the region where the electron is detected determine that the wave could not have come from slit 1 and that the wave could only have passed through slit 2. Therefore, all possible paths that would have gone through slit 1 collapse.

The wave source interpretation of quantum theory essentially states that every time a quantum wave location is detected in a narrow region, this wave collapses to exist only in that region—not as a particle but as a wave source. All other possible paths (that would not allow the quantum being detected in that specific narrow region) collapse and no longer exist.

What about Einstein's corpuscular theory of light? Einstein stated that when a photon contacts a wall, it behaves like a particle. This is true only because a particle is defined as having a specific location in a small region. When a light wave hits the wall, all the waves of a photon would be confined to the specific location where contact with the wall was made. As a result, a light wave hitting a wall would collapse to that specific region where the wall detects the location of the wave. In other words, the wall is made up of countless surface electrons, and whichever electron in the wall that detects the location of the light wave will cause this wave to collapse to a small region that this electron encompasses. Hence, the wave's energy is now located to that small region like a particle. However, within that small region, the light quantum is still a wave. Also, according to Huygens' principle, any wave propagating in a medium and constricted to a small enough area should act like a wave source [6]. The wave source interpretation agrees with the results of Einstein's corpuscular theory of light. In summary, when a quantum wave is detected at a small region, all of its energy collapses to exist in that specific location. Hence, a photon strikes a wall at a spot like a particle, but within this spot it is still a wave. If this spot is small enough, the wave will behave like a wave source [6].

My reasoning leads to vital questions. How should a quantum of energy be treated when it is confined to a very small region? Should it be treated like a particle? Should it be treated like a one-dimensional standing wave? Should it be treated like a wave packet? Should it be treated like a three-dimensional wave source? Elementary quantum theory books at different instances treat a quantum like a particle, a wave packet, or a standing wave in one dimension. For three dimensions, the standing wave version is treated with three waves that are one-dimensional standing waves that do not interfere with each other. If Huygens' principle needs to be applied to quantum theory, it should be treated like a three-dimensional wave source. It is possible that it may be a combination of a wave source and wave packet. (However, in this article, I limit the discussion to the wave source option.) In adapting Huygens' principle to quantum theory, a construct for elementary particles is created. I further discuss wave sources and Huygens' principle in the next section.

I take an approach to the Copenhagen interpretation that is rather literal. When a wave collapses to a particle, I treat that particle in the traditional meaning of a particle. When quanta are waves, I treat them with the characteristics of traditional waves. I need to treat the Copenhagen interpretation concisely and with a clear definition to work with it. Also, in traditional physics, it is notable that a wave that passes through a slit or emerges from a region that is narrower than the wave's wavelength causes the wave to act like a wave source when it emerges from the slit [6]. Indeed, the more narrow the slit is than the wavelength of the wave the more that the wave spreads out in different directions after it emerges out the back end of the slit [6]. This characteristic of a wave does not happen for the traditional particle. Also, detecting a particle's location is treated similarly to passing it through a slit. For the tests or examples that follow, all slits or regions that a wave passes through are equal to or smaller than the wavelength of the wave.

I propose a simple test for the wave source interpretation of quantum theory. In Figures 2A and 2B, I have set up a scenario where an electron wave is propagating towards a wall. In Figure 2B, the electron's locations is detected by a photon with a wider wavelength than the photon has in Figure 2A. As a result, the detected electron will collapse to a narrower region in Figure 2A than it will in Figure 2B. Therefore, the new wave source's spread in Figure 2B is narrower than the new wave source's spread found in Figure 2A. When its location was detected, the electron would not have behaved in this manner if it collapsed temporarily to only a particle. If the electron is only a particle when detected, it should move straight through without spreading, and at some later time it should start behaving like a wave again. In contrast, the wave source interpretation predicts that the electron would immediately spread after collapsing, because it never ceases being a wave. Therefore, there is no temporary existence when the electron is not a wave. Consequently, the Copenhagen interpretation is not accurate enough to predict this test. I will explain further. Using the classical idea for particles, I shoot a beam of these particles towards a target. I now force this beam through a narrow region. In this example, what matters the most is how the particles come out of the small region. It is important because this is what should occur if a wave collapses to a particle when detected in a small region, and out of this small region a particle emerges. From a narrow region, a narrower beam of these classical particles should be emitted. In other words, what emerge from this narrow region are the particles that essentially pass straight through that narrow region. Furthermore, the narrower the region gets, the narrower the beam should get. The narrower that region gets, the fewer possible different directions for the velocity. The particular direction for a particle is the direction of the wave when it was detected and turned into a particle. Hence, when a particle emerges from a small region with a velocity in a particular direction, it should not spread out like a wave.

Next, I force a wave front through a narrow region. What emerges is a wide spread, as shown in Figures 2A and 2B. Indeed, the narrower the region the wave passes through, the wider the spread becomes. (See figures 2A and 2b.) This should be the case when a particle's location is detected. It should not act like a particle. This is what the wave source interpretation predicts, and it is very unlike what the Copenhagen interpretation predicts, which is the opposite result. Figure 2 is only supposed to show the difference between the Copenhagen interpretation and the wave source interpretation. Figure 2 was not created to give an accurate representation of the conservation of momentum for the interactions between electrons and photons.

I propose another experiment to determine whether an electron (once it is detected) turns into a particle only or a new wave source. (See Figures 3A and 3B.) In Figures 3A and 3B, an electron wave passes through a double slit and is detected with a photon. It is detected close enough to one of the slits that the wave collapses so that it could only have passed through one slit—not both. In Figure 3A, the detected electron becomes a new wave source, and it is able to pass through both slits in the second barrier. Hence, on the other side of this second barrier, an interference pattern is created, as shown in Figure 3A. On the other hand, in Figure 3B, no new wave source is created. Instead the electron collapses to a particle only, and it can only pass through one hole located in the second barrier. As a result, no interference pattern exists behind the second barrier. Figure 3A is the only possibility for the wave source interpretation of quantum mechanics, whereas Figure 3B is a real possible outcome for the Copenhagen interpretation of quantum mechanics unless the particle becomes a wave again fast enough to be able to pass through both slits. In Figure 3B, what would cause the wave to turn back to a particle that quickly? There is no reason in the Copenhagen interpretation for it to do that, unlike the wave source interpretation presented in Figure 3A. The whole idea of this scenario is to accept the impression that the Copenhagen interpretation leaves in the human mind. If I accept the idea of a wave collapsing to a particle, then I will give a test to see if it is really a particle when it is supposed to be a particle. Indeed, a quantum wave is supposed to be a particle when it collapses to a particle because its location is now detected. Furthermore, there was no reason for it to change back to a wave in that test that I propose. Although there is no interference pattern in Figure 3B, different particles still pass through either of the two slits, creating two areas of high intensity on the final screen. Figure 3A has an interference pattern on its final screen. Like Figure 2, Figure 3 is only supposed to show the difference between the Copenhagen interpretation and the wave source interpretation. Figure 3 was not created to give an accurate representation of the conservation of momentum for the interactions between electrons and photons.

(I tend to use the term “particle” interchangeably with my “quantum wave source” idea. In this article, particle only means that something is located in a very small region, which includes quantum wave sources. Traditionally, the term “particle” did not mean a quantum wave source was present within the small region encompassed by the particle. It is only when I delineate the traditional particle concept, in contrast to the quantum wave source idea, that the term “particle” takes on its traditional meaning in this work. Other than that particular situation, I use particle to mean the small region where a quantum wave source exists.)

3.3. Wave Sources and Huygens’ Principle

In classical physics, Huygens’ principle was applied to waves in a medium, and it explained much of the behavior of these waves. It especially explained the behavior of a narrow section of a wave when dissected out of a wave front. This narrow section of a wave acted like a wave source.

If Huygens’ principle were applied to quantum theory, this could give us greater insight into the possible structure and behavior of a quantum in small regions. In other words, we could learn about regions that are the size of elementary particles. For this reason, the concept of a wave source in quantum theory is very important. Before I further apply Huygens’ principle to quantum theory, I need to discuss more about this principle and waves sources.

I first describe what I mean by a wave source. In the following example, I assume that the waves are sinusoidal. The scenario involves having a still pool of water. I begin a consistent repetitive motion of dipping my finger in and out of this pool at a central location. My finger is not a wave source. Instead, the central point in the pool where my finger is dipping is the wave source. In other words, the originating point-wave in the water is the point-wave source. If I could follow all the wave fronts in the pool back in time, they would originate at this undulating central point in the water medium. I have described a wave source as an originating wave; therefore, like any other wave, a wave source must be smooth and have a wavelength and frequency. Also, like most waves in a medium, a wave is complete enough that it can stand alone when described at a minimum of ½ a wavelength. In this pool, the best description for a wave source is the originating wave with a ½ wavelength for its diameter. This is obviously not the originating point-wave, but it approximates the originating point-wave’s behavior. Plus, in a medium, a point-wave cannot stand alone because all waves are smooth and continuous. Therefore, a point-wave is smoothly and continuously linked to other point-waves, thereby creating a sinusoidal wave.

As I discussed earlier, Huygens’ principle essentially treats all wave fronts in a medium as if they were made out of an innumerable amount of pointlike wave sources. Consequently, any narrow section of a wave front behaves like a wave source. I would like to add some things to this by using the pool example in the preceding paragraph. First, I begin by making the obvious observation that any wave-front ring moving away from the wave source (an originating wave) was once a central wave source itself. Second, as this ring moves out, some changes occur. For instance, its amplitude or energy at a specific location on the ring decreases. Nonetheless, all the energy or amplitude at every point on this outwardly moving ring should add up to the original energy of the central wave source. Third, the wave source moves out as a wave front in all directions on the plane of the pools surface. Furthermore, any location on this outer wave front is moving in a direction directly out away from the center. If any wave front is taken back in time to its origin and in so doing recreates the original wave source, then every conserved characteristic of these points on that wave front when added up equals the characteristics of the original wave source. This only applies when over time there was no frictionlike influence that would take away from the wave as it traveled.

The next point I discuss is the ability for wave sources in the same medium to create compound wave sources. The simplest example is identical wave sources making a compound wave source. (See Figure 4.) If I take two identical wave sources and gradually bring their centers closer together, a compound wave source starts to emerge when the central wave sources begin to intersect. These central wave sources have a diameter of ½ a wavelength. In Figure 4A, there are no compound wave sources yet. Compound wave sources start to exist in Figure 4B. In Figures 4C and 4D, the compound wave source begins to be more obvious. Essentially the waves emitted from these two wave sources add up in a manner that a new center for a new wave source is created. Of course, this new wave source is a compound of the other wave sources. If a quantum in small regions is best understood as a wave source and if there are compound wave sources, there should therefore be a compound quantum made of other quanta. These compound wave sources are generally referred to in particle physics as compound particles (hadrons). The nuclear strong force is responsible for creating compound particles. It is also interesting that this strong force starts interacting at about the outer edge of the particle with a diameter of ½ a wavelength [7, 8]. In other words, at the distance of the diameter of the hadron, the nuclear strong force starts strongly influencing other hadrons [7, 8]. This is the same distance at which compound wave sources begin to emerge. This similarity to the creation of compound wave sources is more than coincidental.

If the creation of compound wave sources were associated with a force, this force would act more like a cage than a force that is inversely proportional to the square of the distance. In other words, when these central waves no longer overlap to any degree, they rapidly act less like a compound wave source as they are moved away from each other. Therefore, a force associated with the making of a compound wave source would rapidly disappear as the two wave sources are pulled apart. Indeed, the nuclear strong force acts more like a cage than a force that is inversely proportional to the square of the distance from a center.

The whole purpose of the analogy of comparing traditional compound wave sources with hadrons should not be taken any further than the following statements: (1) wave sources in traditional mediums form compound waves sources, and hadrons form compound particles; (2) the interference that forms compound wave sources occurs (i.e., increases or decreases) rapidly like a cliff, and this is true for the nuclear strong force that holds hadrons together; (3) the interference that creates compound wave sources occurs at the diameter of ½ a wavelength for the wave source, and this is the distance for the nuclear strong force's interaction, too. The analogy between traditional compound wave source and hadrons should not be taken too much beyond these statements. Nevertheless, these similarities between compound wave sources and hadrons, I believe, are not just coincidental. These similarities exist, because as I describe in this article, the core construct for elementary particles is the quantum wave source.

If a quantum in a small region is best described as a wave source, what kind of wave source is it? The medium for quanta is unknown and may never be known. Consequently, I can only refer to what is known about any quantum and find possible analogies in traditional mediums for help on this question. It is known that the electromagnetic wave is a transversal wave. In the conclusion of my theory of distance-time, I proposed that basic characteristics of light are preserved when light is transferred to the state of matter [9]. Therefore, in this current article, I conclude that matter must be made out of transversal waves, too. Hence, the construct for all quanta of matter confined to a small volume is a three-dimensional transversal wave source. There is no three-dimensional transversal wave source described in traditional physics. However, a three-dimensional longitudinal wave source is described. The most common example of this is a sound source in the medium of air. Also, there are two-dimensional transversal waves that are found in traditional physics. Nonetheless, there is not even a hint of three-dimensional transversal wave sources. Therefore, I will have to create and develop the constructs for three-dimensional transversal wave sources in a later section. Then I will also show the remarkable similarities between the characteristics of these constructs and those of fermions.

3.4. Wave Sources in One-Dimensional Mediums

In nature a free medium (a medium free of obstructions) never has a wave in it any simpler than a single pulse. A pulse is a wave that is one-directional and one-dimensional with a ½ wavelength. Also, a pulse always has a crest or trough straddled by two locations with zero amplitudes. (See Figure 5.) In Figure 5A, my assistant whips the end of the rope and creates a pulse moving down this rope. She could not create a wave that is any simpler. Figure 5B is not a pulse, even though it has a ½ wavelength, because it does not have a crest or trough straddled by ends that are points with zero amplitudes. Figure 5C represents two pulses. It is my hypothesis that all waves in a free medium can be constructed by pulses within that medium.

In Figure 6A, a rope is tied between two poles. My assistant oscillates the rope at the center, creating a wave source. Notice that in Figure 6A the wave source is not a point-wave source. I drew it with a minimum diameter of ½ a wavelength because a rope tied between two poles in nature cannot propagate a wave with any smaller width. This wave source in the middle is emitting pulses in both directions in a one-dimensional medium, which makes it a wave source in one dimension.

Figures 6B through 6E represent various stages of waves emerging from the central wave source in 6A. Notice that in 6B, there are two pulses coinciding and moving in opposite directions. In Figure 6C, these pulses are now partially coinciding. Finally, in 6D, they are totally separated. At a later stage in 6E, the two outer pulses are separated by ½ a wavelength. Furthermore, there is the wave source at the center that is made up of two pulses emerging in opposite directions. This new wave at the center has an upside-down amplitude. I assert that all waves in a medium can be constructed of pulses, but pulses are one-directional, one-dimensional wave sources. In other words, pulses are the most elemental waves that can exist in a free natural medium from which I build wave sources.

The wave source in the center of Figure 6E is different from this image's outer wave sources. The center wave source is emitting pulses in all directions in a one-dimensional medium, and the outer wave sources are emitting pulses in one direction in the same medium. Hence, they have different constructs. Nonetheless, both are constructed out of pulses.

I next imagine a pulse on a rope that is tied between two poles, such as in Figure 6A. However, now the ½ wavelength of the pulse reaches the full distance between the two poles. Furthermore, the rope is tight, so there is elasticity. Now my assistant plucks the tight rope. In this situation, the pulse does not move down the length of the rope. Instead, it becomes a standing wave. Therefore, energy restricted to a small region, like the wave that is restricted in this manner, can act like a standing wave. Elementary particles are similar to these transversal waves restricted to a three-dimensional region that is ½ a wavelength in diameter. I treat elementary particles as energy trapped within a volume of a diameter of ½ the wavelength of the particle.

3.5. Wave Sources in Two- and Three-Dimensional Traditional Mediums

Figure 7A illustrates a central wave source within a two-dimensional medium. The waves within this medium are transversal. The central wave source has a diameter of ½ a wavelength and is emitting waves in all directions out of this central source with the same wavelength. All the waves emerging from the center are not shown in Figure 7A. If they were to be shown, the two-dimensional wave source would look like it does in Figure 1. Imagine that in the two-dimensional wave source of Figure 7A, waves smoothly and continuously fill the gap between these two waves, as shown in Figure 7A. I can create all of these waves that fill the gap by rotating one of those waves into the other. Each infinitesimal rotation would represent another wave being emitted from the central wave source.

Figure 7B represents a wave source in a two-dimensional medium also emitting waves in all directions in this medium. I did extend two waves represented there into two more waves with reverse amplitude. Notice that these waves are still wave sources but are only emitting waves in one direction, as opposed to the central wave source, which is emitting waves in all directions away from it. All the wave sources represented are essentially waves with a minimum of ½ a wavelength.

Transversal waves in traditional mediums can only exist two-dimensionally. In Figure 7C, I show a single slice of a central two-dimensional central wave source. Of course, there are two waves that are moving outward in opposite directions. This is represented by the double-sided arrow. To represent a three-dimensional central wave source, I need to show waves moving away from this central wave source in a direction that is perpendicular to this double-sided arrow in Figure 7C. I do this by rotating 90 degrees the two waves that will be emitted from the wave source. I create these waves by rotation so I can maintain smoothness and continuity, as I explained earlier for Figure 7A. In Figure 7D, I show that the rotated waves are now moving upward. However, their amplitudes are the reverse of each other and they cancel each other. A wave source cannot be three-dimensional unless it truly is a source for waves emerging from it in all directions three-dimensionally. Because along one axis the waves I have shown cancel each other, there are no three-dimensional transversal wave sources in classical mediums.

If there are three-dimensional transversal wave sources, the following description must be satisfied. I select a point in a three-dimensional space. Next, I draw a straight line through this point. Finally, I put the center of the three-dimensional transversal wave source on this line. This line could pass through the point along any direction, and there should be wave pulses along both directions of the line that are moving away from this wave source's central point. This description has wave pulses moving out from the center in all directions within a three-dimensional medium. Furthermore, all these wave pulses must join smoothly and continuously as they do in Figure 1, which is within a two-dimensional medium. They cannot cancel along any direction as they did in Figure 7D.

3.6. Three-Dimensional Transversal Wave Sources

In a previous section, I described the scenario of a pool with a central wave source and rings of wave fronts propagating away from the center. This wave source is a wave with ½ a wavelength emitting waves in all directions on the surface of the pool. Since this wave source is still a wave, it must be smooth and continuous in all directions. When I say smooth and continuous, I mean that I can draw a line along any path on this wave source's surface so that the line would have no breaks and no corners. It is also important to note that if a wave source is a complete two-dimensional wave source, it will emit waves in all directions on a plane. Therefore, rings of wave fronts will propagate away from the central wave.

Of course, I cannot use a surface of a pool of water for a scenario to illustrate a three-dimensional transversal wave source. Indeed, I cannot use any traditional medium for this scenario. The reason for this, as I showed in the previous section, is that the amplitudes of a three-dimensional transversal wave source would cancel themselves out at least along one dimension. Consequently, I have to create a hypothetical medium to imbed this new kind of wave source. I will show that these new structures I create, three-dimensional transversal wave sources, can only exist with a quantified spin. Furthermore, these spins are quantified so that they correspond to an odd or an even number spin. I will later show how an odd spin and an even spin, respectively, predict fermions (quarks and leptons) and bosons (photons). Also, if this wave source has a spin that corresponds to an even number of wavelengths for a three-dimensional transversal wave source, then all the wave pulses' amplitudes within this particle cancel each other. (This parallels fermions in particle physics. If any two fermions are identical, they can interfere in a manner so that the two are indistinguishably together. Hence, a single particle with an even spin would be created. These two identical particles would cancel each other's amplitudes according to the Pauli exclusion principle, which is better known as "the Pauli exclusion principle".) All of these results come from this new construct, without using traditional physics to derive my results. Although, I do use traditional physics for checking my results.

If a wave source is truly three-dimensional, three-dimensionally it should emit waves in all directions away from its center. This is difficult to do with three-dimensional transversal wave sources without waves canceling each other along at least one axis. If any wave pulses cancel along any axis, a three-dimensional wave source cannot be constructed. A three-dimensional transversal wave source must emit waves out away from its center in all directions without any canceling. This wave source must be smooth and continuous so that a straight or curved line can be drawn on it in any direction without crossing any breaks or corners.

To explain the three-dimensional transversal wave source, I describe a wave source as made of an indefinite number of one-directional wave pulses. (See Figure 8.) In my hypothetical medium, the waves' amplitudes add up in a reverse manner if they move in the opposite directions relative to each other. (See Rule 2 in Table 1.) When they are moving in the same direction, they add up normally. A central wave source has waves moving outwardly in all directions. Hence, a central wave source has pulses that move in opposite directions to each other. These pulses must have reverse amplitudes so they can add up constructively. I color-coded these pulses along with the arrows pointing in the direction in which each is moving. The black pulse and the red pulse are moving in opposite directions and their amplitudes are reversed. The same is true for the blue and green pulses. Therefore, the pulses' amplitudes add up constructively. Notice, I can take the red pulse in Figure 8A or Figure 8B and rotate it, and it will eventually coincide with the green, black, and blue pulses in turn. This means the pulses are components of a completely smooth and continuous wave.

Figure 8A lies on the Z, Y plane, and Figure 8B lies on the X, Y plane. I set the wave in 8B to be 90 degrees out of phase with the wave in 8A. Hence, the waves in 8A are flat (zero amplitude) when the waves in 8B are at maximum amplitude and vice versa. Furthermore, there is an indefinite number of waves, as in the waves in 8A and 8B, and they are waving in between the waves in 8A and 8B. In addition, the phases of the waves on these planes happen in a manner so that the closer the wave is to 8A’s wave, the more it is in phase with it. The same is true for the waves as they get closer to 8B’s wave. As a result, spin is created as all of these wave pulses wave or cycle through their phases. This approach allows the three-dimensional transversal wave source to exist without canceling amplitudes in any direction.

These wave pulses add up to create a wave front moving away from its center location in all directions. These pulses are essentially standing waves because, according to Rule 3 in Table 1, these pulses trap each other. All these wave pulses join smoothly and continuously, which satisfies Rule 6 of Table 1. Hence, there is a force that holds them together and does not let them fly apart in the direction outward from the center. Since they are standing waves, these wave pulses have zero velocity, but I do assign direction to them.

In Figure 9, I create Figures 9A through 9D by looking down in the negative Y axis direction of a three-dimensional transversal wave source like the one in Figure 8. Hence, I am looking down on the X, Z plane. In Figure 9A, the wave is at time (t = 1). In this image, U (up) means that there is a wave crest at the center with a direction to the left, and D (down) means there is a wave trough with a direction to the right. Parallel to the Z axis, the wave amplitudes are zero. I now stand at the center of Figure 9A facing the negative X axis direction and spin in a circle. I first see a pulse with up amplitude. As I continue to spin, this view would smoothly and continuously change to zero amplitude, then to down, and then back to zero amplitude. Finally, I would see the up amplitude where I started. While I spun in this complete circle, I would witness one complete wavelength. Therefore, the wave source presented in this figure has a 1 wavelength spin.

This wave source cycles through its phases. Figure 9B occurs at time (t = 2). At this time the wave source has spun so that in the negative Z axis direction, the amplitude is up; and in the positive Z axis direction, it is down. Along both directions parallel to the X axis, there is zero amplitude. The wave continues to rotate through Figures 9C and 9D. Finally, the wave will arrive back to Figure 9A. I refer to this wave as having spin 1 because its circumference encompasses one wavelength.

Since a wave source is still a wave, it must be smooth and it must fit like any quantum wave in a small region of space. As I spun in a complete circle, I observed how the amplitudes smoothly changed from up to down and back to up. During this observation, I viewed no part of the wave that was disconnected or had a corner. This is a requirement: that a wave source be smooth and continuous when all of its wave pulses fit together. In other words, viewing from the center and turning in any direction, I would see amplitudes of various wave pulses smoothly and continuously forming a single wave source. Therefore, these amplitudes must fit together along a circumference so that an up part of the wave source is a distance of ½ a wavelength away from a down part of the wave source in Figure 9. If I were to create other wave sources of this kind, they would have a spin that exist at integer wavelengths because their amplitudes have to go from up to down and back to up again. If not for this, the wave would not be continuous. In other words, all the crests and troughs have to smoothly fit together in a wave source. However, the diameter of the wave source would exist at ½ a wavelength, which is the length of each wave pulse. This agrees with elementary quantum theory, which requires that the minimum distance that any quantum may span be a distance of ½ a wavelength.

It is interesting that the structure defined requires a spin as the wave source vibrates. Indeed for spin 1, as each wave pulse in the structure vibrates, a corresponding spin occurs according to the relationship where one complete cycle of the frequency equals one complete rotation of the particle. Also, for spin 3 the relationship is that three complete cycles of the frequency equals one complete rotation of the particle. These are both linear relationships. These equations are such that a greater frequency results in a greater spin, or a lower frequency results in a lower spin. This should be a characteristic of fermions if they do have this structure (the three-dimensional transversal wave source) at their core. I state that the energy of the waves that I construct are given by

$$hf = E. \qquad (1)$$

A wave is not a part of a wave. It is the total entity because the existence of one segment of the wave affects all the other parts. Therefore, it is the whole wave that is the wave. If you take away a part of the wave, you have a different wave, and it will act differently, too. Thus, a wave must be understood as a whole.

3.7. Wave Sources with a Different Spin

As stated previously, an even number integer spin is a boson spin, and an odd number integer spin is a fermion spin in this article. Of course, I could divide them both by 2 and get an integer spin for bosons and a ½ odd number spin for fermions [7, 8].

The spin for the wave source in Figures 9A through 9D has a one wavelength spin, or spin 1. I give other possible spins in Figures 10A through 10F. Figures 10A, 10C, and 10E have even spin wavelengths, which are 2, 4, and 6, respectively. Figures 10B, 10D, and 10F have odd spin wavelengths, which are 3, 5, and 7, respectively. I again apply the fundamental rule for amplitude addition for the hypothetical medium of these wave sources. Amplitudes of waves with reverse direction add up in a reverse manner. (For example, two crests would cancel, if one is on a wave moving in the opposite direction to the other.) Therefore, every wave amplitude cancels out for the wave sources with even-spin wavelengths. This is true not only on the X, Z plane but three-dimensionally as well. It is only the wave sources with odd-spin wavelengths that can exist. Do these results parallel fermions' behavior? Yes, they do. Fermions exist stably at odd-number angular momentums. Indeed, they can exist at ½ spin, $\frac{3}{2}$ spin, $\frac{5}{2}$ spin, etc. (The $\frac{5}{2}$ spin would have a greater frequency and angular momentum than the $\frac{3}{2}$ spin because of the $\frac{5}{2}$ represents a greater frequency.) Furthermore, any two identical fermions can interfere in Figure 9, creating a single particle and resulting in an even spin, and they cancel each other out. According to Rule 3 in Table 1, waves that cancel will repel each other. This satisfies the Pauli exclusion principle. If I were to add any of the odd number spins in Figures 9A, 10A, 10C, and 10E, the result would give wave sources that had even-spin wavelengths. Of course, their amplitudes cancel themselves, as previously stated. I have just shown that my three-dimensional transversal wave sources exist stably only at odd number spins and that they obey Pauli's exclusion principle.

In traditional quantum theory, waves do not interfere unless they are identical. However, I will reinterpret that concept. The only way an experimenter can know that two quantum particles interfered is by detecting the results of particles that were so near each other that they interfered. An experimenter must detect the results to determine that wave interference occurred. Instead of stating that only identical quantum particles interfere, I propose that quantum particles interfere with each other where there is no measurable difference between them. The elements of my quantum wave sources (wave pulses) cannot be measured. As a result, they can interfere with each other regardless of which direction they travel.

An interesting point to raise is that these wave sources with odd number wave spins could only exist in my hypothetical medium because of the rule for reversing the amplitudes of waves with an opposite direction. In a traditional medium, these waves with odd spins would essentially cancel themselves. Indeed, the amplitude of the entire wave source would cancel. This leads to the important question: Could a three-dimensional transversal wave source with an even spin exist in a traditional medium? The answer is still no, as the waves emitted on at least one axis would cancel. Nonetheless, three-dimensional transversal wave sources are the foundation for fermions. To eventually complete this structure, more information about fermions is required.

3.8. Reverse Amplitudes

In order for the idea of a quantum wave source to exist, the three-dimensional transversal wave source needed to be made viable in a medium. This was made possible when I created my rule for reversing amplitude interference for waves moving in opposing directions in reference to each other. This rule naturally leads to a question: How can this be possible? To answer this, I link the amplitude for a quantum wave to its change of radians, or degrees. For simplicity, I only refer to radians. In my hypothetical medium, a wave is waving in reverse to another wave if it is moving in a reverse direction to that other wave. I designate a reverse wave with a negative change of radians. This is not the same as taking a normal sine wave in a traditional medium and having it cycle through radians in a negative direction. A normal wave would not have its amplitude associated with the change of radians as I propose here. In this section, I am essentially giving the concept of what is waving a plus or minus direction associated with the direction of the wave. Since the direction of the wave is relative, the direction of whatever is waving is relative, too.

In Figure 11, I have three waves: P, Q, and R, with P moving in an opposite direction to the others. These waves are shown at ½ wavelengths. There are also six points (A through F) in the figure. The waves are shown separated, but in my discussion, I treat them as if they were coinciding. To be more specific, I claim that points A, C, and E coincide as well as points B, D, and F.

Next, I wish to make the amplitudes of these waves dependent on the Δθ (change of radians). Figure 11 shows that wave P is moving to the left and its Δθ is positive in that direction. Furthermore, waves Q and R are moving to the right, and each of their Δθ is positive in that direction. I examine how each wave waves as it moves with their respective Δθ. (I designate Δθ as being positive without the necessity of putting a plus sign in front of it.) Since wave P is moving from right to left, point B is waving ↑ (up) and point A is waving ↓ (down). I represent wave P's amplitude with *Δθ*↑↓. This means that in the direction that the wave is propagating, the wave goes up, then down. In other words, a crest occurs. Wave Q's amplitude is represented in the same manner with Δθ↑↓, which is also a crest. However, wave R's amplitude is given by Δθ↓↑, which is a trough.

A wave always propagates in the direction of its Δθ, and not its −Δθ. Since wave P is waving to the left, it interferes with wave Q in a reverse direction. Therefore, wave Q is a reverse amplitude relative to wave P, with a negative Δθ↑↓, i.e., −(Δθ↑↓). This means that relative to wave P, wave Q's point C is still waving ↑, and point D is still waving ↓. As wave P propagates in the direction from point B to A, it propagates in the direction from point D to C and interferes with all the points from D to C. Hence, wave *P* moves in its direction of Δθ while going from point D waving ↓ to point *C* waving ↑. Wave P interferes with wave Q so that −(Δθ↑↓) = Δθ↓↑, which is a trough. Consequently, when waves P and Q interfere in Figure 11, they cancel. On the other hand, wave R's amplitude is Δθ↓↑, and −(Δθ↓↑) = Δθ↑↓, which is a crest. Waves R and P interfere constructively. The equation −(Δθ↓↑) = Δθ↑↓ does not mean that wave R has changed the direction of its propagation. Instead, it only represents how wave P's amplitude interferes with wave R's amplitude.

In this section, I have discussed how whatever is waving is affected by the direction of the propagation of that wave. This is not the case for waves in traditional mediums. In traditional mediums, the amplitude is not influenced by the direction of propagation of one wave relative to another.

3.9. Single-Directional Wave Sources and Translational Motion of All-Directional Wave Sources

In Figure 1, I delineated two types of point-wave sources found in traditional mediums. However, Figure 1 was only an analogy in two dimensions. I leaped beyond this analogy by creating a three-dimensional hypothetical medium which I claimed to be the cosmic quantum medium. I have up to now constructed for my cosmic quantum medium the type of point-wave source that is spreading out in all directions (a central wave source). This was the three-dimensional transversal wave source. Now I wish to construct the other wave source discussed in Figure 1. This is the single-directional wave source which constitutes a wave front moving in one direction across a medium.

Referring to Figure 12, there are three images (12A, 12B, and 12C), and each represents a wave with a different spin around an axis represented by its respective gray arrows. Figure 12A has spin 0; Figure 12B has spin 1; and Figure 12C has spin 2. The gray arrows in all three images represent the center or axis of rotations for the wave and gives the direction of the wave's propagation. In Table 1, the rules for wave behavior in my three-dimensional quantum medium are given. Rule 4 in this table is as follows: Waves vibrate so that there are opposite points of amplitude at ½ a wavelength apart, and these two opposing points of a wave happen at opposing sides of the center of the wave within any space. Figure 12A satisfies this rule because the crest and troughs are on the opposite sides of the wave center given by the gray arrow. Of course, Figure 12A wave has spin 0 so that the wave is not spinning around the gray arrow. Hence, the wave vibrates so that the crest and trough will always be on the opposite side of the arrow. Figure 12B has a wave with spin 1. This means that for one full wavelength of the wave, the wave will spin once around. Therefore, at ½ a wavelength, the wave will spin halfway around and the trough will be on the same side of the gray arrow as the crest. This contradicts Rule 4. Consequently, the spin for the wave in Figure 12B cannot exist. Figure 12C has spin 2. This means the wave will spin twice around the gray arrow per one wavelength. At ½ a wavelength, the trough will be below the gray arrow because at this time the wave should have one complete spin around the gray arrow. This result agrees with Rule 4. In Figure 12C, at one full wavelength, the crest will occur above the gray line. All these images show that a one-directional wave in my quantum medium can have an even spin but not an odd spin, as an even spin—not an odd spin—results in a permissible vibration according to Rule 4. Hence, one-directional waves have a boson spin. Consequently, wave fronts made out of one-directional point-wave sources should be bosons.

Fermions always move (translational motion) as wave fronts. Therefore, their spin in the wave front (i.e., spin associated with translational motion) should be even. Of course, an even number plus an odd number always gives another odd number. (The translational motion even number spin can be 0.) Consequently, an odd number spin is still the result when the wave front spin and the rest spin (i.e., spin of the particle when it is at rest) are added up for a fermion. Furthermore, photons never come to rest as photons. They always travel as wave fronts. Hence, photons can only have an even spin, which is a boson spin. Like particles of matter, there is a correspondence between the spin of a photon and its frequency, which for spin 2 is the following: one complete cycle of the frequency equals two complete rotations of the particle. Of course, for spin 0 there is no such correspondence because there is no spin. Looking at this equation between a photon's spin and frequency, we see that it is a linear equation. According to this linear equation, as the frequency speeds up, so will the spin, or as the frequency slows down, so will the spin. Furthermore, in my theory, photons necessarily have an axis of spin that is parallel to the direction of the photon's velocity. This means their spins are perpendicular to their velocities. These results are the case in the standard model, too [10]. If two photons are identical, they can interfere constructively. This constructive interference should cause an attractive force between them according to Rule 3 of Table 1.

In this section, I describe a one-directional wave with a single pulse, and I use it to describe the photon. This means these one-directional wave pulses are essentially bosons. They can have even spin, which includes zero spin. Yet previously, I define matter (fermions) as having one-directional wave pulses pointed in all directions. Hence, fermions are constructed out of bosons. Within the construct for fermions, the one-directional wave pulses have zero spin themselves. However, they interfere together in a manner that produces 1/2 spin. The series of events that led to this fermion structure would have to obey the conservation of angular momentum. Therefore, photons would be destroyed and fermions created such that the total angular momentum of all the photons destroyed would equal the total angular momentum of all the fermions created. Also, this parallels the relationship between the two different waves sources discussed in Figure 1. The wave sources that parallel photons are in the wave front that propagates in one direction. The central wave source in Figure 1 propagates in all directions and it parallels fermions. In Figure 1, the wave sources that parallel photons (bosons) can add up to make the central wave source, which parallels fermions. This relationship shows the fundamental similarities and differences between light and matter. It is probable that the constructs for light and matter are more complex than I present here in my work. I intentionally keep all structures to their simplest forms. Figure 1 is only an analogy of the relationship between light and matter. This means that there are differences between Figure 1 and the relationship between light and matter. The one-directional wave pulses are emitted by the central wave source in Figure 1. In Figure 8, the one-directional wave sources are not being emitted with speed c but are trapped within the central wave source, which is the three-dimensional transversal wave source. The forces, discussed in section 5, trap the waves pulses represented in Figure 8. To emit or release these wave pulses, matter needs to be destroyed and light emitted or released. To summarize, the wave pulses in Figure 8 are bosons. Individually, these wave pulses have a zero spin, which makes them bosons. As bosons, these individual wave pulses attract each other, creating a three-dimensional transversal wave source. Also, these individual wave pulses are trapped, making them standing waves.

3.10. Conclusion to Part 3

Instead of the Copenhagen interpretation, I used Huygens' principle to interpret the double-slit experiment for quantum theory and named it the wave source interpretation. Since Huygens' principle describes the behaviors of waves in small regions as wave sources, I concluded that the best way to understand elementary quanta is to understand wave sources. I then gave a definition of a wave source as being the central originating wave to other waves. I also developed Huygens' principle so that characteristics of a central wave source could be conserved in the wave front emitted from it. Furthermore, I discussed the concept of a compound wave source which starts to exist when two identical wave sources overlap. I briefly discussed how this relates to hadrons. I created a three-dimensional transversal wave source structure. Without relying on the standard model and only using this structure, I predicted a quantified odd number spin and the Pauli exclusion principle for these wave sources, both of which parallel fermions' behavior. Furthermore, I discussed the concept of a wave moving in the opposite direction to another wave and how this reverses amplitude interference between them. At the end, I discussed the spin of wave fronts and photons.

In quantum theory all particles are essentially treated as wave packets [1–5]. Here, on the other hand, I create a foundational new structure—the three-dimensional transversal wave source. This structure for the quantum gives us a greater ability to understand and predict fermion behavior than traditional quantum theory does. Hence, the result is a deeper quantum theory.

When I discussed compound wave sources, I brought up the nuclear strong force. (The nuclear strong force is the force that holds quarks together in a hadron.) The idea that compound wave sources correspond to compound particles is a clue to understanding the nuclear strong force and other forces. In section 5, I do discuss forces caused by constructive interference, and these forces are similar to the nuclear strong force and the nuclear weak force. However, I only discuss them briefly.

It is best to think of the spin in these particles as being intrinsic to their structures. It is not the medium that is spinning. A string could spin in such a manner that the wave on it would spin as well. Here I have presented a three-dimensional medium (the cosmos) that is not spinning. Therefore, the spin derives from the intrinsic structure of the particle. I did not put spin in my theory; rather it popped up on its own. A three-dimensional transversal wave source has to spin. Without a spin, the three-dimensional transversal wave source would not work. The spin allows for wave pulses to exist in all directions and mesh in a smooth continuous fashion. There are two aspects of the three-dimensional wave source. There are the wave pulses, which I define as one directional and which exist at ½ a wavelength. These are the most basic components to the holistic wave, which is the other aspect of the wave. The wave pulses themselves are not spinning, but they mesh together or interfere to create the holistic wave, which is spinning. It is how these wave pulses interfere with each other that causes the spin of the holistic or total wave, which is intrinsic to the three-dimensional transversal wave source. Also, all things would have to be considered in designing possible permissible wave constructs beyond what I have discussed so far. In other words, what goes into an interaction, or a colliding of particles, must come out. What comes out, however, may look different in some manner than what went into the mix.

Part 4: PROBABLE LOCATION OF A POINT WAVE SOURCE

4.1. Introduction to Part 4

The idea that the inner frame of elementary particles is that of a wave source is the main theme of this article, even though there are other concepts presented along with this proposal. In quantum theory, the wave's amplitude represents the probabilistic location of a particle. In this article, the quantum is best understood as a wave source. Therefore, I now represent the wave as the probabilistic location of a point-wave source.

4.2. The Probabilistic Location of a Point-Wave Source

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. I now propose that a quantum wave's amplitude does not represent the probable location of a particle, but instead, it represents the probable location of a point-wave source.

If a wave were restricted to a single point, this wave would be represented by a single point-wave source. This is not what really happens. Instead, waves are often restricted to small regions. One way this happens is when a quantum wave's location is detected. It is for a moment located in that small region where it was detected by an observer. (I assume that this region is small enough that the quantum wave acts like a wave source.) In other words, the wave does not collapse to give the location of a particle. Instead, it collapses everywhere else outside of the region where it was detected. The wave's amplitude is representative of the probability of finding a point-wave source. (To read about the cause of this probability, see my theory of distance-time [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 particle used for the measuring and at any point of the wave. The smaller the region where that wave is detected, the more that wave acts like a point-wave source. Moreover, this wave source acts like a particle in many ways. In this article, I have given wave sources energy and interference type forces. Nonetheless, it is still best understood as a wave source according to this article and not as a particle.

4.3. Conclusion to Part 4

It only makes sense that when detecting a wave's location, it is the location of a point-wave source that is being detected, and this point-wave source at each point of the amplitude is what makes up the wave. Of course, this wave source acts like a particle in many ways because I have given wave sources energy and interference type forces. To summarize, point-wave sources are the building blocks of waves. Furthermore, when a wave location is detected in a small region, its point-wave source's behavior becomes more apparent. Therefore, it is best to understand elementary particles as a point-wave source—not as simply a particle or a vibrating string. Finally, the probabilities for finding a point-wave source would still be calculated the same way as done in traditional quantum physics. The idea of a three-dimensional wave source only replaces the wave packet as the construct for elementary particles. For the most part, quantum theory remains the same.

Part 5: INTERFERENCE FORCES

5.1. Introduction to Part 5

In constructing elementary particles, I have created quantum rules for motion. These rules give conditions when forces should occur. The forces are related to the structure of these particles. Inside each particle exist wave pulses. These wave pulses inside quantum wave sources are not detectable. Therefore, according to Rule 1 in Table 1, these wave pulses may interfere with each other. As they interfere, forces will occur while creating any permissible particle, totally canceling the amplitudes of any permissible particle, or holding together any permissible particle. However, since these rules for motion are like laws of motion, they may not be true forces but are phenomena that result from quantum laws of motion. Here I refer to all forces that happen at only short distances as interference forces that result from maintaining, constructing, or destroying an allowable particle. The idea of wave interference may be a part of the electrical or gravitational forces, too; however, these forces do not result from putting together, taking apart, or maintaining an allowable structure for elementary particles. Therefore, they are not close-up forces.

5.2. Close-Up Forces and Their Strengths

First, I would like to discuss the three forces delineated in this article. There is the force that occurs when the two identical particles with odd spin interfere with each other. This was an important clue when I was formulating quantum wave source theory. Traditional physics does not treat this repelling of two identical particle as a force, yet they repel each other. Therefore, I considered this repelling of two identical particles a force. What is so strange about this force is that there are no force carriers for it. It was the interference of the two identical particles that caused the force. There is also a force that attracts identical boson when they interfere. Again, it was the interference that caused that force, as well. This was a clue to me, and led me to ask, Is it interference at the most elementary level that causes forces?

The strongest forces are concerned with preserving permissible wave source constructs because they cannot become nonpermissible constructs. The force associated with the Pauli exclusion principle causes identical fermions to repel, thereby avoiding total amplitude cancelation. The cause for this force is that all the amplitudes constructing the wave source structure are canceled. Because of Rule 3, from Table 1, this type of interference should cause a repulsion. Such a force should be the strongest because it results from the complete cancellation of the amplitudes of both particles involved in the interaction. The next force, the interference force that hold compound particles together, is concerned with the preservation of a permissible amplitude construct of compound particles. A nonpermissible construct is not allowed in nature. The nuclear strong force only concerns the preservation of a compound wave source—not the total cancellation of the wave sources involved. Therefore, the nuclear strong force would not be as strong as the force associated with the Pauli exclusion principle. Nonetheless, the nuclear strong is still a force associated with the prevention of the destruction of a permissible compound wave source because of Rule 3 in Table 1. Hence, the nuclear strong force is the second strongest force.

The interference force that comes from permissible amplitude structures changing to other permissible amplitude structures should be the weakest. This usually happens in the direction from higher-energy particles to lower-energy particles. (It is obvious from my construct that wave sources would possess different levels of energy.) This is determined by the internal structure's amplitude interference only. Since this force involves progression to particles with lower states of energy that are permissible wave source constructs, it would not be nearly as strong as the previous forces discussed. Thus, this is the weakest of all the interference forces.

5.3. Ranges for Forces

If my theory is right, the constructive interfering of two wave sources creating a compound wave source would be the cause of the force that held the compound wave source together. This should emerge at the distance when two particles are close enough that their interference begins to create a compound wave source. The two wave sources are not trying to create an entirely new particle; they are only barely overlapping. (See section 3.3.) Compound wave sources emerge at ½ a wavelength, which is their diameter. This gives a distance for the force for binding a compound wave source together, which corresponds to the nuclear strong force.

Since I am treating the Pauli exclusion principle as a force, in my opinion, it would be like other interference forces because it happens by means of an interference and at a close range. The question is, how close? Two wave sources would have to be close enough so that a new entire wave source would be formed by both particles, and then all amplitudes cancel. In the case of the Pauli exclusion, the entire particles interfere with each other—not just with a part of each particle. They should be closer than the diameter of a particle because each entire particle has to be close enough so that it can totally merge and create a third particle. I obviously cannot give an exact mathematical range. Nevertheless, the two wave sources would be closer than when the two particles barely begin to merge, as happens with the preceding force I discussed. Also, the Pauli exclusion principle happens everywhere there is an amplitude for a wave.

This final interference force should be the closest of them all. Imagine a particle that can break down into two particles. These two particles would essentially be right on top of each other because they are coming from the same group of waves. Of course, a particle would only break down into two smaller particles if there were less energy needed to bind the waves in each particle structure.

Although the forces discussed here are close-up forces, they are not infinitely close contact forces. As I have discussed, there are different distances where these interference forces take over or interact. Since there are different ranges for these forces, it should be concluded that an interference force is not a contact force of infinite closeness.

5.4. A Conclusion to Part 5

The waves in my cosmic quantum medium obey quantum rules for motion while interfering with each other. Hence, any interference between them is not a true force, if they are quantum laws of motion. By following my quantum rules for motion, I derived constructs for matter that ought to have forces similar to the nuclear forces found within the standard model. Also, these wave sources exist within a distance-time manifold where even interference between particles cannot happen any faster than at the speed of light in a vacuum [9].

The idea here is that all forces between particles that occur only at short distances happen by means of their interfering with each other or as a result of their constituent wave pulses interfering with each other. The wave pulses inside quantum wave sources are not detectable. Therefore, according to Rule 1 in Table 1, they may interfere with each other. Consequently, as they interfere, forces will occur while creating any permissible particle, destroying any permissible particle or holding together any permissible particle. If this is correct, all three forces discussed in this section would be essentially unified under the rules that govern the interference of these particles. Thus, all of the forces that are discussed in this article are different manifestations of that single force that comes from wave interference.

Part 6: DISCUSSION

6.1. Conclusion

Figure 1 does not represent any substance or actual medium. It is a two-dimensional hypothetical medium. Its only purpose is to represent to readers the characteristics of waves or, what are more important, wave sources. I put in Figure 1, two different wave sources, which are the central wave source and a wave source located on a wave front. There is no spin in such a figure. I use this figure so that people can relate to it, and from it, readers can understand the two kinds of wave sources that I am discussing. The hope is that readers will then leap beyond this traditional perspective of wave sources and grasp the three-dimensional transversal wave source. Of course, in Figure 1, its medium propagated transversal waves. I discussed certain characteristics of waves in this medium. The waves added up constructively, so they interfered in a smooth and continuous fashion. Moreover, all waves were made up of point-wave sources. These point-wave sources come in two types. There are point-wave sources moving in one direction and another type that moves in all directions. These point-wave sources tend to spread out in the two-dimensional medium to form waves. Furthermore, waves vibrate so that there are troughs and crests that are in opposite up-and-down positions. Essentially, I was examining waves in this two-dimensional hypothetical medium that propagated transversal waves. Combining the information gained from examining these waves with my understanding of elementary quantum behavior, I hypothesized rules that govern waves in a three-dimensional quantum medium. Since I have concluded that the quantum medium is not a physical or a tangible substance, it is necessary to use abstract rules to work with waves in this medium. (These rules are outlined in Table 1.) Considering these rules, I discussed the wave source interpretation of the double-slit experiment in quantum theory as a more correct explanation than the Copenhagen interpretation. I gave tests that could determine the differences between these two interpretations. Also, considering the rules in Table 1, I derived a three-dimensional transversal wave source that had properties that paralleled fermion properties. Indeed, they had an odd number spin; they obeyed the Pauli exclusion principle; and their spins increased with their energy (frequency). Furthermore, I derived that a photon necessarily should have a boson spin, and the axis of the spin is parallel to the direction of photon's velocity. I also predicted that identical photons should attract each other. I discussed how the interference forces ought to exist and explained their similarities to the nuclear strong and weak forces. These results tell me that the foundational construct for elementary particles is a three-dimensional transversal wave source. Lastly, I discussed how the quantum wave represents the probabilistic location of a point-wave source, which agrees with quantum theory.

The three-dimensional transversal wave source is not a complete structure for fermions. Obviously, there is no charge structure in the construct that I presented in this article. Since this structure for elementary particles is not complete, it makes it difficult to make too many predictions, such as predicting the generations of matter. Nonetheless, there are the predictions that I brought up in the previous paragraph. What separates these predictions from those made in the standard model is that, in the standard model, the predictions are essentially given empirically. On the other hand, predictions in this article are derived—not through experiments—but from principles giving quantum rules for motion, as laid out in Table 1.

The rules governing my hypothetical medium seem to be analogous to Newton's laws of motion. Following this line of reasoning, the behaviors of particles that result from Table 1 are essentially the result of following quantum laws of motion. This means that with complete structures for particles, a complete understanding of interference forces could be derived from these laws of motion. Moreover, their relationship to the nuclear strong and weak forces would be clearer.

What stands out in this novel approach to understanding the quantum is that it tends to demystify certain concepts of quantum theory. For instance, the Copenhagen interpretation of quantum theory has always left me questioning how exactly a particle turns back into a wave and how long it takes. The wave source interpretation clearly answers that question because the wave always exists. A quantum never stops being a wave. It only collapses to a new wave source when its location is detected. Another matter I found puzzling was that there was more than one description of the inner structure of the fermion [1, 2, 4]. When an elementary quantum theory book treats the electron like a wave packet, that book is essentially telling me that the inner structure of the electron is a type of wave packet [1–5]. On other occasions, such books treat the fermion as if it were a single wave pulse in one dimension or three wave pulses in three dimensions. Moreover, these three pulses act supposedly independently of each other [1, 2, 4]. In contrast, the three-dimensional transversal wave source gives a far more cohesive and predictive description of the inner structure of a fermion than that found in contemporary physics books. The wave packet is essentially the inner structure for fermions that is found in physics books. However, this inner construct does not predict spin, or the Pauli exclusion principle. Furthermore, the wave packet does not change in spin with an increase of frequency or energy [1, 2, 4]. This structure is in many ways not as accurate as the constructs for elementary particles found in this article.

Since I have replaced the Copenhagen interpretation and the very inner construct of particles with deeper ideas, I have presented in this article a new foundational, elementary, but deeper quantum theory. Nonetheless, I did not replace Schrodinger's equation found in most elementary quantum theory books [1, 2, 4]. In other words, only the most elementary precepts have been replaced. Most of basic quantum theory remains the same. Can my three-dimensional transversal wave source construct predict all particles with mass or a rest momentum? What about mesons, which have a boson spin, unlike the fermions I predict in this article? As stated previously, my structure has not been completed and is therefore limited. Nevertheless, if my quantum wave source structure is a foundational structure to all elementary particles, it should come as no surprise that my theory suggests that some particles would be more stable than others. A fermion structure should be more stable than a boson structure for a particle of matter.

How should I best depict the universe presented in this article? I use another three-dimensional medium found in classical physics to help me with this question. Sound is propagated in the three-dimensional medium of air. A main difference is that sound is a longitudinal wave—not a transversal one. In air, there are three-dimensional longitudinal wave sources and wave fronts that are emitted from this central wave source. The three-dimensional longitudinal wave sources can move (ex., a horn on a passing car) or be at rest (ex., a horn on a stopped car). However, the wave fronts (one-directional waves) that are emitted from the horn on the car propagate and are never at rest in a medium. What I propose is that the quantum cosmic medium is similar. There are three-dimensional transversal wave sources that are matter. Matter can move or be at rest in the cosmic medium analogous to the horn on the car in the medium of air. Furthermore, one-directional wave sources make up wave fronts that are light and never at rest in the medium, which is similar to wave fronts in air. Since matter can be at rest, it has a rest momentum, or mass. Since light can never be at rest in the medium, it will never have a rest momentum, or mass. (See my theory of distance-time [9].) Taking this analogy further, in traditional mediums, I could construct the central wave source out of the wave front it emitted. (See Figure 1 in this article.) In the cosmic quantum medium, when matter is destroyed, light is emitted. In other words, very similar to traditional mediums, a central wave source (matter) emits wave fronts (light) in quantum wave source theory. Furthermore, the reverse is true: matter (a central wave source) can also be constructed out of light (a wave front). The universe presented in this article is that of a nonphysical medium that behaves similarly to traditional physical mediums in classical physics. One important difference is that matter is essentially a three-dimensional wave source which has trapped its waves of energy in a small region. (See Rule 3 in Table 1 for the reason that energy becomes trapped.) Matter has to be destroyed before light is emitted. In traditional quantum literature, this picture has not been presented, as matter and light have not been represented as any type of point-wave sources. I have entitled this article the "Theory of Quantum Wave Sources" because both light and matter are presented as point-wave sources.

Often scientists learn all that a particular field of science has to offer, and then they rush to the cutting edge to make their discoveries and add to the various fields of science. There are strong reasons for following that exact approach. After all, there have been many great minds that have preceded them. Hence, such scientists go to the frontiers where no one has been to venture out into undiscovered landscapes. However, the ivory tower of physics can only climb so high based on old foundations. For this tower to achieve new and greater heights, it must have deeper and broader foundations to hold a new and larger tower. Therefore, someone has to build such a foundation, which can only be done by challenging physics at its most simple and fundamental level. This is not easy, since many minds for decades have perused the simple, fundamental topics. To see principles that many before have never seen is quite challenging. Indeed, to challenge the simplest and most elementary ideas of physics and replace them with even deeper ideas that unify previous concepts with a simple idea is very time-consuming, exciting, and mentally challenging. However, if such a challenge were achieved, the ivory tower of physics could climb higher on this new foundation. Another part is that leaping off of the most fundamental physics theories successfully into the unknown would produce results less speculative than some may think. After all, when someone leaps off of the cutting edge of physics, the foundation from where he leaps is usually not well established, and the unknown territory into where he is leaping is even less certain, whereas when someone leaps off of the inner core of physics, he is leaping off of a foundation that has been tested from many different angles by some of the best minds over the years. These scientific minds have concluded that the foundational theories agree accurately with experiment. The key, however, is to successfully leap off of such an inner core theory of physics. With this approach, there is a problem of trying to predict something new because usually the fundamentals are well tested. The theory I discuss in this article has no inner contradictions and predicts several concepts of elementary quantum theory and properties of elementary particles better than traditional theories can. Indeed, in traditional theories, there was no explanation for some of these properties of particles; instead, these theories were only empirically given. In this article, the most elementary concepts are unified in my quantum wave source theory. The exclusion principle and the quantified spin of particles are different concepts, with no theoretical reason connecting them in the standard model. In my theory, they are both derived from my construct for fermions. The same can be said for any other characteristics that I have derived from my quantum wave sources. This is another reason my work is a successful leap off of the most basic principles of quantum theory. I must note that all predictions were made independent of the standard model. (I used the standard model only as a reference.)

To get to a more accurate and complete theory about the construct of elementary particles, I would have to create a more advanced distance-time theory. In other words, I need a better space and time model. Also, the characteristic of a charge is not even in any quantum wave source model as of yet. To be able to put a charge in there, I need to create an electromagnetic field that is associate with a particle. After all, the main purpose of a charge is that it causes the electromagnetic field. At the minimum, I would have to do the things previously brought up before I were to predict more advanced behavior of particles like the annihilation of a particle and its antiparticle when they collide. I have thought about these things before, and I have possible ways to achieve these things but no complete theory.

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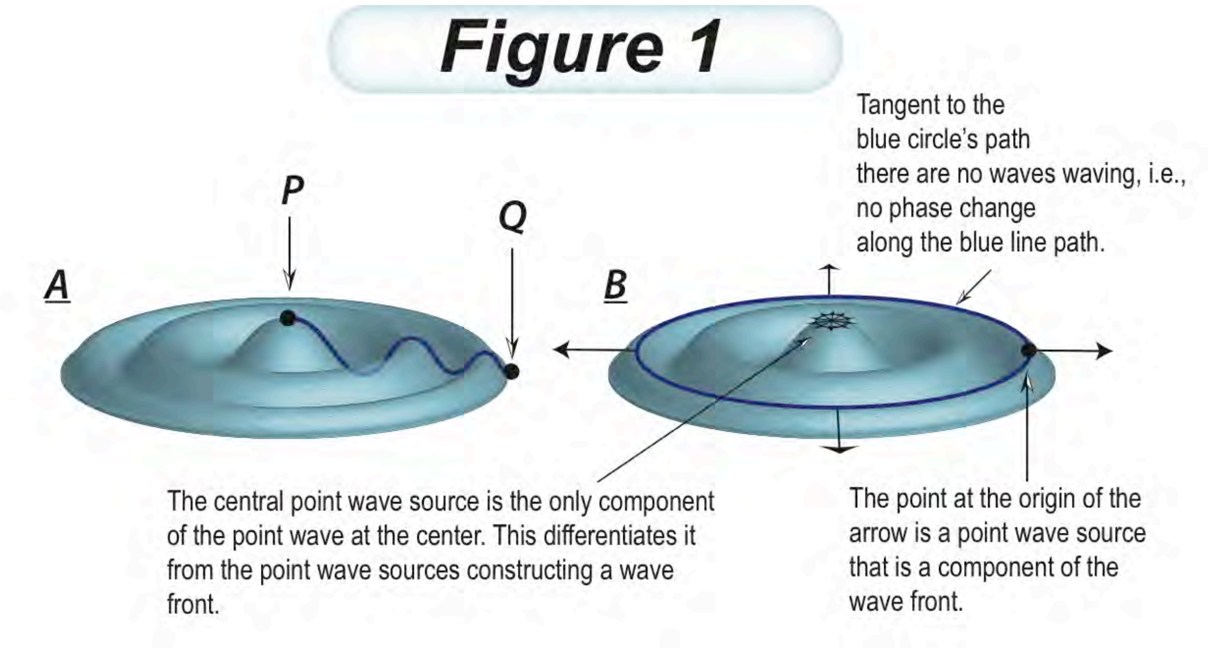

Figure 1. I create two images labeled A and B. In image A at point P, there is a point-wave source in a two-dimensional medium that has emitted wave fronts. These wave fronts are ring shapes expanding outward from the center. According to Huygens, these wave fronts are constructed out of an infinite number of point-wave sources [6]. The line drawn from points P to Q follows the contour of the waves and is smooth and continuous. Any line that follows the contour of the waves will be smooth and continuous because the waves in all directions mesh this way. In image B, I represent some of these wave sources with arrows. Notice that there is only one arrow associated with each distinct point-wave source on the outer wave front. This is not the case for the wave source at the center, which has arrows in all directions pointing away from it. This represents an important difference between the central wave source and wave sources on a wave front. Wave sources on the wave front only emit a wave in one direction, whereas a central point-wave source emits waves in all directions.

Freezing the wave motion, I could walk along the blue circle in image B and never experience any phase change. Hence, there are no waves waving in the direction tangent to the blue circle. Therefore, point-wave sources on the blue circle are only point sources for waves in one direction. However, at the central point-wave source, waves are waving outwardly in all directions. This is a fundamental difference between the two types of wave sources. Nonetheless, I could coalesce all of the point-wave sources on the blue circle, and these would sum up to equal the central point-wave source. Because of the aforementioned differences, I illustrate that the point-wave sources that are components of a wave front are bosons and that the central point-wave source is a fermion in the cosmic quantum medium.

Figure 2

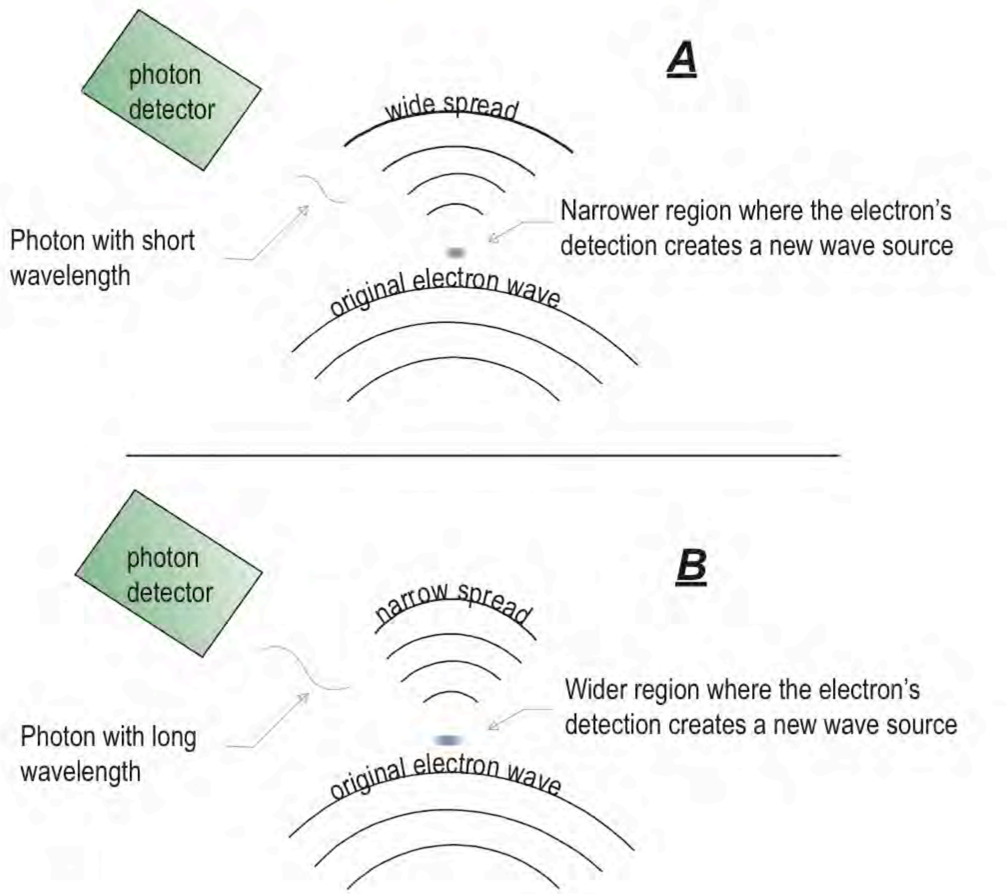

Figure 2. There are two images: A and B. Both images show that when a photon detects an electron's location, it collapses to a new wave source. If this is true, the wavelength of the photon should determine the width of the region for the new source for the electron wave. A photon with a wider wavelength should result in a wider region where the new wave source begins. Also, the electron wave emitted from this would have a narrower wave spread, as exhibited in image B. A photon with a narrower wavelength should result in a narrower new wave source. Moreover, the electron wave emitted from this would have a wider wave spread, as exhibited in image A. This would not happen if the electron collapsed to only a particle. A particle passing through a narrower region would not come out of that region with a greater spread. Instead, it should come out with a narrow spread, which would be similar to the narrowness of the region where the particle is detected. Summarizing, if a wave collapses to a particle when detected, a beam will be produced that is narrow like the region where it was detected. On the other hand, if the wave collapses to new wave source, the narrower the region where it is detected results in a beam spread out more.

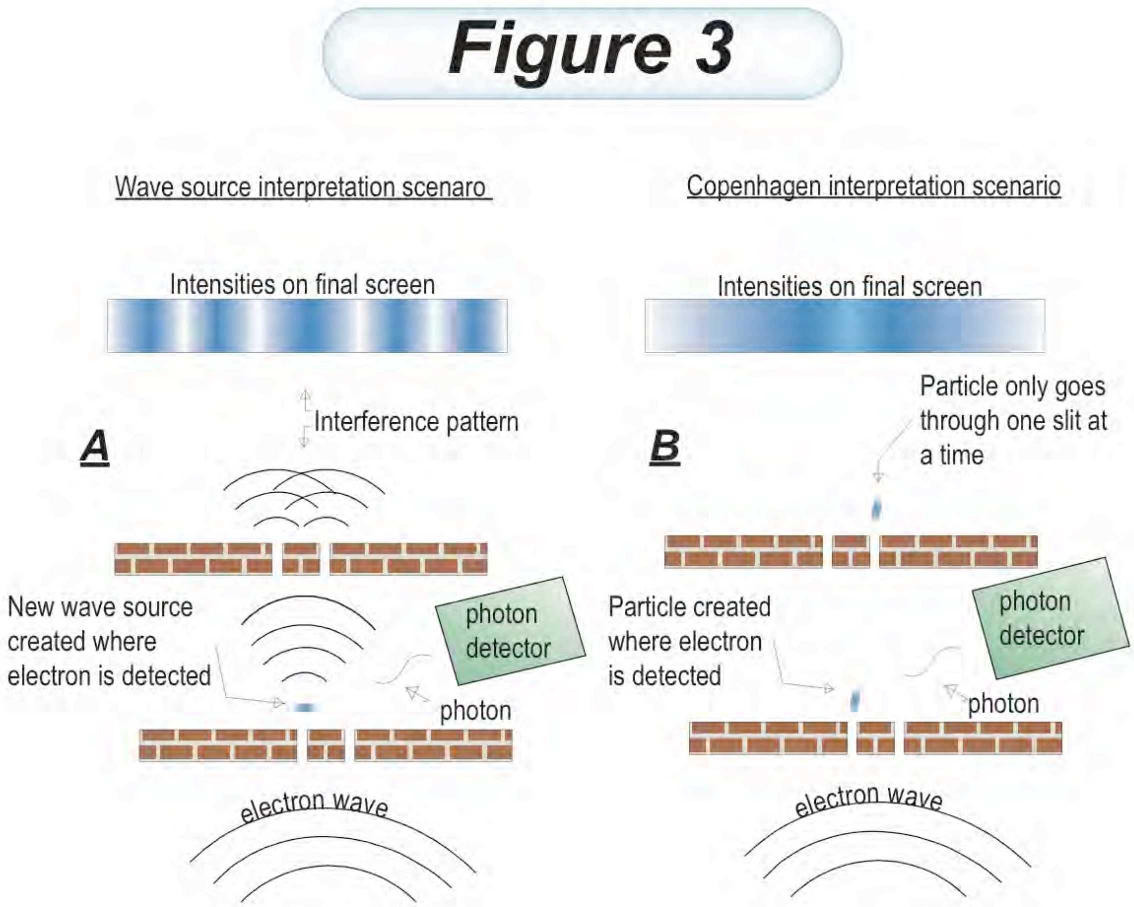

Figure 3. I propose an experiment to determine whether an electron (once it is detected) turns into a particle only or into a new wave source. In images A and B, an electron wave passes through a double slit and is detected with a photon. Also, the electron wave is detected close enough to the first barrier that it causes the wave to collapse so that it could only have passed through one slit—not both. In image A, the detected electron becomes a new wave source, and it is able to pass through both slits in the second barrier. Hence, on the other side of this second barrier, an interference pattern is created, as shown in image A. On the other hand, in image B, no new wave source is created. Instead, the electron collapses to a particle only. And, this particle can only pass through one hole located in the second barrier. As a result, no interference pattern exists behind the second barrier. Image A is the only possibility for the wave source interpretation of quantum mechanics, whereas image B is a real possible outcome for the Copenhagen interpretation of quantum mechanics, unless the particle becomes a wave again fast enough to be able to pass through both slits. However, this is unlikely the case if the wave collapses to only a particle. Although there is no interference pattern in Figure 3B, different particles still pass through either slit, creating two areas of high density on the final screen. Figure 3A has an interference pattern on its final screen. The dark areas on the final screen are where the electron hits the screen.

Figure 4

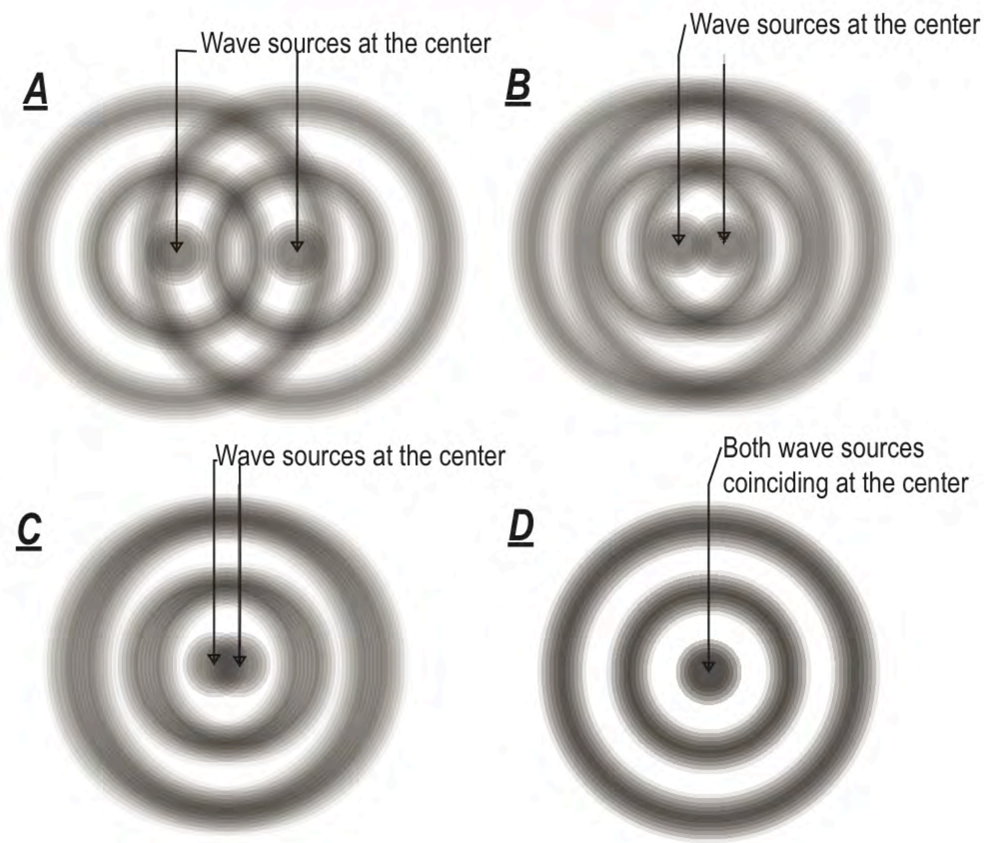

Figure 4. There are four images. These graphics show two wave sources interfering in two dimensions. In image A, only a wave interference pattern is created. In image B, the two central wave sources begin to overlap. When this overlap happens, a compound wave source begins to appear, as in image B. The closer these central wave sources coincide, the more obvious a compound wave source appears. See images C and D. This means a compound wave source emerges as these central wave sources, with a diameter of a ½ wavelength, start to overlap. This parallels the emergence of compound particles. The force that pulls compound particles together (the nuclear strong force) emerges as the particles, with ½ wavelength diameters, begin to intersect [7, 8].

Figure 5

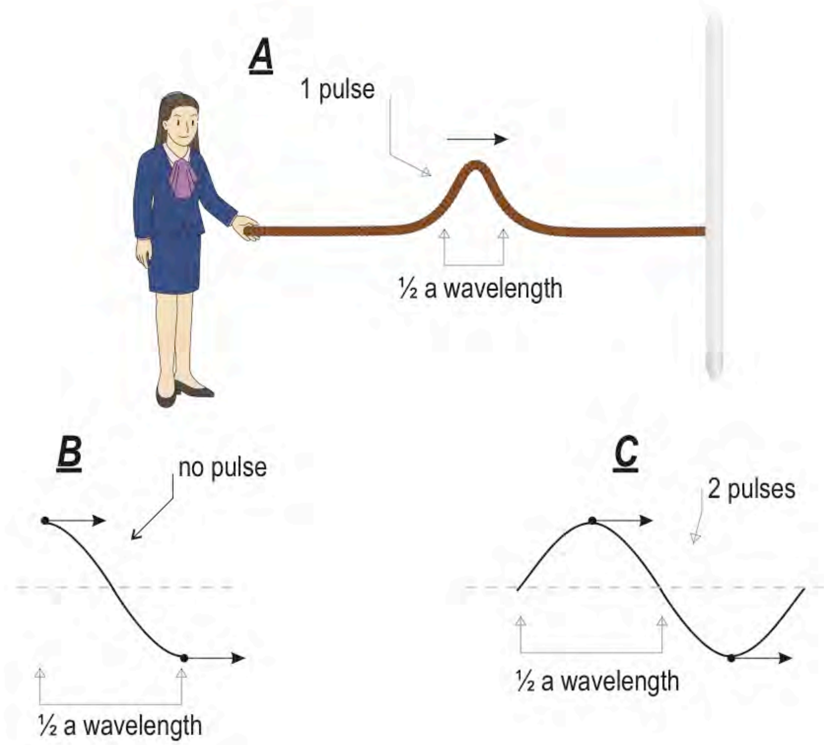

Figure 5. In nature, a free medium (one that is free of obstructions) never has a wave in it that is any simpler than a single pulse. A pulse is a wave that is one-directional and one-dimensional with a ½ wavelength. Also, a pulse always has a crest or trough straddled by two locations with zero amplitudes. In image A, my assistant whips the end of the rope and creates a pulse moving down this rope. She could not create a wave that is any simpler. Image B is not a pulse, even though it has a ½ wavelength, because it does not have a crest or trough straddled by end points with zero amplitudes. Image C represents two pulses. It is my hypothesis that all waves in a free medium can be constructed by pulses within that medium.

Figure 6

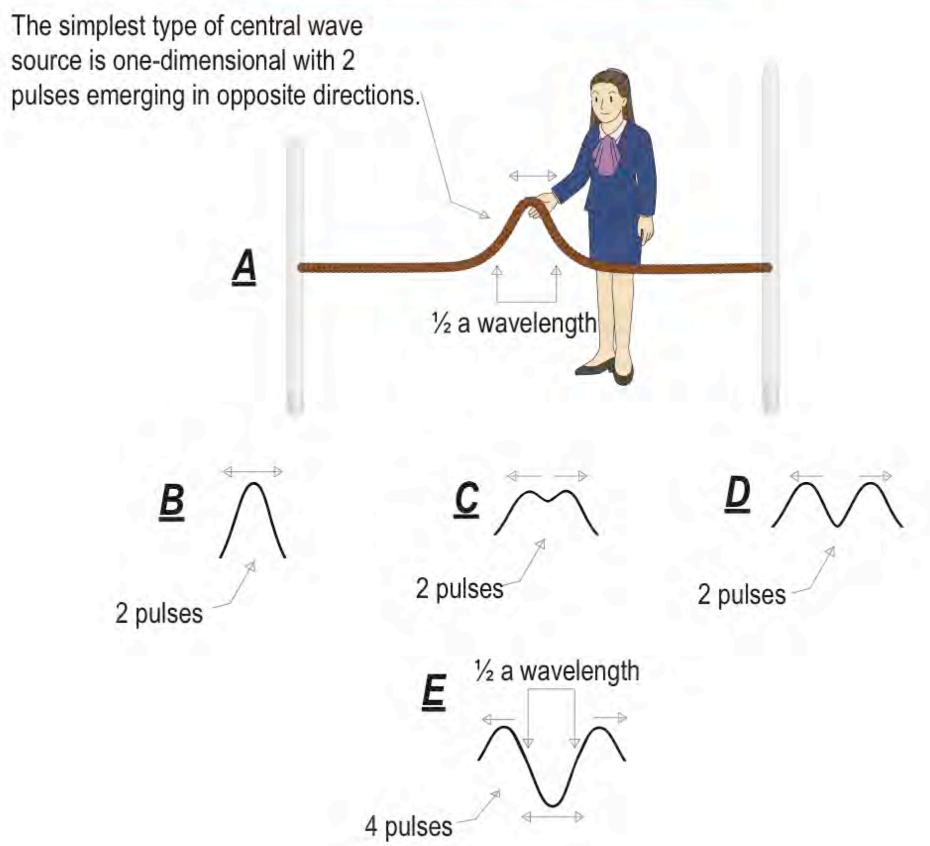

Figure 6. In image A, a rope is tied between two poles. My assistant oscillates the rope at the center, creating a wave source. Notice that in image A the wave source is not a point-wave source. I drew it with a minimum diameter of ½ a wavelength because a rope tied between two poles in nature could not propagate a wave with any smaller width. This wave source in the middle is emitting pulses in both directions in a one-dimensional medium.

Images B through E represent various stages of waves emerging from the central wave source in image A. Notice that in image B there are two pulses coinciding and moving in opposite directions. In image C, these pulses are now partially coinciding. Finally, in D, they are totally separated. At a later stage, in E, the two outer pulses are separated by ½ a wavelength. And the central wave source is made up of two pulses emerging in opposite directions. This new wave at the center has an upside-down amplitude. It is my contention that all waves in a medium are constructed of pulses, but pulses are one-directional and one-dimensional wave sources.

The wave source in the center of image E is different from this image's outer wave sources. The center wave source is emitting pulses in all directions in a one-dimensional medium. The outer wave sources are emitting pulses in one direction in this same medium. Hence, they have different constructs. Nonetheless, both are constructed out of pulses.

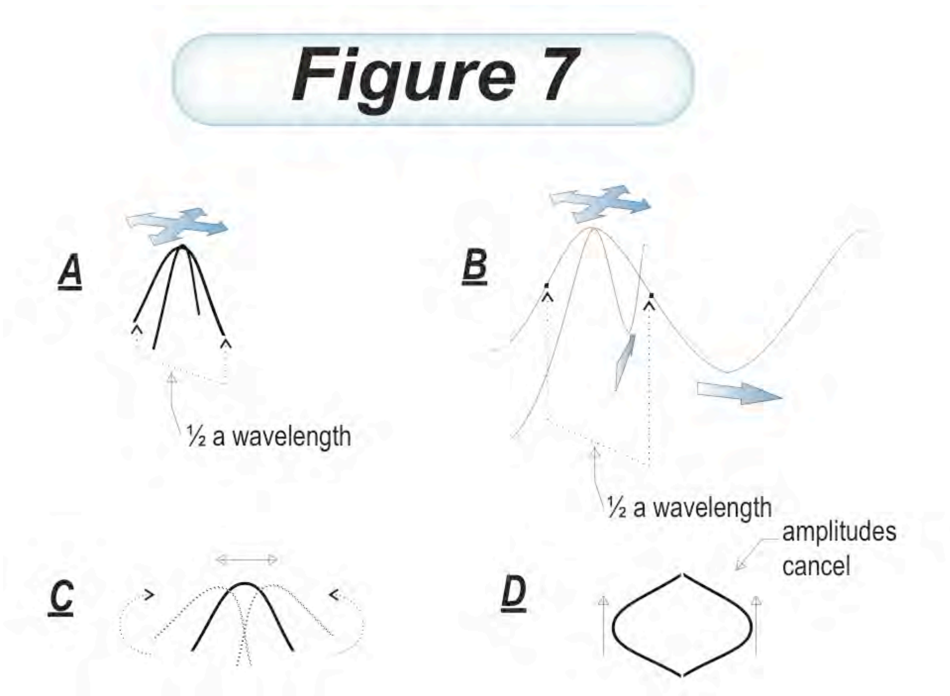

Figure 7. Image A represents a central wave source within a two-dimensional medium. The waves within this medium are transversal. The central wave source has a diameter of ½ a wavelength and is emitting waves in all directions out of this central source with the same wavelength. The minimum width that any wave, existing naturally, could have coming from this wave source would be ½ of that same wavelength. All the waves emerging from the center are not shown in image A. If they were to be shown, the two-dimensional wave source would look as it does in Figure 1. Imagine that in the two-dimensional wave source of image A, waves smoothly and continuously fill the gap between these two waves shown in image A, as in Figure 1. I can create all of these waves that fill the gap by rotating one of those waves into the other. Each infinitesimal rotation would represent another wave being emitted from the central wave source.

Image B represents a wave source in a two-dimensional medium, also emitting waves in all directions in this medium. I did extend two waves represented there into two more waves with a reverse amplitude. Notice that these waves are still wave sources but are only emitting waves in one direction as opposed to the central wave source, which is emitting waves in all directions away from it. All the wave sources represented are essentially waves with a minimum of ½ a wavelength.

Transversal waves in traditional mediums can only exist two-dimensionally. In image C, I show a single slice of a central two-dimensional central wave source. Of course, there are two waves there that are moving outward in opposite directions. This is represented by the double-sided arrow. To represent a three-dimensional central wave source, I need to show waves moving away from the central wave source in a direction that is perpendicular to this double-sided arrow in image C. I do this by rotating 90 degrees the two waves that will be emitted from the central wave source. I created these waves by rotation so that I could maintain smoothness and continuity, as I explained earlier for image A. In image D, I show that the rotated waves are now moving upward. However, their amplitudes are the reverse of each other and they cancel. A wave source cannot be three-dimensional unless it truly is a source for waves emerging from it in all directions three-dimensionally. Because along one axis the waves I have shown cancel, there are no three-dimensional transversal wave sources in classical mediums.

Figure 8

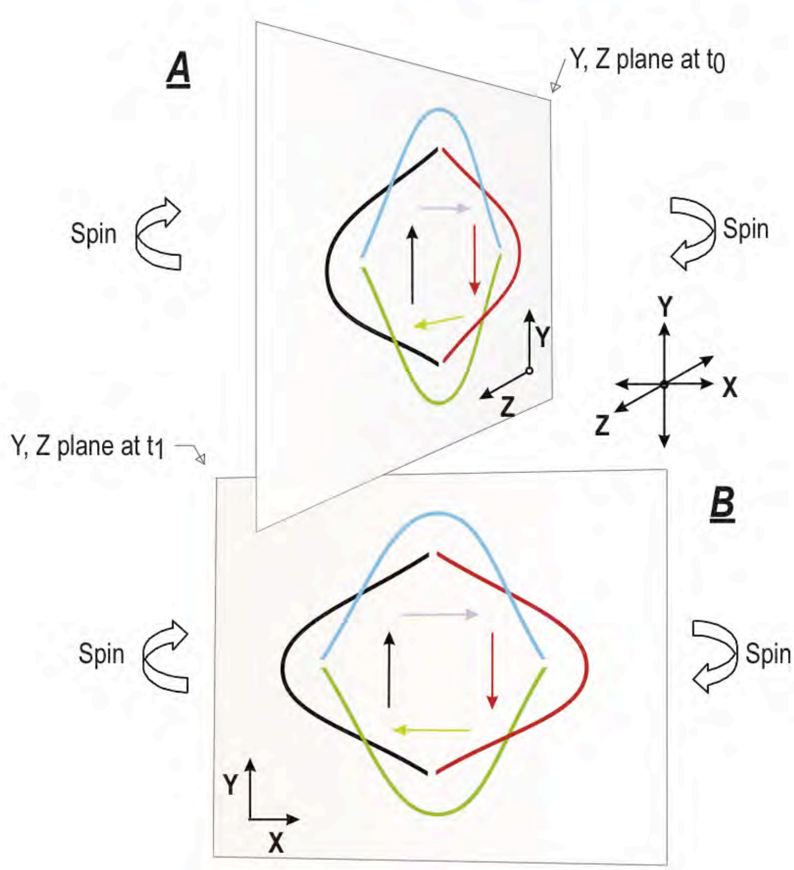

Figure 8. In my hypothetical medium, the amplitudes of waves add up in a reverse manner if they move in the opposite directions relative to each other. (See Rule 2 in Table 1.) When they are moving in the same direction, they add up normally. A central wave source has waves moving outwardly in all directions. Hence, a central wave source has pulses that move in opposite directions from each other. These pulses must have reverse amplitudes so they can add constructively. I color-coded these pulses along with the arrows pointing in the direction that each is moving. The black pulse and the red pulse are moving in opposite directions and their amplitudes are reversed. The same is true for the blue pulse and the green pulse. Therefore, the amplitudes of the pulses add up constructively. Notice that I can take the red pulse in image A or B and rotate it, and it will eventually coincide with the green, black, and blue pulses in turn. This means that the pulses are components of a completely smooth and continuous wave.

Image A lies on the Z, Y plane, and image B lies on the X, Y plane. I set the wave in image B to be 90 degrees out of phase with the wave in A. Hence, the waves in A are flat (zero amplitude) when the waves in B are at maximum amplitude and vice versa. I further state that there is an indefinite number of waves like the waves in A and B, and they are waving in between the waves in A and B. Also, the phases of the waves on these planes happen in a manner so that the closer the wave is to A's wave, the more it is in phase with it. The same is true for the waves as they get closer to the wave in B. As a result, a spin is created as these wave pulses all wave or cycle through their phases. This approach allows the three-dimensional transversal wave source to exist without canceling amplitudes in any direction.

Figure 9

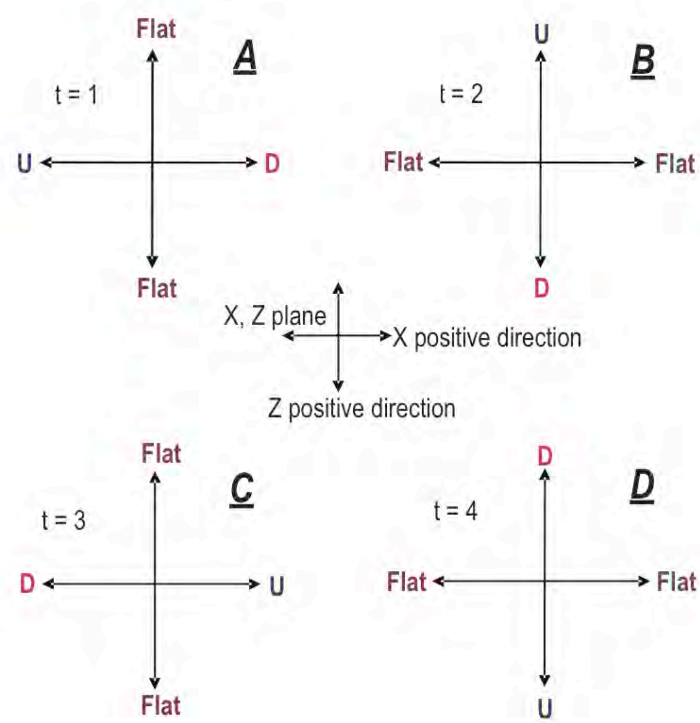

Figure 9. I create images A through D by looking down in the negative Y axis direction of a three-dimensional transversal wave source like the one in Figure 8. Hence, I am looking down on the X, Z plane. In image A, the wave is at time, t = 1. In this image, U (up) means that there is a wave crest at the center with a direction to the left, and D (down) means there is a wave trough with a direction to the right. Parallel to the Z axis the wave amplitudes are zero. I now stand at the center of image A facing the negative X axis direction and spin in a circle. I first see a pulse with up amplitude. As I continue to spin, this view would smoothly and continuously change to zero amplitude, then to down, and then back to zero amplitude. Finally, I would see the up amplitude where I started. While I spun in this complete circle, I would witness one complete wavelength. Therefore, the wave source presented in this figure has a one wavelength spin, or spin 1.

This wave source cycles through its phases. Image B is occurring at time, t = 2. At this time, the wave source has spun so that in the negative Z axis direction, the amplitude is up, and in the positive Z axis direction, it is down. Along both directions parallel to the X axis, there is zero amplitude. The wave continues to rotate through images C and D. Finally, it arrives back to image A.

Figure 10

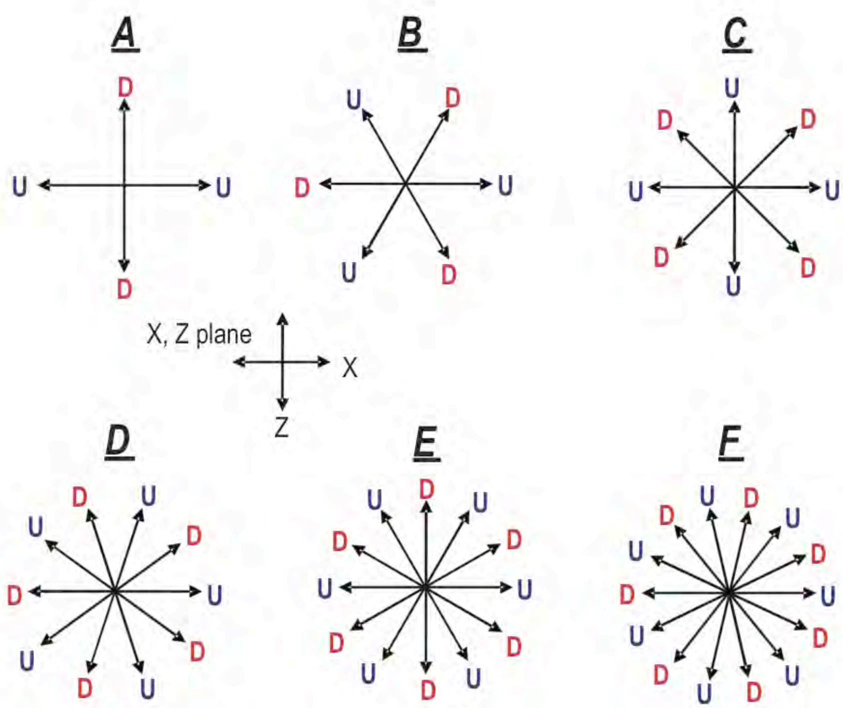

Figure 10. The images in Figure 8 have a spin speed of one wavelength. In this figure, images A, B, C, D, E, and F have a spin speed of wavelengths 2, 3, 4, 5, 6, and 7, respectively. Here, I invoke my rule for amplitude addition. Pulses moving in a reverse direction have an amplitude that is reversed compared to pulses whose direction is not reversed. Therefore, pulses moving in opposite directions with the same amplitude cancel each other. The amplitudes with the even number wavelengths or spins cancel in all directions three-dimensionally because of my rule for amplitude addition. Images A, C, and E have spins of 2, 4, and 6, respectively, and they cancel entirely. It is the odd number spin speeds of B, D, and F, with spins 3, 5, and 7, that have stable structures for a wave source. Actually, all odd number (including 1) spins are stable. If a wave source like that in image B interfered with itself, it would create a wave source like that in image E. However, image E is an even number spin 6, and it cancels itself. Indeed, all stable odd number wave sources that interfere with an identical wave source would create an even number wave source that cancels itself. These characteristics parallel the behavior of elementary particles. Such particles exist at odd number spins of ½ spin, 3/2 spin, 5/2 spin, etc. Plus, if the particles interfere with themselves, they cancel according to the Pauli exclusion principle.

Figure 11

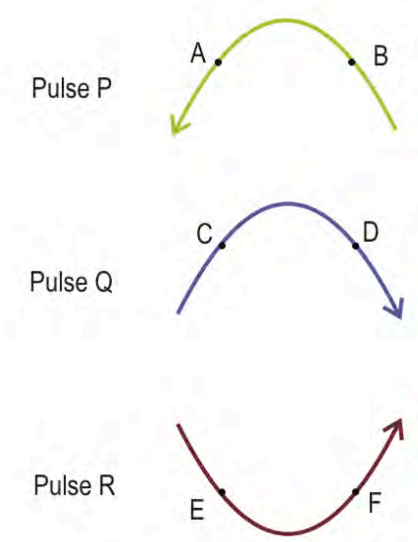

Figure 11. I line up three pulses so that they coincide. However, in this figure, I separate them for easier discussion. Points A, C, and E coincide, and points B, D, and F coincide. In traditional waves, reverse direction does not reverse the amplitude. Here I equate the amplitude to a pulse's phase change ($\Delta\theta$). At point A the pulse's amplitude is going down, and at point B it is going up. Hence, going along pulse P from point B to A, the amplitude changes from going from up ($\uparrow$) to down ($\downarrow$), which gives $\Delta\theta\uparrow\downarrow$. This $\Delta\theta\uparrow\downarrow$ represents the amplitude and it means that as the phase changes, the amplitude goes up, then down a crest. The symbol $\Delta\theta\downarrow\uparrow$ means a trough. Going along pulse P from point B to point A gives the symbol $\Delta\theta\uparrow\downarrow$, which is a crest. Going along pulse *P* from point A to B gives $-(\Delta\theta\uparrow\downarrow) = \Delta\theta\downarrow\uparrow$, which is a trough. In other words, at point *A* the wave is going down, and at point *B* the wave is going up. And going from *A* to B, the amplitude goes down, then up, which is a trough. Therefore, pulse P is a crest going to left, but going to the right, it is a trough.

Now I examine how the other pulses interfere with pulse P. Pulse Q is represented in Figure 11 as moving in the opposite direction with the same amplitude as pulse P. While pulse P is moving to the left, it interferes with pulse Q, which is moving to the right. Hence, relative to P, Q's amplitude is $-(\Delta\theta\uparrow\downarrow) = \Delta\theta\downarrow\uparrow$, which is a trough. These two amplitudes cancel. Nonetheless, P constructively interferes with *R*. Once again, while pulse P is moving to the left, it interferes with pulse R. And relative to P, R's amplitude is $-(\Delta\theta\downarrow\uparrow) = \Delta\theta\uparrow\downarrow$, which is a crest. Hence, pulse P and R add up constructively.

Figure 12

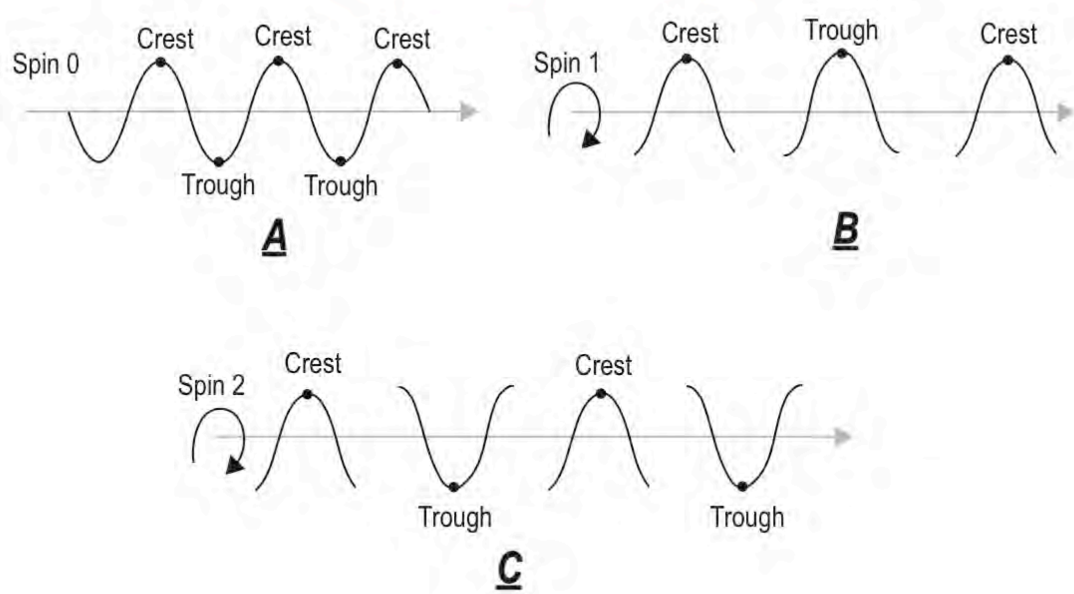

Figure 12. There are three images above and each represents a wave with different spins around an axis represented by its respective gray arrows. Image A has spin 0, image B has spin 1, and image C has spin 2. The gray arrow in all three images represents the center or axis of rotations for the waves and gives the direction of the waves' propagation. In Table 1, I give the rules for wave behavior in my three-dimensional quantum medium. Rule 4 in this table is the following: Waves vibrate so that there are opposite points of amplitude at ½ a wavelength apart. These two opposing points of a wave happen at opposing sides of the center of the wave within any space. Image A satisfies this rule because the crest and troughs are on the opposite sides of the wave center given by the gray arrow. Of course, image A wave has spin 0 so that the wave is not spinning around the gray arrow. Hence, the wave vibrates so that the crest and trough will always be on opposite side of the arrow. Image B has a wave with spin 1. This means that for one full wavelength of the wave, the wave will spin once around. Therefore, at ½ a wavelength, the wave will spin halfway around and the trough will be on the same side of the gray arrow as the crest. This contradicts Rule 4. Consequently, this spin for the wave in image B cannot exist. Nonetheless, image C has a spin 2. This means the wave will spin twice around the gray arrow per one wavelength. At ½ a wavelength, the trough will be below the gray arrow because at this time the wave should have one complete spin around the gray arrow. This result agrees with Rule 4. In image C, at one full wavelength, the crest will occur above the gray line. All these images show that a one-directional wave in my quantum medium can have an even number spin but not an number odd spin because even spins result in a permissible vibration according to Rule 4. Hence, one-directional waves have a boson spin. Consequently, wave fronts made out of one-directional point-wave sources should be bosons. Since the photon only propagates in one-direction and moves in a wave front, it should be a boson.