On the Foundations of Physics

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Narrative

We have evidence before us of the structure and nature of space and energy. The electron is part of that evidence. If we desire to understand the puzzles, we can study the evidence, and derive meaning from the relationships discovered. Much like we have used this evidence to understand Planck's constant and the speed of light, we can also understand the fine structure, the mass of the electron, electric charge, magnetic fields, the strong force, and gravity.

There are many way to measure a property which we cannot otherwise "see". We use inferred measurement for most, if not all things we measure anyway. The nature of energy and particles creates a situation where our measurements are always filtered by the interactions of energy and particles. All of our measurements are indirect. We simply do not have the means to measure anything directly. This is because we are made of particles which are made of energy. All of our measurement involves the interactions of particles and energy. So, all of our measurement is filtered by the nature and organization of particles and the behavior of energy.

But we should not let that situation deter us from exploration, for there is much we can observe nonetheless. Bit by bit, piece by piece, we can construct causal working models to explain the universe.

The universe is quite amazing, but we should avoid "magical" explanations, for we have too much evidence before us that there is a specific and definable cause for everything we observe.

In our theories, when we are faced with two choices, one based on cause and effect, and one based on conjecture, we should always opt for the choice which is based on cause and effect. In this we have erred many times in our history. This is a mistake we seem to keep repeating.

Relativity is one area in which we have opted for a theoretical choice based on elegant, mind stimulating conjecture, rather than cause and effect. Rather than start with the premise that the laws of physics must be the same for all moving frames, we should ask ourselves why the laws of physics seem to remain the same for moving frames. Let us build here, as much as is possible, on cause and effect rather than conjecture.

Many physicists have contributed such significant insight and provided so many pieces of the puzzle. Now we have enough data and information to put the pieces of the puzzle together in a much more complete, simple, and elegant fashion.

We begin by adopting a premise that energy in space is in the form of a displacement of space. This is not a new concept. Maxwell and Lorentz were two among many who felt this was a reasonable conclusion. For the photon that energy would be a differential displacement of two components of space. Planck's constant has helped us sort out many issue of the interaction of matter and energy. The same can be said for the fine structure constant. These constants were derived empirically. We studied nature and found that these constants provided solutions to some problems. We checked the validity of

these constants and were able to accurately apply them to a wide variety of problems. Here we note that we can be fairly safe in assuming that there is a specific cause in nature for each of these constants.

As we proceed we will use the same methods used to find Planck's constant and the fine structure constant to derive constants and relationships. We will use observation and data from experiment to somewhat empirically derive these new constants and relationships, just as was done for all "known" constants and relationships.

The photoelectric effect, and Compton scattering have given us evidence that photons, the transverse propagation of energy in space, are quantized packets of energy. Planck's constant helps define those energy packets, and illustrates that those packets of energy have a set of boundary conditions which cause them to obey certain rules as they oscillate and propagate. By defining and understanding those boundary conditions, we can come to understand also how it is that energy can be confined to become particles.

The steps we will follow are simple, and we use what we have observed to build a causal model as we proceed.

In order to build we need to lay a foundation. Our foundation should be as accurate as we can make it. Small problems here will affect the outcome dramatically. If there are errors in our foundation it could take us many years, even a century or more, to circle back around, find those errors, and fix them so we can proceed in the correct direction toward actual understanding of the universe as it is.

We will begin with relativity.

There is a cause and effect at work which yields the relativistic effects we measure in our experiment. It is not difficult to understand that cause and those effects. When we identify the causes, we can more accurately formulate our relativity theory to reflect the relativity of nature.

The cause of relativity is:

Light propagates through space at *c,* and matter is made of confined light-speed energy.

When we formulate relativity theory using these starting premises, we have a relativity theory which agrees with all experimental data and is without paradox. So we will not use any other form of relativity theory in the remainder of this discussion.

Confinement of Energy

Planck's constant can help us define a set of boundary conditions and calculate forces which cause those boundary conditions. This discloses how energy is confined or quantized.

A photon has forward momentum. That momentum is normally expressed as $p = \frac{E}{c}$.

A photon also can display a discrete value of spin angular momentum. That quantized spin angular momentum is ħ. So, we can define an "action radius" for a photon so that $p\,r = \hbar$.

$$r = \frac{\hbar}{p} = \frac{\hbar\, c}{E} \tag{1}$$

The force required to confine the momentum *p* to the radius *r* is:

$$F = \frac{p\,c}{r} = \frac{E}{r} = \frac{\hbar\,c}{r^2} \tag{2}$$

This is (the majority of) the confinement (quantization) force required for a photon to comply with Planck's rule $E = hv$ when the momentum of the wave is $p = \frac{E}{c}$.

We have therefore derived a confinement force from the requirements for photon quantization.

So the premise is that the energy tensor has this inward force plus the inward force required to cause an EM field surrounding the photon. The force required for the field at the action radius is $Q_F = \sqrt{F\ \frac{\alpha}{2}}$. So that the total energy tensor for the photon is $F_T = F + \sqrt{F\ \frac{\alpha}{2}}$ or:

$$F_T = \frac{p\,c}{r} + \sqrt{\frac{\alpha\,p\,c}{2\,r}} = \frac{E}{r} + \sqrt{\frac{\alpha\,E}{2\,r}} = \frac{\hbar\,c}{r^2} + \sqrt{\frac{\alpha\,\hbar\,c}{2r^2}} \tag{3}$$

Using a similar approach, we derive the confinement conditions for the electron:

The energy within the electron is confined in three dimensions, while the energy in the photon is only confined in two dimensions, and the photon is therefore free to move (propagate) at *c* in the third dimension. The total momentum of the photon is $p_T = \sqrt{2}\frac{E}{c}$. The forward momentum vector is $p = \frac{E}{c}$ and the momentum in the spin direction (perpendicular) is also $p = \frac{E}{c}$. This implies that the electron confinement force is greater than the photon confinement force. We have another reason to think that the electron confinement force may be greater. In the electron, in order to create a static electric charge field, only one of the two components of space is displaced toward the center of the electron. So, the energy is therefore able to have a tensor strength on this one component which is twice that of the photon. In the photon half the energy is in the tensor for one component and half in the tensor for the other component. In the electron, all of the energy in in the tensor for one component.

The spin angular momentum of the electron is ½ ħ, and the action radius of the electron is:

$$r_e = \frac{\hbar}{2p} = \frac{\hbar\,c}{2E_e} = 1.93079654122163\mathrm{E} - 13\ \mathrm{m} \tag{4}$$

This requires a unique and specific topology for the energy circulating within the electron.

The total momentum of the energy within the electron is $p_T = \sqrt{2}\frac{E}{c}$ and half the energy is moving at 45 degrees with respect to the equatorial plane, while the other half is moving at the opposite 45 degrees from equatorial. This provides for a spin angular momentum of ½ ħ when measured in any direction.

The force required to confine the momentum p_T to the radius *r* within the electron is:

$$F_c = \frac{2\,p\,c}{r} = \frac{2E}{r} = \frac{2\hbar\,c}{r^2} \tag{5}$$

This is (the majority of) the confinement (quantization) force required for an electron. Since only one of the two components of space is displaced toward the center of the electron, this confinement force value is twice that of a photon with the same energy.

We have therefore derived a confinement force from the requirements for electron quantization.

So, the premise is that the energy tensor has this inward force plus the inward force required to cause a static charge field surrounding the electron. The force required for the field at the action radius of the electron is $Q_F = \sqrt{F\ \alpha}$. So that the total energy tensor for the photon is $F_T = F + \sqrt{F\ \alpha}$ or:

$$F_T = \frac{2\ p\ c}{r} + \sqrt{\frac{2\ p\ c\ \alpha}{2\ r}} = \frac{2\ E}{r} + \sqrt{\frac{2\ E\ \alpha}{2\ r}} = \frac{2\ \hbar\ c}{r^2} + \sqrt{\frac{2\ \hbar\ c\ \alpha}{2r^2}} \tag{6}$$

The total energy of the electron is 8.187104786845060E-14 J.

Confined momentum creates the inertial mass property of the electron.

The frequency of circulation of the confined energy within the electron is $f = \frac{2E}{h}$. This is because the tensor force for the electron is twice that of a photon, since only one component of space is displaced.

The angular frequency ω of circulation (radians per second) ω of circulating energy in the electron is:

$$\omega = \frac{\sqrt{2}\ c}{r_e} \tag{7}$$

Total momentum of the electron is also $p_T = \frac{E\ \sqrt{2}\ c}{c^2} = \sqrt{2}\ \frac{E}{c}$ just as it is for the photon.

Accelerating this momentum in a circular path about the radius r_e:

$$r_e = \frac{\hbar}{2\ p} = \frac{c\ \hbar}{2\ E} = 1.9307964800289E - 13m \tag{8}$$

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:

$$m = \frac{p_T}{r_e\ \omega} = \ 9.1093826E - 31Kg \tag{9}$$

So, we have derived the inertial mass of the electron from its confined total momentum.

Forces related to the electron

The force of the energy tensor which confines the momentum of the electron to its action radius is:

$$F_c = \frac{p_T\ \sqrt{2}\ c}{r_e} = 0.848054635696108\ \text{N} \tag{10}$$

The force which causes the electric charge field is:

$$F_q = \sqrt{\alpha\, F_c} = 0.078667360908095 \text{ N} \tag{11}$$

The total force of the energy tensor is therefore:

$$F_T = F_c + F_q = 0.926721996605915 \text{ N} \tag{12}$$

The relationship between the energy of the electron and the energy in the field are:

$$\frac{E_q}{E_e} = \alpha \tag{13}$$

The relationship between the momentum confinement force in the electron and the force of the charge field:

$$\frac{F_q}{F_c} = \varrho \;\; (\varrho \textit{ will be shown in equation } 17) \tag{14}$$

The relationship between the displacement r_e of the electron and the displacement δ_q of the charge field in surrounding space:

$$\frac{\delta_q}{r_e} = \varkappa \;\; (\varkappa \textit{ will be shown in equation } 16) \tag{15}$$

Therefore let us introduce these relationships which we will also use in the following discussion.

$$\varkappa = E_e\sqrt{\frac{\alpha}{\hbar c}} = \varrho\, \frac{F_c}{2} = \frac{\sqrt{\alpha\, F_c}}{2} = \frac{8\boldsymbol{\pi}^2 \varrho \hbar}{\sqrt{\varepsilon_0 \mu_0}\, {\lambda_e}^2} = 0.039333680453191 \tag{16}$$

For the electron: $F_q = 2\varkappa$

$$\varrho = \frac{\sqrt{\alpha \hbar c}}{2E_e} = \frac{\sqrt{\alpha}}{\sqrt{F_c}} = 0.092762137719152 \tag{17}$$

$$2\varrho\varkappa = \alpha \tag{18}$$

These relationships, ϱ and ϰ, are important because they are expressions of the properties of space which are key in governing important quantities, like the rest mass of the electron, and the force of gravity. As you can see from the equations above, these relationships can be derived from first principles and known constants.

So, let us first address the rest mass and many properties of the electron. Let us show, from these relationships, why these properties have the exact values we observe in nature.

First, we will derive a term using these new values.

$$\text{Ϗ} = \frac{\sqrt{\frac{2\hbar c\varkappa}{\varrho}}}{4\pi\hbar c^3} = \frac{\sqrt{4\, {E_e}^2}}{4\pi\hbar c^3} = 4.58576946280331E-06 \tag{19}$$

These ratios also indicate that $\mathrm{K} = \frac{\varepsilon_0 \mu_0}{\lambda_e}$.

In a bit, we will show that this term is part of the cause for Planck's constant, but first let us also define the other part of the cause for Planck's constant.

$$\S = \frac{8\boldsymbol{\pi}^2 \hbar^2 c^3}{\sqrt{\frac{2\, c\, \hbar\, \varkappa}{\varrho}}} = \frac{8\boldsymbol{\pi}^2 \hbar^2 c^3}{\sqrt{4\, {E_e}^2}} = \frac{E_e}{\mathrm{K}^2 c^3} = 1.444920006063590\mathrm{E} - 28 \tag{20}$$

The term $\sqrt{\frac{2\hbar c\varkappa}{\varrho}}$ shows up so often that we can simplify our equations by using:

$$\mathfrak{v} = \sqrt{\frac{2\hbar c\varkappa}{\varrho}} = \sqrt{4\, {E_e}^2} \tag{21}$$

$$\mathrm{K} = \frac{\mathfrak{v}}{4\pi\hbar c^3} = 4.58576946280331E - 06 \tag{22}$$

$$\S = \frac{8\boldsymbol{\pi}^2 \hbar^2 c^3}{\mathfrak{v}} = \frac{E_e}{\mathrm{K}^2 c^3} = 1.444920006063590\mathrm{E} - 28 \tag{23}$$

$$\mathrm{K} = \sqrt{\frac{E_e}{\S\, c^3}} \tag{24}$$

$$h = \mathrm{K}\, \S = 6.62607004E - 34 \tag{25}$$

You may ask why we have done all this math just to come up with two variables whose product is Planck's constant. That will become more obvious as we proceed.

The creation of mass

The mass of the electron is:

$$m_e = \mathrm{K}^2 \S\, \mathrm{c} \tag{26}$$

The energy of the electron is of course:

$$E_e = \mathrm{K}^2 \S\, \mathrm{c}^{\mathbf{3}} \tag{27}$$

The radius of the electron is:

$$r_e = \frac{1}{4\pi \mathrm{K}^2 c} \tag{28}$$

The total confined momentum of the electron:

$$p_T = \sqrt{2}\mathrm{K}^2\S\,\mathrm{c}^{\mathbf{2}} = \frac{E\sqrt{2}\,c}{c^2} = \sqrt{2}\frac{E}{c} \tag{29}$$

But there is much more to what we have just defined.

Gravity

The gravitational constant related to energy is:

$$G_{\mathrm{q}} = \frac{\alpha^2 \varrho\, c\, \hbar \sqrt{\frac{\sqrt{\frac{\alpha}{\varrho}}\alpha\, \hbar\, c}{1-\left(\frac{\varrho+\varkappa}{2}\right)}}}{4\varkappa} = 8.262112922369050\mathrm{E}-45 \tag{30}$$

$$G_q = \frac{G}{c^4} = 8.262112922369050\mathrm{E}-45 \tag{31}$$

The gravitational constant related to mass is:

$$G = \frac{\alpha^2 \varrho\, c^5\, \hbar \sqrt{\frac{\sqrt{\frac{\alpha}{\varrho}}\alpha\, \hbar\, c}{1-\left(\frac{\varrho+\varkappa}{2}\right)}}}{4\varkappa} = 6.673811533003440\mathrm{E}-11 \tag{32}$$

$$G = G_q c^4 = 6.673811533003440\mathrm{E}-11 \tag{33}$$

Uncertainty in the gravitational constant *G* also leaves the possibility of another solution for *G*.

$$G = \frac{\mu_0 \alpha^2\,(1+\alpha^2)^3}{(4\pi\mathrm{K})^2(1+\alpha)c} = 6.674017511605500E-11 \tag{34}$$

Let us use the distance $\frac{\hbar\, c}{2\,E_e} = 1.93079632559013\mathrm{E}-13\ \mathrm{m}$, and compute the force of gravity between two electrons.

So, the force of gravity under these conditions is:

$$F = G_q \frac{E_e\, E_e}{r^2} = 1.48552768342978\mathrm{E}-45 \tag{35}$$

Then when we compare that result to the conventional gravitational equation for the electron's mass:

$$F = G\frac{m_e\, m_e}{r^2} = 1.48552768342978\text{E} - 45 \tag{36}$$

Gravity is an interesting property of space. If we imagine empty space as consisting of tiny nodes which are made of at least two components, and these two components are collocated when no energy in present, then we have no "extended objects" in empty space. When energy is present, these components are displaced, and space opposes this displacement with a force (tensor). Now we have extended objects as these nodes of space. Moving an extended object takes more time than moving an object which is not extended, under such circumstances. This is because there is a very fast but finite reaction time for a change in force to propagate between displaced components of a node. Such a reaction would have the effect of slowing a transverse wave moving through a region of space where energy is present. While this effect is more complicated to model than the force of electric charge, it is modeled by recreating the relationships which we can empirically determine given the experimental data available. We take steps to determine the displacement magnitude, the effect this displacement magnitude has on the apparent "density" of space (the amount of slowing which would occur in the propagation of a transverse displacement "wave"). Then, we model the curvature (diffraction) such slowing would cause, and finally the acceleration of a particle if subjected to this diffraction. The results of this exercise are shown in equation (30).

Electric charge

The force of electric charge can be computed from the displacement and energy of the field surrounding the electron.

First, we find the displacement in the charge field adjacent to the electron.

The displacement in the electron is its action radius: $\delta_e = r_e$

The displacement in the charge fields is: $\delta_q = \delta_e \boldsymbol{\varkappa} = r_e \boldsymbol{\varkappa} = 0.039333680454047\, r_e$ (37)

The total force in the field is:

$$F_\delta = \frac{E}{\delta_q} \tag{38}$$

We then take the product of the force and the radius of the electron.

$$F_q = F_\delta\, r_e = 1.518906683483820\text{E} - 14 \tag{39}$$

As it turns out F_q is a constant. This value is the same at the distance r_e from any charged particle.

The force of electric charge between two charged particles is:

$$F_e = \frac{{F_q}^2}{r^2} = \frac{e^2}{4\pi\varepsilon_0 r^2} \tag{40}$$

So, we have two terms for properties of space, $\varkappa$ and ϱ, which lead us to a cause for Planck's constant, a cause for the specific rest mass of the electron, a cause for electric charge, and a cause for gravity. These terms are the result of the behavior of an energy tensor in space. If we treat space as a Euclidian three-dimensional medium, through which displacements propagate, we have explanations for relativity, charge, gravity, the mass of the electron, and perhaps all other observed phenomena.

The term $\varkappa$ is simply a coupling ratio which tells us how much displacement occurs in space surrounding a charged particle $\delta = r\,\varkappa$. 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 of momentum confinement within the particle. (The force of momentum confinement is the portion of the energy tensor which opposes the momentum of the energy). $F_q = F_c\varrho$

The only way any of this can work, is if the longitudinal divergent displacement of the field, propagates many times faster than the transverse propagation of energy. But given experimental evidence from studies of gravity and electric charge, this may well be the most economical solution.

For charged, spin ½ particles, energy displaces space toward a point in the center of the particle, creating charge, which, in many circumstances, makes the charge seem as if it is a point charge.