On Electric Charge

Abstract

Electric charge has been a compelling topic of study for far more than a century. Parts of this persistent puzzle have been a bit elusive. Our objective is therefore to move closer to a full and objective understanding of fields, energy, and space.

For quite some time, classical approaches to the problems of physics have been explored. It would seem that we would have covered all possibilities. However, you will see a bit of new exploration in the discussion which follows. It often takes only a small change in perspective to help elucidate an otherwise obscure subject.

When we find ourselves contemplating the bizarre and unexplainable, to answer questions, it is most often because we do not have a real grasp of the underlying causes and mechanisms at work. Coming to adopt ambiguities routinely in our explanations can easily be caused by trying to apply theories which are incorrect in some detail. We find ourselves in this situation in theoretical physics, at this time. So logically we should review what we know, and don't know, and see if we can correct some of these issues.

Each step of logic is fairly simple. Nature and the universe are before us to observe. The pieces of the puzzles all work together harmoniously to create this universe we inhabit. If our theories do not all fit together seamlessly then our theories contain error. We do not have to ridicule anyone in order to recognize this fact. We are not attacking anyone when we say that our theories are incorrect. We are simply stating the obvious in order to better serve humanity. The longer it takes for our academic establishment to recognize our lack of accurate knowledge, the more our intellectual resources are wasted pursing dead ends, and pursing problems we have made unsolvable, by using incorrect assumptions.

Introduction

When we study subatomic physics deeply, giving the topics requisite thought, and considering the implications, we often cannot help but think that we may have missed some of the basics along our way. This has been voiced, in various ways, by many, including Einstein, Feynman, John Archibald Wheeler, and John Stewart Bell…, and the list goes on. Our quest to understand has taken us on a strange journey. We have considered many possibilities in the last few hundred years.

At times in our history we have found new pieces to the puzzles, which caused us to temporarily reverse course, and rebuild portions of our foundations. While this process is often a struggle, it also has proven to be quite valuable.

Here we propose a fresh look at the evidence, and we suggest a set of conditions which require taking a somewhat different perspective compared to the currently accepted scientific theories.

What we will propose, as it turns out, is a simpler, more robust, and theoretically economical approach.

What follows is a new perspective of the experimental evidence, from which emerges a set of conditions which parallels observation.

Energy

In order to lay foundation for our discussion we need to begin by better defining the term “energy” as it relates to this discussion. We will introduce a premise which is intended to help us visualize the action of propagating “energy” in space.

Let us imagine that space *is a frictionless tensor medium* comprised of components, and we will use two of these components for the majority of our discussion. Space itself may well be more complex than this, but we only need these two components to illustrate the cause for electric charge. We are not attempting to define the exact composition or constitution of these components of space. We are not saying these components are tiny particles, nor are we claiming they are not. That issue is for another time, and does not have much impact on our discussion.

Following the premise we are outlining, these two components of space are displaced by energy, and this direct kinetic transverse displacement (propagating “energy”) is perpetually in motion. These two components of space could then often be differentially displaced, with the force of energy pulling one component from one direction and the other component from the opposite direction. This would be the energy configuration of a photon. The basic energy, which we can sense and measure (according to this premise) is the force which causes the transverse propagating displacement of these two components of space. Actually we can sense in various ways, energy which is either transverse or longitudinal displacement energy. But radiant energy, light, and confined energy, matter, are principally made of the propagating transverse displacement.

Such an approach envisions that energy, in this sort of “space”, contracts space. More energy contracts space more. More energy therefore confines itself more. Less energy is spread over a larger area, because it does not have the force required to confine itself more. In such a tensor medium of space, we would observe that a photon, for example, *would be a smaller photon if it had more energy*, which is what we observe in nature.

Light and matter would then be comprised of transverse displacements which propagate at a fixed velocity. These displacements would of course be in a direction perpendicular to the direction of propagation of the “energy”. We would therefore sense this energy as a transverse disturbance of space, and it would create what we would perceive, and measure, as a transverse wave propagating through space.

Forces and Planck’s constant

Planck’s quantization of action has helped to clarify many issues in physics. The term *E=hf* (E̲nergy equals Planck’s constant times f̲requency, often written “*E=hv*”) implies a quantization of light. The unit of light quantization is the photon. The study of photons can become a very complex subject, with spin angular momentum, orbital angular momentum, and a host of unique polarizations and diffractive behaviors. However, for now, we will intentionally keep our analysis simple, so that we can lay a theoretical foundation. Let us therefore start with an elementary analysis of a *simplified* circularly polarized photon. In this analysis, we will address forces and "quantization" (confinement) of energy.

A Simple Photon Model

For the purposes of this initial foundational analysis, we observe and note the following:

The longitudinal momentum p of a photon is:

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

Where momentum is p, the energy of the photon is E, and the speed of light is c.

But this momentum equation is in ways counterintuitive from the perspective of energy being a propagating transverse displacement of a tension medium of space. If we vary the velocity term in this equation we get an inverse of the result we expect. We would not expect that momentum should decrease with velocity increase. So, this equation is not complete enough to be accurate under a set of circumstances where the velocity of energy may vary at all. When velocity increases, momentum would not logically actually decrease, so when velocity is increased we would logically conclude that momentum should also increase. Let us sort this out simply. We understand that there is a mass energy equivalence, and we basically understand the relationships between mass, velocity, and momentum.

This equation $p = \frac{E}{c}$ has been simplified to an extent that it leaves part of the information regarding the creation of momentum out. If it were possible for energy to move faster or slower than c, how would we write this equation so that we would get the correct momentum for that energy? Let us start over, and put together an equation which retains as much information as is needed to make our momentum equation more understandable.

The conventional momentum equation for mass is:

$$p = m\,v$$

And due to mass-energy equivalence:

$$p = \frac{E}{c^2}\,v$$

And if the velocity v is the velocity c:

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

Which can be *oversimplified* to:

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

But as we noted, that extent of simplification does not allow us to accurately compute momentum for energy unless the energy is always moving at precisely c.

So later, as we discuss this new perspective, we will use $p = \frac{E}{c^2}\, v$ in a few circumstances.

Back now to our *simplified* photon example…

The frequency of this photon is:

$$f = \frac{E}{h}$$

Which is derived from $E = hv$ mentioned above, where *f* or *v* are frequency, and *h* is Planck's constant.

The wavelength of our photon is:

$$\lambda = \frac{c}{f} = \frac{h\, c}{E}$$

Where λ is wavelength. Wavelength is the distance it takes for the spin of this photon to make one revolution.

Now we can define an action radius for the simple spin polarized photon:

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

Where ħ is the reduced Planck's constant $\frac{h}{2\pi}$.

This is the radius of action, when the photon is moving forward at c, spinning at *c* at a radius, and this spin makes one revolution in one wavelength. Not coincidentally, this radius also would provide the photon with a spin of ħ. This spin of ħ, called spin 1, is also borne out by experiment.

Note: We are not saying that this is a complete description of what comprises a photon. We are simply using a model to study certain properties, behaviors, quantization, and forces.

Next let us explore the implications of this greatly simplified model of a circularly polarized photon.

Planck's constant illustrates a type of quantization. This quantization is a form of confinement, simply because it defines a form of boundary (oscillatory) conditions for the photon. In our simplified photon model, part of that quantization (or confinement) is the definition of an "action radius" for this photon.

As we have mentioned, the photon has momentum. We consider this to be correct because photons can move particles of mass. Experiment indicates the value of that longitudinal momentum to be $p = \frac{E}{c}$ as shown above. The total (internal and local) momentum is however $p = \sqrt{2}\frac{E}{c} = \frac{E}{c^2}\sqrt{2}\, c$. We accept this because it is the total momentum we derive from the vector addition of spin momentum and forward momentum. From Wikipedia, on the photon: "*The photon also carries a quantity called spin angular momentum that does not depend on its frequency. The magnitude of its spin is* $\sqrt{2}\,\hbar$ *and the component measured along its direction of motion, its helicity, must be ±ħ*".

So, the concept is that the simple photon model is moving forward at the velocity *c,* and spinning about the longitudinal axis of motion, the energy quantization radius, at the velocity *c. If the photon's forward momentum is* $p = \frac{E}{c}$ then its perpendicular momentum in the spin direction is also

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

In order for this simple photon to be confined to a radius which causes one revolution in one wavelength, there must then be a force of confinement which counteracts momentum, $p = \frac{E}{c}$, in the spin plane, to contain the energy and maintain the radius (oscillatory boundary conditions). So, according to this premise, energy itself provides this confining force, and momentum as well as space oppose the resultant displacement. The consequence is simply quantization of energy which obeys Planck's rule.

So how much force are we talking about?

The conventional (classical) form of the centripetal force equation is:

$$F = \frac{m\,v^2}{r}$$

The conventional form of the angular momentum equation is:

$$L = r\,m\,v = r\,p$$

The energy is circulating at the velocity c, so we can restate the centripetal force equation in terms of energy, using the mass-energy relationship. $E=mc^2$

$$F_c = \frac{m\,v^2}{r} = \frac{m\,c^2}{r} = \frac{E}{r} = \frac{p\,c}{r}$$

Which is also equivalent to:

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

So that:

$$F_c = \frac{m\,v^2}{r} = \frac{m\,c^2}{r} = \frac{E}{r} = \frac{p\,c}{r} = \frac{\hbar\,c}{r^2}$$

As a result of these relationships, the force F_c would be required to quantize the frequency of this photon, meaning confine the momentum of this photon to its action radius.

The simplified photon example here, exhibits a balanced bidirectional spinning (inward) displacement of two components of space.

An Electron Model

In order to understand the quantized elementary charge (and the Coulomb field) we will also need to create a simplified model of an electron. The electron serves us well in this study simply because it is the easiest source available in nature for us to study the Coulomb field.

Our simplified electron model will follow some of the same steps we used for the simplified photon model above.

The electron is a *spin ½ ħ, charged particle*, which has a rest mass of 9.1093826E-31 kg, and a rest energy content of 8.187104786845060E-14 J.

If we assume the energy of the electron is confined and moving about the equatorial plane at *c*, and displays the same momentum, in the equatorial plane of the electron, as the forward momentum of the photon $p = \frac{E}{c}$ then we can calculate a "quantization radius" r_e for the simplified electron model.

Since the electron displays the spin ½ ħ property the radius would need to be such that:

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

When we rearrange to solve for the electron's action radius at rest, we have:

$$r_e = \frac{\hbar}{2\,p} = \frac{\hbar\, c}{2\,E} = 1.93079654\mathrm{E} - 13$$

The obvious differences in the two models (photon and electron) are as follows:

1. The energy of the photon is confined in two dimensions and moving longitudinally at *c* in the third dimension. The energy in the electron, at rest, is confined in three dimensions and moving about a point.
2. The photon has a spin angular momentum of ħ, while the electron has a spin angular momentum of ½ ħ.
3. The electron has a fixed charge -- the photon does not.
4. The electron has rest mass -- the photon does not.

We should mention a couple of things about items 1, 2, and 3, which are helpful. The photon displaces one component of space with half its energy and the other component of space with the other half of its energy. So, for a gamma photon with the energy of the electron, the available force pulling each component of space is less than (1/2) that of the electron. Since the photon is a balanced differential displacement of two components of space, there is no force which tends to make it curve, so it travels in a straight line. The photon is confined in 2 dimensions, but travels through space in the 3rd dimension. But the electron is comprised displacement of only one component of space, and that is what changes the nature of the forces to make the electron confined in 3 dimensions. This simple configuration causes the electron to be able to be stationary, have rest mass, and possess electric charge. It also causes the radius of the electron to be smaller (1/2) than a photon with the same energy.

Next, let us address item 4 in the list above, the rest mass of the electron.

The simple photon model above has energy within, causing displacement which is spinning at *c* about the action radius and moving forward longitudinally at *c*. The forward component of the photon's momentum is $p = \frac{E}{c}$ and the total momentum is $p = \sqrt{2}\frac{E}{c}$. The angle of the path described by the motion of displacement within the photon, is 45 degrees, so that it makes one rotation in one wavelength. $cos(45) = \sqrt{2}$

So, we suggest, for our simplified electron model, the total momentum of moving energy induced displacement, in the electron (when the electron is at rest) is:

$$p = \frac{E \, \frac{\sqrt{2}\, c}{c}}{c} = \sqrt{2}\frac{E}{c} = 3.862110042183240E - 22$$

Where *E* is the rest energy of the electron.

This is not surprising, since the photon exhibits a total angular momentum of $\sqrt{2}\,\hbar$ but only the vector quantity of spin ħ would be measured in either the perpendicular or longitudinal directions. The displacement within the photon has a form of helicity to its motion, at 45 degrees to the longitudinal axis. These factors may well be indications of the way energy propagates through space, so we have incorporated that information into the electron model as well. One of the results of those indications could be that the local, *internal* velocity of energy within a particle is normally $\sqrt{2}\, c$. Here we break slightly from the theory of Special Relativity, and proceed on the premise that space is Euclidian, and some things can move faster than *c*. This does not mean that energy is normally transferred between particles faster than *c*.

Here we use the standard Euclidian velocity vector addition, and arrive at a velocity of $\sqrt{2}\, c$ for the internal velocity of energy *within a particle*. This particular velocity would only exist locally, within particles.

But if all the energy in the electron is moving on one equatorial path as it circulates about the action radius r_e, the spin angular momentum of the electron would be:

$$L = p\, r = 7.456948711264710E - 35$$

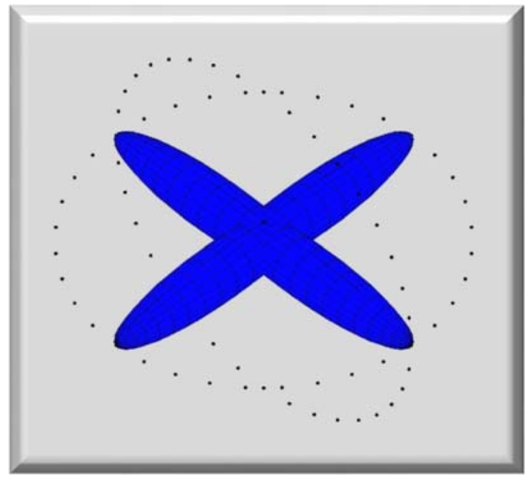
This is $\sqrt{2}$ times the measured spin angular momentum of the electron. So, all of the energy in this electron model is *not* moving in the same direction along the equatorial path. This implies that there is a more complex structure within the electron than that of the photon. The three-dimensional confinement of energy in the electron also indicates a more complex structure than the photon. So, let us imagine that the electron always has half of its energy moving at a 45-degree angle from the equatorial plane and half moving in the opposite 45 degrees from the equatorial plane.

$$cos(45) = \sqrt{2}$$

Then, when we construct a simulation of this electron model, the net spin angular momentum of the electron <u>*measured from any direction*</u> is:

$$L = \frac{p\, r}{\sqrt{2}} = 5.272859000695560E - 35 = \frac{1}{2}\hbar$$

This requires a specific configuration of energy induced displacement within the electron, as we have discussed above, but yields an important result. Experiment seems to indicate that the spin angular momentum of the electron is the same *when measured from any direction.* One simple topology for such an electron model would be two balanced opposing displacements, with the one component of space pulled from opposite directions and displaced to the center of the electron. This particular component leaves an electrically negative polarization visible from outside the electron. We will discuss the details of how this works as we proceed.



These two balanced opposing displacements within the electron, would always be perpendicular to each other, and spinning about the center of the electron. Each of the displacements would be spinning in a direction which is 45 degrees from the equatorial plane of the electron (dotted lines). Interestingly, computer simulation shows that, as the displacements spin in this fashion, they remain perpendicular. This configuration accomodates the "spin up" and "spin down" states we measure experimentally, when studying the electron.

Let us continue studying this model, with a derivation of mass for the electron.

The angular frequency (radians per second) ω of our circulating energy is:

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

Here ω represents an acceleration, and forcible changing of direction, of the propagating 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 energy (with 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:

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

Richard Gauthier [1] derived the relationship between mass and confined momentum of the electron using a similar method, but did not relate the internal $\sqrt{2}\, c$ velocity and *total momentum* of the electron's moving energy to the mass, nor did he account for the correlation of the spin ½ ħ, when measured from any direction, to the inertial property of the electron when accelerated in any direction.

Since the total momentum of the photon implies that in Euclidian space the *internal* velocity vector of the photon 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:

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

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*:

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

Note: Here we consider momentum to be more fundamental than mass, since the most fundamental of particles, the photon, has no rest mass but possesses momentum.

Energy with a total momentum = $3.862110042183240E - 22$, 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 1.93079654122163E-13m at the equatorial spin plane, yields the property of inertia (inertial mass = 9.1093826E-31kg) (in all directions).

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

And a notable result is the fact that we have simply derived the famous equation $E = mc^2$ from this electron model. (Which Richard Gauthier [1] also achieved from his model.)

As a next step, in order to address the force of electric charge, we will need to know the force which confines the energy within the electron. This force F_c is caused by the displacement force of energy in the electron, and is precisely the force required to confine the electron's momentum at the radius r_e.

The force counteracting momentum F_c for this electron model is:

$$F_c = \frac{p\,\sqrt{2}\,c}{r_e} = 0.848054635696108\ \mathrm{N}$$

The active (direct) energy we have discussed so far is "transverse" energy, meaning the energy causes a displacement which is transverse (perpendicular to the direction of motion of the energy).

The displacement in the electron is not like the displacement in the photon. The photon can have a *balanced* bidirectional displacement of the two components of space. The electron's displacement is also from the outside toward the center, but with only one component of space displaced toward the center region, and the other component of space *not displaced*. So, in the photon, both components are displaced and the radius of action is $r = \frac{\hbar\, c}{E}$, but in the electron *one component* is displaced and the radius of action is $r = \frac{\hbar\, c}{2\, E}$. The action radius of an electron is therefore ½ the action radius of a photon with the energy of the electron.

Only one component of space is displaced in creating the electron, and this displaced component is displaced toward a very small area at the center of the electron. So, the electron itself consists of a tiny dense region, surrounded by a region of "lower density". This would theoretically, and may in fact, make the electron appear point-like (and very spherical).

Coulomb Field

From this point, with simplified models of the photon and electron, and a quantization force definition, we can continue discussion of electric charge and the Coulomb field.

So, Let us discuss electric charge.

We experience electric charge in two varieties, or two polarities. Negative electric charge, as produced by the electron, and positive electric charge, as produced by the positron and proton.

We have talked about a force of confinement which can aid the quantization of action described by Planck's constant. These two components of space would provide, in the simplest manner, the ability for space to be polarized only when there is a displacement. When no energy is present, no displacement exists, and there is no polarization. So, obviously no EM fields are created unless energy is present.

If we then envision the simple photon model we have created above, to be a transverse differential displacement of two (electromagnetically active) components of space, which is propagating forward at *c*, and spinning as it propagates, making one turn in one "wavelength", we then have the makings of a simple model which would carry oscillating electromagnetic energy. Such a model would naturally create fields (we will explain further in the next section). There is much more to the photon and electron than just these simple analogies, but nonetheless this simplified concept helps to illustrate our topic.

Now to explore the electric charge of the electron…

According to the classical Abraham-Lorentz theory of the electron [3], the energy contained in the Coulomb field of a charge *e* in all space outside the electron's radius is $e^2/(8\pi\,\varepsilon_0\,r)$. Where *e* is the elementary charge, ε_0 is the permittivity of free space, and *r* is the particle radius.

When the radius *r is* r_e *= 1.930796E-13m* (as we have calculated for the electron), the energy in the Coulomb field is 5.974419E-16 J. If we then divide that Coulomb Field energy at this radius by the energy of the electron, we derive the fine structure constant. 5.974419E-16J / 8.18710479E-14J = α. Where α is the fine structure constant. The portion of the electron's energy which makes up charge (the Coulomb field surrounding the electron) is α = 0.0072973525664 of the total energy of the electron in our model. So, the fine structure is an *energy ratio*, which compares the energy of the particle to the energy in the charge field generated by the particle.

If the energy in the dynamic spinning portion of the electron is a propagating displacement of space, then the stationary charge field (Coulomb field) caused by the electron, and surrounding the electron, is also a displacement, (but a static longitudinal displacement, instead of a propagating transverse displacement) with a field divergence from the center of the electron. This displacement of space, external to the electron, will exert an equal and opposite (pulling) force on the electron, from all directions, to oppose the displacement. This force is exerted on the electron from surrounding space. *The force of electric charge is that force of space which acts on a charged particle and seeks to normalize the longitudinal displacement of space*. Longitudinal displacement, diverging from the center of the electron, and extending into space, causes electric charge. Charged particles cause diverging longitudinal displacement of the space surrounding the particle. Since the displacement is comprised of *only one of two equal but opposite components*, charge has polarity. If one specific component is displaced, the charge on the particle is negative, as in the electron.

The suggestion that energy in the charge field is the fine structure constant times the energy of the particle, is enlightening. It seems to disclose a specific property of space. It shows us that the influence which the displacement within the particle, has on the displacement of surrounding space, is quantifiable. While the conditions causing the displacement within the particle, are the pulling force of energy, the counteracting force of momentum, and the opposing force of space, the conditions in space outside the particle are a bit different. The displacement of space outside the particle is due only to the tensor force caused by the component of space which is displaced within the particle. Displacement within the particle, due to the direct force of energy, also causes a tensor based displacement surrounding the particle, due to the tensor medium of space attempting to normalize displacement.

At this point we will introduce another ratio related to the electron at rest, similar to the fine structure, but dealing with *displacement* instead of energy. We will use the symbol ϰ for this ratio:

$$\varkappa = 0.039333680454$$

It will become obvious why this ratio is this specific value as we proceed.

The *displacement* δ_e within the electron is the action radius of the electron r_e *= 1.930796E-13m.*

The *displacement* of the field, immediately adjacent to the action radius of the electron, is:

$$\delta_q = \delta_e \varkappa = 7.59453341741912\text{E} - 15m$$

In order to complete this charge field picture, we need to introduce one additional ratio. The ratio of the force F_c within the electron, to the total force of electric charge in space immediately adjacent to the electron. This is the force ratio of the electron at rest, and we will use the symbol ϱ to represent this ratio.

$$\varrho = 0.0927621377171$$

$$\text{F}_e = \text{F}_c\, \varrho = 2\varkappa = 7.86673609080946\text{E} - 02\text{N}$$

These two ratios we have introduced are related to the charge of the electron. They also play a role in the mass quantization of the electron. But to define the charge field of all charged particles we need to introduce two new constants which represent the relationship between energy in the particle and a couple of forces of interest.

The first new constant is the "energy-to-confinement force" "E to Fc" constant for spin ½ particles. We will use the symbol Ο to denote this constant:

$$\text{O} = 1.2652115111\text{E} + 26$$

This force F_c is the force which confines the momentum of the propagating energy to the action radius of the particle, as discussed previously.

Then the force of confinement for a spin ½ charged particle is:

$$F_c = E^2\ \text{O}$$

The next new constant is the "energy-to-charge field force" constant. We will use Γ to denote this constant:

$$\Gamma = 1.17363724431773\text{E} + 25$$

Then the force of the charge field immediately adjacent to any spin ½ charged particle is:

$$F_\delta = E^2\ \Gamma$$

The total force of energy in a spin ½ charged elementary fermion is then:

$$F_T = F_c + F_\delta$$

How the Coulomb Field Reacts with Charged Particles

When an electron and positron are in proximity, the force of charge of one, compliments the force of charge of the other in the space between the particles. The displacements are sympathetic, increasing the opposing (pulling) force of space, pulling on the particles, in the direction between the particles, so the particles move toward each other. (The displacement is inward, toward the particle center, so the opposing force of space is pulling on the particle.)

When two like particles (electrons) are in proximity, the displacements are anti-sympathetic, so the pulling force of space is reduced on the particles in the direction between the particles, and the particles move away from each other. (In the case of two electrons, there is force from space pulling on the electron, in all directions equally, except the direction between the particles.)

We can also envision the force of electric charge to simply be the action of space attempting to cause equal amounts of the two components of space in all locations. So that if an electron and positron are in proximity, the electron has displaced one component toward its center, and the positron has displaced the other component toward its center, so for space to be normalized, the particles must move toward each other. So the force of charge is simply space seeking the lowest energy level. Seeking a balance.

Electric charge is then a simple cause-and-effect mechanism, which can be understood from this perspective. We will show the mathematical elegance, and simplicity of this idea as we proceed.

The magnitude of the displacement, at a point in space, distant from the electron, is governed by the $1/r^2$ rule since we have a spherical volume of space surrounding the electron. We can therefore calculate the force that this external displacement of space would exert.

We begin this calculation by once again identifying the force of quantization of the electron which opposes the force of spinning momentum.

The force opposing the acceleration of momentum in the electron, and causing confinement of the electron is:

$$F_c = \frac{p\,\sqrt{2}\,c}{r_e} = 0.848054635696108\ N$$

As we have shown, this force is the required force to contain the momentum of the moving energy in the electron to a circular path at a radius which yields a spin angular momentum of ½ ħ. We find this tremendous force relative to the mass of the electron enlightening. Such a force of confinement provided by energy would indeed make the electron a very durable energy structure.

From this force, the opposing force, and displacement information, we can create a function which will show how much force is available from the *charge field* surrounding the electron, at a point in space. We have suggested that α times the energy of the electron is in this external field. Logically then this energy will be associated with a displacement of surrounding space, the force of space opposing this displacement would be the opposing outward force (the pulling) surrounding space exerts on the electron, from all directions, due to the Coulomb field.

If the Coulomb field is caused by this external converging displacement, then we should be able to accurately calculate the resultant force between particles, with another charged particle placed in space near the electron. As it turns out we can do that calculation with great accuracy.

The energy E_q in the field surrounding the electron is α times the electron's energy. We arrive at this conclusion because we have calculated a radius of 1.930796541221630E-13 m and solved the following equation:

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

We then calculate the total force of displacement F_δ of this field energy is:

$$F_\delta = E^2\ \Gamma = 7.86673609080044\text{E} - 02\text{N}$$

Where F_δ is the force upon the electron from the charge field, E is energy of the particle, and Γ is the energy to force constant of the charge field.

The force of the interaction of two charge fields at the action radius of the electron at rest is then:

$$F_{ere} = {F_\delta}^2 = 6.18855367224440\text{E} - 03\text{N}$$

This value is the force of the interaction of two Coulomb fields at the radius of the electron, at rest:

Therefore, in order to find the force at some other distance we can use the expression:

$${F_q}^2 = (F_\delta\ r_e)^2$$

The force of charge, at a distance is therefore:

$$F_e = \frac{{F_q}^2}{r^2} = {F_\delta}^2$$

Which is precisely the same force we get when we calculate:

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

So that:

$$\frac{{F_q}^2}{r^2} = \frac{e^2}{4\pi\varepsilon_0 r^2}$$

Which also means that:

$${F_q}^2 = \frac{e^2}{4\pi\varepsilon_0} \qquad F_q = \sqrt{\frac{e^2}{4\pi\varepsilon_0}} \qquad F_q = \frac{e}{\sqrt{4\pi\varepsilon_0}}$$

Then, as we refer again to the equation…

$$F_e = \frac{{F_q}^2}{r^2} = \frac{e^2}{4\pi\varepsilon_0 r^2}$$

Calculation of the force of electric charge using the displacement of space yields the same answer we obtain when using the conventional equation $F_e = \frac{e^2}{4\pi\varepsilon_0 r^2}$. However, we arrive at this exact force from a simple causal basis derived from displacement forces. Charge is simply a displacement of space.

So, to review, and construct a model of the Coulomb field…

We then take the product of the total force and the radius of the electron…

$$F_q = F_\delta \, r_e = 1.518906683483820\text{E} - 14$$

This yields a value which is equivalent to the term:

$$\frac{e}{\sqrt{4\pi \, \varepsilon_0}} = 1.518906683483820\text{E} - 14$$

This would naturally give us a force equation of…

$$F_e = \frac{{F_q}^2}{r^2} = \frac{e^2}{4\pi\varepsilon_0 r^2}$$

Lorentz [3] called a displacement the "dielectric displacement" and saw the correlation between this displacement and the "displacement current" of Maxwell, but Lorentz did not clearly identify this displacement as a displacement which is dependent upon the existence of two components of the medium of space. So, Lorentz did not explore the consequences implied by such displacement.

We can relate force and displacement directly to energy in the Coulomb field. In this static field, energy is equal to force times displacement:

$$E_q = F_\delta \, \delta_q = \alpha \, E_e$$

Inducing this particular displacement in space deposits 0.0072973525664 of the energy in the electron into the surrounding space. So, we now have energy, force, and displacement ratios *which describe electric charge accurately* in terms of a displacement of space.

Williamson/van der Mark [4] proposed a model for the electron in 1997, which was comprised of a circulating photon, with the negative end of its electrical fields always pointing outwards. This model of the electron has had a significant impact on the physics community. While this model did not predict the exact charge for the electron, it did significantly inspire further investigation.

We are however *not proposing that the electron is comprised of a circulating photon*. We are proposing that *the displacement configuration within the electron is not the same as the displacement configuration in a photon.* While both the photon and electron have this transverse displacement induced by energy, it is not accurate, or informative, to propose that there is a photon within the electron.

This approach, that energy causes a displacement of space, leads to a model of the electron which displays *exactly* the elementary charge. And the elementary charge quantization is shown by this displacement approach as we will show a bit later.

Some additional useful terms

Let us show some additional relationships for the electron:

$$\varkappa = \frac{\sqrt{\alpha\, F_c}}{2} = \frac{\alpha}{2\,\varrho} = \varrho\,\frac{F_c}{2} = 0.039333680454047\ \textit{is the radius to field displacement ratio}$$

$$\varrho = \frac{\sqrt{\alpha}}{\sqrt{F_c}} = \frac{\sqrt{\alpha}}{\sqrt{\frac{2E}{r_e}}} = \frac{\alpha}{2\,\varkappa} = 0.092762137719152\ \textit{is the confinement to field force ratio}$$

Where F_c is the quantization (momentum confinement) force of the electron.

And, interestingly we can start to understand the cause for the specific rest mass of the electron:

$$\text{Ҡ} = \frac{\sqrt{\frac{2c\hbar\varkappa}{\varrho}}}{4\pi\hbar c^3} = 4.585769462803310\mathrm{E}-06$$

$$\S = \frac{8\pi^2\hbar^2 c^3}{\sqrt{2}\,c\,p_t} = 1.444920006063590\mathrm{E}-28$$

Some of the useful relationships we can then develop are as follows:

The mass of the electron is: $m_e = \text{Ҡ}^2\S\ \mathrm{c}$

The energy of the electron is of course: $E_e = \text{Ҡ}^2\S\ \mathrm{c}^{\mathbf{3}}$

The radius of the electron is: $r_e = \frac{1}{4\pi\text{Ҡ}^2 c}$

Planck's constant is: $h = \text{Ҡ}\S$

The fine structure is: $\alpha = 2\ \varrho\ \varkappa$

We have already shown how:

$$\alpha = \frac{E_q}{E_e} = 2\ \varrho\ \varkappa = 0.0072973525664\ \textit{is the}\ \boldsymbol{energy\ ratio}, \textit{the fine structure constant}$$

These terms and ratios compare the properties of displacement and charge in space surrounding the electron (displacement, force, and energy) to the same set of properties within the electron.

The term $\varkappa$ is simply a coupling ratio which tells us how much displacement occurs in space surrounding an electron $\delta_q = r\,\varkappa$. Just as the term α, the fine structure, is the relationship between the energy in a charged particle and the energy in its charge field $E_q = E\ \alpha$. And then, the term ϱ allows us to calculate the force in the charge field from the force F_c, the force of momentum confinement within the electron. (The force of momentum confinement is the portion of the energy tensor which opposes the momentum of the energy).

$$F_q = F_c\varrho$$

It was first assumed that the $\varkappa$ term would *transform with motion* according to:

$$\varkappa' = \gamma\, \varkappa$$

But that is not the whole story. This term actually changes (transforms) *with energy*. So that, when a particle is accelerated, the increase in energy changes the displacement ratio, and when a particle has a higher rest mass, and therefore more energy, this increased energy also changes the $\varkappa$ term.

The $\varkappa$ term *transforms with rest energy* according to:

$$\varkappa' = \frac{E}{E_e}\, \varkappa$$

Where *E* is the total energy of the charged particle, whether it is at rest or moving, and E_e is the energy of the electron at rest.

It was first assumed that the ϱ term would *transform with motion* according to:

$$\varrho' = \frac{\varrho}{\gamma}$$

But again, that is not the whole story. This term actually also changes (transforms) with energy. So that, when a particle is accelerated, the increase in energy changes the force ratio, and when a particle has a higher rest mass and therefore more energy, this increased energy also changes the ϱ term.

In the following two equations, we have used the energy of the electron as a reference energy.

$$\varrho' = \varrho\, \frac{E_e}{E}$$

$$\varkappa' = \frac{E}{E_e}\, \varkappa$$

For the electron at rest:

The *constant* δ_q *is* the *charge field displacement constant:*

$$\delta_q = \varkappa\, r_e = 7.594533417419120\text{E} - 15\, m$$

This is the displacement which exists in space, causing the Coulomb field, at the distance r_e *(1.930796541221630E-13 m)* from the center of any charged particle.

For the electron in motion:

$$\delta_q = \varkappa\, \gamma\, \frac{r_e}{\gamma} = 7.594533417419120\text{E} - 15\, m$$

This charge field displacement fits the definition of a constant because it does not change with (increased energy due to) relativistic motion, it is therefore Lorentz invariant.

So, we review…

$$F_\delta = E^2\, \Gamma$$

Energy in the charge field of the electron is:

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

Force in the charge field is:

$$F_\delta = \frac{E_q}{\delta_q} = E^2\, \Gamma$$

The energy of the electron is:

$$E_e = \frac{\delta_q\, F_\delta}{\alpha} = \frac{\delta_q\, F_\delta}{2\, \varrho\, \varkappa} = F_c\, r_e$$

The fine structure constant is:

$$\alpha = 2\, \varkappa\, \varrho$$

The quantization force (force opposing momentum) for the electron at rest is:

$$F_{ce} = \frac{2\, \varkappa}{\varrho} = 0.848054635696108\, N$$

Why the elementary charge is quantized

Let us perform a thought experiment, and the underlying math, to show cause for the fixed (quantized) value of electric charge.

We will 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, 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 radius of this accelerated electron is: α 5.78930204742442E-12 J or 4.22465781534373E-14 J.

So, we will now calculate the force of electric charge at an arbitrary distance from an electron at rest, and at the same distance from this moving electron with more energy. We will just choose any fixed distance, let's use the distance *r* = 1.544637232977300E-12 m, which is 8 times the radius of the electron at rest.

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

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

$$F_c = \frac{p\,\sqrt{2}\, c}{r_e}$$

$$\delta_q = \varkappa\, r_e = 7.594533417214880\text{E} - 15$$

$$F_\delta = \frac{E_q}{\delta_q} = (\varrho\, F_c)^2 = E^2\, \Gamma$$

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

$$F_q = F_\delta\, r_e = 1.518906683483820\text{E} - 14$$

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

$$F_e = \frac{{F_\delta}^2\, {r_e}^2}{r^2} = \frac{{F_q}^2}{r^2}$$

$$\boldsymbol{F_e = 9.669615112881880\text{E} - 05\ \text{N}}$$

Now let us calculate this same solution for the more energetic moving electron.

To accelerate the electron, we must add energy to the electron, so the radius r_{e1} of the accelerated electron is:

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

We calculate the force F_c or this more energetic electron.

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

$$F_{c1} = \frac{\gamma 2E}{r_{e1}} = \frac{70.71244595 * 2 * 8.18710478684506\text{E} - 14}{2.730490389959\text{E} - 15} = 4240.49839548672 \text{ N}$$

Which can also be stated as:

$$F_{c1} = \frac{\gamma 2E}{r_{e1}} = \gamma^2 Fc = 4240.49839548672 \text{ N}$$

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.

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

$$E_{e1} = \gamma\, E_e$$

$$E_{q1} = E_{e1}\, \alpha$$

$$\delta_1 = \varkappa\, \gamma\, r_{e1} = 7.594533417214880\text{E} - 15$$

$$F_{\delta 1} = \frac{E_{q1}}{\delta_1} = E_{e1}{}^2\, \Gamma$$

$$F_{e1} = \frac{F_{\delta 1}{}^2\, r_{e1}{}^2}{r^2}$$

$$F_{q1} = F_{\delta 1}\, r_{e1} = 1.518906683483820\text{E} - 14$$

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

$$F_e = \frac{F_\delta{}^2\, r_e{}^2}{r^2} = \frac{F_q{}^2}{r^2}$$

$$\boldsymbol{F_{e1} = 9.669615112881880\text{E} - 05 \text{ N}}$$

$$\boldsymbol{F_{e1} = F_e}$$

So, we can see that regardless of the energy in the source particle, the force of the elementary electric charge always remains quantized (the same value at a specific distance from the particle).

This constancy (quantization) of the elementary charge can now be shown from a causal basis, when charge is viewed as a displacement of space.

Whether the energy in the charged particle is caused by acceleration or is inherent, the principle shown above for the quantization of the force of the elementary charge would still apply. Electric charge is quantized.

Electric charge and the muon

Let us take a quick and simplified look at the muon, a charged particle, to see what force there would be in the Coulomb field at this same distance.

The muon mass is: 1.883531594E-28 kg Therefore it has an energy of: 1.692833774422E-11 J

If the muon radius is calculated in the same way as the electron radius then we have:

$$r_\mu = \frac{\hbar\, c}{2\, E_\mu} = 9.337970495691\text{E} - 16 \text{ m}$$

$$p = \frac{E_\mu \; \frac{\sqrt{2}\, c}{c}}{c} = \sqrt{2}\frac{E_\mu}{c} = 7.985619446873\text{E} - 20$$

$$F_c = \frac{p\, \sqrt{2}\, c}{r_\mu}$$

$$E_q = E_\mu\, \alpha = \delta_q \sqrt{\alpha\, F_c} = \frac{e^2}{8\pi\, \varepsilon_0\, r}$$

$$\delta_q = \frac{E}{E_e}\, \varkappa\, r_\mu$$

$$F_\delta = \frac{E_q}{\delta_q} = (\varrho\, F_c)^2 = E_\mu{}^2\, \Gamma$$

$$F_q = F_\delta\, r_\mu = 1.518906683483820\text{E} - 14$$

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

$$F_e = \frac{F_\delta{}^2 r_\mu{}^2}{r^2} = \frac{F_q{}^2}{r^2}$$

$$\boldsymbol{F_e = 9.669615112881880\text{E} - 05 \text{ N}}$$

So, the muon, with mass and energy 206.7683 times larger than the electron, exhibits the same value for electric charge as the electron.

The Elementary Charge

The value of electric charge of the electron, the elementary charge, in Coulombs is:

$$e = \sqrt{2\, h\, \alpha\, \varepsilon_0\, c}$$

Using our model of the electron, the elementary charge can also be expressed as:

$$e = 2r_e \sqrt{\frac{\boldsymbol{\pi}\, \alpha\, p_T\, \sqrt{2}c\, \varepsilon_0}{r_e}}$$

Where p_T is the total momentum of the energy within the electron and r is the radius 1.93079654122163E-13 m. This yields a calculated value for e of -1.60217662076511E-19 C. Which agrees very well with the CODATA value -1.6021766208E-19. This calculated value is based on the premise that charge is a displacement of space. The only variables in this equation are momentum p_T and radius r, and they vary oppositely maintaining spin ½ ħ, so that when the momentum is larger the radius is smaller, and the elementary charge remains unchanged. The relationship $2r\sqrt{\frac{p_T}{r}}$ always yields the same result for a spin ½ ħ elementary fermion. So, the elementary charge value is constant, and each elementary charged particle has the same value of charge.

From a displacement of space viewpoint, again using the electron model we have proposed, we can calculate the value of electric charge in Coulombs.

$$e = \sqrt{\frac{10^7\, F_{er}\, {r_e}^2}{c^2}}$$

$$e = 1000\sqrt{\frac{10\, re^2}{c^2}}E^2\, \Gamma$$

Where e is the elementary charge, F_{er} is the force of the elementary charge at the electron action radius, r_e is the electron action radius, Γ is a constant defined previously, and of course c is the speed of light.

So, if we use the equation: $F_{er} = \frac{{F_\delta}^2\, {r_e}^2}{r^2} = \frac{{F_q}^2}{r^2} = 6.188553672244410\text{E} - 03\ \text{N}$ to calculate the force F_{er} at the radius $r = re = 1.93079654122163E - 13\ m.$

We can then solve for e:

$$e = \sqrt{\frac{10^7\, F_{er}\, {r_e}^2}{c^2}} = 1000\sqrt{\frac{10\, re^2}{c^2}}E^2\, \Gamma\ =\ 1.602176620821240\text{E} - 19\ \text{C}$$

The permittivity of space

We have defined the value for the permittivity of space in the SI system, but we have not defined the cause for space to exhibit this property.

Our SI definition is simply an empirical one. We have defined:

$$\mu_0\ = 4\pi\ \times\ 10^{-7}$$

$$\varepsilon_0 = \frac{1}{\mu_0\, c^2} = \frac{1}{4\pi\ \times\ 10^{-7}\, c^2}$$

$$c = \sqrt{\frac{1}{\varepsilon_0 \, \mu_0}}$$

Where $c = 299792458 \, m/s$ exactly.

But we can also calculate the value of ε_0 from a different perspective, so that we might understand what causes space to have this property. By using the premise that electric charge is caused by a displacement of space, as defined in this text, we can show that, for the electron…

$$\varepsilon_0 = \frac{5 \times 10^6 \, F_{\mathrm{er}} \, r_{\mathrm{e}}^{\,2}}{h \, \alpha \, c^3}$$

In fact, for every elementary charged fermion…

$$\varepsilon_0 = \frac{5 \times 10^6 \, F_{\mathrm{er}} \, r^2}{h \, \alpha \, c^3}$$

Then, of course, we can derive the magnetic permeability of space in the same context:

$$\mu_0 = \frac{h \, \alpha \, \mathrm{c}}{5 \times 10^6 \, F_{\mathrm{er}} \, r^2}$$

Which is not to say that permittivity and permeability are properties of charged particles, but rather properties of space. These are properties of space which help to form charged particles, and all particles for that matter. Permittivity is a property of space which allows the transfer of charge from one region to another. Permittivity is the tensor response to space in the presence of the displacement of space which causes electric charge.

As it turns out, the term: $5 \times 10^6 \, F_{\mathrm{er}} \, r^2$ is not only a constant for all charged particles, it is also a roundabout representation of a property, a constant, of space, which helps to determine the dynamics of particles:

The fixed value of this term is:

$$5 \times 10^6 \, F_{\mathrm{er}} \, r^2 = \varepsilon_0 \, h \, \alpha \, c^3 = \frac{h \, \alpha \, \mathrm{c}}{\mu_0} = 1.15353875656592\mathrm{E} - 21$$

So we have calculated a constant of space which defines a property of space, which in turn causes permittivity and permeability.

For now, let us just assign the common symbol K to this constant and show the math:

$$\mathrm{K} = 1.15353875656592\mathrm{E} - 21$$

$$\varepsilon_0 = \frac{K}{h \, \alpha \, c^3} = \frac{2500000}{\pi \, c^2}$$

$$\mu_0 = \frac{h \, \alpha \, c}{K} = \frac{\pi}{2500000}$$

$$K = \frac{2500000\, h\, \alpha\, c}{\pi} = 1.15353875656592\mathrm{E} - 21$$

We know that space displays the properties of permittivity, and that light can only propagate at the fixed rate *c* in space. Why then would we assume that space is empty? Every indication is that space is a medium through which displacements propagate. Otherwise what can limit the speed of light? It is logically insufficient to say that this speed is a property of light itself. If we then ignore these indications and attempt to construct our theories and models ignoring the medium of space, we are stuck with the requirement for all forces to be mediated by particles. But, using particles, we still do not have an explanation for permittivity, and the fixed speed of light. Nor do we understand how it is that energy forms particles in space. The solution is so much easier, more elegant, complete, robust, as well as theoretically economical, if we assume *space is a tensor medium*.

When we treat space as a frictionless tensor medium, and energy as causing displacement, we have a simple and elegant means to solve most, if not all the puzzles of physics.

Two manifestations of energy of the electron, direct and indirect energy.

Direct energy, is the form of energy which we can most readily sense. It is that energy which directly displaces space in a direction which is perpendicular (transverse) to the direction of propagation. *Direct energy*, is kinetic in nature, in that it directly and forcibly causes a displacement of space, and propagates as a transverse displacement. But there is another form of energy in space. This form of energy we call *indirect energy*, and it is more like potential energy. Indirect energy is that energy which is stored in space by “static” displacement of a component of space surrounding a charged particle. Indirect energy is caused by the effect that the tensor displacement of direct energy (within the dynamic circulating portion of the particle) has on surrounding space. Indirect energy is caused by the response of space to displacement within the particle.

The *direct energy* E_d of the electron is less than the particle’s total energy by the amount of the *indirect energy* E_i in the Coulomb field, in space surrounding the electron.

$$E_e = E_d + E_i$$

So that:

$$E_d = E_e - E_i$$

In the case of *direct energy*, displacement of space is the direct result of the force of energy. In the case of *indirect energy*, displacement is caused by the tensors of space, and the tendency for space to normalize displacement. The Coulomb field, electric charge, is comprised of *indirect energy*.

This shows how it is that particles are, by their nature, both local and non-local entities.

The ratio of indirect to total energy for the electron is the fine structure:

$$\alpha = \frac{E_i}{E_e} = 0.007297352566400$$

The ratio of indirect to direct energy for the electron is:

$$\left(\frac{1}{1-\alpha}\right) - 1 = \frac{E_i}{E_d} = 0.007350995371339$$

The majority of the force which quantizes energy within the electron, is the force of direct energy. However, the displacement which causes the Coulomb field also causes space to exert a small force aiding quantization and stability of the electron.

Two major types of electromagnetic energy in the universe

The electron is made of confined propagating nodes of energy which pull on (displace) one component of space. The positron is made of confined energy which pulls on (displaces) another component of space. The type of energy which makes up the spin ½ ħ elementary fermion determines the polarity of charge the particle will possess. If a particle is made of displacement of only one component of space, that particle will be confined in 3 dimensions, and have mass. Energy displacing space cannot travel in a straight line, as light does, unless that energy is a balanced displacement of both components of space.

The photon is made of equal amounts of these two types of displacement, one which displaces the same component of space the electron displaces, and the other displaces the component of space which is also displaced by the positron. Therefore, the photon exhibits no net charge, and has a spin of ħ, and can move, must move at c, in a "straight" line. The displacements of the photon are opposite each other, and toward the center of the photon. Note: There may actually be 4 displacement nodes in a photon. More on this concept in a later publication.

Two gamma photons, each with the energy of the electron, can, in the right circumstances, create an electron-positron pair. This is a way for enough of each of the *two types of electromagnetic displacement energy* to be available, so that both the electron and positron can be created. This is also why "pair production" is far more common than the production of just an electron alone, or just a positron alone.

When an electron-positron pair annihilate, the simplest result is a pair of gamma photons, each with the same total energy as the electron or positron, and each taking half their energy from the electron and half from the positron.

The universe contains principally equal amounts of these two types of electromagnetic displacement caused by energy.

The action radius of a photon with the energy of the electron is twice the action radius of an electron, so the spin angular momentum of the photon is twice the value of the spin angular momentum of the electron. This can be understood easily if we realize that there are two energy components within the photon, each with ½ the energy of the photon. So, each energy component can only pull on space ½ as much as the single energy component in the electron.

Displacement properties of space

Self-confinement of energy is the reason $f = \frac{E}{h}$, and therefore the cause for $E = hv$. The fact that propagating transverse displacement has momentum, coupled with the tensor force of energy, and the opposing tensor force of space, yield this perfect balance of forces which produces $E = hv$.

Displacement of space which causes the charge field, is not a transverse propagating displacement, but rather, in the case of charge, can be viewed as a "static" longitudinal displacement. The displacement of space in the charge field surrounding the particle is related to the energy in the charge field, but that energy and displacement is the result of the displacement and energy within the particle, and the reaction of surrounding space to that displacement.

Since charge is quantized, this charge displacement value would be the same magnitude at a fixed reference distance, from any charged particle. We have shown why this quantization occurs. And since charge obeys the spherical $\frac{1}{r^2}$ rule, the displacement would diminish at that $\frac{1}{r^2}$ rate with distance from the charged particle.

The forces of quantization and charge

We have discussed the mechanisms which can cause quantization. Now let us clearly define, as best we can, the forces and origins of those forces for the electron.

There are two fundamental forces from which all other force is derived. 1) The force of energy pulling on space and counteracting momentum, and 2) the force of space (the tensors of space) which oppose displacement.

Using the example electron above, we can quantify the force of energy and relate that force to the energy in the particle.

In the electron, we have a total energy of:

$$E_e = 8.18710478684506\text{E} - 14\ \text{J}$$

But $\alpha\ E_e$ of that energy is in the field surrounding the electron and $E_e - (\alpha\ E_e)$ is the dynamic, kinetic energy, or "direct" energy E_d circulating within the quantization radius of the electron. The static, potential energy, or indirect energy, of the electron, contained in its charge, field is $\alpha\ E_e$.

$$E_d = E_e - (\alpha\ E_e)$$

$$E_i = \alpha\ E_e$$

$$E_e = E_d + E_i$$

$$E_d = E_e - E_i$$

The energy E_d is that energy which confines the momentum $p = \frac{E_e}{c^2}\sqrt{2}\,c$ to the quantization radius r_e.

We have proposed that:

$$F_c = \frac{p\,\sqrt{2}\,c}{r_e} = \frac{E_e}{r_e} = \frac{4{E_e}^2}{\hbar\,c} = 0.848054635696108\ \mathrm{N}$$

But that is not quite the complete picture. There is also a *force of space* which opposes the displacement caused by the direct energy of the electron. The force from surrounding space on the electron at rest is:

$$F_s = F_c\,\varrho = 7.86673609080946\mathrm{E} - 02\ \mathrm{N}$$

That force between two charged particles, calculated for a single point at the distance of the action radius of the electron at rest is:

$$F_e = {F_s}^2 = \frac{(F_s\,r_e)^2}{{r_e}^2} 6.18855367224441\mathrm{E} - 03\ \mathrm{N}$$

$$F_q = F_s\,r$$

(F_q is a constant, as we have shown, because it has the same value for any charged particle.)

$$F_q = 1.51890668348382\mathrm{E} - 14$$

The force of space on the lone electron at rest, from all directions, is then:

$$F_\delta = \frac{\delta}{E_i} = 0.078667360908095\ N$$

The complete force of quantization (the force of direct energy) for the electron is:

$$F_T = \frac{p\,\sqrt{2}\,c}{r_e} + F_\delta = 0.926721996604202\ \mathrm{N}$$

Remarkably, the total tensor force that direct kinetic energy E_d of the electron exerts, approaches 1N. This is a huge force compared to the mass of the electron.

This is the force required to confine momentum and create the force of the charge field. So again, the total inward force F_T of energy, which provides for confinement and charge of the electron is actually: 0.926721996604202 N. In other words, this is the force which the energy within the electron at rest, can exert. Some of that force contains (confines) the opposing force of momentum of the propagating energy, and some creates the electric charge field surrounding the electron.

Momentum creation case study, electron.

$$p = mv$$

Momentum *p* in this equation, represents the inertial force that is exerted by *m* at velocity *v*. This force is expressed in Kg in the SI system. 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 a force times a distance divided by a time.

A difference in the force F_c at the front and back (leading and trailing portions) of the transverse displacement, can therefore cause momentum:

$$p = \frac{\Delta F_c \sin\theta\ d}{t}$$

Note: Always, in an elementary spin ½ ħ fermion: $2\pi\, r\, \sqrt{2}\, p_T = h$

We should recognize here that this mechanism for momentum cannot work for the propagation of energy confined within a particle, unless the longitudinal displacement velocity of space is much faster than the propagation of transverse waves in space. If the longitudinal displacement velocity were c the particles would not produce the momentum required at the action radius required, nor could elementary fermions create the property of mass at anywhere near the observed values.

So we will compute these values using a velocity which is sufficiently fast to accommodate these requirements, as an example.

If the velocity of longitudinal displacement in space is:

$$v_{long} = c\left(\frac{1}{\alpha}\right)^2 = 18778.8650597923 \text{ c}$$

Then the displacement envelope shape is 18778.8650597923 times longer, in the perpendicular direction, than it is wide, in the direction of propagation. In the electron, this would mean that the displacement from the radius to the center is 1.930796541221630E-13 m, and the width of that displacement is:

$$Width = \frac{1.93079654122163\text{E} - 13 \text{ m}}{18778.8650597923} = 1.02817531042155\text{E} - 17\text{m}$$

Then momentum would be caused by a slightly different force on the front and rear of the energy inducted displacement. Momentum would be the delta force ΔF_c , multiplied by the sine of the mean angle of the displacement contour θ, multiplied by the distance across the contour d, divided by the time t. The *Width* term in the equation above is the *d* of the following equation:

$$p = \frac{\Delta F_c \sin\theta\ d}{t}$$

The sine of the mean angle describing the displacement contour can be estimated by:

$$\frac{v_{long}}{\sqrt{\left(\sqrt{2}c\right)^2 + {v_{long}}^2}} = \sin\theta = 0.999999997164293$$

Time *t* is the time required for the displacement width *d* to propagate past a point, at the velocity of motion of the displacement.

$$t = \frac{d}{\sqrt{2}c} = 2.425110154864730\text{E} - 26\ \text{S}$$

Now we can rearrange and solve for ΔF_c:

$$p = \frac{\Delta F_c \sin\theta\ d}{t}$$

$$\Delta F_c = \frac{p\ t}{\sin\theta\ d} = \mathbf{9.10938366E - 31}$$

And the summed momentum vector is therefore:

$$p = \frac{\Delta F_c \sin\theta\ d}{\sqrt{2}\ t} = 2.7309242\text{E} - 22$$

The total momentum is:

$$p = \frac{\Delta F_c \sin\theta\ d}{t} = 3.86211004\text{E} - 22$$

You may have noticed that the delta force ΔF_c shown above is approximately equivalent to the mass of the electron:

$$\Delta F_c = \frac{p\ t}{\sin\theta\ d} = \mathbf{9.10938366E - 31} \approx \mathbf{m}_{\boldsymbol{e}}$$

The mass of the electron is listed by CODATA as: 9.10938356E-31 (+/- 1.1E-38)

It is unlikely that this is coincidental, and this indicates that the velocity of longitudinal displacement of space is perhaps $\left(\frac{1}{\alpha}\right)^2 c = 18778.8650597923\ \text{c} = 5.629762114725450\text{E} + 12\ \text{m/S}$. This is a velocity which allows all the pieces of the puzzle to fit correctly. This velocity gives us clues as to why the field of the electron contains α times the energy of the electron. It gives us better insight into the mass of the electron, and it provides a mechanism which creates momentum for a transverse EM wave.

If $p = \frac{\Delta F_c \sin\theta\ d}{t}$ is an accurate expression describing momentum, then $\Delta F_c = \frac{p\ t}{\sin\theta\ d}$ should equal the mass of the electron. In order for this condition to be true, within the measurement accuracy of the mass of the electron, which is 9.10938356E-31 Kg +/- 1.1E-38 Kg [CODATA], the velocity of longitudinal displacement in space must be a *minimum of approximately 9101 times the speed of light*. At lower longitudinal displacement velocities, the action radius of the electron, which is the momentum radius, and principally the magnetic moment radius, would have to be some different value, and that would cause the electron to display a spin angular momentum which is not ½ ћ, and a different magnetic moment. So, we are stuck with the theoretically economical requirement for the longitudinal displacement propagation velocity being *much* faster than the speed of light.

A logical guess at a speed which accommodates these requirements is:

$$\left(\frac{1}{\alpha}\right)^2 c = 18778.8650597923 \text{ c}$$

Any speed, *9101 c to less than infinite,* for the longitudinal displacement propagation velocity, sufficiently satisfies the velocity requirement for the formula: $\varDelta F_c = \frac{p\, t}{\sin\theta\, d} = m_e$.

If we have accurately expressed the cause for the creation of momentum, we have also found additional suggestion that the speed of longitudinal displacement of space is much faster than the speed of propagation of transverse displacements, faster than the speed of light. So, electric charge, meaning the Coulomb field, and gravity, would also be faster than light. But, as we have discussed, *this is actually to be expected, because longitudinal displacement propagation velocity, in any medium, is faster than transverse displacement propagation velocity.*

We have chosen a velocity related to the fine structure constant because the energy in the Coulomb field of a charged spin ½ particle is α times the energy of the particle. So, if the speed is related to the fine structure it could lead us toward cause for this particular energy ratio.

But if the speed were infinite, then there could be no momentum "time constant" to create a difference in force at the fore and aft portions of the displacement, no $\varDelta F_c$ and no momentum could be created, so the speed of longitudinal displacement propagation must be less than infinite.

While this high velocity, for the longitudinal displacement creating the charge field, seems surprising, this very high velocity is suggested by many calculations, including the calculation of oscillating charged bodies done by Feynman and others. This velocity is also inherent in our theories of gravity, even though we may have not really focused on, or recognized this requirement, as it is insinuated in the equations we use. However, this velocity is quite convenient in many respects as well, for it offers cause for "non-locality", cause for a "pilot" wave, and offers many refinements to our existing theories. The refinements offered by this approach provide for remarkable agreement between theory and experiment.

Magnetic Moment Anomaly

The charge field would logically have a small remnant of a sort of motion near the electron, which is induced by the spin of the electron. Based on the topology we have discussed, and the relationships we have discovered, we can perform a first order approximation for this small "spin component" in the very near field of the electron.

$$U_1 = 2\frac{\left(\frac{\sqrt{F_q}}{\sqrt{F_c}}\right) - 1}{2\pi} = 0.0011592986241$$

Then when we run the series:

$$U_2 = U_1 + U_1 \frac{1}{2^{\left(\frac{1}{\sqrt{\alpha}}\frac{1-\alpha}{2\pi}\right)}} = 0.001159648858977$$

$$U_3 = U_2 + U_2 \frac{1}{3^{\left(\frac{1}{\sqrt{\alpha}}\frac{1-\alpha}{2\pi}\right)}} = 0.001159651917548$$

$$U_4 = U_3 + U_3 \frac{1}{4^{\left(\frac{1}{\sqrt{\alpha}}\frac{1-\alpha}{2\pi}\right)}} = 0.001159652023389$$

$$U_5 = U_4 + U_4 \frac{1}{5^{\left(\frac{1}{\sqrt{\alpha}}\frac{1-\alpha}{2\pi}\right)}} = 0.001159652023389$$

$$U_6 = U_5 + U_5 \frac{1}{6^{\left(\frac{1}{\sqrt{\alpha}}\frac{1-\alpha}{2\pi}\right)}} = 0.001159652032103$$

We arrive at a relative value for this spin of the charge field near the electron which is accurate within about 10 significant digits, for the magnetic moment anomaly of the electron.

$$\mathbf{1.001159652}18073 - \mathbf{1.001159652}032103 = 0.000000000148627$$

$$\frac{0.000000000148627}{1.00115965218073} = 0.00001282\%$$

But perhaps the magnetic moment anomaly provides an additional clue regarding the specific geometry of the circulating displacements within the electron. We could argue that the magnetic field outside the electron is created entirely by the dynamic spinning portion of the electron. If the displacement envelope extends slightly beyond the momentum (action) radius of the electron making the effective magnetic radius 1.001159652 times larger than the momentum radius then of course the magnetic moment anomaly would be the obvious result.

Dynamics of the charge field

The field we have described is not really a static field, even though we have addressed it as a static field so far. The very fast longitudinal displacement of space causes all charge fields to contain an in-and-back dynamic motion at the twice frequency of circulation (twice the Zitter frequency) of the source elementary fermion. The displacement values we have calculated and shown, to this point, are averages for these values. The forces we have described are also averages. The spin mechanisms of the particle produce a specific topology for this dynamic action in the charge field. One of the effects of these dynamics is magnetism. *The interaction of circulating force vectors created by these displacement dynamics cause the magnetic fields of particles*.

Gravity

Adding the topic of gravity, to a discussion of electric charge, may seem unrelated, but as it turns out that is not the case. The displacement we have discussed fits so well into the clarification of the force of gravity that it would be remiss to not include some review of this topic.

Gravity is a natural consequence of the displacement (curvature) of space, when energy is present, pulling on (locally condensing and warping) space. Space is simply warped by energy. The displacement caused by energy is not outward, but inward, toward the particle center. Energy is contracting one of the two components of space causing polarization and therefore electric charge. This also causes a small net displacement of space. Space is contracted by energy, and space pulls back with an equal and opposite force in an attempt to normalize the displacement. Space is therefore warped by energy, and gravity is a result.

We can begin to see how this might work when we examine the following:

$$G \approx \frac{\mu_0 \alpha^2}{(4\pi\text{Ƙ})^2 (1+\alpha) c}$$

$$G = \frac{\mu_0 \alpha^2 \, (1+\alpha^2)^3}{(4\pi\text{Ƙ})^2 (1+\alpha) c} = 6.674017511605500\text{E} - 11$$

The property μ_0 is perpendicular to the property ε_0 in space, in the presence of an electric field. While we get the impression that gravity is a force between massive objects, it is rather a refraction of the light-speed energy within particles which make up massive objects. This continual refraction causes acceleration of the particle. Therefore, the effect of gravity is more easily characterized with reference to the perpendicular μ_0 than it is with the term ε_0.

Gravity, the warping of space, refracts waves (propagating transverse displacements) in space. Electric charge, and gravity, are results of energy displacing space. Space consists of two electromagnetic components. The tensor medium of space allows propagation of transverse displacements at only one "forward" velocity. The propagation of longitudinal displacement is much faster than propagation of transverse displacement. In fact, longitudinal displacement propagation is faster in any medium, but *significantly* faster in space, than transverse displacement propagation. This allows the force of electric charge, and gravity, to appear almost instantaneous.

Energy (which causes electromagnetic fields) is the displacement of one or both of the components of space we have discussed throughout this writing. There is a force between the displaced components and space itself when a component is displaced. This force is the tensor medium of space attempting to normalize displacement. There are equal amounts of these two (electromagnetic causing) components in space. When energy displaces one part of space, it causes a net displacement of space itself. In the tensor medium of space, the forces between the components of space are very strong, making space quite "stiff", which tends toward a more homogeneous tension medium.

Energy, pulling on space, causes space in the vicinity of energy to have a slightly higher "density", which also slightly slows the velocity of light in that region. The more energy in a region of space, the greater the displacement, and therefore the higher the density gradient, and the more light refracts. The gradient to this density variation causes the density variation to decrease with distance from the center of mass (energy) at the rate $1/r^2$. The space density gradient across a particle causes refraction of the confined propagating displacement which constitutes the particle. The result is the particle is moved (accelerated) toward the large mass (energy), which is in the direction of a higher density of space. Particles of matter (with mass) are confined in three dimensions. The model we have presented asserts that elementary spin ½ particles always have two components of spin, with directions which are 90 degrees apart. This configuration causes it to be harder to refract the moving energy of mass-carrying particles (exactly twice as hard) as it is to deflect the energy in light. Light energy is only confined in two dimensions. So, light is bent twice as much as we would otherwise expect. This also agrees precisely with experiment. The "acceleration" of light toward a massive body is twice the acceleration of mass toward that same massive body.

The refraction of light by gravity is principally achromatic. So, light of all frequencies, photons of all energy levels, are refracted the same by gravity. This may at first seem counterintuitive when considering the model of the photon we have used. However, once we review this topic we can see that we would actually *expect gravitational refraction to be achromatic under these circumstances*.

A photon with lower energy has a larger action radius, *and a lower frequency*. This is precisely why all photons are refracted the same by the gravitational "density" gradient of space. Let us just quickly run the math to illustrate this point.

The action radius of a photon is:

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

The frequency of the photon is:

$$f = \frac{E}{h}$$

So, the number of times per second the energy in the photon traverses the gravitational gradient, in the span of the photon's action radius, is this frequency. To understand this effect for a photon, we can simply multiply the frequency by the action radius. If we always get the same answer for the product of the frequency times the radius, it simply means that every photon will be refracted the same amount, if exposed to the same gravitational gradient.

Therefore, if we solve the equation:

$$n = f\,r = \frac{E}{h}\,\frac{c\,h}{2\pi E}$$

We will always get the same result:

$$n = \frac{c}{2\pi}$$

And the gravitational refraction of light will be achromatic using this approach (the tensor medium of space, the nature of energy, matter, and the forces caused by displacement).

Previously we used the electron model to show how inertial mass is created. Confined momentum within the particles is the cause for inertial mass. Interestingly, the force of the weight of an object *does not come directly from the gravitational field*, but rather this force is caused by refraction of the propagating momentum of the energy within the object itself. When the gravitational field refracts the trajectory of the propagating displacements within the particle, they create a force, just like the force of inertia is created. In this manner, *gravitational and inertial mass are identical*, and the force created is related to the energy of the particle and the total magnitude of the quantized gravitational field.

So, while the gravitational field is quantized, just as electric charge is quantized, the reaction of the dynamic energy within the object, to this quantized field, is the cause for the force we sense as gravity. We do not normally sense any quantization related to gravity, even though quantization of the gravitational field does exist, just as the Coulomb field is quantized, because the gravitational field is created by the net displacement of space from the charge fields of particles, which causes a “density” change (a density gradient) of space.

We have discussed displacement of space as a cause for electric charge. The absolute displacement of space which is caused by electric charge is equal to the energy in the charge field divided by the force in the charge field. And the charge field is quantized. So that for any charged particle, the displacement is the same at a given radius from the particle.

$$\delta_q = \frac{E}{F_q}$$

At r_e for the electron, this total displacement, of one component of space, in the charge field is:

$$\delta_q = \frac{\alpha E_e}{F_q} = \frac{(0.0072973525664)\ (8.187104786845060\text{E}-14\ \text{J})}{(0.078667360908095\ \text{N})}$$

$$\delta_q = 7.59453341741912\text{E}-15$$

The displacement which causes gravity is the *net displacement* of space. Since one, of two components of space, is displaced to create the charge field, the total *gravitational displacement* for a charged particle, is ½ the electric field displacement value we just calculated above.

$$\delta_G = \frac{1}{2}\ \frac{\alpha E_e}{F_q} = \frac{1}{2}\ \frac{(0.0072973525664)\ (8.187104786845060\text{E}-14\ \text{J})}{(0.078667360908095\ \text{N})}$$

$$\delta_q = 3.79726670870956\text{E}-15$$

This displacement would be accompanied by a change in density of the fabric of space, increasing the density of space near massive objects, since space is displaced toward massive objects.

We can therefore show specific cause for the refraction of propagating energy, which produces gravity, using the concept that space is a tensor medium and energy pulls on space to displace space. The quantized field then causes a “density gradient” of space. A density gradient causes energy propagating through this gradient to be refracted toward the more “dense” region of space. The force we feel from this refraction is due to the energy (confined momentum) within the affected mass. So we repeat, the force is therefore not a force of the gravitational field, but rather a *force from the energy in matter (confined momentum of confined propagating energy) when refracted by the gravitational field*. So, gravitational mass is, in many respects, equivalent to inertial mass.

Refraction of the propagation of transverse displacement causes light to be refracted in a gravitational field. Differences in light and matter, in this respect, are fairly easy to define. When light travels for 1 second perpendicular to the gravitational gradient, in a uniform gravitational field of 1G, light moves forward approximately 299792458 m and refracts “falls” approximately 9.806650 m. Assuming that Planck’s rule applies to all transverse displacement propagating energy in space, we could therefore assume light to be quantized into photons. Photons would then have a set of boundary conditions which cause the oscillation at a frequency related to energy content, as recognized by Planck. Photons would be confined by these boundary conditions, in two dimensions, and propagate forward in the remaining dimension. However matter, in the earth’s 1G field, “falls” (when started from motionless) only 4.903325 m in the same 1 second period in which light curves 9.806650 m. This is simply because particles of matter, unlike photons, are confined in three dimensions. So, in matter, while half of the propagating energy is perpendicular to the gravitational gradient, the other half is parallel with the gravitational gradient, so only half of the propagating energy is refracted by the gravitational field, but the force of confinement within the particle holds the complete particle in a localized space, so the particle is further constrained, and can only move ½ as much as light moves in the same gravitational field. The difference in refraction for light and matter is simply due to the difference in the nature of confinement (quantization) of each.

Next we should go through the steps to define the gravitational gradient.

For the electron model above, we know the total force of space upon the electron, outside the electron’s action radius r_e. This force is a force opposing the displacement of space toward the center of the electron. So, this force pulls on the electron from all directions. The total force F_q can be calculated as follows:

$$E_q = F_q \delta_q$$

Energy E_q in the charge field equals force F_q of the charge field times displacement δ_q of the charge field.

So:

$$F_q = \frac{E_q}{\delta_q} = F_c\, \varrho$$

When we solve for displacement:

$$\delta_q = \frac{E_q}{F_q}$$

The total energy E_q in the charge field is:

$$E_q = E_e \alpha = 5.974419012766950\text{E} - 16 \text{ J}$$

The force F_q in the charge field is:

$$F_q = F_c\, \varrho = 0.078667360909807 \text{ N}$$

So the displacement of the charge field is:

$$\delta_q = \frac{E_q}{F_q} = 7.594533417253770\text{E} - 15 \text{ m}$$

*This implies that the stiffness **k** of space so high that a force of 10,358,419,219,156.5 N is required to displace space 1 meter.*

$$k = \frac{F_q}{\delta_q} = 10{,}358{,}419{,}219{,}156.5\ N/m$$

Of course to represent space as a tensor medium we would need to understand more of the properties of space, many of which we may already know. But, compiling a proper stiffness matrix for space which preserves all of the experimental data we have on the behavior of energy and particles, is not a trivial task. We will leave that Discussion for a later publication.

Now, we will address the gradient in space, caused by the net displacement of space, which is in turn created by the charge field. For it is this gradient which refracts the propagation of energy, and causes gravity. (As a note: The fields of photons also contribute to the displacement of space, and therefore affect the gravitational field.)

At the action radius of the electron the net displacement of space δ_s is ½ the charge field displacement. So, space has a net displacement toward the electron, from all directions, of 3.79726670862688E-15 m, at the action radius of the electron.

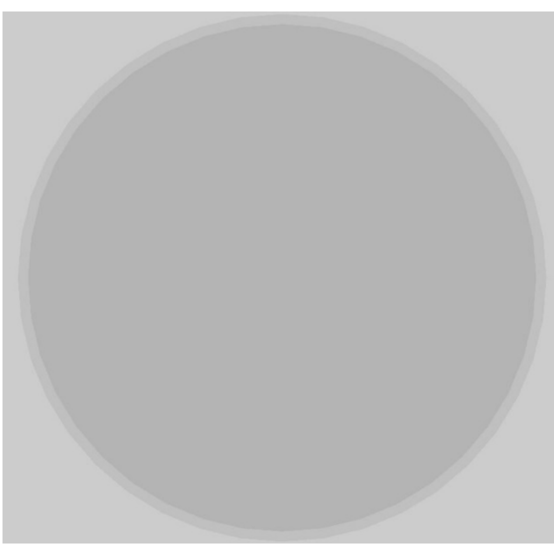
At 2 times the action radius for the electron at rest, the net displacement of space is:

$$\delta = \frac{\delta_s\, r_e{}^2}{r^2} = \frac{(3.79726670862688\mathrm{E}-15\mathrm{m})\quad(1.930796541221630\mathrm{E}-13\mathrm{m})^2}{(3.861593082443250\mathrm{E}-13)^2}$$

$$\delta = 9.493166771567210\mathrm{E}-16\mathrm{m}$$

The displacement falls off with distance at $1/r^2$ just as we would expect in this spherical space. So that the net displacement of space, caused by the electron at rest, at 1 meter is 1.415611643497310E-40 m.

So now we can visualize a relative "density gradient" of space prompted by this displacement.



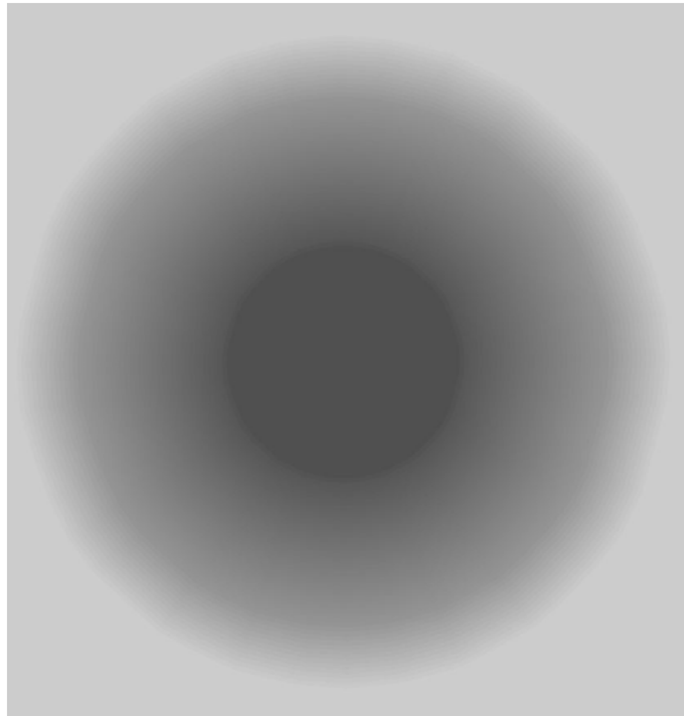
To begin we can create a simple model of the displacement. The figure here contains models of two spheres. The inner sphere represents the action radius of the electron. The outer sphere represents the area of space which once displaced fits within the radius of the electron. The spheres are approximately to scale.

We can see then, that a volume of normalized space is compressed into a smaller volume by displacement, caused by energy pulling on space.

Then, we can extend this simple step model, by reducing the force of displacement for each step, and therefore reducing the displacement, because the force is spread over a larger volume of space, with each step. This illustration extends to 70 times the radius of the electron.

If we extend this process to infinity we can better comprehend the gradient of space caused by energy pulling on space, a reasonable suspect for the cause of gravity. Such a gradient would naturally cause refraction of waves (displacements) propagating through the gradient.

The acceleration for all mass carrying particles in this gradient would be principally the same.



The net displacement of space, which causes the gravitational field, is in turn caused by *every particle in existence*. (Photons included) The gravitational field of a particle is quantized, just as charge is quantized. The quantized gravitational field generated by a massive object is not generated directly due to the mass of the object. The total gravitational field of a massive object *is generated by the total number of elementary particles within the object*. The gravitational *field* is quantized, in a similar manner to the quantization of electric charge. The *force* of gravity is *not* in the gravitational field, it is the confined momentum of the particles, redirected by refraction, and this redirection is naturally caused by the gravitational field.

So we have suggested that space is displaced toward a particle by the energy within the particle, and that the displacement is quantized. Meaning the displacement is the same at a fixed distance from any particle. That displacement would cause a gradient in space. That gradient causes transverse propagating displacements in that gradient, to refract. The amount of refraction, which determines the amount of acceleration caused by the refraction is quantifiable.

We estimate the acceleration of gravity, per elementary particle, at a distance of 6371000m (mean earth radius) to be: 9.180138364615630E-52 m/S^2. This represents the quantization of gravity, and agrees with the acceleration 9.0665 m/S^2 we see from earth's gravity.

The following table is a first approximation, which yields the acceleration per particle we have suggested. We used the most abundant elements in the earth's mass, and their frequency of occurrence, to approximate the number of elementary particles in the earth.

			AMU to kg						
			1.66053904E-27						
Element	Approximate contribution to earth mass	Atomic weight AMU	Atomic mass kg	mass number	Estimated number of elementary particles per atom	Total mass of element in the earth	Number of atoms of this element in the earth	number of particles	
Oxygen	0.466	15.9994	2.6567628316576E-26	16	64	2.7830452E+24	1.04753242059759E+50	6.704207491824590E+51	
Silicon	0.277	28.0855	4.6637069207920E-26	2	8	1.6542994E+24	3.54717701625870E+49	2.837741613006960E+50	
Aluminum	0.081	26.9815	4.4803834107760E-26	27	108	4.8374820E+23	1.07970268534722E+49	1.166078900175000E+51	
Iron	0.05	55.845	9.2732802688800E-26	56	224	2.9861000E+23	3.22011188427140E+48	7.213050620767940E+50	
Calcium	0.036	40.078	6.6551083645120E-26	40	160	2.1499920E+23	3.23058901860218E+48	5.168942429763490E+50	
Sodium	0.028	22.9897	3.8175294367888E-26	23	92	1.6722160E+23	4.38036176980110E+48	4.029932828217020E+50	
Potassium	0.026	39.0983	6.4924253547632E-26	39	156	1.5527720E+23	2.39166708148720E+48	3.731000647120030E+50	
Magnesium	0.021	24.305	4.0359401367200E-26	24	96	1.2541620E+23	3.10748414871003E+48	2.983184782761630E+50	
All others	0.015	26	4.3174015040000E-26	26	104	8.9583000E+22	2.07492863281311E+48	2.157925778125640E+50	
Total	1.000							**1.068246426197590E+52**	Total
		Earth mass	**5.9722E+24**	kg			**Acceleration per charge in 1G**	**9.180138364615630E-52**	m/S^2
		Earth Acceleration 1G	**9.80665**	m/S^2					

The refraction (acceleration rate) is the rate at which a *fermion* is accelerated, light is accelerated at twice this value. As mentioned above, this is very simply due to the differences in the confinement of propagating displacements for light and matter.

Casimir Effect

Since energy pulls on one or the other, or both, components of space to create particles, causing a net displacement of space toward the particles, there is a slight tendency for particles, in close proximity, to move toward each other. This is simply because space is under a slightly increased tension between two particles. This effect is quantifiably very much smaller than the force of electric charge. But two thin flat plates, very close together, demonstrate this effect clearly. We know this effect as the Casimir effect.

The Casimir effect is not caused by gravity, nor by electric charge, nor is it caused by some huge energy (Zero Point Energy) in the fabric of space. It is however caused by the same displacements of space which cause electric charge and gravity.

Conclusion

We have presented a model for the reactions of space to energy which supports quantization for light and particles and therefore shows cause for Planck's rule, shows cause for inertial mass and electric charge, shows that electric charge is quantized, identifies energy as the principal cause for the strong force, unifies electric charge and the strong force, shows cause for magnetic fields, unifies gravity with

the other forces, and shows that space insists on mass-carrying fundamental fermions have charge and spin ½ ħ. This model also leads to a clear definition why charged particles have ½ integer spin. We have illustrated how space is displaced by energy causing charge, and how that displacement warps space to cause gravity. We have also demonstrated a mechanism which can create momentum for EM radiation. We have shown that a force must exist, equivalent to the strong force, within every subatomic particle and every photon, in order to provide the boundary conditions which cause E=hv.
While conducting this research it became evident that this concept seems to accurately explain not only electric charge, but provides insight into the nature of fields, including gravity, insight into "non-locality", and defines quantization.

This causal view, may indicate that, while we have made many advancements in our studies and theories, including QED, there is significant value in causal semi-classical models, and that the quantum nature of particles is caused by definable mechanisms. Cause and effect are principals we should not ignore or abandon in our research and theories. In fact, any theory which is not based on the principles of cause and effect should be suspect, and will probably either be incomplete, or inaccurate.

As a result of this research, we would like to state that, all forces are *not* mediated by "virtual" particles traveling at the speed of light, but rather by space itself. Gauge bosons are just a mental tool we have manufactured, and do not describe reality.

This treatise is based on the Abram-Lorentz theory of the electron due to the convenience of explaining the relationship which is the fine structure constant. However it remains to be seen whether some other ratio of energy within a charged particle, to energy in the field of the charged particle, would yield similarly accurate results. But one basic premise set remains, space is a three dimensional Euclidian tension medium, and energy pulls on space to displace space. The simplicity and elegance of that approach, and the accuracy with which we can model the reactions we see in the universe using that approach is quite remarkable.

If this is the correct approach there are several implications which we will need to address. Relativity will need to be reformulated, but only slightly, due to these implications. A causal basis for Quantum Mechanics is inherent in such an approach, including entanglement research, because longitudinal propagation of displacements is much faster than light, and particles would naturally influence each other due to this displacement. Also, if photons exist, they would be guided by the very fast "pilot waves" of these fields, as would all particles. So such an approach explains wave particle duality quite succinctly.

The photon…
In this research, one thing has become apparent. We still do not really understand light. Photons are a convenient method of doing the theoretical "accounting", but the concept of the photon is not developed from a causal basis enough to call it a complete theory. There are behaviors and properties of light that we still have not really clearly identified and/or explained. This author would certainly like to more fully understand the answer to the simple question, "What is light?"

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