Space, Relativity, and Quantization

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Preface

A new perspective, a new interpretation of what we observe, is indicated as a necessary step in order to attain a better understanding of the physical universe. Our current set of theories are clearly not a full and accurate description of the physical universe, and we still do not have a unified single theory which describes what we observe. So it is apparent that some things have been misinterpreted, or some things have been missed altogether, or both, in our quest for a complete physical theory.

In light of this situation, and in the absence of causal explanation to support portions of existing theories, we will propose a model of space and its reaction to fundamental energy. This interpretation of the observable has a unique ability to show cause for much, if not all, of what we observe. An added benefit is that this interpretation provides a single unified theory describing quantization, relativity, and the forces of nature, including gravity.

What follows is a model of the properties of space and its reaction to energy, describing the quantization of energy, the quantization of charge, the quantization of light, and the quantization of mass, as well as providing causal definition for relativity, and a description of gravity.

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Abstract

The things we see, sense, and observe, in nature and in experiment, each have a cause. Herein we explore causes. Exploring the nature of electromagnetism, cause for quantization of energy, and the quantization of mass carrying particles. We show how mass carrying elementary fermions are made of energy. We show cause for the quantization of electric charge, and we also show cause for the quantization of photons. We examine the specific cause and nature of electric and magnetic fields, and we show why an accelerated electron has a larger magnetic field. We directly link all forces of nature to the reaction of space to the energy within particles. A review of our popular theoretical basis is discussed, and a concept is presented regarding the nature of space, and as mentioned, the reaction of space to fundamental energy. This concept provides us with an environment which simply and causally exhibits the properties we observe in the natural universe. This interpretation of the observable evidence has the unique capability to unify relativity and quantum mechanics, and to unify all the forces of nature. The result is a single self-consistent theoretical description of, and unification of, the known constants of nature and the forces of nature.

The goal is of course a simple, elegant, coherent, unified theory, which describes our universe.

Introduction

Our scientific history of discovery, over the las 300 years, has yielded a significant number of pieces to the puzzle of the nature of space, matter, energy, charge, magnetism, and gravity. Yet we have not been able to assemble those pieces into a simple, self-consistent, and coherent, single theory, which accurately describes what we observe.

Given the complexity of the problems, and viewed from our current theoretical perspective, this is not a surprising situation. However, our history has also provided us with lessons which can lead us to a means of greater understanding of the details of our universe. We, (scientists, physicists, humans) have the scientific history of trying to model the universe *so that it fits our theories*. In other words, we use theory to guide our research, and we allow theory to dictate our *interpretation* of experimental data. This is of course a seemingly reasonable approach, and only becomes a problem, which inhibits our progress, *when we inadvertently allow theory to obtain the status of physical law in our thought processes*. When that happens, we stop questioning our theory, and we try to force the universe to fit what we believe. Historically, when we find ourselves in a situation where theory does not match observation, we first and most often try to find ways to explain away the differences between theory and observation by creating more and more complex “solutions”, thereby forcing observation to fit theory. But our history has also shown us that such an approach usually does not lead to real progress. The eighteen century lapse between theories proposed by Aristarchus of Samos and similar conclusions by Nicolaus Copernicus is an example of a sound theory which was rejected and neglected for substantial time, thereby hindering our understanding of the physical universe. The complexity of the epicycle theories in comparison to the heliocentric system proposed by Copernicus illustrates how we continually add more complexity to try to make observation match theory. This is still the way we

handle such issues in general. We certainly are influenced by our existing beliefs as we try to decipher the puzzles of the universe. Such is the human condition.

In our day-to-day lives, we experience three dimensional Euclidian space. That is the nature of the universe as we sense it. However our scientific inquiry and our current theoretic framework is not based on this Euclidian space we have come to know. A four dimensional space, space-time, has replaced three dimensional Euclidian space in our most prevalent theories. And some of our theories use even more complex multi-dimensional spaces. The theory of Special Relativity has been the largest contributor to this change in dimensional view of space. For Special Relativity suggests, according to the most prevalent interpretation, that nothing can move faster than the speed of light, that all motion is relative, and that the very nature of space itself is therefore four-dimensional space-time.

Relativity theory emerged due to our desire to explain experimental observations, to show cause. Special Relativity is only one of perhaps several relativity theories which have been suggested, but it is of course the most popular -- the theory of relativity which is most widely accepted. This is a curious twist in our historical development related to relativity theory. Many physicists since Lorentz and Einstein have noticed that there are other, equally viable or even more viable explanations and formulations of a relativity theory, which also explain observation and experiment quite accurately. Perhaps even more accurately than Special Relativity.

So we will take another look at space, and relativity theory, to see if there is a more complete, simple, and elegant way to address relativity theory and the nature of space itself. John Stewart Bell looked into the dichotomy between Special Relativity and Quantum Mechanics, and shared his observations. Some of those observations, as it turns out, are quite poignant.

Maxwell's equations suggest waves in space. Transverse waves are composed of translating circular (oscillating) motion. Waves suggest that there is likely some form of displacement of a medium. But there are two distinct types of displacement we notice as we study displacements in a medium. Transverse waves are made of displacements in a medium which are perpendicular to the direction of propagation of the displacement. Transverse propagating displacement is the form which seems to be indicated by Maxwell's equations. The other form of displacement of a medium is longitudinal. Longitudinal displacements propagate faster than transverse displacements in any medium. We can see certain situations, like vortex action in a liquid, where both longitudinal and transverse propagation of displacements can be identified in the same system.

Assembling the pieces of such a complicated puzzle as this universe, in a more coherent way, often requires that we reexamine our theoretical basis. Scientists have done this several times in the last 300 years, especially in the period beginning about 300 years ago and extending through about 100 years ago. Starting about 100 years ago, the common consensus was that space is not a medium through which waves propagate. But that space could indeed be empty. This view quickly became so accepted and prevalent that quantum mechanics theory was initially created using this concept that space is an empty void. However, several discoveries have been made prior to, and since that time, which attribute properties to space itself, indicating that space is not really empty, and cannot be just a void. In fact, it has been established by experiment, fairly convincingly, due to the nature and behavior of light and particles, that space can be a sort of medium. Einstein did not have the concept that space was an empty void when he said, "*There Is an Important argument In favor of the hypothesis of the ether. To deny the existence of the ether means, in the last analysis, denying all physical properties to empty space*"… and when he said, "*the ether remains still absolute because its influence on the inertia of bodies and on the propagation of light is conceived as independent of every kind of physical influence.*"

We will explore and explain this subject in more detail as we proceed.

To assume that electromagnetism is a vector force in space without some sort of properties of space, a sort of qualified medium to support that vector force, seems logically inconsistent. Einstein's General Relativity suggests that space is warped by gravity. Warping of space suggest either a displacement or strain on space itself. Lorentz suggested that motion through space deforms material objects and slows their perception of time so that a moving frame always measures the same velocity for light. Many experiments have verified that we always measure the same speed for light regardless of velocity of the observer or of the source. Each of these issues suggest that space is some sort of qualified medium.

In the last 100 years or so, theory has been established, based on both observation and conjecture, just as we have always developed theory. History has shown us that it is beneficial for our progress if we are continually aware of the status of our theoretical basis. It helps if we identify the portions of our theory which are conjecture, so that we may know how to modify our working theory as new information becomes available. However, we experience an obstacle, as we attempt to point out inconsistencies in our theoretical basis. The longer a particular theory remains, the more it becomes instilled in the minds and thought processes of the scientific community, the harder it is to modify or replace the theory with a more accurate description of nature. The longer a theory remains active, the more work is done using that theory to propose "solutions" to various problems. But we must take care in this. For a "solution" is not really a solution until *all the pieces fit*. We must view physics as a single system and propose solutions *which are not myopic*, but rather solutions which consider all parts of the puzzle.

A Simple Cause for "Relativity"

Let us imagine a fixed Euclidian three dimensional space, where light moves forward at a fixed speed. And then let us consider that evidence indicates light is quantized into photons, and each photon has an internal motion which causes a photon to oscillate as it moves through space. This indicates an internal velocity of circulation or oscillation which is locally faster than the forward motion by as much as $\sqrt{2}$. And let us also imagine that this motion within particles of mass is confined but also moves internally (circulates) at this same fixed speed $\sqrt{2}$ c. This is reasonable if we also observe that $E=mc^2$. Both light and matter are made of energy and this energy causes a motion at a fixed speed in space.

This set of circumstances, by itself, correctly understood, causes the Lorentz transformations to be *required* for *matter* moving thorough space.

Our observation of relativity is then caused by these (or a very similar set of) circumstances. So there is no need to assume that all motion is relative in every sense, for motion is actually therefore relative to the local frame of space.

Let us now discuss experimental observation, some existing theory, and some new theory, and then follow with a set of conditions which match observation, and also match many portions (but not all portions) of our current theories.

A list of conditions is proposed, which we will explain in more detail as we proceed.

1. Matter and light are made of energy. For matter $E=mc^2$ so $m=E/c^2$.

2. A portion of transversely moving longitudinal displacement, which creates an impulse force of momentum, and which we perceive as a transverse "wave", has a specific local velocity through space due to the properties of space.
3. A more energetic quantized energy structure is perceived as a smaller quantized energy structure. This is the cause for E=hv.
4. Electric Charge is quantized.
5. Energy moving through space creates momentum under a specific set of conditions.
   Forward-- p=E/c. Total-- $p_T=\sqrt{2}$ E/c. Angular ħ or ½ ħ.
6. Electric Charge apparently propagates much faster than light.
7. Gravitational fields are apparently updated much faster than light.
8. Gravity warps space. Gravity refracts the propagation of energy. Gravity acts on light and matter.
9. Magnetic fields are perpendicular to electric fields.
10. Magnetism is a $1/r^3$ field.
11. Electric Charge and Gravity are $1/r^2$ fields.
12. The fundamental forces of nature are Strong Force, Electric Charge, Magnetism, and Gravity.

Some will argue that items 6 and 7 above are not accurate statements. But experiment by many, and calculations by Feynman, have clearly indicated that the Coulomb field is a faster than light phenomenon. And studying the orbital decay of pulsars clearly indicates that the gravitational field updates itself in ways which are similar to the Coulomb field and much faster than light.

John Stewart Bell, during his research, studied relativity and quantum mechanics, both in some depth. He provided valuable insight into aspects of the nature of particles which were contrary to the EPR premise. He came to understand the nature of the some of the potential errors in our theories. As a result of that effort he said: *"I would say that the cheapest resolution is something like going back to relativity as it was before Einstein, when people like Lorentz and Poincar´e thought that there was an aether – a preferred frame of reference – but that our measuring instruments were distorted by motion in such a way that we could not detect motion through the aether. Now, in that way you can imagine that there is a preferred frame of reference, and in this preferred frame of reference (some) things do go faster than light."…" Behind the apparent Lorentz invariance of the phenomena, there is a deeper level which is not Lorentz invariant, a pre-Einstein position of Lorentz and Poincar´e, Larmor and Fitzgerald, was perfectly coherent, and is not inconsistent with relativity theory. The idea that there is an aether, and these Fitzgerald contractions and Larmor dilations occur, and that as a result the instruments do not detect motion through the aether – that is a perfectly coherent point of view."—John Stewart Bell*

As we explore the possibilities implied by Bell's comments, perhaps surprisingly, the simplest composition for space, which fulfills all of the requirements in our numbered list above, is a Euclidian three dimensional space which is a special type of qualified medium. This type of Euclidian, three dimensional space is in complete agreement with the sort of space that we experience in the macroscopic realm as well. This three dimensional space, and the properties and principles we will discuss, agree with Bell's conclusion, and will show a means to obtain John Archibald Wheeler's dream, which he stated in this way, *"It is my opinion that everything must be based on a simple idea. And it is my opinion that this idea, once we have finally discovered it, will be so compelling, so beautiful, that we will say to one another, yes, how could it have been any different."—John Archibald Wheeler*

What we are suggesting is that all of the items in the numbered list above are satisfied in a three dimensional Euclidian space, if we properly construct our theoretical models. And that the concept is so

elegant and simple that we can easily begin to have the sentiment expressed by Wheeler. Bell understood and tried to tell us that the velocity c is not the limiting velocity for all information in the universe. And what we have discovered, about entanglement, charge, and many other topics, indicate that Bell was right. When we refuse to look beyond our existing theory, and we choose to conduct research with the artificial mandate that c is a limiting velocity for everything, we are forced to try to solve the puzzles *by adding extra unobserved dimensions to our universe*. But when we recognize the error, and find the specific importance and cause of c and other velocities, then the pieces of the puzzle are much more easily understood and assembled.

Above we stated, if we have a fixed Euclidian three dimensional space, where energy in light moves at a fixed speed, and the energy within particles of mass is confined but also moves at this same fixed speed, this set of circumstances, by itself, can cause Lorentz transformations to be required for *matter* moving thorough space. If that internal speed at the momentum radius of the momentum creating spinning longitudinal displacements of space is $\sqrt{2}\,c$ then the Lorentz transformations work out to be precisely correct. Meaning that an elementary fermion moving at c through space (if that were possible) would have a calculated length of zero, as one would expect from the Lorentz transformations.

We will show in more detail, as we proceed, how all these results in our numbered list above, are quite naturally obtained in a three dimensional Euclidian space.

Space as a Unique Medium

If space is indeed some unique medium, we would need to consider a set of principles which relate to that premise.

In any known medium, *longitudinal displacement propagates faster than transverse displacement*.

The speed of propagation of a transverse displacement (wave) is:

$$v = \sqrt{\frac{\mu}{p}}$$

The speed of propagation of a longitudinal disturbance is:

$$v = \sqrt{\frac{K + \frac{4}{3}\mu}{p}}$$

Where *v* is velocity, K is the longitudinal modulus, μ is the transverse modulus, and *p* is the "density" of the medium. (Of course space is a unique type of medium, frictionless and without mass, but the basic principle that longitudinal displacement is faster than a transverse ware still applies.)

1. *All known media support the propagation of longitudinal displacement*.
2. *Not all media readily support transverse waves under all conditions.*
3. *The propagation of longitudinal displacements is faster than the propagation of transverse displacements in any medium.*

Our present popular theories of quantum mechanics try to solve the puzzles by postulating that all force at a distance is mediated by particles. This is, in part, due to the premise that space is an empty void instead of any form of medium. If space is empty then particles must mediate force, for there would be nothing in space to mediate force. But there is yet another logical problem with that approach. If space

is really empty then what is it that supports the wavefunctions of particles themselves? The most economical solution is that space is not empty, but is a special type of qualified medium.

Planck's action indicates that more energetic particles are smaller particles. A photon with more energy has a shorter wavelength which means a smaller extent of action and a higher frequency. A fermion with more energy is smaller than a fermion with less energy. This is demonstrated by deep inelastic scattering, and in several other ways. Since more energetic particles are smaller particles, and if space is a medium, then the simplest explanation is that energy pulls on space and displaces space toward the particle center, and more energy therefore creates a *smaller* particle. We will get deeper into the mechanics of this as we proceed.

While exploring the concept that energy causes a displacement of space and can propagate through space in the form of displacements, it became clear that the nature of that displacement of space would need to be different than our experience with waves in a material medium. In a material medium, generally a more energetic wave is a larger wave, but in space the opposite is very strongly illustrated by experiment. The only explanation found to remedy this dichotomy was to understand that energy pulls on space to displace space, pulling toward the particle center. This condition is then the cause for quantization (localization) of energy to form particles. This action is then responsible for what we observe when we note that a more energetic particle is a smaller particle. Of course this is only part of the puzzle, but an important first step.

So now let us review the specific requirements which would need to be considered while examining space as a medium.

1. Electric charge presents itself in two polarities.
2. Electric charge is quantized.
3. Magnetic fields exist, and are perpendicular to electric fields.
4. Gravity is a natural consequence of the composition of space and the quantization of energy within space.
5. And of course, more energetic particles are smaller particles.

Perhaps not surprisingly, all of these clues lead us logically to a very narrow set of possibilities (qualifications) for a description of space, if space is in fact a medium. But there are some surprises along the way.

The good news is that a set of conditions *does exist* which would provide a Euclidian three dimensional space which presents as an environment which would fulfill the requirements listed, and display the properties we observe in electromagnetic fields, particles, electric charge, magnetism, entanglement, and gravity. It was thought for many years that such a solution was not possible, but as it turns out, this solution is not only viable, but is also the *simplest solution which describes what we observe*.

Next we can now look at a set of proposed physical principles to illustrate how easily solutions become apparent by viewing space as a three dimensional Euclidian medium.

1. Space is a unique tension medium which is comprised of two components.
2. The fundamental energy of particles pulls on space to longitudinally displace one or the other or both components of space toward the particle center.
    a. If one component of space is displaced by the energy in a particle the particle is charged.

   b. The polarity of charge of a charged particle is dictated by the component of space which it displaces.
   c. If a particle displaces two components of space it does not carry the "static" elementary charge, but rather it creates an apparent oscillating electromagnetic field.
3. The fundamental displacements of space caused by energy of particles are principally *longitudinal*, toward the center of the particle.
4. Longitudinal displacements of space must also move transversely due to the properties of space.
   a. This set of properties of space causes spin of particles.
   b. This spin is caused by a mechanism which also creates momentum for longitudinal displacements moving transversely, under a specific set of conditions.
   c. The Spin of photons is different from the spin of fermions. Photons displace two components of space and have a two dimensional spin of ħ. Elementary fermions displace only one component of space, and have a three dimensional spin of ½ ħ. Photons are therefore confined in two dimensions moving at c in the third dimension, while elementary fermions are confined in three dimensions and stationary when at rest. The displacement of one component of space has a three dimensional spin characteristic. Only when two components of space are displaced is part of this three dimensional spin canceled, so that the photon exhibits two dimensional spin. This is the cause for the difference between particles of matter and particles of light.
5. There is a region of a transversely spinning longitudinal displacement which carries detectible momentum.
   a. That region is located a distance in space from a particle center where the transverse velocity of the existing longitudinal displacements with spin is $\sqrt{2}c$.
   b. The radius on a spinning longitudinal displacement where transverse motion due to spin (and/or forward motion) is $\sqrt{2}c$, causes a force which is manifest as momentum.
6. More energy within a particle causes more displacement of space (more confinement) and a faster spin rate. A more energetic particle is therefore a smaller particle with a higher frequency.
7. Using the suggestions in this list requires that the position of the center of a particle is a localized point in space, but that *particles by their very nature are non-local entities*.

A common term in practically all relativity theories, including Special Relativity, is the Lorentz factor.

The common expression for the Lorentz factor is:

$$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$$

We already know, and can easily see that this equation is derived using the Pythagorean Theorem. The *Pythagorean Theorem is a fundamental relation in Euclidian Geometry*. This factor γ was developed to explain the transformations which *material objects* encounter with motion through space. Experiment has verified that this set of transformations is at least very close to correct.

The direct implications of this are *space itself is of a Euclidian geometry*, and that motion of *material objects* through a fixed frame of space causes these transformations to *material objects*.

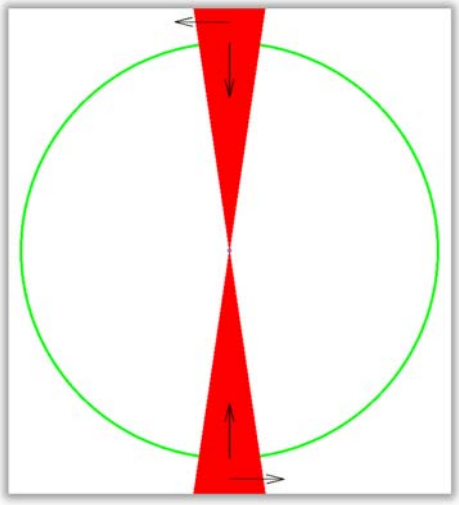
This is part of what J. S. Bell was saying to us.

Let us frame this situation as simply as we can. Light is a form of energy which propagates in the forward direction through space at the velocity c. The energy within the photon appears to circulate about the momentum radius of the photon at $\sqrt{2}c$. The plane of circulation determines the polarization of light. Matter is also made of energy. If the energy in matter is (spherically) confined but moving at this same speed $\sqrt{2}c$, when matter moves through three dimensional Euclidian space, it will naturally be transformed, and those transformations will be precisely the Lorentz transformations. So that if a particle of matter were moving at c (if that were possible), in one sense it would have zero length, and all of the particle spin would be in a plane perpendicular to the direction of motion. The rate of spin at the momentum radius in this situation would be c, and the forward motion would be c, so the velocity vector at the momentum radius would be $\sqrt{2}c$ when the particle has reached maximum velocity. And in fact this velocity vector at the action radius, for all particles, is $\sqrt{2}c$ as a normal condition imposed by space.

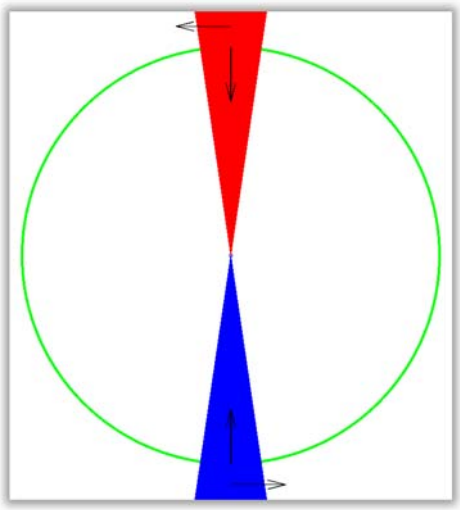
What we have just illustrated is a simple and direct cause for relativity.

So let's take another look at space, relativity, and the quantum nature of particles, to illustrate a way that all the pieces of this puzzle can fit together properly.

We are proposing a constitution of space which causes the things we observe in nature. And we are proposing that the energy of particles pulls on space to displace space toward the particle center. These displacements are longitudinal displacements toward the particle, and these displacements spin due to the properties of space.



The figure to the left is a simplified illustration of the spinning longitudinal displacement regions for a charged particle. The green circle represents the point on the radius which is moving transversely at $\sqrt{2}c$ and therefore creates momentum. The displacements are much smaller than the circumference of the particle, and that is what causes the value of electric charge we measure, and the creation of magnetic fields due to the transverse motion of these displacements. Note: the displacements extend off into space getting wider with distance and exhibiting less displacement density (force) with the inverse of the square of the distance. This picture is a partial illustration of the displacement configuration of an elementary fermion.



A photon displaces two components of space. Which yields an oscillating electromagnetic field as the photon displacements spin. A simplified illustration is shown in the picture to the left.

In both of these illustrations, the displaced regions (colored regions) spin about the particle center, at an angular rate determined by the energy content of the particle. As we proceed we will define the width of displacement regions, the angular rate, the force of displacement, etc.

The space we have been describing is unlike any material medium. It is a two component tension medium, and displays none of we would normally define as inertia or friction. Inertia and friction are present in material media, but not in space. Some have used the term "ether" to describe space. It is good that we use a specific unique word to describe space, for space cannot be a medium like a material medium, but it does have a set of properties, and all motion of displacement and of particles in space is relative to space itself. This frame of space is the cause for relativity, for gravity, and for inertia, as well as for the rest mass of electrons and positrons, and the speed of light. We will explain these items in more detail as we proceed. So when we call space a medium please understand that we refer to a *very special type of medium*. We are suggesting that space is a tension medium. We have not attempted to describe what space is made of, but only researched and described the properties which space must exhibit in order to provide an environment which yields what we observe.

Quantized electric charge we observe in nature, created by particles, and due to properties of this form of space, requires the following constants and relationships:

1. The force of energy of an elementary fermion at the momentum radius is: $F_c = E^2 C_F$, where the constant $C_F = \frac{4}{\hbar c} = 1.26521151107644\text{E}+26$
2. The total width of displacement in any plane, at the momentum radius (Planck action radius) of the spinning displacements constituting an elementary fermion at rest is: $d = \frac{d_w}{E}$,

Where the constant $d_w = \frac{h c \varrho}{2} = 9.213348055472120\text{E}-27.$

For the electron at rest $d_w = 2\pi r_e \varrho = 1.125348739920370\text{E}-13$

Where $r_e = \frac{h c}{4\pi E_e}$ *(Herein the term* r_e *will refer to the momentum radius of the electron at rest and is* $r_e = \frac{h c}{4\pi E_e} = 1.930796541221630E-13\ m$*.) The term* r_e *does not refer to the classical electron radius in this document.*

The term ϱ *is the ratio of the square root of the force of electric charge at the radius* r_e *over the force of confinement energy at the radius* r_e*.*

$$\varrho = \frac{\sqrt{F_e}}{F_c}$$

3. The sum of the time it takes the displacements to pass a point in space at the action radius of an elementary fermion at rest as the displacement spins is:
   $t = \frac{t_w}{E}$, Where the constant $t_w = \frac{h\,\varrho}{2\sqrt{2}} = 2.173110334702360\text{E} - 35\ \text{S}$
4. The spin of an elementary fermion can be expressed using a constant related to its energy:
   a. For an elementary fermion (which displaces one component of space) that constant of action is 2.34266952895051E-34 = $\frac{h}{2\sqrt{2}}$
      i. Due to the three dimensional displacement spin topology of an elementary fermion the component of this spin which can be measured (as a momentum vector) in the equatorial or in a polar plane, is $\frac{h}{2}$.
   b. For a photon (which displaces two components of space) that constant of action is: 6.62607004E-34 = *h*

Note: The calculations above represent total values and do not represent the values for a single displacement. It is suggested that the electron has at least 4 individual displacements. We will review this when we discuss the electron in more detail below.
For an elementary fermion…

$$\frac{t_w}{d_w} = \frac{m}{p_T} \qquad \frac{t_w}{d_w} = 2.358654336749680\text{E} - 09 \text{ and } \frac{m}{p_T} = 2.358654336749680\text{E} - 09$$

$$\frac{d_w}{t_w} = \frac{p_T}{m} \qquad \frac{d_w}{t_w} = \sqrt{2}\ \text{c} \text{ and } \frac{p_T}{m} = \sqrt{2}\ \text{c}$$

Where m is mass, and p_T is total momentum.
The constants d_w and t_w are stated relative to the elementary fermionic particle itself with any motion related to particle translation removed.

Momentum

If we use the example of a rubber band, and instantly apply a specific and thereafter constant force to the rubber band, the rubber band will initially be extended very rapidly, then the rate of extension will slow, and finally, when the force of the rubber band equals the force we applied, the extension will stop. There is a time constant associated with this action. The time constant is dependent on the length and tensile properties of the rubber band, and the amount of force applied. If the rubber band were then replaced by a taught infinite sheet, there would still be a time constant associated with displacement in this manner. This time constant is not due to inertia in the medium of space, but rather it is due to the velocity of propagation of longitudinal displacement and therefore the reaction time the associated opposing forces display to incident displacements.

When the force of energy, pulling on space, is initially incident on a region of space, some displacement occurs rapidly, with less resistance. Then, when space is displaced enough, it begins to oppose the force of displacement more, until an equilibrium is reached where the force of energy and the opposing force of space are equal. This situation creates a delta force across a transversely moving longitudinal displacement. That difference in the opposing force of space, at the fore and aft of a displacement, causes the displacement to continually seek an area of least force in space. This makes the displacement spin about the origin of displacement force. A delta force, across the fore and aft regions of spinning displacement, is the source for measureable momentum. But space focuses this momentum in a region which is moving transversely at $\sqrt{2}\ c$ because this region is conditioned by the forces present and the transverse velocity of the displacements to be more capable of supporting what we have previously

assumed to be a "transverse wave". In other words, this region is the only region where the conditions in space and the transverse velocity matches the properties of space closely enough for the creation of momentum which causes the *appearance* of a transverse wave to be created. When in fact transverse momentum is created at this velocity under these circumstances, but there is actually no physical transverse wave in the normal sense. This momentum creation can only occur at a specific velocity, just as the conditions for a transverse wave can only propagate through a material medium at a specific velocity. But there is no actual need for a transverse wave for us to measure what we observe. All that is required is the creation of the impulse force of momentum at this velocity. The properties of space determine this velocity, and this velocity determines the momentum radius of the particle.

Representing momentum at this location, from the delta force we mentioned, can be shown using simple steps.

Conventional momentum is expressed as:

$$p = mv$$

Momentum *p* in this equation, represents the inertial force that is exerted by *m* at velocity *v*. Since momentum is generally expressed as a mass at a velocity, and velocity is distance divided by time, then the following would also be true:

$$p = m\frac{d}{t}$$

So, we can write:

$$p = F\frac{d}{t} = \frac{Fd}{t}$$

Momentum is the product of force and distance divided by time.

A difference in the force of space which opposes F_c at the front and back (leading and trailing portions) of the transversely moving longitudinal displacement, can therefore cause the impulse force which is momentum:

$$p = \frac{\Delta F_c\, d}{t}$$

Where ΔF_c is the difference in the force of space at the fore and aft portions of the displacement region, *d* is the distance across the displacement region, and *t* is the time it takes the displacement region to pass a point in space as it spins.

The momentum action radius of a particle is readily calculated using the known, measured, spin angular momentum of the particle and the energy of the particle. Assuming that this internal momentum of circulation is as we have measured for photons.

The forward momentum of a photon in a single direction is stated as:

$$p = \frac{E}{c}\ which\ is\ equivalent\ to\ p = \frac{E}{c^2}c$$

For a photon, the "Planck action" radius would then be:

$$r = \frac{\hbar}{p} = \frac{h\,c}{2\pi\,E}\ so\ that\ L = rp = \hbar$$

For an electron, the "Planck action" radius would then be:

$$r = \frac{\hbar}{2p} = \frac{h\,c}{4\pi\,E}\ so\ that\ L = rp = \frac{1}{2}\hbar$$

A more energetic photon is a *smaller* photon, with a shorter wavelength and smaller transverse extents.

The force F_c, for a *photon*, is the force of energy within the photon which acts at the Planck action radius on space. The force of energy of a photon is: $F_c = \left(\frac{E}{2}\right)^2\ C_F$, because half the energy of the photon pulls on one component of space, and half on the other component of space.

This is the force which causes a more energetic photon to be a smaller photon.

$$F_c = \frac{E}{r} = \frac{E^2}{\hbar\,c} = \left(\frac{E}{2}\right)^2\ C_F$$

The *photon* is a differential displacement toward the particle center of two components of space. One component of space is displaced by half the energy of the photon from one direction toward the center and the other component of space is displaced from the opposite direction toward the photon center.

Fundamental Properties and Planck's constant

Planck's constant was derived as an empirical value which applies to the behavior of light. Due to differences in the nature of light and matter as we have discussed, there is a more fundamental constant. The constant similar to Planck's constant but more fundamental, has ½ the value of Planck's constant, and applies to elementary fermions instead of photons. We say that this is a more fundamental constant because this constant discloses the properties of the displacement of one component of space. Planck's constant is the sum of two of these more fundamental constants, and *relates specifically to light* because light is the displacement of two components of space, as we have discussed.

So we will use the expressions $\frac{h}{2}\ or\ \frac{1}{2}h$ for this more fundamental constant of the quantization of action. However, due to the spin (action) differences of fermions and photons there is still more to this story.

When we study light, we can relate Planck's constant and energy to wavelength, simply because the quantization of action causes an electromagnetic oscillation which possesses a specific wavelength. The mechanics of circulation of displacement of the two components of space cause a circulation of opposite "charges" which therefore displays an electromagnetic oscillation we can sense. And the period of oscillation is such that as the photon moves forward at c it completes one cycle of oscillation in one wavelength.

But the situation in an elementary fermion, like the electron, is quite different. There is no easily detectible "wavelength" in the electron like there is in the photon, simply because there is only one component of space displaced, so no opposing charges exist for us to measure a wavelength from. The electron does however possess a frequency of circulation. The frequency of circulation of an electron at rest is faster than the frequency of a photon with the same energy as an electron at rest. The circulation within the electron is in two directions. So the total momentum, the sum of these two circulations, is $p_T = \sqrt{2}\,\frac{E}{c}$, but the vector sum of these two, measured in the mean equatorial plane, or in a polar plane, is $p = \frac{E}{c}$.

Causal Relationships

Approaching the two component nature of space in this manner allows us to describe specific cause for the following:

1. Electric charge, which is easily and clearly shown.
2. The quantization of electric charge, as a natural consequence of this approach.
3. Magnetic fields, as an action perpendicular to the electric field.
4. The constitution and quantization of a photon.
5. The constitution and quantization of an electron.
6. Pilot "waves" in the form of spinning longitudinal displacements which propagate longitudinally very rapidly.
7. Energy creates momentum.
8. Energy can create mass.
9. The origin of Gravity.
10. The behavior of photons and electrons in double slit experiments.
11. The spin of the photon and the electron.
12. Why E=hv.
13. The appearance of entanglement.
14. The specific cause of relativity.

We have already discussed some of the items in this list. So we can now address many of the remaining items.

The Electron Spin

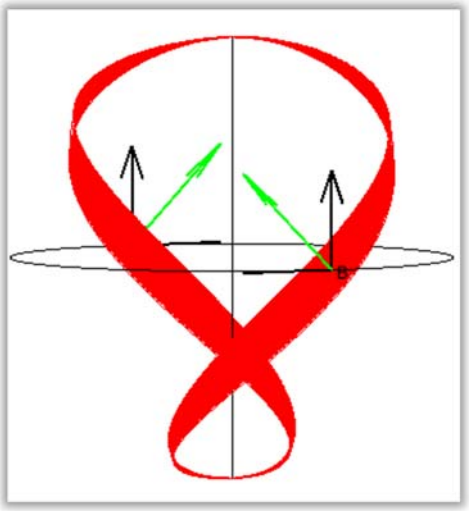
We have discussed how the circulating momentum of the photon is confined in two dimensions and that the particle moves forward at c. The electron momentum is confined in three dimensions, so it is a stationary particle when "at rest". Neither are actually local entities, but both have a point-like central region which we identify as the "location" of the particle. The behavior of the magnetic field of an electron yields some valuable information regarding its spin. The spin of the electron results in the confinement of momentum for the electron to create inertial mass. Once we understand how the magnetic field is created by the same displacements which create the particle and its electric charge field, we can then decipher the spin of the electron by looking at the known properties of the electron and its magnetic field. The electron possesses a specific magnetic moment, which means it has magnetic poles. The existence of magnetic poles is therefore one clue to the spin topology of the

electron. The magnetic field is an interaction of the spinning displacements of the electron and spinning displacements of other particles.

We need to discuss the velocity of the transversely moving portion of the spinning longitudinal displacements which create the momentum of the photon. The circularly polarized photon has displacements spinning about its axis of motion, the portion of these displacements which create momentum we can sense, is the portion with a local velocity vector of $\sqrt{2}\ c$. Circularly polarized photons are moving forward at c, and their displacements are spinning at c at the action radius, so in a Euclidian three dimensional space, the transverse velocity vector, of the momentum creating portion of these displacements, in a circularly polarized photon, is at 45 degrees related to the forward axis, and 45 degrees to the spin direction. And these displacements, at their momentum radius, are moving transversely at $\sqrt{2}\ c$. In the electron we also naturally have the same velocity $\sqrt{2}\ c$ for the portions of the spinning displacements which create momentum (and therefore create mass) for the electron.

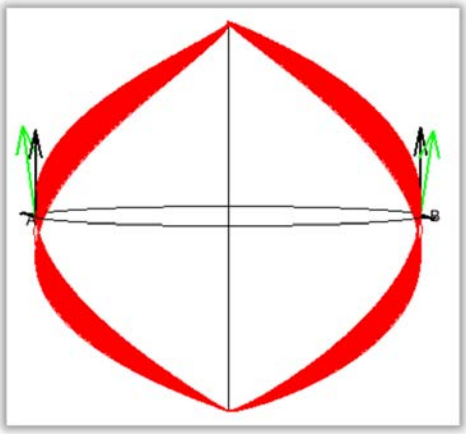
We are able, using the concepts presented here, to show the electric charge of the electron, the cause for the magnetic fields of the electron, the quantization of electric charge, and so many of the observed physical phenomena and properties, all in a Euclidian three dimensional space, that it is likely we are on a viable path. There is no scientific need to assume that the universe consists of extra dimensions beyond those we directly experience. There is no need to assume magical properties of space or particles. We have unintentionally obscured solutions from our grasp by refusing to question popular theory. Some portions of our existing theories have no causal basis, and no logical basis when all of the data from experiment and observation are considered. But solutions lie before us and are becoming evident.

The spin of the electron is a complex topic. It is complex because the electron must have a spherical shape, and the spin must yield ½ ħ when measured in the equatorial plane and in any polar plane. Additionally the spin must provide for a dipole magnetic field, and must exhibit a principally spin up or spin down attribute. There are few solutions for a spin topology which satisfies all of these requirements. After significant research into the possible spin topologies we will suggest only one topology which satisfies all of these requirements.

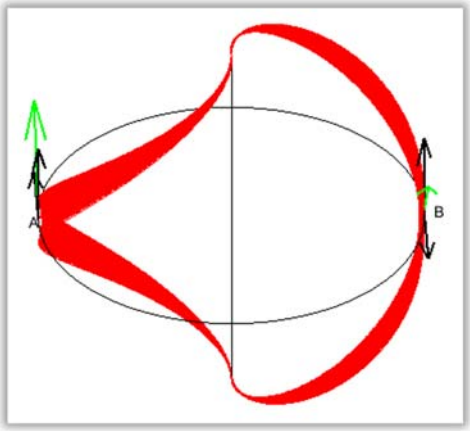


We will provide graphical illustrations of this topology, with explanations, to illustrate how it fulfills the requirements.

The displacement motion of this spin topology is a motion with two components. There is a flow of displacement which is in a direction from one polar extent to the opposite pole. And there is a spin of these displacements in the equatorial plane. At the points marked ‘A’ and ‘B’ are black arrows which indicate each of these components of motion (at velocity c) and green arrows which are the vector sum of these two components of motion (representing$\sqrt{2}\ c$). Once a portion of a displacement reaches its terminating pole, the energy of the electron causes a displacement to appear at the opposite pole to keep the total displacement of the electron constant. (Note: The small red and blue arrows are not drawn to scale.)



The illustration to the left is a rotated view of the same model of electron spin. Of course in both of these illustrations it is easy to see that this is a "spin up" electron. In these illustrations the green arrows represent the total momentum p_T of the electron. And the black arrows at points 'A' and 'B' represent p the measureable momentum vectors. Using this spin topology the charge field of the electron is spherical, the magnetic field is a dipole, and the measureable spin angular momentum is ½ ħ.



In this view (to the left) it may be easier to discern the spherical nature of the spin topology we are proposing. The black circle is at the equatorial plane. All arrows in these three illustrations are instantaneous (and therefore principally tangential) velocity (and/or momentum) vectors.

Electric Charge

The force of energy within the electron, which pulls on space to displace one component of space toward the electron center, is also the force which confines the electron. This is the mechanism which underlies the cause for Planck Action for the electron. We have called that force F_c.

When we compute that force for the electron at rest we obtain:

$$F_c = \frac{2E}{r_e} = 0.848054635696107 \text{ N}$$

The force F_c has an associated constant which relates this force at the momentum radius to the energy of an elementary fermionic particle.

That constant is: 1.265211511076440E+26 and we will use the symbol C_F for this constant.

$$C_F = \frac{4}{\hbar\, c} = 1.265211511076440\text{E} + 26$$

$$F_c = E^2\, C_F$$

We can also calculate the resultant force of electric charge from this force F_c. The force of electric charge, at the action radius of the electron, is the mean force caused by the spinning displacements of space at the action radius. The circumference of the electron at the action radius is:

$$2\pi\, r_e = 1.213155245895690\text{E} - 12 \text{ m}$$

The displacements spinning within an elementary fermion have a width *d* which is determined by a constant. The width constant d_w is:

$$d_w = \frac{1}{2} h\, c\, \varrho = 9.213348055472120\mathrm{E} - 27$$

So for the electron at rest the width of displacement is:

$$d = \frac{d_w}{E} = 1.125348739920370\mathrm{E} - 13\ \mathrm{m}$$

The ratio of the circumference of the electron at the action radius to the width of displacement is:

$$\frac{d}{2\pi\, r_e} = 0.092762137717132 = \varrho$$

Note: We previously discussed this ratio ϱ*.*

The width of displacement can also therefore be expressed as:

$$2\pi\, r_e\, \varrho = 2\pi\, r_e\, 0.092762137717132 = \ 1.125348739920370\mathrm{E} - 13\ \mathrm{m}$$

So the mean force at the action radius of the electron which causes electric charge is:

$$F_q = \sqrt{F_c\, \alpha} = F_c\, \varrho = F_c\, 0.092762137717132 = 0.0786673609080946\ \mathrm{N}$$

So the ratio of the force in the field F_q at the action radius, over the force of confinement F_c for the electron at rest is:

$$\varrho = \frac{F_q}{F_c}$$

And the force of electric charge between two electrons, at any distance is:

$$F_e = \frac{{F_q}^2\, {r_e}^2}{r^2} = \frac{e^2}{4\pi\, \varepsilon_0\, r^2} = \frac{\alpha\, \hbar\, c}{r^2}$$

The elementary charge in Coulombs created by the electron is then simple to calculate in a host of ways based on these forces:

$$e = \mathrm{r}_e\, F_q\, 2\sqrt{\pi\, \varepsilon_0} = 1.60217662076511\mathrm{E} - 19\ \mathrm{C}$$

$$e = \mathrm{r}_e\, 2\sqrt{F_c\, \alpha\, \pi\, \varepsilon_0} = 1.60217662076511\mathrm{E} - 19\ \mathrm{C}$$

$$e = F_q\, \frac{\mathrm{r}_e}{c} \sqrt{10^7} = 1.60217662076511\mathrm{E} - 19\ \mathrm{C}$$

$$e = \frac{\mathrm{r}_e}{c} \sqrt{F_c\, \alpha\, 10^7} = 1.60217662076511\mathrm{E} - 19\ \mathrm{C}$$

Quantization of Electric Charge

One way to validate a theory is to compare the predictions of that theory to what we observe.

We will therefore study the prediction of this premise regarding the constitution of space, as it relates to the nature of electric charge to see if it matches what we observe.

Let's start by finding the force of electric charge at an arbitrary distance from particles with different energy and mass.

We can calculate the force of electric charge for an electron at rest using the information we have covered so far.

So, we will now calculate the force of electric charge at an arbitrary distance from an electron at rest. We will just choose any fixed distance, let's use the distance *r* = 1.544637232977300E-12 m, which is 8 times the momentum radius r_e of the electron at rest for our reference distance.

For the electron at rest, the force of electric charge as we have previously shown, is calculated using the following steps:

$$r_e = \frac{\hbar\, c}{2\, E}$$

$$F_c = \frac{2E}{r_e} = 0.848054635696107 \text{ N}$$

$$F_q = F_c \, \varrho = F_c \, 0.092762137717132 = 0.0786673609080946 \text{ N}$$

And the force of electric charge at our distance *r* is:

$$F_e = \frac{{F_q}^2 \, {r_e}^2}{r^2} = 9.66961511288188\text{E} - 05 \text{ N}$$

Which agrees with the conventional calculation:

$$F_e = \frac{e^2}{4\pi\, \varepsilon_0\, r^2} = 9.66961511288188\text{E} - 05 \text{ N}$$

The model we have proposed agrees precisely with the experimentally verified force of electric charge at a distance.

We will now imagine a charged particle with much more energy than the electron, and then calculate the force of electric charge of that charged particle with more energy. Then we will compare that value of electric charge with the electric charge of the electron at rest.

To accomplish this comparison, we can add energy to an electron, and make it have much more energy than its rest energy. A realistic way to add energy to the electron is to accelerate the electron. So, we will use an accelerated electron for our example.

The radius of an electron at rest, according to this theory is:

$$r_e = \frac{\hbar\, c}{2\, E}$$

Then the radius of the accelerated, moving electron is:

$$r_{e1} = \frac{\hbar\, c}{2\,\gamma E}$$

Where r_{e1} is the radius of the accelerated electron, E is the rest energy of the electron, and γ is the Lorentz factor.

The Lorentz factor is of course:

$$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$$

If the electron is accelerated to 0.9999 times the speed of light, the Lorentz factor is then 70.71244595, so that the radius of the electron has contracted from 1.930796541222E-13m to 2.730490389959E-15m

The total energy of this relativistic electron is now 5.78930204742442E-12 J. The energy in the charge field outside the action radius of this accelerated electron is: α 5.78930204742442E-12 J or 4.22465781534373E-14 J.

We calculate the force F_c or this more energetic electron.

We will represent this force using the variable F_{c1}.

$$F_{c1} = \frac{\gamma 2E}{r_{e1}} = \frac{70.71244595 * \ 2 * 8.18710478684506\text{E} - 14}{2.730490389959\text{E} - 15} = 4240.4984 \text{ N}$$

Which can also be stated as:

$$F_{c1} = \frac{\gamma 2E}{r_{e1}} = \ \gamma^2 Fc = 4240.4984 \text{ N}$$

The radius of the accelerated electron is:

$$r_{e1} = \frac{\hbar\, c}{2\,\gamma E}$$

The width of displacement varies according to the equation:

$$d_1 = \frac{d}{\gamma^2}$$

So we can calculate the width of circulating displacement at the action radius, for any elementary fermion from the energy of the particle:

$$d = \frac{d_w}{E}$$

Which causes:

$$F_{q1} = \frac{F_{c1}\ 0.092762137717132}{\gamma} = \ F_{c1}\, d$$

Now we have the information required to calculate the force of electric charge related to this more energetic particle, at the distance we have chosen.

$$r_{e1} = \frac{\hbar\, c}{\gamma\, 2\, E}$$

$$F_{e1} = \frac{{F_{q1}}^2\, {r_{e1}}^2}{r^2}$$

And the force of electric charge at our reference distance *r* is:

$$F_{e1} = \frac{{F_{q1}}^2\, {r_{e1}}^2}{r^2} = 9.66961511288188\text{E} - 05\ \text{N}$$

$$F_{e1} = F_e = \frac{e^2}{4\pi\, \varepsilon_0\, r^2}$$

So we have demonstrated a prediction that the value of electric charge for any elementary charged particle is the same value. This theory predicts that *electric charge is quantized* in a natural and causal way.

The elementary charge in Coulombs created by this more energetic particle is also:

$$e = 2\, \mathrm{r}_{e1}\, F_{q1} \sqrt{\pi\, \varepsilon_0} = 1.602176620765110\text{E} - 19\ \text{C}$$

Using the concept that particles are made of spinning longitudinal displacements of space, we have shown that electric charge is the mean force of these displacement and that the properties of space and these displacements cause the quantization of charge.

Magnetic Fields

The electric field of an elementary fermion is caused by the mean displacement of one component of space toward the particle center. The force of the magnetic field is caused by a reaction between the transverse motions of these displacements, which is in turn caused by the spinning of these displacements of the elementary fermion. *Actually a magnetic field is created by interactions of any transverse motion of these longitudinal displacements in space*. So that an electron in motion creates more magnetic field than an electron at rest. The magnetic field which is created by a particle at rest is of course meaningless unless it is reacting with the displacements of another particle. It is this reaction between displacements of different particles which creates the force of the magnetic field. It is this interaction of displacements which creates the appearance of magnetic poles as well.

The force which is created between displaced regions, when these regions interact with displaced regions from other particles, is the cause for the force vectors of the magnetic field surrounding the electron. This shows specific cause for the perpendicular nature of electric and magnetic forces when a field is present. When a particle encounters transversely moving regions of displacement interspersed with regions not displaced, moving across the particle and its fields, this causes forces between the fields of the particle and the fields moving across the non-local particle, resulting in a net force vector, which is the magnetic force.

The displacement regions in space surrounding an electron have a specific shape due to the force of energy and the opposing force of space, and a specific direction of movement induced by the spin of the particle. Electron spin causes a particular field topology. That specific spin topology of the electron is the cause for the "right-hand rule" of magnetism.

The fields are not really composed of propagating transverse displacements. They are narrow regions of near instantaneous longitudinal displacements which are spinning about the particle. The motion of the fields is caused only by the spinning motion of the displacements of the electron. The fields are a dynamic set of longitudinal displacements of space. These longitudinal displacements propagate very much faster than light, so that the fields are updated almost instantaneously.

The rules which govern *electromagnetic* forces between displacements are as follows:

1. Displacements of the same component of space in opposite directions tend to separate.
2. Displacements of the same component of space in the same direction tend to move toward each other.
3. Displacements of opposite components of space in opposite directions tend to move toward each other.
4. Displacements of opposite components of space in the same direction tend to separate.

These force rules summarize the causes of the forces of electromagnetism. Rules 1 and 3 are principally the rules which govern electric charge. Rules 2 and 4 are principally the rules which govern magnetic fields.

While the charge field is not related to a particle's energy, and is quantized, *the magnetic field of a particle is related to its energy.* A more energetic particle spins faster causing a stronger magnetic field. So the magnetic field of an elementary fermion is related to its energy and mass. This is part of the reason that an accelerated electron displays a greater magnetic field than an electron at rest.

Using the concept that particles are made of spinning longitudinal displacements of space, we have shown how the magnetic fields of particles can be described as an interaction of these spinning longitudinal displacements.

The Particle Core

Each particle has a region at its center where the displaced density of space is uniform and principally spherical. We can calculate the radius of that core region quite simply.

Let us perform that calculation for the electron at rest.

Using the equation we mentioned from the Abraham-Lorentz theory of the electron for finding the energy in the field of a particle outside a specific radius:

$$E = \frac{e^2}{8\pi\,\varepsilon_0\,r}$$

By setting energy E to be equal to the energy of the particle, and rearranging to solve for r_c, we can find:

$$r_c = \frac{e^2}{8\pi\,\varepsilon_0\,E}$$

So that, for the electron at rest, the core radius is:

$$r_c = \frac{e^2}{8\pi\,\varepsilon_0\,E_e} = 1.408970309589350\mathrm{E} - 15\ \mathrm{m}$$

$$\frac{r_c}{r_e} = \alpha$$

The uniformity of this core volume causes the core to have no pronounced gradient of space within, so that the gradient in the charge field does not exist within the core. The most fundamental form of energy could then be simply a mechanism which causes space around this core region to occupy less volume. All other displacements in space caused by the particle, would then be the result of the properties of space and the reduction in size of this volume of space, creating the core of the particle. The force F_c is the total inward force at the action radius caused by the energy in the core. At the action radius of the particle the displacement regions do not occupy all of the spherical area described by the action radius. The displacements are smaller than the circumference described by the action radius. We have calculated the width of displacement above. This situation creates a *mean displacement force* which causes electric charge, and an in-and-out displacement action, with resultant force gradients, as the displacements spin, which causes the force of magnetic fields. This situation also causes the momentum we have been discussing.

The force of energy at the particle core is however much greater than this force at the action radius. The force of energy varies with the inverse of the square of the distance from the particle core. So that for the electron at rest the force at the action radius is 0.84805464 N, but at the core radius this force is 15925.50356707 N in localized displacement regions, and has a mean value of 1477.2837551 N.

We suggest that this particle core exists for the simple reason that the energy of a fermion is finite. If this core region did not exist then we would be led to the inaccurate conclusion that a particle would be required to have infinite energy. Since we know that individual particles have finite energies we also suggest that this more uniformly dense core region is real.

How Energy Creates Mass

We have discussed the creation of momentum by the spinning longitudinal displacements of space which create particles.

The angular rate (radians per second) ω of our circulating momentum is:

$$\omega = \frac{\sqrt{2}\,c}{r_e}$$

Here ω represents an acceleration, a changing of direction, of the momentum. Accelerating this momentum $p = \frac{E\sqrt{2}\,c}{c^2}$ in a circular path about the radius r_e:

$$r_e = \frac{\hbar}{2\,p} = \frac{c\,\hbar}{2\,E} = 1.9307964800289E-13m$$

The "confined" momentum moving about the action radius, in the context of the momentum topology of the electron, is equal to the inherent property of inertial mass for the electron:

$$m = \frac{p}{r_e\,\omega} = 9.1093826E-31Kg$$

Since the total momentum of the photon implies that in Euclidian space the *internal* velocity vector of the photon at its momentum radius is $\sqrt{2}\,c$, and since it is likely that the $\sqrt{2}\,c$ internal velocity vector also holds for the circulation of energy in the electron, we derive a value for *p* and a value for *ω* from this velocity.

$$p = \frac{E\,\frac{\sqrt{2}\,c}{c}}{c} = \sqrt{2}\frac{E}{c}$$

$$\omega = \frac{\sqrt{2}\,c}{r_e}$$

The spin ½ ħ for the electron, when measured from any direction, demands something like this $\sqrt{2}\,c$ velocity vector, and two circulations of energy, each at +/- 45 degrees from the mean spin plane (equatorial plane).

So, in that context, when we show that:

$$m = \frac{p}{r_e\,\omega} = 9.1093826E-31K$$

We are actually saying (by expanding the full equation) that:

$$m = \frac{\left(\frac{E\left(\frac{\sqrt{2}\,c}{c}\right)}{c}\right)}{\left(\frac{c\,\hbar}{2\,E}\right)\left(\frac{\sqrt{2}\,c}{\left(\frac{c\,\hbar}{2\,E}\right)}\right)} = \frac{E}{c^2} = 9.1093826E-31Kg$$

When we solve for *E*:

$$E = m\,c^2$$

And a notable result is the fact that we have simply derived the famous equation $E = mc^2$ from this electron model. Note: We consider momentum to be more fundamental than mass, since the most fundamental of particles, the photon, has no rest mass but possesses momentum.

For the electron, A total momentum = $3.86211E-22$, moving at $\sqrt{2}\,c$, accelerated in two perpendicular circular paths, the plane of each circulation offset 45 degrees from the mean equatorial spin plane, with a radius 1.93079654E-13m at the equatorial spin plane, yields the property of inertia (inertial mass = 9.1093826E-31kg) .

Therefore $m = \frac{E}{c^2}$

A More Direct Calculation of Mass

There is another, more fundamental way to derive the mass of the electron from the creation of confined circulating momentum.

Regarding the section above discussing momentum, you may recall that we used a formula to represent the relationship between momentum and the delta force of space which causes momentum.

$$p_T = \frac{\Delta F_c\, d}{t}$$

Where ΔF_c is the difference in the opposing force of space at the fore and aft portions of the displacement region at the momentum radius of a particle, *d* is the distance across the displacement region, and *t* is the time it takes the displacement region to pass a point in space at the action radius, as the displacement spins.

If we rearrange this equation to solve for ΔF_c of the electron we obtain:

$$\Delta F_c = \frac{p_T\, t}{d}$$

Momentum (total) p_T is: $p_T = \frac{E}{c^2}\sqrt{2}c = \sqrt{2}\frac{E}{c} = 3.86211\text{E}-22$

Distance *d* (thickness of displacement) is:

$$d = 2\pi\, r_e\, \varrho = 2\pi\, r_e\, 0.0927621 = \ 1.1253487399\text{E}-13\ \text{m}$$

Time *t* (time required for the displacement to pass a point as it spins) is: $t = \frac{d}{\sqrt{2}c} = 2.6543087\text{E}-22\ \text{S}$

Then when we insert the values for momentum *p*, time *t*, and distance *d*, we obtain:

$$\Delta F_c = \frac{p_T\, t}{d} = \frac{(3.86211\text{E}-22)\ (2.654308687\text{E}-22)}{1.1253487399\text{E}-13} = 9.1093826\text{E}-31\ \text{kg}$$

So that the delta force ΔF_c we have been discussing, is precisely the mass of the electron:

$$\Delta F_c = 9.1093826\text{E}-31\ \text{kg} = \text{m}_e$$

Note that this distance *d* and time *t* are required in order for the electric charge to be the value of the elementary charge, and for the momentum and mass to be correct. But with these values for distance

(thickness of displacement) and time, all three of these parameters: electric charge, momentum, and mass, are correct.

Now it also becomes evident that always for any particle: $\Delta F_c = \frac{E}{c^2}$

And that:

$$p_{Total} = \frac{\Delta F_c \, d}{t}$$

And the forward momentum component of a photon is then:

$$p = \frac{\Delta F_c \, d}{\sqrt{2}\, t}$$

Using the concept that particles are made of spinning longitudinal displacements of space, we have shown that space exhibits a transverse velocity sensitivity in relation to these displacements and that this transverse velocity is the cause for the momentum radius of particles.

Mass Quantization – The Rest Mass of the Electron

The rate of spin of an elementary fermion is directly related to the energy content of the particle. So we can write:

$$w = 2.68206216435247\text{E} + 34 \; E$$

Or

$$w = \frac{E}{3.72847435563235\text{E} - 35}$$

What we propose, is that a *stable elementary fermion* in space, at rest, *can only have one value for E due to the properties of space and its reaction to energy*. That value is 8.18710478684506E-14 J. This is a familiar value, the energy of an electron or positron. This value for E_0 of the electron provides for a stable, stationary, force balanced, resonant, spinning, system of displacements of space. The tensors and time constants of space impose the boundary conditions which allow only this configuration to be stable for an elementary fermion at rest.

Similarly, there is only one stable value for E when a single elementary fermion is moving through space at a specific velocity, and that value is always greater than the value for E_0 at rest. This is simply because motion through space affects the time constants and tensors of space related to the reaction of space to moving energy. An elementary fermion cannot move unless energy is added to that fermion. We must apply a force (add energy) to an elementary fermion to move it in space.

This set of properties of space, is specifically why we have no stable fermions which are of less mass than the electron.

We therefore can predict that collisions of electrons and positrons, with enough energy density, will yield protons and neutrons. So that the quarks of protons and neutrons are bound relativistic electrons and positrons which have had their properties somewhat modified by the strong force, the binding force, which holds these elementary fermions in their bound state within nucleons.

Above we discussed the constants which relate to the width of displacement and the time for displacement to pass a point in space. We said the total width of displacement in any plane through the particle center, at the momentum radius of the spinning displacements constituting an elementary fermion is: $d = \frac{d_w}{E}$

Where the constant $d_w = \frac{h\, c\, \varrho}{2} = 9.213348055472120\text{E} - 27.$

For the electron at rest $d = 2\pi\, r_e\, \varrho = 1.12534874\text{E} - 13$

The time it takes the displacement to pass a point in space at the action radius of an elementary fermion as the displacement spins is $t = \frac{t_w}{E}$, Where the constant $t_w = \frac{h\, \varrho}{2\sqrt{2}} = 2.1731103347\text{E-}35$
Note: The calculations above represent total values and do not represent the values for a single displacement. It is suggested herein that the electron has at least 2 individual displacements.

For an elementary fermion…

$$\frac{t_w}{d_w} = \frac{m}{p_T} \qquad \frac{t_w}{d_w} 2.35865433674968\text{E} - 09 \text{ and } \frac{m}{p_T} 2.35865433674968\text{E} - 09$$

Where m is mass, and p_T is total momentum.

The constants d_w and t_w are stated relative to the elementary fermionic particle frame with any motion related to particle translation removed.

When we refer to the width of displacement we are specifically talking about this width at the momentum radius of the particle.

When we move an elementary fermion we must add energy, as we have discussed. So as it turns out, the constants d_w and t_w when viewed from a fixed frame, are fixed properties of space related to any elementary fermion. And these constants are the cause for the mass of the electron at rest being 9.1093826E-31 Kg, and the energy of the electron at rest being 8.187104786845060E-14 J.

We can provide an example to illustrate. Suppose an electron is moving at 0.866025403784439 c so that the Lorentz factor γ which relates to that motion through space is 2.0. The energy of that electron would be $E = \gamma\, E_0\ or\ 2E_0$. So the width of spinning displacement related to the frame of the moving electron would be $d = \frac{d_w}{E} = 5.626743699601860\text{E} - 14\ \text{m}$, but the width of displacement related to the fixed frame of space would be:

$$d = \gamma\, \frac{d_w}{E} = 1.12534874\text{E} - 13\ \text{m}$$

And the width of displacement of an electron at rest is:

$$d = \frac{d_w}{E_o} = 1.12534874\text{E} - 13\ \text{m}$$

Which indicates that there is only one value for the width of displacement, viewed from the fixed frame of space, which is compatible with the properties of space. So that the time constant of space, coupled with the width of displacement at the momentum radius, viewed from the fixed frame of space, determines the rest energy and rest mass of the most stable elementary fermions, the electron and

positron. Here we should note that this width of displacement is also the cause for the specific value of the elementary charge of these particles.

Therefore the electron at rest possesses the following relationships regarding width of displacement, time for displacement to traverse a point, and energy.

$$E_0 = \frac{d_w}{d} = \frac{9.21334805547212\text{E} - 27}{1.12534873992037\text{E} - 13} = 8.18710478684506\text{E} - 14\ \text{J}$$

$$E_0 = \frac{t_w}{t} = \frac{2.17311033470236\text{E} - 35}{2.65430868576898\text{E} - 22} = 8.18710478684506\text{E} - 14\ \text{J}$$

We can also state that the total momentum for any particle is:

$$p_T = \frac{d\ E}{t\ c^2}$$

Which means that for the electron:

$$p_T = \frac{d_w}{t\ c^2}$$

And the forward momentum of a photon is:

$$p = \frac{d\ E}{\sqrt{2}\ t\ c^2}$$

At the momentum radius of a particle, is the only region where this time constant of space is active, because this time constant is the cause for momentum, and this time constant requires a specific velocity. Transverse motion properties of longitudinal displacements in space are only supportive of this transverse time constant when their motion is at the velocity $\sqrt{2}c$. This only occurs at the one point the longitudinal spinning displacement, and forms the momentum radius of a particle. So this time constant of space, and the properties it generates, including momentum (and in the case of fermions, mass), can only occur at the region of a longitudinal displacement which is moving transversely at $\sqrt{2}c$. This set of properties, this time constant related to displacements of space at a specific transverse velocity, are what makes it possible for light and particles of matter, as we know them, to exist in our universe.

The electron has the rest mass and rest energy it possesses because, at rest, the following condition is met.

$$d = 1.12534874\text{E} - 13\ \text{m}$$

And this condition is required for a stable elementary fermion in space, moving or stationary.

When we review the proposed structure of the electron we can see that the proposed rate of spin for a fermion is…

$$w = \frac{E}{3.72847435563235\text{E} - 35}$$

So we have shown cause for a constant of action relating to *fermions:*

$$\hbar_f = \frac{\hbar}{2\sqrt{2}} = 3.72847435563235\text{E} - 35$$

Leads us to see that …

$$2\hbar_f \sqrt{2}\ 2\pi = 6.62607004\text{E} - 34$$

And for a photon, which constantly moves forward at c we see that we must have…

$$w = \frac{E}{1.054571800139110\text{E} - 34}$$

$$w = \frac{E}{\hbar}$$

The difference in the constant of action for a photon and a fermion at rest, is simply due to the forward motion of the photon and the reaction of space to that motion. The photon does not convert to a mass carrying particle because it is comprised of energy which displaces both components of space, and an elementary particle of mass must displace only one component of space in order to form the spin topology of a fermion.

We can now show that the mass of the electron at rest is:

$$m_e = \frac{t_w}{t\ c^2} = \frac{d_w}{d\ c^2} = 9.1093826\text{E} - 31$$

Where:

$$t = \frac{t_w}{E_0} = \frac{\sqrt{2}\ h\ \varrho}{4E} \qquad and \qquad d = \frac{d_w}{E_0} = \frac{\varrho\ h\ c}{E}$$

And:

$$t_w = \frac{\varrho\ h}{2\sqrt{2}} = \frac{\sqrt{2}\ h\ \varrho}{4} = \frac{d_w}{\sqrt{2}\ c} = 2.1731103347\text{E} - 35$$

And we can show that:

$$d_w = \frac{\varrho\ h\ c}{2} = \sqrt{2}\ c\ t_w = 9.21334805547213\text{E} - 27$$

And that:

$$h = \frac{2\sqrt{2}\ t_w}{\varrho} = \frac{2\ d_w}{c\ \varrho}$$

The reaction of space to longitudinal displacement moving transversely at $\sqrt{2}c$ is the cause for *E=hv*. It is the cause for momentum of particles and the mass of fermions. It is the reason the universe contains particles of light and matter which react in the manner we observe.

The width of displacements of the electron in relation to the circumference of the electron is the cause for the specific value of the elementary charge.

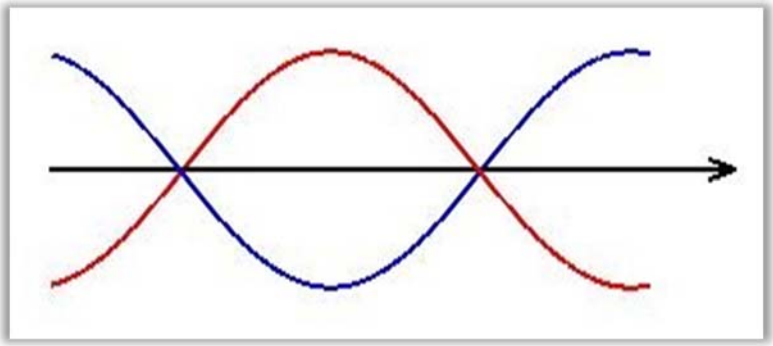
Using the concept that particles are made of spinning longitudinal displacements of space, we have shown that space exhibits a specific reaction in relation to these spinning displacements and that *this reaction of space is cause for the rest mass and the charge of the electron*.

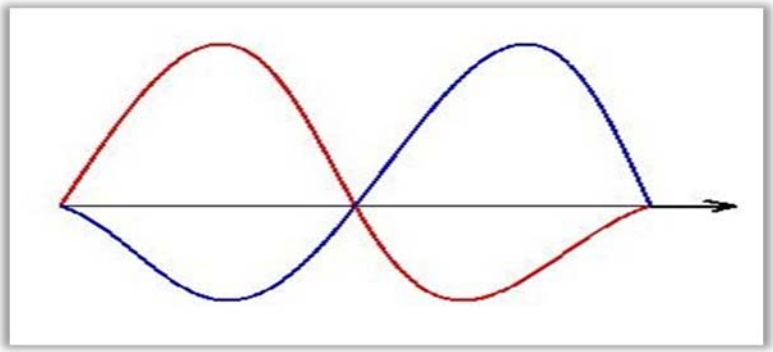
Photon Spin

Spin polarized photons are only one possible polarization. Photons can also be plane polarized.

The ability for photons to exhibit different types of polarization is one aspect of the underlying mechanisms of photons which has been elusive. However, when we consider the approach presented in this article, it becomes apparent that the photon can indeed exhibit many different polarizations, and still comply with the models and concepts proposed.

Since the formative longitudinal displacements of the photon are much faster than c, they can spin in any plane as the photon core moves through space at c. We detect the portions of these spinning displacements which generate momentum, (the portions moving transversely at $\sqrt{2}c$ through space, as the photon moves forward at c) so we perceive Maxwell's equations as a result of what we can sense of these spinning displacements. Maxwell's equations and Planck Action are an estimation of this momentum related force and of the electromagnetic field, but Maxwell's equations are only a shadow of the actual physical dynamics of photons and electromagnetism.





A circularly polarized photon plot of the momentum radius, using this model, is much as one might expect, and is illustrated to the left. The displacements of two components of space spin about the longitudinal axis as (at c) the photon move forward (at c).

However, a plane polarized photon exhibits a slight asymmetry in the plot of its momentum radius using this model. The electromagnetic field intensity exhibits a slight asymmetry which is opposite the momentum radius asymmetry.

In both plots the local velocity vector at the momentum radius remains $\sqrt{2}\,c$.

It may be difficult to find evidence of this asymmetry, because the direction of spin of a plane polarized photon determines the asymmetry, and we generally have the abilities create plane polarized photons which would statistically have an equal distribution of right and left spins, viewed from the side of the photon. This would effectively make the stream of photons display not net asymmetry in their fields.

Due to the properties of space, the velocity c is a very important velocity, because of the constitution of particles, c is the limiting forward velocity for any particle, and therefore it is the maximum speed at which we can communicate using photons. So that c is the limiting velocity for particles to exchange energy by means of photons. But c is not the limiting velocity for every sort of propagation of *displacements* in space. It may or may not be possible for us to communicate using the faster propagation of longitudinal displacement, but particles themselves continually "communicate" in this manner. This communication is the cause for entanglement of complimentary particles, created at the

same time by the same event. These spinning longitudinal displacements also cause part of the behavior of photons in double slit experiments which we will address later.

The Field of a Photon

To understand the force of the electric field of a photon we can begin by calculating the force of charge in the field of a charged particle. We will use the electron for our example.

The electron is of course a spin ½ ħ particle, because all the energy is pulling on one component of space, so its action radius is:

$$r_e = \frac{1}{2}\frac{\hbar}{p}$$

The photon is a spin ħ particle, because half the energy is pulling on each component of space, so its action radius is:

$$r = \frac{\hbar}{p}$$

Where p is: $p = \frac{E}{c}$

The sum of the mean force of electric charge in the field of one electron, at the action radius of the electron is:

$$F_q = \sqrt{\frac{e^2}{4\pi\ \varepsilon_0\ {r_e}^2}} = F_c\ \varrho$$

NOTE: Again we use the term r_e to signify the momentum (action) radius of the electron. This radius is defined as:

$$r_e = \frac{h\ c}{4\pi\ E_e}$$

Where E_e is the rest energy of the electron.

The force of electric charge between two electrons is:

$$F_e = \frac{e^2}{4\pi\ \varepsilon_0\ r^2} = \frac{{F_q}^2\ {r_e}^2}{r^2} = \frac{\alpha\ \hbar\ c}{r^2}$$

Because the electron is confined in three dimensions, forming a mass carrying spin ½ ħ particle, the total force of energy which localizes the electron is:

$$F_c = \frac{\sqrt{2}p\ \sqrt{2}c}{r} = \frac{2E}{r}$$

The electron is confined in three dimensions because all the energy of the photon is displacing only one component of space, so the electron does not have a counter-balancing force like the photon, which allows the photon confinement to be in just two dimensions. All the energy of the electron is displacing

one component of space, so the force F_c of the electron is stronger than that of the photon with the same energy. This makes the electron radius smaller, and makes the electron a spin ½ particle, while the photon is a spin 1 particle. For the electron we must keep in mind the *total* momentum which is $\sqrt{2}\,p$ instead of p which is only the *longitudinal* momentum of a photon with the same energy as an electron. The electron at rest has no longitudinal momentum component so all of its electromagnetic momentum is circulating within the electron structure.

The ratio at the electron action radius of the force F_q of electric charge of a single particle to the force F_c is:

$$\frac{F_q}{F_c} = 0.092762137717132 = \varrho$$

This ratio $\varrho = 0.092762137717132$ is quite important. It can be calculated using the following equation as well:

$$\varrho = \frac{\sqrt{\frac{1}{\pi\,\varepsilon_0}}\,e}{4\,E_e} = 0.092762137717132$$

But the ratio at the electron action radius of the force F_e between two electrons to the force F_c is:

$$\frac{F_e}{F_c} = 0.0072973525664 = \alpha$$

$$F_q = \sqrt{F_e}$$

$$So\ F_e = {F_q}^2$$

The ratio of the energy in the field outside the action radius to the energy of the electron is:

$$\frac{E_q}{E_e} = \alpha$$

The energy in the field of a particle at a given radius can be represented using an equation from the Abraham-Lorentz theory of the electron:

$$E_q = \frac{e^2}{8\pi\,\varepsilon_0\,r} = \alpha\,E_e$$

Based on the calculations above, the total width of the displacement regions circulating in any plane, which form the electron, are the circumference of the electron at the action radius times the ratio $\frac{F_e}{F_c}$.

We now have enough information to calculate the force of the electric field of a photon.

The sum of the mean force F_q in the field of a photon with the energy of the electron, $E_p = E_e$ at the action radius of the *photon* is:

$$F_q = \sqrt{\frac{e^2}{4\pi\,\varepsilon_0\,r^2}} = 0.039333680454904\ N$$

Where:

$$r = \frac{\hbar}{p} = \frac{h\,c}{2\pi\,E}$$

So that for this photon:

$$F_{\mathrm{q}} = \sqrt{\frac{\pi\,E^2\,e^2}{\varepsilon_0\,c^2\,h^2}} = 0.039333680454904\,N$$

And the ratio of the force in the field F_q at the action radius, over the force of confinement F_c for this photon is:

$$\frac{F_{q\,photon}}{F_{c\,photon}} = \frac{\sqrt{\frac{1}{\pi\,\varepsilon_0}}\,e}{2\,E_p} = 0.185524275438304$$

So that:

$$\frac{F_{q\,photon}}{F_{c\,photon}} = 2\,\frac{F_{e\,electron}}{F_{c\,electron}}$$

The total width of displacement regions for this photon at the action radius of the photon is:

$$D_W = 2\pi\,r\,0.185524275438304$$

What we have suggested is that spinning longitudinal displacements of space constitute particles. The photon is a set of displacements of *two components of space*, both displacements are displacement toward the center of the photon from opposite directions, each causing a different field polarity. Half the energy of the photon displaces one component of space. The electron is a set of displacements of *one component of space*, providing a *single polarity* of the charge field for the electron. The propagation velocity of these longitudinal displacements in very much faster than c. However the transverse motion of these displacements at the action radius of the particle is $\sqrt{2}c$, and the *forward motion velocity of the photon is c*. Particles are smaller if they contain more energy, and that applies to photons, electrons and positrons, etc. A charged particle of either polarity (electrons or positrons) obeys the same set of rules in this two component medium of space. This provides for particles which have both local and non-local aspects and behaviors.

The photon we have modeled shows us another important aspect of the quantization (self-confinement) of energy in space. The field intensity of a photon is also quantized, just like the field intensity (electric charge) of an electron is quantized. And the quantization value is the same as that for electric charge. This is precisely why the frequency of a photon is directly related to its energy. The field intensity for all photons is the same but the frequency and "size" (momentum radius or action radius) changes with energy.

Maxwell's equations are a representation, like a shadow, of part of the observables of the fields of photons which are constructed in this manner.

Momentum is created by a delta force across the spinning displacements. Spinning longitudinal displacements create electric charge and the magnetic field of the electron and oscillating electromagnetic fields of photons.

The Behavior of Photons and Electrons in Double Slit Experiments, and Pilot Waves

As we mentioned above, and somewhat as John Stewart Bell envisioned, c is not the limiting velocity for every sort of propagation of displacement of space. As noted, it may or may not be possible for us to communicate using the faster longitudinal displacement, but particles continually communicate in this manner. These spinning longitudinal displacements cause what has been called a "pilot wave" for the photon and electron. But as we can envision the concept of a "pilot wave" is a bit of a naive explanation for the actual phenomenon.

The forces of these displacements which cause the fields of particles also cause the diffractive behavior of the photon in double slit experiments. The fields therefore also serve as a pilot which guide the particle. Since these displacements are longitudinal they are faster than c, these displacements *are the particle*, so clearly they will guide (influence) the particle.

Entanglement

The manifestation of entanglement is a natural artifact of the description of particles we have provided.

When particles are of the same internal frequency and their phase is complimentarily correlated, as when two particles are created by the same event, so that they are complimentary twins so to speak, each of these particles is naturally attuned to the field of their complimentary twin. The fields being moving (spinning) longitudinal displacements of space which propagate much faster than c. Under these circumstances the complimentary twin particles will remain in a sort of lockstep until either great distance or very strong perturbations disrupt that synchronicity. So we would naturally measure a greater than "chance" statistic when analyzing the complimentary spin of such particles in the laboratory.

Atoms and the Quantization of Electron Orbitals

Spectral distribution of emissions from the elements have confirmed the concept that electrons can only occupy certain "orbital positions" in an atom. Experiment has also confirmed that certain wavelengths which may be created by moving electrons appear to play a significant role in this quantization of orbital positions and energy levels. De Broglie's wavelength has been found to correlate very well with the quantization of orbitals. So we would like to propose that there is a clear cause for this quantization of orbitals, but that de Broglie's wavelength is only a partial description of this cause.

The frequencies of the fields of the nucleus are only properly correlated to the frequency of the field of the electron at certain discrete distances from the nucleus. Meaning there is a lower energy state at specific distances from the nucleus.

$$\frac{1}{2\alpha} = \frac{\left(\frac{\lambda_{em}}{\lambda_p}\right)}{\left(\frac{f_{zp}}{f_{ze}}\right)}$$

Where n = 1, 2, 3…, and if f_{ze} is $\sqrt{2}$ times the conventional Zitterbewegung frequency of the electron, λ_{em} is a beat frequency created by the electron in orbital motion, λ_p is the circumference of the charge radius of the proton, and f_{zp} is the internal Zitterbewegung frequency of the proton.

If we model an electron with a momentum radius at rest of:

$$r_e = \frac{\frac{1}{2} h\, c}{2\pi\, E} = 1.93079654122163\text{E} - 13\ m$$

And then place that electron in an orbital around a proton, as in the hydrogen atom. The orbital radius for that electron is assumed to be $r_{orbit} = 5.29177266317597E - 11\ m$, and the velocity in orbit is assumed to be α c, or 2187691.26277 m/S.

Then we calculate the Doppler shifted Zitterbewegung frequencies of this electron at the electron's outer radius and at the electron's inner radius:

The actual Zitterbewegung frequency of the electron at rest is:

$$f_{ze} = \frac{\sqrt{2}c}{2\pi\, r_e} = 3.49477580412838\text{E} + 20\ \text{Hz}$$

The Lorentz factor for the electron moving at α c, or 2187691.26277 m/S is:

$$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} = 1.00002662674068$$

So this is fairly insignificant.

The velocity of the outer radius of this electron is:

$$v_{outer} = v + \frac{r_{orbit} + r_e}{r_{orbit}} = 2.18769226642234\text{E} + 06\ m/S$$

The velocity of the inner radius of this electron is:

$$v_{outer} = v - \frac{r_{orbit} - r_e}{r_{orbit}} = 2.18769026642234\text{E} + 06\ m/S$$

The Doppler frequency of the outer radius of this electron is:

$$f_{outer} = f_{ze}\frac{c + v}{c} = 3.52037146608421\text{E} + 20\ Hz$$

The Doppler frequency of the inner radius of this electron is:

$$f_{inner} = f_{ze}\frac{c - v}{c} = 3.46927320455991\text{E} + 20\ Hz$$

The difference frequency between outer and inner frequencies is:

$$f_{diff} = f_{outer} - f_{inner} = 5.10052224515644\text{E} + 18\ Hz$$

The wavelength of this frequency is:

$$\lambda_{\text{em}} = \frac{\sqrt{2}c}{f_{diff}} = 8.31229706155041\text{E} - 11\ m$$

The de Broglie wavelength for this electron is:

$$\lambda_{\mathrm{dB}} = \frac{h}{m_e\, v} = 3.32491882462019\mathrm{E} - 10\ m$$

So that: $\frac{\lambda_{\mathrm{dB}}}{\lambda_{\mathrm{em}}} = 4$

And therefore:

$$\lambda_{\mathrm{em}} = \frac{n\sqrt{2}c}{2\alpha\, f_{\mathrm{Ze}}}$$

Where n = 1, 2, 3…, and f_{ze} is the Zitterbewegung frequency of the electron:

$$\lambda_{\mathrm{db}} = 4\frac{n\sqrt{2}c}{2\alpha\, f_{ze}}$$

Which would mean that in each atomic orbital, 4*n* wavelengths of λ_{em} would fit exactly.

So can we find an instance of 4 λ_{em} for the proton structure?

The charge radius of the proton is approximately 8.4122769669E-16m. This yields a charge circumference of 5.2855895038408E-15m, which is of course a wavelength associated with the proton charge radius.

If we examine the result of this wavelength at the orbital radius of an electron in the hydrogen atom we can write:

$$\lambda_{or} = \lambda_{cr}\frac{r_c}{r_o} = 3.32491882462019\mathrm{E} - 10$$

Where λ_{or} is this wavelength at the orbital radius, λ_{cr} is the wavelength created by the charge radius of the proton, r_c is the charge radius of the proton, and r_o is the orbital radius of the electron in this hydrogen atom.

Our mass wavelength λ_{em} at this velocity is $\frac{1}{4}\ \lambda_{dB}$, so we have indeed found a reasonably good correlation of an instance of 4*n* λ_{em} from within the proton structure. But this "proton wavelength to electron orbital" relationship is fairly self-evident. However indications are clear that the quantization of orbitals is then simply an interaction between the fields of the nucleus and the fields of orbiting electrons. And while we may not find a direct physical cause for the de Broglie wavelength, we have easily found physical cause for an electron matter wave λ_{em} which is *precisely ¼ the de Broglie wavelength*. This is not likely just a coincidence. Since the matter wave of the electron circulating a proton in the hydrogen atom is a transient, moving waveform, emanating from the electron and propagating theoretically no slower than c, it follows that this wave, by itself, cannot be responsible for the quantization of electron orbitals to specific discrete values. There must be an interaction between the fields of the proton and the fields of the electron which creates these lower energy states at specific intervals. The intervals are then likely dependent on the harmony of the field components of the electron and proton. And these satisfactory phase conditions can only exist at specific distance intervals.

Gravity

If there is a mechanism, due to the properties of space, so that space can only create momentum in the region which has been conditioned to allow this, and since that region would be the distance from the particle core which has a specific velocity, any fields which alter the local conditions in space which support momentum creation will also have a direct effect on the way the particle creates momentum. This effect can cause the force of gravity, and can be expressed in a quantifiable manner.

Which brings us to one of the unique features of the medium of space. When space has been displaced and is under a strain from the fields of other particles, and when the conditions for the creation of momentum have been met, the momentum moves slightly more slowly through space, or takes a slightly different trajectory. This action is a slight redirection of the confined momentum of a particle in the direction of displacement of the external displacement fields in which the particle finds itself. So the same thing which causes light to be diffracted in a gravitational field also causes the force of gravity to be generated *within particles*. Light curves in a gravitational field because its fields and therefore momentum components have been slightly redirected. The gravitational mass of a particle is equivalent to its inertial mass because gravitational and inertial mass are both caused by circulating momentum within the particle. Gravitational mass being equivalent to inertial mass is due to external fields redirecting momentum within a particle to cause the force of gravity within the particle. This is momentum, which when fully confined, normally creates inertial mass (as we have shown), and when redirected, creates the force of gravity. Providing a clear, natural, causal explanation for inertial and gravitational mass equivalence.

The conventional equation for the gravitational force is:

$$F = G\,\frac{m_1 m_2}{r^2}$$

The gravitational constant is: $G = 6.67408\text{E} - 11$ (with an uncertainty of 3.1E-15)

The mass of the electron is: $m_e = 9.10938E - 31kg$

Let us use the distance of 8 times the momentum radius of the electron r_e:

$$r_e = 1.93079654122163E - 13\ m$$

So our r (8 times r_e) will be 1.5446372329773E-12 m.

And the computed gravitational force between two electrons at this distance is:

$$F = G\,\frac{m_e\, m_e}{r^2} = 2.321136486909570\text{E} - 47\ \text{N}$$

Now we need to review the concept that gravity is caused by a redirection of the momentum of a particle, and that the momentum is an artifact which acts perpendicular to spinning displacements which create electric charge. Since momentum is perpendicular to charge, momentum has a similarity, or a correlation to, the action which creates the force of the magnetic field. This indicates that gravitational action will be more correlated to the constant μ_0 than to the constant ε_0.

The gravitational constant G, as related to the field action of the electron, in terms of the mass of the electron, can be expressed as:

$$G = \left(\mu_{0+}\,\frac{\mu_0 \alpha_e}{2\pi}\right)\frac{\alpha^2\, {r_e}^2\, c^3}{1+\alpha} = 6.67418301304375\text{E} - 11$$

Where r_e is the action radius of the electron, α_e is the magnetic moment anomaly of the electron, and of course α is the fine structure constant.

This value $6.67418301304375\mathrm{E}-11$ is within the specified uncertainty for the gravitational constant per CODATA.

However, a more informative expression of the gravitational constant comes from converting this constant to relate it to energy of the electron rather than mass. This is easily accomplished.

Since the gravitational constant expresses the contribution of two bodies to the equation we would divide the mass related gravitational constant by c^4 to convert it to an energy related constant. We will call this constant G_E.

$$G_E = \frac{G}{c^4} = 8.262572810998840\mathrm{E}-45$$

We can now analyze the energy related gravitational constant.

The force of gravity between two electrons computed using this constant is:

$$F = G_E \frac{E_e\, E_e}{r^2}$$

Where G_E is the energy-related gravitational constant, and E_e is the energy of the electron.

Next we need to break the gravitational constant into its constituent parts, which represent the contribution of each body to the constant. We will use the term G_q to signify this quantum gravitational constant related to the energy of a single particle.

$$G_q = \sqrt{G_E} = 9.089869532066370\mathrm{E}-23$$

Computing this using the configuration of energy of the electron:

$$G_q = \alpha\, r_e \sqrt{\frac{\mu_{0+}\frac{\mu_0 \alpha_e}{2\pi}}{c\,(1+\alpha)}} = 9.089869532066370\mathrm{E}-23$$

$$G_q = r_c \sqrt{\frac{\mu_{0+}\frac{\mu_0 \alpha_e}{2\pi}}{c\,(1+\alpha)}} = 9.089869532066370\mathrm{E}-23$$

Where G_q is the quantum gravitational constant, r_e is the action radius of the electron, r_c is the core radius of the electron, α_e is the magnetic moment anomaly of the electron, μ_0 is the permeability of free space (the magnetic constant), and α is the fine structure constant. It seems that the electron is the only particle which allows computation of this constant in this manner. Which may be related to the stability and mass of this most fundamental elementary fermion.

However the equations above could be considered numerical coincidence, so we must show specific cause for gravity in order to sort out this puzzle of nature.

If we use the field intensity at a specific distance from any particle, instead of specifically using the action radius of the electron only, we should also be able calculate this value from the quantized field intensity and the momentum circulating within the mass affected by the field.

The field intensity, to which we refer, is the intensity of the gravitational field caused by a particle at a fixed distance.

Field intensity F_I at a fixed distance equal to r_e, for any elementary fermion, can be derived. And that field intensity is always the same value for any elementary fermion at a fixed distance from that elementary fermion. If we find the product of the energy E and the action radius r, for any elementary fermion, we obtain the same answer for any fermion regardless of the mass and energy of the particle. And if we find the energy in the field at a fixed distance from a charged particle we always obtain the same answer for any charged particle, regardless of mass and energy of the particle. So, while the derivation of the quantum gravitational constant G_q above was calculated using the attributes of the electron, we should also find a way, to calculate that gravitational constant from the attributes of any elementary fermion.

One way to analyze the quantum gravitational constant is to relate this constant to the elementary charge constant to find their relationship.

$$\frac{G_q}{e} = 5.67345036366696\text{E} - 04$$

Then, if we express the force of gravity with the same analytics we used to dissect the force of electric charge we can state the following:

The force of gravity created by two electrons separated by the distance of the radius of the electron, is:

$$F_{gT} = 1.4855273516221E - 45\ N$$

If we then take the square root:

$$F_{gq} = \sqrt{F_{gT}} = 3.8542539506656\text{E} - 23$$

Then to calculate the force of gravity between two electrons at any distance we can use the alternate equation:

$$F = \frac{{F_{gq}}^2\ {r_e}^2}{r^2}$$

We also find:

$$\frac{F_{gq}}{G_q} = 0.4240164214815 = \frac{E_e}{r_e}$$

We can dissect the force and relate that force to a field. Half the force we have calculated, which exists due to gravity between two electrons, is created by the redirection of momentum in each electron. So we can then state that the force of gravity of one electron, when in the proximity of another electron, is caused by:

$$F_1 = \frac{{G_q}^2\ {E_e}^2}{2\ r^2}$$

Which sort of makes sense, since the energy of both electrons work to create the force in one of the electrons. One electron creates a field which redirects the momentum created by the energy in the other electron, causing the force of gravity. This explains why the two forces *appear* to be multiplicative functions instead of just adding. However, the fields we have been discussing are not simply related to

the energy of a particle. *The fields themselves are quantized*. Meaning that the intensity of the gravitational field caused by a single elementary fermion is *the same value* at a *fixed distance* from any elementary fermion, regardless of the energy within the fermion. *So our current Newtonian gravitational constant is an approximation*. There is a fixed contribution to the field by each elementary fermion (photons also contribute to the gravitational field). So the *number of elementary particles in a mass* is the property which determines the gravitational field the mass creates. But the *energy in a mass is the property which determines how much force the mass creates when within a gravitational field from another body*. Of course a more massive body generally contains more particles, thereby creating a greater gravitational field. So there is a reasonable correlation between the mass of a body and the gravitational field created by that body.

This means that the *gravitational field* itself is not directly related to energy or mass, but is related to the number of particles in a body, so that a massive body when accelerated does not increase the gravitational field it creates, just as a charged particle, when accelerated, does not increase its electric charge. However a body in motion does increase its inertial mass and it therefore increases the internally generated force it creates internally when subjected to a gravitational field. Since we have proposed that the gravity field is caused by the same displacement which creates the particle and causes electric charge, we are also proposing that the gravitational field is quantized in much the same way as the electric charge field is quantized.

The gravitational force between two electrons at our reference distance of 8 times the momentum radius of the electron computed with the G_q constant above is:

$$F = \frac{{G_q}^2 \, {E_e}^2}{r^2} = 2.321255785557930\mathrm{E} - 47$$

Which is in excellent agreement with the conventional method for calculating this force (*within the uncertainty of the gravitational constant as published in CODATA*). But as we mentioned the conventional gravitational constant is an approximation because the field is quantized.

We can now recast the gravitational force equation for the force experienced between two particles, based on the energy of two electrons:

$$F = \frac{G_q \, E_e \, G_q \, E_e}{r^2} = \frac{{G_q}^2 \, {E_e}^2}{r^2}$$

When we take our assumption that the gravitational field is quantized one step further, in our analysis of a potential quantized gravitational field, we must then consider two parts of the gravitational situation. One part is the gravitational field which is created by particles, the other part is the force which particles create internally when subjected to this gravitational field.

The force which particles create internally, when subjected to a gravitational field, is caused by a redirection of the internal circulating momentum within the particle affected by a gravitational field. *So the internal momentum of a body is an important part of this study*. For electromagnetic radiation the commonly accepted equation for momentum is:

$$p = \frac{E}{c}$$

We have shown why it is that this equation for a mass carrying elementary fermion should actually be:

$$p_T = \sqrt{2}\frac{E}{c}$$

$E=mc^2$ for any massive body, so the internal momentum circulating in the particles within a massive body is:

$$p_T = \frac{\sqrt{2}\, m\, c^2}{c} = \sqrt{2}\, m\, c$$

And the relationship between this total momentum and mass is:

$$\frac{m}{p_T} = 2.35865433674968\text{E}-09$$

$$\frac{p_T}{m} = 423970560 = \sqrt{2}\, c$$

We then begin to break the Newtonian gravitational constant into its components. We can start by showing that there is a component of G for each mass in the gravitation equation:

$$F = G\frac{m_1\, m_2}{r^2}$$

So that we can take the square root of G as the component of G for each mass:

$$G_1 = \sqrt{G} = 8.16935737986777\text{E}-06$$

$$F = \frac{G_1\, m_1\, G_1\, m_2}{r^2}\ or$$

$$F = \frac{\sqrt{G}\, m_1 \sqrt{G}\, m_2}{r^2}$$

Of course this equation yields the same result as the conventional gravitation force equation. But we want to perform this separation so that we can replace each of these G_1 components in the equation with expressions which represent the force created in one mass and the field generated by the other mass respectively.

It is a simple matter to deal with the expression of G_1 to cause it to represent the redirection of momentum within a mass, and describe the force of gravity created within a particle. We can simply multiply the mass/momentum relationship (shown above) by G_1 to obtain a gravitational force constant which is related to the momentum of energy confined within a mass.

$$G_1\,\frac{m}{p} = (8.1693573798678\text{E}-06)(2.3586543367497\text{E}-09) = G_2 = 1.9268690212483\text{E}-14$$

We will use the expression $G_2 = 1.9268690212483\text{E}-14$ to represent the momentum related gravitational force constant.

Note*:* $\frac{Mass}{Total\ Confined\ Momentum}$ for any fermion is always: 2.3586543367497E-09

Our objective is to derive a gravitational field constant to represent the quantized field created by each elementary particle in a mass. We face several difficult issues in doing this. First, we have assumed that

an artifact of the same electromagnetic fields which constitute particles also creates the gravitational field of a mass. Which would make the gravitational field a quantized field much like the Coulomb field is quantized. However we do not yet know how to accurately calculate the total number of elementary particles which contribute to that field within any given massive body. And the gravitational field is so weak that it is impossible to measure it accurately for any small mass, like a single particle. But we can begin by using the gravitational field of the earth as a starting data point.

We know the inertial mass of the electron. We have also concluded that inertial and gravitational mass are equivalent, and we have shown, in this discussion, direct cause for that conclusion. So we can conclude that the gravitational force created by the redirected circulating momentum within the electron in the earth's gravitational field, at the earth's surface, is 8.93339057E-30 N.

This means that if we express the gravitational force equation based on our findings, the form of that equation to express the force of this electron at the earth's surface would be:

$$F = \frac{G_3\, n_1\, G_2\, p}{r^2} = 8.93339057\mathrm{E} - 30\ \mathrm{N}$$

Where G_3 is a field constant, n_1 is the number of particles in the earth, G_2 is our momentum redirection force constant, p is the total circulating momentum of the electron, and r is the earth's radius. We know the values for G_2, p, and r, so we can derive the product of $G_3\, n_1$.

Finding the product of $G_3\, n_1$we can write:

$$G_3\, n_1 = \frac{F\, r^2}{G_2\, p} = 4.875716730674450\mathrm{E} + 19$$

Which means that if we can accurately estimate the number of particles in the earth, which each contribute a specific value to the quantized gravitational field of the earth, we can also determine the value of G_3 the quantized gravitational field of a single particle. We have shown previously that all elementary particles including fermions and photons have the same quantized electric field intensity, so each elementary particle, based upon our premise, also possesses the same gravitational field value.

This indicates we could calculate the force of gravity between two bodies if we can accurately estimate the number of elementary particles, the total energy (momentum), in each body, and the distance between the bodies:

$$F = \frac{G_3\, n_1\, G_2\, p_2}{r^2} + \frac{G_3\, n_2\, G_2\, p_1}{r^2}$$

However there is a difference in these gravitational theories. Our suggested approach evaluates the force of one body caused by the field of another body, and does so in a manner which is independent of any reciprocal forces and fields between the bodies. This allows independent calculation of force on one body in the field of another, and requires the addition of forces on each body to derive the sum of forces on both.

But this indicates that there is either an error in our new approach, or there is a subtle fundamental error in the Newtonian gravitational theory.

If gravity is caused by the reaction of "mass" (confined momentum) to a quantized field, or a quantized warping of space if you prefer (which is highly likely, since the electric charge field is also quantized).

Then the equation in the form:

$$F = G\ \frac{m_1\ m_2}{r^2}$$

Is only an estimation, and fails under certain circumstances, simply because it does not take into consideration the equivalence of gravitational and inertial mass.

Examining this in another way. If inertial mass and gravitational mass are equivalent, as we have concluded based on all experimental evidence, and based on our model of space and particles, then the Newtonian gravitational equation cannot be the full and correct formulation for gravity. For if inertial and gravitational mass are equivalent, then the "force of gravity" must take on a form which describes the relationship between the inertial and gravitational mass and the inherent energy of the mass. Which is another way to say that for any mass there is a mass-energy equivalence, and for any mass there is a gravitational and inertial mass equivalence. So that the energy of a mass determines both its gravitational and inertial mass. Then, once we have derived the constant G_2 above, the gravitational field intensity is the only remaining contributor to the force of gravitational mass. So that the correct formulation for gravity must include the cause for the force of gravity which is related to energy in a mass (just as inertial mass is related to the energy in a mass) and the gravitational field intensity which causes a mass to create that specific force of gravity. So we need two constants to expresses these two different contributing factors in order to properly and accurately define gravity itself. We have called those two constants G_2 and G_3.

Let us create examples to illustrate this problem.

In order to break the Newtonian equation into its various gravitational field and force components we would need to begin by rewriting the equation in the following form:

$$F = \frac{\sqrt{G}\ m_1 \sqrt{G}\ m_2}{r^2}$$

This equation assumes the bodies are separated enough so that the distribution of the particles within the bodies does not appreciably change the field vector from the center of gravity of the bodies. As two large massive bodies approach, the field vectors are spread somewhat across the body diameters, increasing the complexity of the equation.

But this equation does not accomplish our final goal. Based on what we have discussed, what we need is an equation which will allow us to calculate the force of one body in the gravitational field of another body.

A suitable form for such an equation is as we have defined above:

$$F = \frac{G_3\ n_1\ G_2\ p_2}{r^2}$$

In situations where we need to know the total gravitational force between two interacting bodies we would then use:

$$F = \frac{G_3\ n_1\ G_2\ p_2}{r^2} + \frac{G_3\ n_2\ G_2\ p_1}{r^2}$$

In the equations above we have separated the components which create gravity into the two parts which express 1) the force (acceleration) created in one mass by 2) the field from the particles in the

other mass. Now we should further quantify the field itself and relate that to the redirection of momentum caused by that field, in order to fully understand the action of gravity.

We have suggested that the field configuration which causes gravity is the same displacement of space which causes electric fields, both positive and negative. If that is true then we can define the field configuration responsible for gravity. Since electric fields displace only one component of space in this scenario, gravitational fields would be the net displacement of space which is ½ the displacement of the electric charge fields. Gravitational fields would also always be attractive in this scenario, because the net displacement of space is in one direction, toward the particle or collection of particles from which the studied field emanates. And since electric charge is quantized, the gravitational field is also quantized.

Note: The *gravitational field* of a moving body is the same intensity as the field of that body at rest. But the *force of gravity* created internally by a moving body in a fixed gravitational field is increased because the energy and therefore momentum of a moving body is increased with velocity. Inertial mass and gravitational mass are equivalent because the confined momentum within a body is the source of both, and because the same acceleration is applied to all particles in a specific gravitational field intensity. The confined momentum of a moving particle is greater than that of a particle at rest, so the force of gravity is increased on a moving body. Which is another way of saying that the more energy an object possesses the more inertial and gravitational mass it possesses. So that $E=mc^2$.

In the section on the creation of inertial mass above, we presented two different means of showing the creation of mass of an elementary fermion. We subsequently suggested that the gravitational field redirects the circulating momentum within the fermion, causing acceleration or force.

We calculated the mass of the electron by stating that:

$$m = \frac{p}{r_e\ \omega} = \ 9.1093826E - 31Kg$$

If the momentum *p* is redirected from a uniform path, accelerated and decelerated so that the confinement of that momentum is no longer a balanced confinement, but rather an accelerated confinement, under these specific circumstances a net force (or acceleration) can be created, like the force of gravity we have suggested. The displacement fields of other particles can have such an effect, on this momentum which causes the required circumstances to create this non-uniformity of confinement and the resultant force of gravity.

If we know that inertial and gravitational mass are equivalent, we can know that the electron weighs $8.93339057\mathrm{E}-30$ N at the earth's surface, for the same reasons we know that a 1Kg mass weighs 9.80665 N at the earth's surface.

So in order to use our new equation … $F = \frac{G_3\ n_1\ G_2\ p_2}{r^2}$ …We need to quantify the term G_3 and estimate the number of particles n_1 in the mass of the earth. We have previously derived the value of the momentum related gravitational force constant G_2.

$$G_2 = 1.9268690212483\mathrm{E}-14$$

We have previously determined that the product of $G_3\ n_1$ is:

$$G_3\ n_1 = \frac{F\ r^2}{G_2\ p} = 4.875716730674450\mathrm{E}+19$$

Since G_3 is the gravitational field constant for a single particle, if we can accurately estimate the number of elementary particles in the earth we can also derive the G_3 term.

We can estimate fairly well the number of elementary fermions in the earth, but is it much more difficult to estimate the number of photons which exist continually exchanging energy within the earth's mass. It is however quite reasonable to assume that there are very many photons exchanging energy between particles, continually, within a massive object, especially one like the earth where the temperature of the interior is quite elevated. But since our analysis indicates that every elementary fermion, and every photon, contribute to the gravitational field a massive object creates, it seems we must consider the number of photons within the earth during this analysis.

In order for our electron to react the way we think as related to gravity, in the gravitational field of another electron, the value of G_3 must be a single specific value. In other words, for our equation to yield the same answer that the conventional Newtonian gravitational equation yields, for all circumstances, G_3 can only be a single value. But the problem with that is that we do not know how gravity actually works between two electrons. That force is so weak we have no way to measure it, especially since the force of electric charge is so much stronger than gravitational forces. This single value for G_3 places the number of elementary particles in the earth which cause gravity fields at a number which is much higher than we calculate based on the statistical distribution of elements and the mass of the earth.

When we list the elements of the earth and their contribution to the mass of the earth we find the values in the table below:

Element	Approximate contribution to earth mass
Oxygen	0.466
Silicon	0.277
Aluminum	0.081
Iron	0.05
Calcium	0.036
Sodium	0.028
Potassium	0.026
Magnesium	0.021
All others	0.015
Total	1.000

Then we can use the makeup of each element to estimate the number of elementary particles in each atom. We can then estimate the number of atoms required to comprise the mass of each element. In this manner we can estimate the number of elementary particles.

The most aggressive estimate for the number of elementary fermions we have calculated is 1.0682464262E+52 fermions constituting the earth's material mass. But the value for G_3 which yields the same value for the force of gravity between two electrons, that we obtain using the Newtonian gravitational equation, requires that there be approximately 6.5526007148369E+54 elementary particles within the earth.

If these estimates are close to accurate, it would mean that there are 612 photons (or other bosons) for every elementary fermion in the earth. But there is more to this issue. Using this quantized gravity approach it may be that we would need to model the distribution of the particles in the earth. Meaning that the particles in the mass of the earth which are closer create a stronger field than the particles in the mass on the other side of the earth. We will study this further, but for now we have obtained an estimate for G_3.

$$G_3 = 7.4408878899556\text{E} - 36$$

As we have pointed out, this estimate yields the same answer we get from the Newtonian gravitational equation for electron-electron gravitational interaction and electron-earth gravitational interaction if the number of particles in the earth contributing to the gravitational field is approximately 6.5526007148369E+54 elementary particles.

$$F = \frac{G_3\, n_1\, G_2\, p_2}{r^2} = G\, \frac{m_1\, m_2}{r^2}$$

As stated earlier, If we know that inertial and gravitational mass are equivalent, we can know that the electron weighs $8.93339057\mathrm{E}-30$ N at the earth's surface, for the same reasons we know that a 1Kg mass weighs 9.80665 N at the earth's surface. Because of this we also know that our G_2 momentum related gravitational force constant is the correct value.

When we combine the gravitational field constant and the gravitational momentum constant, so that we have a composite momentum related constant which expresses the action the field has on the momentum of the particle, showing acceleration of one particle in the field of another we obtain:

$$G_p = (7.4408878899556\mathrm{E}-36)\,(1.9268690212483\mathrm{E}-14) = 1.4339335724413\mathrm{E}-49$$

We can of course then create such constants, relating the acceleration of a particle in the field of another particle, using energy

$$G_E = (7.4408878899556\mathrm{E}-36)\,(6.7643072784993\mathrm{E}-58) = 9.0907259705261\mathrm{E}-23$$

Or mass.

$$F = \frac{G_3\, n_1\, G_2\, E_2}{r^2} = G\, \frac{m_1\, m_2}{r^2}$$

$$G_m = (7.4408878899556\mathrm{E}-36)\,(6.0794561971184\mathrm{E}-41) = 8.1703370444877\mathrm{E}-06$$

Where ${G_m}^2 = G = 6.6754407420527\mathrm{E}-11$

$$F = \frac{G_p\, n_1\, p_2}{r^2}$$

$$F = \frac{G_E\, n_1\, E_2}{r^2}$$

$$F = \frac{G_m\, n_1\, m_2}{r^2}$$

Since inertial and gravitational mass are created by confined, circulating momentum, it seems more intuitive to conduct our gravitational analysis in terms of momentum.

As we follow this specific premise, that energy displaces space, we have not talked about the *actual magnitude of displacement* of space which occurs when energy pulls on space. The displacement distance, per unit of force, is a way to quantify the stiffness of the medium of space. But we have very little information disclosing exactly the amount of physical longitudinal displacement which occurs with a given force of energy. We have derived the forces, but we don't know the actual displacement caused by those forces. The physical longitudinal displacement magnitude is impossible to sense directly and difficult to measure. Gravity may be the only easily accessible clue we have which provides this kind of information.

When a spinning displacement which makes up the field of a particle, crosses another particle, it will slightly displace the components of the particle in the field by an amount which is determined by the displacement in the gravitational field. Since we have the information to calculate the spinning displacement width and frequency which causes the electric and magnetic field components, we could then assume we can calculate the magnitude of the net displacement of space from the acceleration caused by the gravitational aspect of a particle's field. Then we could theoretically estimate the physical displacement magnitude caused by a particular force or a specific particle's energy. Once we have that information we can then derive the stiffness of space related to gravity, charge, and magnetism.

But we can only accurately accomplish this set of tasks if the force of gravity between two electrons is defined properly by the conventional Newtonian gravitational equation.

What we are assuming is:

1. Gravity is caused by a quantized field created by every elementary particle, which redirects (refracts) confined circulating momentum within particles in that field.
2. Our gravitational field constant G_3 is based on the concept that the Newtonian gravitational equation is accurate for the interaction of two electrons, which may or may not be true.

But if these assumptions are correct, we can find the displacement of space by understanding the displacement caused by gravity, and we can state that the apparent net longitudinal displacement of space at the momentum radius of the electron at rest is 2.1248446421E-66 m. Which makes space an incredibly stiff medium. The displacement of one component of space, creating charge, at the momentum radius of the electron is then 4.2496892841E-66 m.

So that the net displacement of space toward a particle center caused by energy is 3.170052715E-40 m per J^2 and the displacement of electric charge (one component of space) is 6.34010543E-40 m per J^2.

Using the concept that particles are made of spinning longitudinal displacements of space, we have shown that space exhibits a displacement toward massive objects which causes an acceleration of particles toward a massive object. The concept that particles are longitudinal spinning displacements of space provides a simple and elegant means of explaining phenomena like gravity, electric charge, momentum and mass. And it shows why gravitational and inertial mass are equivalent.

The Properties of Space which Create Momentum

We have discussed the idea that momentum is created in space at the point on a spinning longitudinal displacement which is moving transversely through space at the local velocity $\sqrt{2}\,c$. Now we want to discuss why that idea has been proposed.

First, the concept that particles are principally made of longitudinal displacements of space is supported by the following evidence. Electric charge propagates much faster than light, and in the laboratory frame seems almost instantaneous. The analysis we have done, showing that charge is the result of longitudinal displacements of one component of space toward the particle center, show a remarkable accuracy in the description of the behavior of charge. And more energetic particles are smaller particles, which agrees completely with the concept that energy of the particle pulls on space to displace space toward the particle center. More energy equals more force, which causes smaller particles with a higher spin rate. The creation of magnetic fields by these spinning displacements of charged particles also agrees completely with the observed magnetic fields of elementary fermions. In short, this

configuration describes electric fields and magnetic fields as being caused by the same thing, and shows why we observe the electromagnetism we see in nature.

But the specific point we would like to make, deals with the creation of momentum at the point on a spinning, transversely moving, longitudinal displacement which is moving through space at the local velocity $\sqrt{2}\ c$. One question we would ask is, why does space only create momentum about this region of transversely moving displacements? Why not at all points on a transversely moving longitudinal displacement? The answer to that question is fairly simple, but we have to look at some examples in nature to help us illustrate this answer.

When we observe transverse waves in a material medium we find that these waves can only propagate through a given medium at a specific velocity. In an elastic solid medium we express the physics of transverse wave propagation by the equation:

$$v = \sqrt{\frac{\mu}{p}}$$

Where *v* is velocity of transverse wave propagation, *u* is the shear modulus of the medium, and *p* is the density of the medium.

But space is not a material medium. Space is not an elastic solid. Space is a frictionless, principally inertia free, tension based medium, and as such does not have a material density term as in *p* in the equation above. In fact space does not support lone transverse waves. What we sense as transverse waves have been described in this document, and these things we sense are the results of transversely moving longitudinal displacements of space. However even though space does not support transverse waves, space does possess some properties which are in certain ways analogous to an elastic solid. There is a time constant in space which causes space to react in a way which creates momentum. Just as transverse waves can only propagate through an elastic solid at one velocity, space can only create momentum at one velocity. That one velocity is the only velocity which works in this way to create momentum out of transversely moving longitudinal displacements of space. Once we examine it, this actually seems to be the only way such a medium could possibly respond. Since space is a frictionless, inertia free, tension medium, longitudinal displacements in space can move transversely at almost any velocity. However space has only one set of properties which govern the behavior of displacements with energy. And just as transverse waves can only move through an elastic solid at a specific rate, space will only respond to a specific velocity of transversely moving longitudinal displacement in a manner which creates momentum. This one velocity is the only velocity where the delta force we have discussed is created, by the reaction of space to transversely moving displacements.

We have discussed a time constant of space as it relates to the creation of the mass of the electron and positron. We have shown why this time constant cause the specific rest mass of the electron. But we have not yet discussed the implications that this time constant of space has on the creation of momentum itself, in all transversely moving longitudinal displacements in space.

So let us review the math to illustrate:

We discussed properties of space which govern the geometry of longitudinal displacements and their spin rates. The width of longitudinal displacements at the momentum radius for any particle are

determined by the constant d_w and the energy. The time it takes that spinning displacement to pass a point in space at the momentum radius is governed by the constant T_w and the energy.

$$d = \frac{d_w}{E}$$

Where the constant $d_w = \frac{1}{2} h\ c\ \varrho = 9.21334805547212\text{E} - 27.$

$$t = \frac{t_w}{E}$$

Where the constant $t_w = \frac{h\ \varrho}{2\sqrt{2}} = 2.17311033470236\text{E} - 35$

The rate of spin of an elementary fermion is therefore also directly related to the energy content of the particle

$$w = 2.68206216435247\text{E} + 34\ E$$

The total momentum of a particle is:

$$p_T = \frac{d\ E}{t\ c^2} = \ \Delta F_c \sqrt{2}\ c$$

And the forward momentum of a photon is therefore:

$$p = \frac{d\ E}{\sqrt{2}\ t\ c^2} = \Delta F_c\ c$$

The measured spin of any elementary particle is then:

$$L = \ \Delta F_c\ c\ r$$

We have shown why these conditions also create the exact quantized value for the elementary charge for any elementary charged particle, and why these conditions dictate the rest mass of the electron.

It is not surprising that at the momentum radius of any elementary particle:

$$\frac{d}{t}\ always\ equals\ \sqrt{2}\ c$$

Due to the properties of space, the total width of longitudinal displacement is determined by the displacement force density in that longitudinal displacement at that distance from the particle center.

$$d = \frac{K_{Fc}}{\sqrt{F_c}}$$

Where *d* is the width of displacement, K_{Fc} is a constant, and F_c is the force of energy at that location.

The value of the constant K_{Fc} in this equation is 1.0363323260365E-13

This simply means that space has a tendency to localize a longitudinal displacement (making the displacement smaller in the direction of spin). And due to these properties of space, the total width of displacement at any radius (distance from the particle center) is the product of the circumference of a circle at that radial distance and $\varrho = \ 0.0927621377171239.$

When we calculate the time constant of space related to the electron displacements we find that time to always be 2.654308685422190E-22 S. But the place on these spinning displacements of the electron which creates momentum is the location where the distance across the displacement is 1.125348739871410E-13 m. At this location the spinning displacement is moving transversely through space at $\sqrt{2}\ c$.

We could argue that with any displacement width or displacement magnitude, traveling at this velocity, some form of momentum must be created. But the momentum we actually measure is the result of the displacement magnitude (force), the width of displacement, and the velocity. Due to the properties of space, a specific force of energy causes a specific width of displacement, and a specific spin rate for those displacements, at the action radius (the point of momentum creation). This makes the action (momentum) radius dependent on energy of the particle, and establishes a functional relationship between width of displacement, spin rate, energy, and momentum radius. In short this causes the Planck action relationship.

When we look at the possibility that momentum is not just created at the point on a particle which is moving transversely at $\sqrt{2}\ c$ we can imagine that momentum is a $1/r^2$ force. So when we use that approach almost everything seems to be acceptable, until we try to compute the mass of the particle. The spin angular momentum is correct but the mass is not correct except at one specific radius.

We have shown two different methods for computing mass:

$$m = \frac{p}{r_e\ \omega} \qquad and \qquad m = \Delta F_c = \frac{p_T\ t}{d}$$

Each of these is accurate only at the Planck action (momentum) radius we have defined. Another indication that the momentum is only created at this one radius is the transfer of momentum between particles. This transfer can be the momentum at that radius but no other location. So these situations rule out the idea that momentum is created all along a transversely moving longitudinal displacement. So momentum is only created at that point on a transversely moving longitudinal displacement which is moving transversely at $\sqrt{2}\ c$. So that if momentum is created by ΔF_c, and mass = ΔF_c, then momentum can only be created at the location on the spinning longitudinal displacements which are moving transversely at $\sqrt{2}\ c$. This is because:

$$p = \frac{\Delta F_c\ d}{t} \quad and\ \ m = \Delta F_c = \frac{p_T\ t}{d}$$

Only has one solution which matches the results of experiment, for mass, momentum, and spin angular momentum.

With this configuration of longitudinal displacements of particles, we have explained quantized electric charge with the value of the elementary charge. We have an explanation for Planck's constant, and we have an explanation for the mass of the electron, the momentum of photons, as well as for spin angular momentum of photons and elementary fermions.

Why a More Energetic Particle is a Smaller Particle – Cause for Planck Action

We have shown the math to illustrate the constitution of particles. Now let us review that math to illustrate the cause for Planck action.

We found the force of energy for an electron at the action radius (momentum radius) of the electron.

Some simple steps are available to begin. The conventional angular momentum equation is:

$$L = r\,p$$

Where L is angular momentum, r is the radius of circulation, and p is the momentum.

The momentum of energy propagating through space, as in the forward momentum of a photon, is:

$$p = \frac{E}{c}$$

But the total momentum of this energy is:

$$p_T = \sqrt{2}\frac{E}{c}$$

We know the angular momentum of an electron is:

$$L = r\,p = \frac{1}{2}\hbar$$

We know the energy of the electron is: 8.18710478685E-14 J

So that indicates this total momentum component of the energy circulating within the electron is: 3.86211E-22

We have proposed that the electron is confined in three dimensions and that this confinement consists of two different spin components which are separated by 90 degrees. So we therefore have to accommodate the vector sum of the two spins in our equatorial or polar spin angular momentum estimations.

The centripetal force required to confine this circulating momentum to a radius which yields a spin angular momentum of $\frac{1}{2}\hbar$ is not difficult to calculate.

The radius is:

$$r = \frac{\sqrt{2}\,\hbar}{2\,p_T} = \frac{\hbar}{2\,p} = 1.930796541221630\text{E} - 13\ \text{m}$$

The centripetal force at the momentum radius is:

$$F = \frac{p_T\,\sqrt{2}\,c}{r} = 0.848054635696108\ \text{N}$$

This force we have just calculated is the pulling force of energy which displaces space toward the particle center, and confines the particle momentum. This is the force which the energy of the electron exerts at the distance of the action radius. The force of energy pulling on space is greater closer to the particle core and falls off with the inverse of the square of the distance from the particle core. But the total force of energy at the particle core is directly related to the square of the energy of the particle. So

the pulling force of energy, the confinement force of the particle, *at the momentum radius of the particle*, is related to energy squared.

So we can define the math which describes all of this in a few simple equations.

The force of energy of an elementary fermion at the momentum radius is: $F_c = E^2\, C_F$ --where the constant $C_F = \frac{4}{\hbar\, c} = 1.26521151107644\mathrm{E}+26.$

The rate of spin of an elementary fermion is directly related to the energy content of the particle.

$$w = K_w\, E = \frac{2\sqrt{2}}{\hbar}\, E.$$

The constant $K_w = \frac{2\sqrt{2}}{\hbar} = 2.68206216435247\mathrm{E}+34$

And momentum is created, due to the properties of space, at the points on these spinning displacements which are moving transversely at $\sqrt{2}\, c$. So the spin rate determines the momentum radius of a particle, as well as the particle frequency. And since the spin rate is related to energy, a more energetic particle is a smaller particle (smaller when discussing its wavelength, or momentum radius).

Now we get into some very interesting topics. The force of energy which pulls on space to displace space at 1 meter (or any fixed distance) from an elementary particle *is a constant*, and *does not depend on the amount of energy in the particle.*

Let's do the math to illustrate. The action (momentum) radius of an elementary fermion is:

$$r_m = \frac{\hbar\, c}{2\, E}$$

The frequency of circulation of an elementary fermion is:

$$f = \frac{2\sqrt{2}E}{h} = \frac{\sqrt{2}\, c}{2\pi\, r_m} = \frac{K_w\, E}{2\pi}$$

The force of energy at the momentum radius of an elementary fermion is:

$$F_C = \frac{4\, E^2}{\hbar\, c}$$

The force falls off with the inverse of the square of the distance so that at 1 meter:

$$F_{1m} = \frac{F_C\, r^2}{1^2} = F_C\, r^2$$

When expanded and then simplified this becomes:

$$F_{1m} = \hbar\, c$$

So that the force of energy within displacement regions, pulling on space from any particle, at any distance outside the particle core, regardless of energy, can be calculated by:

$$F_C = \frac{\hbar\, c}{r^2}$$

As you may have noticed, this is the exact value of the strong nuclear force as well.

As we have previously discussed, the particle core is a region where there is no density gradient of space, and therefore a region of no charge or electromagnetic field. That core becomes smaller with energy, so that the total force at the particle core radius does vary with the energy because the core is smaller for a more energetic particle. The radius of the particle core for a fermion is:

$$r_c = \frac{\alpha\, \hbar\, c}{2\, E}$$

The total width of displacements in any plane through the particle center at any radius (larger than the particle core) is:

$$d = 2\pi\, r\, \varrho$$

Where the constant $\varrho = 0.092762137717132.$

So the displacements occupy 33.39436958 degrees of space surrounding the particle. The force of electric charge is the exact quantized value we experience due to the ratio of the width of displacement to 360 degrees, and the resultant mean force. The force of charge in space at a distance from a charged particle is:

$$F_q = F_C\, \varrho = \frac{\varrho\, \hbar\, c}{r^2}$$

So that the force between two charged particles is

$$F_e = \frac{F_q^2 r_e{}^2}{r^2} = \frac{\hbar^2\, c^2\, \varrho^2}{r_e{}^2\, r^2} = \frac{\alpha\, \hbar\, c}{r^2}$$

Where r_e is the momentum radius if the electron, F_q is the force of charge of the electron at the electron momentum radius, F_e is the force of charge between two charged particles, α is the fine structure constant, and ϱ has been previously defined.

So that the simplest expression for electric charge is:

$$\frac{\alpha\, \hbar\, c}{r^2} = \frac{e^2}{4\pi\, \varepsilon_0\, r^2}$$

We have shown that the reason Planck action causes a more energetic particle to be perceived as a smaller particle is the increase in spin rate and the momentum creation velocity for longitudinal displacements. A more energetic particle therefore has a smaller Planck action radius and a higher frequency. We have also shown that the force of energy is quantized in space just as the force of electric charge is quantized. We have tied together the pieces of the Planck action puzzle and the charge puzzle, and provided a simple, elegant, and robust solution to the questions of charge and mass, while simultaneously (from the same solution) providing explanations for relativity, entanglement, “pilot waves”, gravity, and all forces and fields.

Energy in Space

Physicists have been able to surmise that particles are a form of oscillating or circulating energy. The wavefunctions of particles proposed by Schrodinger and Dirac bear this out. This can also explain why $E=mc^2$. In this document we have discussed the properties of space, and the fact that space must be a principally inertia free and friction free tension medium. Oscillation in a medium which is devoid of inertia or friction can only take on one general form. That form of oscillation is a circulation. Any other form of oscillation requires an inertial component, but no detectible inertial component exists in space.

What this means is that microscopic electromagnetic energy must consist of a specific form of oscillation. In that form of oscillation, the electric and magnetic fields must be perfectly in phase. This is contrary to the assumption that the energy in an "electromagnetic wave" alternates between the magnetic field and the electric field. The energy does not ever vanish, and there is no inertia to sustain an oscillation through a zero potential. So the oscillation must be in the form of a continuous circulation.

We have explained a means for this continuous circulation to occur in photons which yields photons with the abilities to be polarized in the manner we observe in nature.

We have also explained how the circulation (spin) of a photon differs from the spin of an elementary fermion. The model for energy in space we have proposed shows cause for the electromagnetic fields generated by particles which are precisely the fields which we experience and measure. The fields of this model simply display the properties of the fields we measure in nature.

Then if energy in space is a displacement, the displacement must be a circulating longitudinal displacement of space which is directed toward the particle center. The concept that energy in space is in the form of transverse waves is contrary to the evidence we have just discussed. Of course spinning longitudinal displacements have a transverse motion, and it is therefore possible for us to jump to the conclusion of the presence of a transverse wave. But a normal transverse wave is contrary to the property of a "static" electric charge field exhibited by elementary fermions. So there is simply more to the story than energy being in the form of confined circulating transverse waves.

We have explained how it is that these spinning longitudinal displacements are capable of displaying the property of charge in elementary fermions, and the property of a perceived oscillatory electromagnetic waveform in the photon.

Conclusion

When we take all experimental evidence into consideration, it only leaves a very narrow set of possibilities which can explain *all of what we observe*. We have come quite close to describing cause for all of what we observe in these few pages.

Using the concept that particles are made of spinning longitudinal displacements of space, we have shown how electric charge is created, why electric charge is quantized, the cause of magnetic fields, the cause of entanglement, the quantization of mass, the quantization of light, the cause for more energetic particles being smaller particles, the cause for momentum, the way mass is created in fermionic particles, the manner in which gravity is caused by displacements of space, the cause for the behavior of particles in double slit experiments, the cause for a "pilot wave" which guides the trajectory of particles, and a direct cause for relativity. We have shown that Maxwell's equations are an expression for what we

are able to sense, but are not a description of the conventional sense of transverse waves in space. We have shown how all forces are caused by the strong force, and we have unified all forces into a single coherent theory in three dimensional Euclidian space. We suggested therefore that we experience time as the rate at which fermions can exchange energy in the form of photons. This causes our perception of time to slow with motion through space. We have shown why Lorentz transformations so aptly describe the motion of material objects through space. And we have shown that relativity has a specific form, that motion is relative to the fixed frame of space, that c is not the limiting velocity for longitudinal displacement of space, and that the correct form of relativity does not imply that space is 4 dimensional space-time, but rather implies a three dimensional Euclidian space, with time separate from the dimensions of space. We have shown how it is that gravitational and inertial mass are equivalent, and we have found reason to suspect that the gravitational field is quantized just as electric charge is quantized.

The ability to accomplish all of these items in the framework of a three dimensional Euclidian space, or in fact any space, is credible indication that this sort of interpretation is indeed viable.

There is a simple, elegant, coherent, and unified proposal for a theory which describes our universe.

Remaining Questions…

1. Work out the math for the magnetic field. Show how the magnetic pole of electrons are created.
2. Figure out the specifics and the properties of space which cause momentum to be created only at those portions of spinning longitudinal displacements which move through space with a transverse velocity of $\sqrt{2}\,c$. Consider that momentum can only be measured when there is a reaction between two or more particles.
3. Study the possibilities of interference or interactions of photons in space.
4. Try to determine the velocity of longitudinal displacement of space.
5. Study and figure out exactly why photons move through space at c, and elementary fermions are able to be principally still in space. Figure out how the action of momentum of the photon propels the photon forward only at c, or find another cause for this required motion through space.
6. Consider the induced velocity of a fermion if displacement spins as modeled for the electron. This is presenting the possibility that massive particles also are forced to be continually moving in space, but at a much lower velocity and/or in a more localized trajectory.

$$E = \frac{\sqrt{2}gh}{4T}$$
$$E = \frac{cgh}{2D}$$