The Universe Puzzle

Relativity and Quantum Mechanics revisited, a study of causes and effects

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We live in a cause and effect universe. One in which we get to make choices. Our individual destiny is not predetermined. We can see cause and effect in our everyday lives and we learn from our experience. These simple principles are quite important, so consider these issues as we proceed to a path of discovery.

For several generations now, most physicists have taken Einstein's relativity to be a law of physics. It is a remarkable piece of work, and many parts of relativity are proven to be quite valid. Similarly Quantum Mechanics [QM] has predicted, and calculated, so many things, to a very high degree of accuracy, that it is also considered to be absolute law by many. But these two theories are not completely compatible. Even though relativity is used in many of the QM and Quantum Field Theory [QFT] calculations, the two theories, Quantum, and Relativistic, come to different conclusions when extended to their limits. For example relativity suggests that there is an energy density of the universe on the order of 10^{-9} J/m^3. But QM and QFT suggest that the energy density of the universe is on the order of 4.6 X10^{113} J/m^3. QM postulates that entangled particles are interconnected and "communicate" their condition instantaneously across great distances, but Einstein's relativity asserts that nothing can travel faster than c, the speed of light, and that there must be a cause which is no faster than c for any such "signaling". We propose that neither view is precisely the correct view of nature.

Relativity was conceived from a specific philosophy of space and time and purports a philosophy of cause and effect, QM was built and modified based on empirical results of experiment ***using a particular interpretation*** of the results of those experiments.

For about 100 years physicist have been struggling to decipher the remaining puzzles. Our understanding has grown in that time, but in some respects it seems we are no closer to grasping the real workings of the universe. This may be, in part, because we have assumed our current theories are correct, when small parts of the foundations of those theories may have errors. In other words, our capability to understand the remaining puzzles may be impeded by our assumptions. Starting with even a small error in the foundations of a complicated theory can have significant effects.

So now, what I would like to do, is suggest some areas we should question. It seems that we are stopped in our quest by the following assumptions:

1. Nothing can travel faster than light.
2. Nature is not deterministic and causal. (presumed by certain interpretations of QM)
3. The superposition of states is a real phenomenon.
4. Non-local "Entanglement" of particles is a real phenomenon.
5. Our universe consists of Minkowski spacetime, instead of 3 dimensional, Euclidian space, and time.

We will also discuss other misconceptions as we proceed, but these are the most important for our initial discussion.

So let us first address item 5 above: "*Our universe consists of Minkowski spacetime, instead of 3 dimensional, Euclidian space, and time.*"

This concept was born from Einsteinian Relativity, and based on the starting assumption that the laws of physics are the same in all moving frames, and that motion is only relative to other objects. This implies that there is no reference rest frame in space, and we cannot detect, by any means at all, when we are moving relative to the frame of space. So let's explore that idea, and propose an alternate solution, based on first principles.

Before we continue let's suggest a basis for a working theory upon which we can build a deeper understanding. Let us suppose that fields (when fully understood with all their associated properties), and 3 dimensional space, are for the purposes of our current discussion, the most fundamental building blocks, from which everything in the universe is made, including the time that we measure. That requires some consideration, and envisioning confined, circulating fields, with high energy density, very high circulation frequencies, and a specific topology, in order to make stable charged particles, like electrons and protons, and the less stable mass carrying but neutral charged neutron. This is not to say that there is nothing possible which is more fundamental regarding the makeup of space and these EM fields, but simply that, given our ability to measure and interact with these fields, this is a reasonable place to begin our "foundation". We will propose some models later to illustrate how particles can be made from EM fields. "Photons" then would of course be linearly propagating EM fields. So, in this thought experiment, light is made of propagating energy and particles are made of propagating energy, and all this energy propagates at velocities directly related to the "speed of light".

Now consider the implications of that hypothesis. If we are made of the same stuff that light is made of, and this energy can only propagate through space at a finite velocity, then the appearance of relativity is one of the obvious side effects. Now let us also consider that space is therefore **made of some medium** which allows the propagation of energy at finite velocity. Space would then most likely have a relatively fixed reference frame. Everything would appear to us to be relative, because we would not normally be able to detect if we are moving relative to space itself. Time, as we know it, would then be caused by the rate at which particles can interact, which is limited by the speed of light in space. This approach is quite similar to the Lorentz and Larmor models for space.

So from a physics standpoint what would this mean?

First, it would suggest that Time is not part of space as is assumed in certain interpretations of relativity. In General Relativity and much of QM, the 4 dimensional Minkowski concept of spacetime is assumed, in much of QM the wave functions are computed using "4 Vectors", using 3 spatial dimensions, and time, to constitute the 4 dimensions of "spacetime". But if time is created by the fixed speed of light in space, then the 4 dimensions of "spacetime" are quite separable, into time, and 3 spatial dimensions, and in certain computations they MUST be separated for accuracy.

Second, it would suggest that there is a fixed reference **time** in space, even if we cannot detect that specific time. This fixed reference time would then be the reference for time in the universe, and it would be the "fastest" possible time in the universe. All other "times" would be slower than this

"reference time". Time would move in only one direction, but could be slowed for objects traveling at high velocities, or by gravity, and there would never be any possibility of moving backwards in time, for any object, ever.

Third, relativistic transformations would then apply only to particles which are "at rest" *when they are not moving*, which are made up of confined circulating EM fields, fermions so to speak. Relativistic transformation, of any kind, would specifically not apply to particles which are light speed when "at rest" such as "photons". This is because time is created by the velocity of light, the velocity of light is then the fundamental which makes time as we know it. Light then would not be subject to, but would be the cause of, these transformations for confined EM particles with motion of their center of mass. So if we follow this hypothesis then we would define "rest" to be the natural state for a particle. The fields in the particles, photons or fermions, are always traveling at c, but the center of mass/energy is either stationary as in fermions, or light speed as in "photons". Einstein used material objects to illustrate relativity, specifically because he was dealing with the reaction of moving rigid bodies, material objects in space. His Special Relativity was based on the constancy of the speed of light. Yet Einstein did not propose that time is then the *result* of the speed of light.

Fourth, if "frame dragging" does not occur in space around massive moving objects, then a slight adjustment to relativity would be required. If this scenario of the universe is true, then motion would no longer be strictly relativistic. The "time" of a moving body would decrease relativistically with velocity, but relative to the fixed rest frame in space, instead of relative to another reference frame. So the earth, by some reports, is moving, relative to the Cosmic Background Radiation, at about 390Km/Sec, or 872K mph, toward the constellation Leo. This speed is 0.0013 the speed of light. So **time** on the earth, at this velocity through space, would be running at about 0.999999153829274 the rate of time in the reference rest frame of space. If this is true, then a spaceship traveling from earth in a direction opposite the constellation Leo, at a velocity relative to Earth of less than 872K mph, would show a *faster* time rather than a slower time, than the reference clock on Earth. If frame dragging does occur around a moving massive object, then the amount of frame dragging at any point near the object would likely be related to the strength of the gravitational "field" of the massive object at that point. With frame dragging around objects with a strong gravitational field, the effects of motion through space would be even more difficult to detect.

Fifth, this hypothesis implies that there are no charges, only fields and waves. Charge is then a topological, geometrically induced effect, cause by the confinement and arrangement of fields.

Sixth, this *fields only* approach would imply that the foundations for QM can be understood, and that a deterministic model can be created which underlies QM and gives us information about the proper limits and constraints, which space, and EM fields, apply naturally to the QM mathematics. It could refine our understanding and make QM and relativity stronger and more accurate theories, and it could unify them into one theory. It could provide deterministic and causal solutions for physics.

Do we need new, updated, field equations?

With Maxwell's background in wave mechanics, he framed his solutions in the 1860's, to the field equations based on the assumption of a medium of space which could be called an "elastic solid". Not

saying, of course, that space is a solid in the sense of a material body, but that space displays the wave propagation characteristics that is more familiar in solids, rather than in liquids or gasses. When we compare his original equations (circa 1864) to those of normal physical wave mechanics we can see some striking similarities. Maxwell held that these were *analogies* to the physical properties of an ideal elastic solid medium, but perhaps they are *more than analogies*, perhaps such a medium, with these unique properties, exists as space.

So if we analyze the behavior of fields, in their entirety, and evaluate the fields based on their global and local nature, and look at what that implies for knotted or confined fields, as in fermions, we can clearly see quantization as a direct result. We will delve into this in more detail a bit later.

What we are proposing is a potentially viable quantum solution for particles and a cause for relativity. Starting with the velocity of light, **if we are made from light**. If this is the case, then light itself could not be subject to relativistic transformation, because light would be the cause for the transformations.

I think that part of the reason the puzzles have been so difficult to solve, may be caused by ignoring the possibility that anything, anywhere, can travel faster than c, when we have experimental evidence for FTL tunneling which is clear evidence of FTL fields.

We may be applying artificial constraints which nature does not actually apply, simply because of our lack of information and making generalizations based on partial information, and hallowed theories. Confinement, and finite velocity of fields moving through space, may be specifically the reasons for any relativistic transformations being required for matter. At the level of the linearly propagating "photon", velocities **are** Euclidian vectors, and must be transformed relativistically, specifically only for **confined fields** (particles of mass or collections of particles of mass) due to a finite limit for the velocity of fields in space. Looking for causes for what we observe, perhaps should lead us to believe that this may well be the way it is in nature. Why propose that we are made from light, and then ignore the possible implications? The specific form of the Lorentz transformations, is *exactly* the form they would take on, if the velocity of light causes these transformations. Of course correlation does not prove causality, but it does indicate clearly where we might look to find causality.

It may be, that unless we are willing to review all reasonable possibilities, regarding existing theory and nature, we may be stuck with the same sort of partial results currently extant in physics. **The theories themselves may be impeding progress.** So yes, I am saying that it is possible that both relativity and QM are partial and incomplete, and each therefore, in a few ways, potentially inaccurate.

I know that I may be viewed as being heretical when saying that relativity is a theory based on thought and observation, but not offering specific cause. Lorentz and Larmor were at least better in this respect, for they illustrated cause much more clearly. Relativity does not provide a full definition, starting from first principals, for time, i.e. point out the cause for time as we sense and measure it, nor does it fully point out the cause for the velocity c, nor does it illustrate clearly the cause for the required transformations. Thought experiments, using mirrors in a moving frame, rely on the speed of light to illustrate time dilation, *but then certain interpretations of Einstein's relativity seems to ignore the possibility that time, as we know and measure it, is actually created by the motion of light*. This form of Relativity is not a theory created with the same postulates of first principles rigor that Maxwell used when formulating field equations. We need to establish that level of rigorous treatment, for the development of a relativistic theory, if we are to use it for a foundation for our understanding. As it

stands we have accepted both relativity and QM as foundations in our understanding, but really not started with first principals to discover if they are flawed in subtle, or perhaps, not so subtle ways.

As a next step, let's address relativity from a different perspective. Consider the implications of matter being made from light. Matter consisting of the same waves, or fields, only confined in circular, spherical, or toroidal, or more complex "knots". The velocity that these waves, or fields can travel through space is fixed at a specific velocity for homogeneous space (not within a gravitational field). The speed at which these particles of matter can interact is determined by the speed at which they can exchange energy. Energy is exchanged using the same fields or waves. So if a group of these particles of matter are traveling very fast through space, approaching the speed of light, the energy exchange is slowed down, because light has to travel farther to get from a particle to its commoving neighbor. The amount that energy exchange is slowed is calculated using Pythagorean's Theorem. Using the forward velocity of the particles, and the transverse velocity of light, as two vectors which are added to get a total distance vector, for the distance light must travel for the energy exchange. This is precisely the cause for the Lorentz transformations taking their form from the Pythagorean Theorem. And, in this application, the Pythagorean Theorem is based on ***regular Euclidian vectors***. But if this is the case, then we have just discussed the *cause for relativity*, the *cause for the Lorentz transformations* being required to understand the behavior of matter at high velocities approaching the speed of light, the *cause for time dilation* in relativity, and the reason that lengths, time, etc., change for matter in inertial frames moving at high velocities.

Robert Close has used an enlightening sonar illustration. In his example, a submarine is outfitted with a sonar clock, which ticks at a rate determined by the speed of sound in water, and a sonar ruler whose length is based on the speed of sound in water. From this example he has shown that relativistic measurements would be the natural result of this scenario, as the submarine moves through the water.

So we have started with a set of basic premises:

1. Moving fields displace space (displacement current), and these fields propagate at a fixed velocity, causing "waves" in space.
2. Matter is made of these moving fields, confined to create "particles" of matter.

From that basic, "first principles" approach we can see the cause for relativistic transformations.

So what are the implications of these observations? One important implication is the definition of "time". From these first principals we can see that time, as we know it, as we can measure it, is created in our universe, from the motion of these fields and their "fixed" velocity. This also tells us some very interesting facts about time.

1. Time can only move in the forward direction. There is no possibility, in our universe, to travel back in time.
2. Time cannot move faster than it moves in flat, motionless, homogeneous space.
3. Relativistic transformations for time cannot be accurately applied to the linearly moving light-speed fields (light or photons) because they are the cause for time. This means that "time" for a photon is not stopped because it is moving at the speed of light, time progresses for a photon

normally, without transformation. Space does not have time built into it, but time is a result of the velocity of light travelling through space.

Space

Let's discuss what we know of space. Space appears to be close to an "ideal" elastic "solid" medium. For our purposes is it frictionless. Maxwell's equations illustrate this. Space has properties. It allows the formation and propagation of EM fields, space has resonances (allowing the formation of *confined* EM fields to comprise particles). Space can be homogeneous in regions, and becomes inhomogeneous in regions of concentrations of energy (massive objects), so space can therefore be "curved", in a sense (which is gravity). Space can be displaced (EM fields exhibit *displacement* current). Other clues to the properties of space include, the spin of particles, $E=hf$, $E=mc^2$, Casimir effect, etc. Many of the clues we have now were not available to James Clerk Maxwell in the 1860's, so we could conclude that it may be time to update the field equations in light of the new material.

Our observable universe consists of three spatial dimensions and time. Any useful model of physics must also directly reflect these observable dimensions. Regardless of whether we choose to model physical processes in mathematics which contains more or fewer dimensions, we must be able to project those models back to our three spatial dimensions and time. Otherwise our models are not really useful. Space appears to us as a three dimensional medium. So any mathematics we do to describe space and matter, or light, must be easily projected back in its entirety, to those three dimensions, and must be accurate in its formulation, especially in respect to the separate and distinct nature of space and time.

Now let us address, individually, the items in the list of areas we should question in our theories, which we mentioned earlier.

So let us discuss – "Nothing can travel faster than light".

Faster than Light FTL tunneling is a well-known phenomenon. We cannot ignore anything, **even one item,** which indicates that something can move faster than light. But we have more than one phenomenon which indicates that some things do move faster than light. In 2012 an experiment was performed to measure the velocity of the Coulomb Field (electric charge). The experiment mentioned above, "Measuring Propagation Speed of Coulomb Fields" [], was conducted in 2012 and repeated in 2014 with the same results. This gives us some very valuable new information, and requires that we consider the implications of this discovery. This discovery may help us understand the apparent "pilot wave" concept, and even may shed light on the evidence of non-locality and entanglement. At the very least this discovery tell us that charge is not correctly understood by the exchange of "virtual photons" traveling at the speed of light.

So let us first look at a possible explanation for this discovery. We believe that normal EM radiation is in the form of transverse waves, as Maxwell suggested, where the wave motion is perpendicular to the

direction of travel. Let us look at the possibility that charge is propagated as a longitudinal wave ("by analogy a compression wave") instead of a transverse wave.

The velocity of a standard longitudinal wave in a medium is $v_l = \sqrt{\frac{K+\frac{4}{3}\mu}{p}}$ where K is the "bulk" (longitudinal or compression) modulus of the medium, μ is the shear (transverse or elastic) modulus of the medium, and *p* is the "density" of the medium. Maxwell's equations describe a transverse wave. The velocity of a transverse wave is: $v_t = \sqrt{\frac{\mu}{p}}$. We know that the velocity of normal transverse EM waves is $c = \sqrt{\frac{1}{\varepsilon_0 \mu_0}}$ (where ε_0 is the electric permittivity of space and μ_0 is the magnetic permeability of space), so that we can restate that $\sqrt{\frac{\mu}{p}} = \sqrt{\frac{1}{\varepsilon_0 \mu_0}}$ or $\frac{\mu}{p} = \frac{1}{\varepsilon_0 \mu_0}$ and $\mu = \frac{p}{\mu_0 \varepsilon_0}$ or $p = \mu_0 \varepsilon_0 \mu$. If we start by arbitrarily assigning:

$p = 1.027\text{E} - 19 \frac{\text{kg}}{\text{m}^3}$ Which is Lord Kelvin's estimate of the density of space;

Then we can arrive at a transverse modulus: $\mu = 0.009230215686538$

And a longitudinal modulus: K = 1.733206677174016e+02

Yielding a propagation velocity of c for EM waves and a speed of 137.0359991 c for charge. Which provides for a coupling constant between charge and normal transverse EM waves of:

$$\frac{1}{137.0359991} = \alpha$$

This may not be the correct velocity for charge, but it may be possible to calculate, with further research, the correct values for $p, \mu, and\ K$. Establishing a realistic value for p "density" will be an interesting challenge.

But we can see that it is possible for a longitudinal (and by analogy) pressure wave, in space to propagate much faster than c, provided there are the appropriate transverse modulus, and longitudinal modulus.

Using this approach, charge interaction can be viewed as an exchange of a new type of virtual particle. That virtual particle could be comprised of a possibly asymmetric longitudinal wave with a specific polarity (+ or -) arriving first, and traveling much faster than the speed of light. However we also need to keep in mind the possibility that charge is a "polarization" of space. This "polarization" may be able to propagate faster than light, and may be caused by a longitudinal action in space, so that principally the same longitudinal propagation formula would hold.

If this is the actual mechanism at work, we also then have an explanation for faster than light quantum tunneling. In FTL quantum tunneling events, the energy in the normally transverse wave would be topologically forced to adopt a longitudinal configuration while tunneling.

One additional implication exists related to this possible new speed of the Coulomb field. These longitudinal artifacts may only be sensed by either another charge, or by a change in ε0 and μ0 induced

in spacetime, in areas with a high density of these longitudinal artifacts. This provides a possible cause for gravity, and would suggest that gravity also propagates much faster than the speed of light.
Note: "Cancelling" one charge with another does not reduce the density of these artifacts. The concept is that a high density of these crossing and interacting longitudinal artifacts adds an embedded "stress" to spacetime, affecting $\varepsilon_0 \; and \; \mu_{0,}$ reducing the speed of transverse waves and therefore the speed of the waves comprising light and matter.

Now, therefore, another example of something possibly traveling faster than light is gravity. Let us then take for example the concept of gravity as it relates to a black hole. Something is extending beyond the black hole or we could not feel its gravity. So how is it that space around the black hole, or a massive object in that space, is affected by the mass in the black hole, if nothing can travel faster than the speed of light, and the speed of light is zero at the horizon of the black hole? This, of course assumes that the speed of gravity is affected in the same way the speed of light is affected near a black hole. But relativity is the reason we think black holes exist, and relativity posits that the laws of physics remain the same for all frames. So that implies that, according to Einstein's relativity, the speed of gravity, would be affected in the same way that the speed of light is affected by gravity.

If, as some have speculated, gravity is a "shadow" manifestation of the EM fields, or more specifically is caused by the interaction of Coulomb Fields, changing permittivity and permeability (the index of refraction), which in effect curves space for light and for massive bodies, since the massive bodies are made of the same stuff that light is made of, then there *must be a component of charge which is faster than c*. If gravity is caused by a certain stress of space induced by the presence of *Coulomb Fields*, which would, due to this stress, slightly change the permittivity and permeability of space, thereby changing the velocity of propagation of transverse EM fields through space, and if the velocity of the Coulomb Field is significantly faster than c, then we would be able to experience gravity from a black hole. Otherwise, upon the black hole reaching the critical mass density to create a black hole, we would stop feeling its gravity because the force of gravity could not escape the black hole just as light cannot escape the black hole, and "nothing can travel faster than light". So, if gravity is an EM effect, and we can feel the force of gravity from a black hole, then gravity must be a result of charge, instead of the more commonly understood transverse waves of EM fields, a result of the faster longitudinal artifacts of the Coulomb fields, and the Coulomb fields travel faster than c.

So we have at least two, maybe three examples of faster than light speed. It can be argued that all of these examples may be explained by the velocity of charge being the velocity of a longitudinal wave in space.

One more example is worth noting. Photons move forward at c. Photons in QM have a spin of 1. So they are moving forward and spinning. It is likely they are spinning at the velocity c as well. If we assume that light is the cause for relativity as discussed previously, then velocities become classical Euclidian vectors when dealing with photons. So the fields inside a photon would be moving at the $\sqrt{2}\; c$.

So in summary, we have four clues that something actually does move faster than light. There are several others which have not been mentioned. But it is sufficient to cause us to question this basic premise of this Minkowski interpretation of Einstein's version of relativity as it applies to light and space.

John Stuart Bell said this regarding faster than light speed and relativity…, *"I would say that the cheapest resolution is something like going back to relativity as it was before Einstein, when people like Lorentz*

and Poincar´e thought that there was an aether – a preferred frame of reference – but that our measuring instruments were distorted by motion in such a way that we could not detect motion through the aether. Now, in that way you can imagine that there is a preferred frame of reference, and in this preferred frame of reference things do go faster than light."," Behind the apparent Lorentz invariance of the phenomena, there is a deeper level which is not Lorentz invariant, a pre-Einstein position of Lorentz and Poincar´e, Larmor and Fitzgerald, was perfectly coherent, and is not inconsistent with relativity theory. The idea that there is an aether, and these Fitzgerald contractions and Larmor dilations occur, and that as a result the instruments do not detect motion through the aether – that is a perfectly coherent point of view."

Relativity

So let us discuss a cause and effect scenario. As mentioned earlier, many examples have been used, by Einstein and others, of two mirrors reflecting light between them, and with the mirrors traveling perpendicular to the path of the light being bounced back and forth. These examples were used as thought experiments to illustrate aspects of relativity. Our definition for a meter is the distance that light travels in 1/299792458 seconds. Since light travels at 299792458 meters per second, our ruler length is determined by the speed of light. Our reference for the second is defined as 9,192,631,770 cycles of radiation, from cesium 133 atoms, between two hyperfine levels, at their ground state. **The nature of light is that length and time measured by light propagation is the same as length and time measured by mechanical devices.** While this is a simple and quite basic part of physics which we understand, **it implies that mechanical devices are made of "particles" which are made of energy propagating at the speed of light.** This view is able to generate de Broglie's wave hypothesis, Dirac's velocity operator in QM, and concurs with experimental observation of electron-positron annihilation, producing photons. As is also pointed out by Robert Close. The laws of physics are principally invariant for different inertial frames simply if time and distance for material objects (mass-carrying particles with confined wave functions) transform according to Lorentz transformation. The Lorentz transformations specifically contain the speed of light in space, c, which must be the same for any inertial frame to maintain the consistency of the basic set of physical laws. So the first thing that distinguishes light from other types of waves (like sound waves) is the fact that transformation is required for an accurate treatment of the effects of motion on matter in inertial frames. Why is that the case? If matter is made of the same waves that make up light, and those waves in matter are traveling at c, then the requirement for these length and time transformations are the natural result when describing the motion of matter through space. So Minkowski 4-space or spacetime, is appropriate only for material objects, but space, and the understanding of the motion of light, is Euclidian with 3 spatial dimensions, and time is separate.

The velocity *c* is then a factor which relates the units of length to the units of time for material objects. This would likely require a preferred reference rest frame in space. And in that rest frame, space would be simple Euclidian three dimensional space. So what is the difference between this view and the popular interpretations of Einstein's Relativity? In some cases it makes no difference whether we assume that Lorentz invariance is a property of space itself, or simply caused by matter being made of waves which travel at the speed of light. However, if space can support different types of waves, like longitudinal instead of transverse, it begins to make a significant difference in the possible explanations for things like the velocity of charge and perhaps even gravity. Einstein's relativity requires that no

wave can travel faster than light, but this causal approach we have proposed does not make that assertion. If space is as Minkowski envisioned, then 4 vectors must be used for everything in space, and velocities in space are not simply Euclidian in nature, but this proposed causal approach differs in that assumption, and requires that 3 dimensional Euclidian space and time are separate, and 4 vectors would then only apply to transformations relating to the motion of matter (material objects) through space.

But if we assume that we are not surrounded and living in space and time as separate presentations, but rather living in and surrounded by "spacetime" which inherently is a 4 dimensional construct, then it brings us to some irreconcilable conclusions. For example, if the universe is "spacetime" it clearly implies that transformations should be applied to photons as well as matter. But we can easily see and detect that photons have length, frequency, wavelength, etc. So it is not possible to apply standard relativistic transformations to a free photon traveling through space and still have a photon. Some have suggested, without giving any plausible explanation, that we therefore only apply a sort of time transformation to photons. In various examples of such conjecture, the photon can see all past and all future, so that it "knows" how to interact in an exchange between emitter and absorber. This conjecture is however untenable, in that it requires complete predetermination of events for billions of years. Let us consider that point for a moment. If there exists a photon, whose "inertial" frame is c, then that photon, according to this scenario, would experience the aspect of time we call "now" to be all time, at least from the point of emission to the point of absorption. The concept is that a photon occupies a "single point in spacetime", in its "inertial" reference frame. But a photon has no inertial frame, because it has no rest mass, and therefore no inertia, it only has energy and momentum. If confined it can create "mass" (convert momentum into inertial mass), but unconfined it is clearly a rest-massless item. So if a photon leaves a star a billion years ago, and strikes the retina of your eye tomorrow night when you happen to look up at the stars, then according to this conjecture, the photon, in its frame, "knew" a billion years ago, in your frame, that you would be standing outside looking at the stars tomorrow night. There is no logical way around this conclusion, so the premise must be flawed. Of course people are free to believe anything they wish, so some will believe this, but people are free to look at the stars or not look at the stars. And I choose to believe that our actions are not predetermined for billions of years by photons.

One additional consequence to assuming that "now" for a photon is all time from emission to absorption, meaning that the photon must identify the absorber in order to be emitted, is the fact that in such a scenario we could easily remotely modify the emission pattern of an omnidirectional source. So let us do a thought experiment. We start with a known omnidirectional light source, and then we enclose this source in a large spherical shell, large enough that the inside surface of the sphere is clearly in the far field of the radiation. If this scenario is correct then we can change the radiation pattern of the omnidirectional source simply by coating the inside of the spherical shell with more or less absorptive materials in specific areas. One requirement of the emission absorption event conjecture is the concept of conservation of energy, so a refection does not qualify as an event, we must have an emission and an absorption to create a photon exchange event according to this hypothesis. I find it highly unlikely that we can change the emission pattern of an omnidirectional source in this manner. So the hypothesis is counterintuitive and has too many implications which seem to directly contradict the observations of nature. **We know that radiation energy exists in the media of space, is managed and contained by space, so space is a perfectly satisfactory "absorber" of emitted radiation**. Allowing ourselves to accept this also allows us to reject more outlandish conjecture, allows us to reject the

application of some but not all Lorentz transformations to photons, and probably brings us to a better understanding of the true nature of space and the universe.

Let's take another look at this from a slightly different perspective.

Most of us will acknowledge that monochromatic light consists of photons, which consist of EM waves. These EM waves (EM fields) have a sinusoidal form providing for the monochromatic nature.

So let's consider the implications of those statements.

First, light normally propagates at the speed of light, matter cannot. Second, light is not subject to Lorentz contraction, Lorentz time dilation, or other relativistic transformations which regulate matter. We say that because light is traveling at the speed of light and still has length, theoretically, matter would have zero length at the speed of light. If light did not have length we could not sense the sinusoidal component which gives light its property of frequency. If light underwent Lorentz transformations, all light would be the same, because it is traveling at the velocity c, and there would be no color, or frequency. Light is not like a massive relativistic particle in several ways. It is unreasonable to claim, without any explanation why, that time is to be transformed for a photon, but that a photon does not experience any other of the Lorentz transformations. The photon is clearly not subject to Lorentz transformations, but if any item is subject to Lorentz transformations, then that item must be equally subject to all the time and space Lorentz transformations. The transformations are simply caused by the fixed velocity of the propagation of fields.

We hold that spin ½ particles are made of energy, similar to photons (EM waves, EM fields), and that the behavior of light (photons, EM waves, EM fields) is the reason that Lorentz transformations apply to spin ½ mass carrying particles, and to the atoms and molecules they comprise. Transverse EM fields propagate at the speed of light, and in the general sense, cannot move faster in free space. The energy in photons, confined to create spin ½ particles also obey this rule. With motion through space, the statistically spherical "orbit" of electrons, or any principally circularly confined EM wave becomes elliptical in shape, flattening in the direction of travel, causing Lorentz contraction. This is due solely to the property of light propagating at the velocity *c*. The time-of-flight for light (or photons) in this high velocity, moving reference frame, becomes longer, due to the vector sum of the forward and perpendicular path length, with high forward velocity. And we therefore use Pythagorean's theorem to calculate that vector.

$$A = \sqrt{B^2 + C^2}$$

Which is exactly why the Lorentz transformation for energy in matter takes the form: $\gamma = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}}$ and the Lorentz transformation for length and time takes the form: $\frac{1}{\gamma} = \sqrt{1 - \frac{v^2}{c^2}}$

So at this point we will restate, light is not subject to Lorentz contraction, Lorentz time dilation, or other relativistic transformations which regulate matter. Light is (photons are) the cause for those transformations being required for matter. This is a simple, and fundamental issue.

So we cannot look to the erroneous relativistic transformations of photons to try to explain a relativistic theory of "photon exchange" in a desperate attempt to answer questions raised by experiment.

Photons and the properties of photons are the basis upon which time is created. Their fast but finite speed is the foundation upon which the transaction time of matter (time itself) is created. Therefore it is inappropriate, and erroneous, to apply time transformations to photons. It is in fact an error to apply any of the Lorentz transformations to free photons themselves. Photons are the cause of those transformations, and are not the subjects of those transformations.

There are different views of what space is. One view, in summary, is that space does not exist, and that space is just empty regions between particles. Immediately after Einstein introduced Relativity, and further augmented by the Michelson-Morley experiments, there was a popular view that space did not have to be a real media. That view has, sometimes slowly, changed, so that most physicists now believe that there is at least a "fabric" of space, and some believe that space fabric is a "quantum foam".

If space has a structure, or fabric, then it seems there must be a preferred reference rest frame in space. Even though we may not be able to detect such a rest frame, if space is constituted of a fabric or structure of practically any sort, it implies that such a frame exists. We will call this the God frame. If such a frame exists, then in that frame is the only place where time could be a fixed reference. If we were able to measure all experimental events from that frame we would see that relativity, for moving frames, is a natural consequence of motion in that frame. We would see why our length and time transformations are required for moving frames. We would clearly understand the cause for redshift or blue shift is actually a frequency change caused by the motion of the emitter or absorber through that frame. We would understand that, since we are made of light, we can never measure any speed for light other than the actual speed of light that we could measure in that rest frame. All of this was introduced for the simple reason of helping us to know exactly why, and how to apply, Lorentz transformations. So that if we simply take a step back, and look at all the circumstances from the "God frame", we can understand when and how to apply, any and all, Lorentz transformations.

The simplest explanation is that relativity is the Lorentz and Larmor type consisting of three spatial dimensions and time, Euclidian, and not strictly the "spacetime" type consisting of 4 dimensions, Minkowski Spacetime. Due to the makeup of material objects, space only becomes "spacetime" for material objects. So given these significant clues, it is reasonable to recognize that relativity is the consequence of matter being made of waves, confined, and traveling in confinement at the speed of light. If this is true then space is, as mentioned above, simple Euclidian three dimensional space. But if we are careful with the implementation, we *can* compute relativistic transformations for material objects using 4 vectors, because the material objects made of **confined waves** are subject to such transformation.

Now to discuss—"Nature is not deterministic and causal. (Presumed by certain interpretations of QM)", and lets also discuss--"The superposition of states is a real phenomenon".

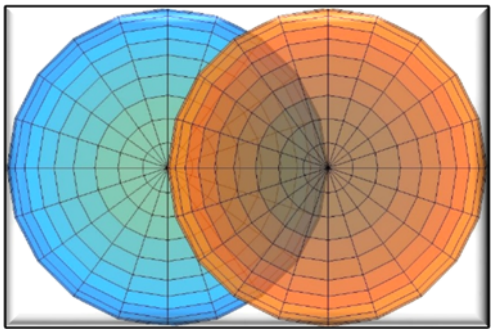
In this matter, this author feels that Einstein was right, in that there must be causal and deterministic "local" conditions which describe the behavior of particles. "Local" is in quotes because fields are specifically non-local and extend off to infinity, and the propagation velocity of charge itself is

significantly faster than the velocity of light, so that some of the effects of charge will be perceived as being non-local, even though charge is *generated* by principally a "local" condition.

Wave function collapse

There are many different views of wave function collapse. And many different conditions where QM invokes the use of this term. Just as in QM there are many views of several different types of terminology. Like "superposition of states." The nomenclature of QM is rather ambiguous and unspecific. The more unspecific a theory is in its use of terms and nomenclature, the more valid the theory may seem, because it can be made to fit many more explanations for the observable. Some view this "flexibility" of QM as a strength. But scientifically we need to be very specific with nomenclature and completely separate definitions for different things. In that sense QM is not a clean theory. It is very messy and ill defined. And again we quote John Stuart Bell, *"the orthodox theory [QM] is "unprofessionally vague and ambiguous" in so far as its fundamental dynamics is expressed in terms of words which, however legitimate and necessary in application, have no place in a formulation with any pretension to physical precision … ".* And "*I think there are professional problems. That is to say, I'm a professional theoretical physicist and I would like to make a clean theory. And when I look at quantum mechanics I see that it's a dirty theory. The formulations of quantum mechanics that you find in the books involve dividing the world into an observer and an observed, and you are not told where that division comes... So you have a theory which is fundamentally ambiguous".*

We suggest that the "superposition of states" is not a real phenomenon, but simply a way to avoid the extensive work of creating the real (but somewhat difficult) definition of what is going on in the particle. But as long as QM assumes point charges, it will remain burdened with the requirement to be ambiguous in these and many other regards. With point charges as a foundation of QM, it will always require renormalization and experience infinities and singularities in situations where they do not exist in nature. When two sets of fields interact in such a way that all of the energy in one field is transferred to the other, the interaction will have a specific location which is its center of action. This center of action location resolves to a point. But neither field is point-like. So photon-fermion, or even photon-atom, interactions do not really have any wave function collapse in the QM sense, they simply have wave function interaction and an assignable "center of action" location for that interaction. The simplified illustration here shows the overlapping fields of fermionic particles as they interact. The "location" of the particle is the black dot at the center of each field. The fields emanate from, and are part of, the particle's energy structure.



Point particles cannot and do not exist. They are a physical impossibility. They engender infinities where those infinities do not exist in nature. They are an imaginary concept, erroneously conjured, to try to explain various experiment, and to try to remain consistent with the current structure of QM. But the fictitious point particle, creates more problems than it solves in our theories, and now stands in the way of progress in physics research. There are

many attributes of physics which can, in certain ways, lead to point-like mathematical solutions for various forces, charges, or fields, but that is a generally mathematical artifact, due to the structure and limitations of the math, or due to making too many assumptions and approximations, and not due to the physical structure of the particle.

While understanding the probability of finding a particle in a specific state or location is valuable information, QM does not adequately explain why. QM is, more or less, a statistical analysis of the behavior of particles, but not a causal derivation of the particle's properties or action. So it is not a complete or sufficiently rigorous theory. This does not imply that QM has no value, on the contrary QM provides us with a *tremendous insight* and much data and information, but it is a theory which is not yet fully developed, and which may prevent, *due to interpretation*, further development, unless its weaknesses, and the causes for those weaknesses are recognized.

Back to the point, if "wave function collapse" does not exist, then it cannot be the mechanism at work in supposed "entanglement" experiments where the wave function of one particle is envisioned to collapse at the instant of measurement of its "entangled" particle.

So next let's discuss the assumption that -- Non-local "Entanglement" of particles is a real phenomenon.

Entanglement has been suggested by so much literature, and by QM philosophy, to such an extent that many assume that particle pairs are indeed entangled and that there is a "spooky action at a distance" in particle physics. Ever since the EPR controversy, much of the physics community has considered the topic settled, and would argue that entanglement is a real phenomenon. Especially since Bell's work, most of the physics community has regarded the QM interpretation of these events to be the correct view.

John Stuart Bell wrote, *"For me **this is the real problem with quantum theory**: the apparently essential conflict between any sharp formalism and fundamental relativity. That is to say, we have an apparent incompatibility, at the deepest level, between the two fundamental pillars of contemporary theory…"*

Understanding, in detail, the relationship between the mathematics and the physical, is a very important part of physics. This is not always an easy task, because the physics dictates the proper mathematics, not the other way around. It is very easy to miss something when reducing the physical to concise mathematics. But once we have done this task correctly, we then have a new and powerful way of communicating, and analyzing the physics.

J.S. Bell underwent a valiant attempt to reduce the physics to mathematical proofs. His was a daunting task, because so many issues had to be considered.

Before his work, these issues were more vague and ambiguous to us, but now they are so much better defined, due to his efforts. However, it appears he missed at least one important consideration. If he had considered the scenario we have outlined, where particles are not point-like, and particles are made of the same EM fields as light, but the fields are confined in circular or spherical trajectories, he may have not missed this important detail. It has been shown, by **Robert Close[], and by Joy Christian[],** that considering the "spherical" nature of particles, the angular momentum or "spin", requires us to use a class of "local" variables involving rotations, occupying space, which Bell did not consider in his proofs. It seems that Bell's mathematics assume that the "local" variables are standard commuting variables or

functions based on the principle of "point particles", however it is well known that spatial rotations (and therefore spins for non-point like entities) do not commute. It has also been shown that, if we consider these rotations as the important local deterministic variables, and dismiss the notion of point particles, Bell's inequality and CSHS inequality are achieved in a local variable theory. This is a scenario where "entanglement" is shown to be an illusion and does not really exist. This scenario duplicates the predictions of QM in a causal "local variable" manner, removing the need for any "spooky action at a distance" to explain the results of experiment. So in this case of "entanglement", ***a misinterpretation of experiment has caused us to waste much time and pursue years of research looking for things which do not exist.*** Part of the cause for the misinterpretation of experiment is due to flaws in Quantum theory itself. Error in QM theory dictated the assumption of entanglement.

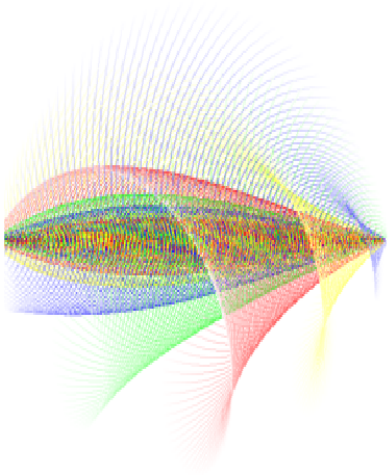
So let us review some of the issues to more clearly illustrate this point. Probably the easiest approach is to now quote Robert A. Close in "A Geometrical Model of Fermion Spin Correlations" from the *Electronic Journal of Theoretical Physics November 2012.* "*Bell's derivation assumes that the density of states, or sampling rate, is independent of the orientation of the measuring device. However, points on a rotating sphere are sampled at different rates at different positions, making Bell's Theorem inapplicable…" to "…spin one-half fermions as having a spherical distribution of observables with azimuthal symmetry, and assuming that a Stern-Gerlach device uniformly samples points on a spherical surface. Application of Bayes' Theorem yields the joint density of states for two device orientations. Numerical calculations based on this model yield the fermion spin correlations observed in Stern-Gerlach experiments."…*
Bell's assumption appears to be motivated by the common interpretation of matter as "particles". A point-like particle might be described by a fixed set of parameters such as Bell used. Measurements of vector quantities would still depend on the relative orientation between the vector and the measuring device, but any measuring device would sample only the single point where the particle is located at a given time. Hence the unique density of states of the particle is also the density of states sampled by any measuring device. However, matter may also be interpreted as consisting of waves, which are extended through space. There is a plethora of evidence for the wave nature of matter:"…
"With a wave theory of matter, massive particles must be interpreted as soliton waves which extend through space. Any property of the wave, such as spin or polarization, may have different values at different points in space. In particular, an observable may have an angular distribution, so that measurements made at one orientation sample points of the wave differently than measurements made at a different orientation. For example, in Stern-Gerlach experiments with a primary magnetic field B_z increasing in the z-direction, a spherical wave surface may be regarded as being preferentially sampled at the highest point of the sphere along the z-axis."… And …"the key assumption in Bell's derivation is not locality but the integral form of the correlation function."

Robert Close's explanation would however require a more complete and rigorous definition of the photon in order to provide such correlation in "entangled" photon experiments. But this is actually a good thing, for our definitions of photons still may be rather naive and somewhat lacking for a full scope and description of photon configuration. And such definition of the photon will lead us to further discovery.

Fields and Charge

If we assume space to be a type of frictionless media, and assume that the media of space is comprised of tiny, Planck scale, entities we will call nodes, we can envision the displacement of these nodes as a

transverse wave propagates through the media. Similarly, when we study the motion of water molecules in a transverse wave in water, we can see a simple illustration of such particle motion. The particles exhibit a circular motion, in a plane principally parallel to the direction of the wave, as the wave passes. We could envision that when a water molecule is rising and advancing in the direction of the wave the "field" would be positive, and conversely when the molecule is descending and retreating we could envision the "field" to be negative.



But this is not the complete picture. A "photon" (packet of light waves) has the ability to exhibit the property of spin. So the nodes of the space media would not just move in the plane parallel to the direction of wave travel. They also have a component of motion perpendicular to the direction of wave travel, so that, with spin, the composite of these two components is at an angle 45 degrees from a plane in the direction of wave propagation. But the media of space, is different from the physical media with which we are familiar, and from which we can draw analogy. But similarities exist nonetheless. The media of space allows two waves to easily pass through each other and then proceed principally undisturbed. These two incident waves experience minimal interaction. But they do experience some limited and specific interaction which we will explore later.

Non-Interference of Waves [NIW] is a property of EM radiation. This means that two waves can pass through each other and continue relatively uninterrupted. This also means that two waves, of the same frequency, may exist in the same place, and traveling in the same direction, and still retain their individual properties. In other words a wave with right spin and a wave with left spin may be superimposed and yield a net spin of zero, resulting in a plane polarized wave. But it appears that every *individual* wave possesses the property of spin in the media of space, left or right, and that plane polarization, and several other polarization modes, are the result of the interaction of individual waves. **This is the principal of "superposition" in its simplest and true form.** So a photon may consist of more than one wave but the total energy in the waves which make up a single "photon" obey the principal E=hv. Which is, Energy equals Planck's constant times frequency. Or stated in another way, the frequency of the waves in a "photon" are proportional to the energy of the "photon". But we have to keep in mind that what we sense as a "photon" is actually the strongly quantized and resonant reaction of fields, in a fermion or atomic structure, as they react with the energy and fields in light.

Photon Quantization and confinement:

So if we assume that space is Euclidian, and time is separate, when dealing with light and photons, and that space is an acceptable "container" of energy, it brings us to some additional considerations. "Photons" seem to have a point-like region of interaction, meaning they tend to act on one particle, or atom, as an absorber of their energy from space. This may mean that the fields of photons are centered about one localized point, but surround this point extending off into space. The fields of the particle the photon is absorbed by, also have a "central" point of interaction, and also extend off into space. This particular concept requires that photons be "quantized" in a sense, and have a localized center of action, instead of having a continuous, purely wavelike nature. This would bring us to a different

definition of “field” for the microscopic world. The fields of photons or particles are specifically defined by this approach, and differ from the Maxwellian model in the microscopic sense, but agree with Maxwell in the macro, combined and total effect sense. In this view it becomes clearer that photons would seem to interact at a localized point and that, the frequency of the waves in a photon are proportional to the energy of the photon. But this may not be the way nature works.

There are two possibilities then regarding the quantization of photons. One is that photons are “corpuscular” themselves. The other is that light *seems corpuscular* due to the corpuscular nature of matter. In the second possibility, the confined wave and field topology of the particle, or atom, captures energy from incident light, and that energy causes a change at the center of action of the of the confined fields of the particle, or atom. In this view, particles are confined, resonant, structures, so they can only react to energy which is sufficient in amplitude, phase, and frequency, within a finite amount of time, in order to meet their resonant conditions. So the entire reaction *seems quantized*, because it is quantized by the particles or atoms. Chandrasekhar Roychoudhuri points out that most of the interactions of light and matter are in the situation of light interacting with and atom, or two particle system, which creates a charge dipole. In his writings: “*Next Frontier in Physics—Space as a Complex Tension Field*” in the Journal of Modern Physics 2012, 3, 1357-1368. While we know that light can “bounce off” of an electron as in Compton Scattering, imparting some of the “photon” energy to the electron, it seems that more absorption may occur in the presence of a charge dipole arrangement of particles.

Modelling Space

Eventually we will need to **create a working model of space** in order to understand and predict the behavior of particles, fields, waves, and forces.

What do we need to model? We need to know space **density**, **bulk modulus**, **shear modulus**, the nature of the discrete “corpuscles” (nodes) which occupy space. The **linear** and **angular reaction** of those nodes to displacement. How they interact with each other. How they “move” and why they move in that specific manner. We need to identify the “size” of these nodes, their “energy content” and therefore their mass equivalence, and how their arrangement and flow creates EM fields and charge, by implication therefore, how and whether they are “polarized” by the propagation of energy. We need to understand whether they have inherent angular momentum, and what the “resonant” characteristics are of this sea of entities in space. And we need to identify all the forces that the nodes and tensors create in space, not just the EM forces, but also the Poincare forces, and the strong nuclear force. We need to understand how all these forces are created by the reaction of energy with space.

From this we will be able to define what energy is in the media of space, how it works, what it does to space. We will also be able to understand time, the velocity of light, the fine structure constant, elementary charge, the Coulomb field, EM fields and Electroweak forces, Planck’s constant, gravity, the strong nuclear force, etc.

We quote Einstein: *"When in the first half of the nineteenth century the far-reaching similarity was revealed which subsists between the properties of light and those of elastic waves in ponderable bodies, the ether hypothesis found fresh support. It appeared beyond question that light must be interpreted as a vibratory process in an elastic, inert medium filling up universal space. It also seemed to be a necessary consequence of the fact that light is capable of polarization that this medium, the ether, must be of the nature of a solid body, because transverse waves are not possible in a fluid, but only in a solid. Thus the physicists were bound to arrive at the theory of the "quasi-rigid" luminiferous ether, the parts of which can carry out no movements relatively to one another except the small movements of deformation which correspond to light-waves."*

Einstein has a point worth pondering regarding the nature of the fabric of space being similar in certain properties to a solid. It is not too much of a reach to envision a medium through which transverse waves can travel as they do in space. This is the approach that Maxwell used when deriving his famous equations. And then neither is it much of a reach to envision longitudinal artifacts in space which travel much faster than light. It seems likely that any medium which can support transverse waves can also support longitudinal displacement. It is also possible that space can be "polarized", so that an offset occurs due to the "pressure" of fields, like Coulomb fields.

So space can be viewed as a semi-rigid media, not like a liquid, and not exactly like a solid. A media which is "displaced" and "polarized" by energy, but which has a strong set of inherent forces, which causes space to return to a normal distribution, once the disturbance of energy has passed. We have a significant amount of information regarding exactly how this happens, if we look at the known behavior of fields, forces, light, and particles. Energy displaces and "polarizes" the media of space, and creates forces and fields, which interact with themselves in specific ways. These specific methods of self-interaction are defined by the behavior of the fields, and the existence of the forces in space.

When all the evidence is considered, and the pieces of the puzzle are assembled correctly, they paint a perfect picture. Just as with a "jigsaw puzzle" there is only one correct way to assemble all the pieces, and only one correct picture results. What complicates this universal puzzle further, is that some of the pieces of the overall puzzle of the universe are in themselves puzzles, and these contributing puzzles must be understood and assembled correctly, in order to really see and understand the big picture.

We are at a point in physics where the pieces of our major individual theories attempting to describe the foundations of physics do not fit together seamlessly into the larger puzzle. This is a clear indication to us that we are misinterpreting some items, and that our "foundational" theories need another look.

So, let us list a set of properties of space we can use as a starting place:

1. Space can propagate energy in transverse waves at a "fixed" velocity (the speed of light).
2. When space propagates energy, the energy creates the property of momentum.
3. Space has no inherent net momentum, no spin net angular momentum, and no inherent net linear momentum. In other words, space does not impose any "friction" on non-relativistic moving bodies in space. Space does however impose a limit on the motion of energy through space. The velocity of light. And since all objects are made of energy, space imposes limits on the motion of objects.

4. Waves in space appear to us principally the way Maxwell described. But waves in space can display a form of spin angular momentum which cannot exceed h (Planck's constant) in magnitude. A plane wave can contain components of spin angular momentum.
5. Space is the container which holds and manages all energy in the universe.
6. Energy in space causes gravitational effects. Gravity may be faster than the local velocity of light.
7. The principal, and most easily detectible, energy transmission mode of space, is in the form of transverse waves.
8. Under certain conditions, energy can travel faster than the speed of light, as in FTL tunneling.
9. Space has at least two major inherent resonances, one for the electron geometry, and another for the proton geometry. These resonant properties are likely caused by what may be described as non-linear interaction of fields at these energy densities, and at these scales dimensionally. These resonances assist in the creation, and stability, of the most stable particles of matter, the electron and the proton. The result of the non-linear interactions are the creation of forces, including binding (Poincare) force in the electron, and the binding force of the proton (which engenders the strong nuclear force).
10. Regarding the propagation of energy through space, space is a 3 dimensional Euclidian space. Lorentz transformations are required, specifically, when dealing with the confined waves of particles with rest mass (fermions).

So, in order to model space we could start by considering item 3 above: "*Space has no inherent net momentum, no spin net angular momentum, and no inherent net linear momentum.*"
This is required for the existence of stable particles, without decay, like the electron and proton.
When we look at the speed of light equation, $c = \sqrt{\frac{1}{\varepsilon_0 \mu_0}}$ and compare it to transverse wave propagation velocity equation $v_t = \sqrt{\frac{\mu}{p}}$, we can see that Maxwell substituted $\sqrt{\frac{1}{\varepsilon_0 \mu_0}}$ for $\sqrt{\frac{\mu}{p}}$ for the velocity of energy propagation in space. But in all other respects the equation is the simple description of a transverse wave velocity. So we can restate the mass-energy equivalence in the following ways: $E = m\,c^2 = m\frac{\mu}{p} = m\frac{1}{\varepsilon_0 \mu_0}$ So: $m = \frac{E^2}{c^2 \mu\, V}$ where μ is the transverse modulus of space and V is the volume. And we then know: $\frac{1}{\varepsilon_0 \mu_0} = \frac{\mu}{p} = c^2$

Does space have conventional *mass based*, "density" *p?* Space can be envisioned as consisting of nodes, separated by Planck length distances, with each node connected to its neighbors by both attractive and repulsive lines of force. One easy way to envision this is to imagine that each node is a very small unit. But the lines of force, between the nodes, are not electric, or magnetic, but a force more *fundamental*, and *stronger*, than any of the observable forces. In this scenario these nodes and the forces between them, *would be the source of* the resultant electric, and magnetic fields, as well as the other detectible fields or forces of space.

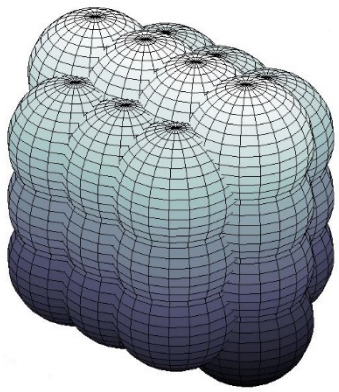
So in our analysis we must *refine* the "density" term for use in modeling space. Material density is generally defined as its mass per unit volume, or $p = \frac{m}{V}$, where *p* is density, *m* is mass, and *V* is volume. The reason that a density term is used in the calculation of transverse wave velocity, in physical media,

is that the term *p* represents the media's resistance to motion, and then the transverse modulus μ, represents the stress tensor, which moves the mass in *p*. But in space, the nodes we have envisioned, have no conventional inertia, but they do resist motion. Maybe they resist motion in part by a type of force similar to "back-EMF". But we will also discuss later, a reason for space to display resistance to motion, in a more conventional sense. But all of this provides for a space which is free of friction and only displays the tension fields, the forces which cause space to normalize itself after being disturbed by energy. The resistance to motion in the nodes, causes a sort of time delay in the full displacement of a node, when reacting to the motion of adjacent nodes. **But since all of the incident energy is contained in the tension between the nodes**, the reaction of space to energy is frictionless. In other words, space will give up all of the incident energy as it renormalizes. This view is completely compatible with Maxwell's equations.

We know that ε_0 and μ_0 are the electric permittivity and magnetic permeability of space, and are measureable, and therefore may be assumed to be proven properties of space. But in our scenario, these are secondary constants, caused by the more fundamental properties, caused by the tensors of space.

A stable, self-organizing, self-normalizing tension field would be the result. Without the balance of attractive and repulsive forces, the universe (space) would either collapse, or explode.

But let us now consider the nodes we have discussed. We have specifically not assigned any inherent energy to the nodes. So are the nodes are nothing? They are only the junction points of the tension fields, and the tension fields related to that specific junction point. That's it. So that, in one sense, we just wind up with a fabric of space. But we do not yet have an envisioned fabric which behaves like space, that is to say that this fabric should display the properties we know that space has.



We know that space has no directional differences or preferences. So if we envision the nodes and their force to be spherical, overlapping and uniformly spaced, then we could model the nodes of space something like the illustration to the right: Where each sphere in the illustration here represents a node and its forces.

Regarding the forces; The assumption is that the forces are both attractive and repulsive between nodes, which gives space its "stiffness" and stability.

These nodes are envisioned to be, on average, one Planck length apart, making them very small compared to the dimensions of subatomic particles, so that in the volume of the proton there about $4.372381596144681 \times 10^{60}$ of these nodes, and in the volume of the electron there are about $2.706727085870004 \times 10^{70}$ of these nodes.

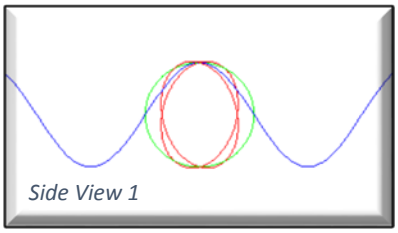
A uniformly spaced, 3D arrangementof nodes, could create properties in space much like the properties we know to exist. We have speculated about the nature of the fabric of space. The usefullness of such speculation may not be imediately obvious. But what we are trying to do, is to identify as many of the pieces of the puzzle as possible, so that we can build a more complete picture later.

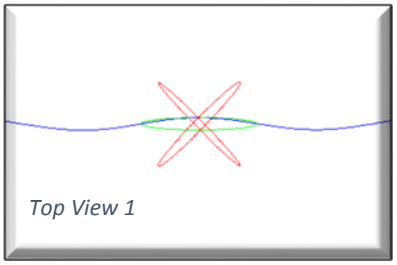
Wave propagation

Transverse waves, moving through a medium cause an undulation of the medium. If you look at the motion of water molecules on the surface of a tank, and chart their motion as a wave passes, you see a

circular motion in the vertical plane, with the plane perpendicular to the direction of the wave. It could be argued, that the medium of space, requires a similar circular action for "transverse" waves in space to propagate. This would give both a transverse and longitudinal component to the wave as a result of the circular motion.

But that does not tell the whole story. When energy dispalces space, and creates these waves, the displacement of space occurs, according to the properties of space. It causes electric and magnetic disturbances as one result, and changes the stress on the tensors, these electric and magnetic forces, and other forces created by the displacement of space, also affect the wave and the surrounding space. The combination of these effects *has an impact on the way space moves, and therefore the way the wave propagates. These self-generated forces affect the way space moves in response to the wave.* The circular motion of a node in space, as a wave passes, would then be acted upon by the fields and forces which are engendered in the process. So it is proposed that these effects at least add an angular offset to the circulation. In the illustration, (Side View 1) the green circle is the motion of space if the motion remained in a plane parallel to the direction of propagation. Let us now look at a top view of this illustration (Top View 1). The red circles are at angles, left and right, of 45° from the longitudinal. This motion of space, caused by the forces generated by energy's reaction with space, causes space to display a component of angular momentum for each left and right components of motion. So that if we excite space with energy which is a plane wave, the magnitude of the left and right components are equal, so the red circles sum to provide an apparent motion similar to the green circle as a composite. However if we excite space with a wave which has only the left or right component, we have a wave with a fixed angular momentum, because the specific displacement of space itself causes the angular momentum. So it is possible that space cannot support propagation in the manner described by only the green circle. Then space could only support transverse wave propagation with the left and/or right types of propagation depicted by the red circles. And we would normally only be able to measure the sum of the action of the left and right red circles.





But this is not just blind speculation. Maxwell's equations were created in the 1860's and built upon the information then available. Electromagnetism had been studied, using conductors and the other means available at the time. When we use wires to measure the reaction of these waves, and how they cause electrical and magnetic phenomena, we are constrained by our means of measurement to see only part of the picture. We then can only see the transverse sum of the actions of of the propagation of these waves, when they react with the wires. The angular momentum components become much more difficult to detect using these methods of measurement. If Maxwell's equations were properly rewritten to include 3 spatial dimensions, time, and the speed of light, we could derive a set of equations which naturally have both left and right solutions, and more completely describe the remaining phenemona we have discovered since Maxwell. So that when energy propagates in space, the reaction of space causes an additional "twist" which is manifest in the spin property of "photons".

At the level of the field equations, the velocity and displacement of the "nodes" of space are important. The velocity of these nodes is important, both in magnitude, and direction, so that we may properly

understand and define the fields and forces, including Poincare forces, generated by the interaction of energy and space. The magnitude of the velocity vector is determined by the displacment force, the resistance to motion of the nodes, and the strength of the tensors or forces between nodes. The strength and nature of the tensors or forces between nodes determines the maximum energy density which space can support. If we consider that the tensors may be "unbreakable" bonds which increase in force with their distance (from the normalized condition of space,) then space would have practically an infinite capacity to hold energy. The Young's Modulus of a media, is the stress (force), divided by the strain (deformation), of the media. If space is as we have envisioned, with practically an infinite energy capacity, then the local, instantaneous, Young's Modulus of space would increase with energy. So we need to better understand the relationship between the transverse (shear) modulus, the local, instantaneous, Young's modulus, and the desnity of space, so that we can understand how it is that light slows in regions of higher energy density. But if the tensors of space retain the same force, regardless of the deformation of space, then space would still have an enormous capability to hold energy, and the Young's Modulus of space would still decrease with the application of energy.
We have discussed tensors which have both an attractive and a repulsive component which stabilizes space. It is likely that these two forces, attractive and repulsive, are not linear, and are varying with distance between nodes. If this is the case the Young's Modulus is too simple an expression to use, for computing the transverse modulus, which affects most of the transmission of energy in space. If the tensors of space are only repulsive, then space is expading at a tremendous rate. But our measurements of distance, time, and volume, would also be changing at the same rate, so we would likely not detect such an expansion. We will not assume this to be the way nature works for now. All of this will hopefully become more understandable in the following discussion.

Energy Creates Mass

Before we can proceed, we need to address the subject of the mass-energy relationship. We will state a no so new idea that **Energy in space creates mass**. We are already aware of the famous equation $E = m\,c^2$. But we will talk about why the reciprocal is also true: $m = \frac{E}{c^2}$.
We will start by stating the premise that…
When energy is confined, in any way, in space, it always creates mass-like properties.
So let us first discuss the properties of mass. Mass has "inertia", mass is affected by gravity.
For a first example, let us imagine an EM wave confined to a circular path in space instead of traveling in a straight line. The EM wave has momentum, so its circular confinement causes it to display resistance to motion. You must act against the reaction forces of momentum, and confinement, in order to move the confined wave. The "photon-in-a-box" thought experiment is another example of this effect. This is inertia.
But when we look at this carefully, we can see that momentum, in itself, is a resistance to any **change** in motion.
Martin van der Mark has written a paper "light is heavy" which addresses some of these issues.
We know that energy moves (propagates) through space at a finite velocity. *The fact that space imposes a limit to the velocity of the propagation of energy, also means that all energy is, in a sense, "confined" by space.* The tensors of space, reacting with the nodes of space, eject the incident energy, as they renormalize space, causing the energy to propagate at a finite velocity through space. This simply

means, that the reaction of energy with space, creates the property of momentum, in a very clear and understandable way. But if space itself has an inherant energy density, then it has an inherant "momentum", because energy in space is always moving at a determined velocity. The simple effect of a momentum density, is the effect of space displaying the property of mass density. The same effect of momentum creating inertial mass, as in the circularly confined energy in a particle creating mass. So that the more energy you add to space, the more momentum space contains, and the more "massive" space behaves. And, therefore the more "density" *p* space will display.

However there may be a difference in the mass-like reaction of space when evaluating energy density contributed by a single ray of light traveling linearly. It may be that space does not exhibit much of a mass-like reaction unless there is sufficient energy, traveling in many different directions, so that the momentum of the energy density in space is capable of reacting against incident waves from "any" direction. We will reserve this thought for further discussion as we proceed.

If we assume that the estimated energy density of space, of 10^{-9} Joules per cubic meter, is correct, then we could compute a mass-equivalence 1.112650056053619e-25 kg/m^3 for the nodes of space, and therefore we could know an estimated value for the density *p* of space. If this "density" estimate is correct then the transverse modulus of space is:
μ = 1.000000000098650e-09.
(And if the velocity of the Coulomb Field is *(1/α) c*, the longitudinal modulus of space is:
K = 1.877753170895984e-05.)

We know that fields are comprised of energy and extend off to infinity, and are weaker the farther they are from the source. Space in the vicinity of massive objects then has a greater energy density, due to the presence of these fields in space, which emanate from all of the rest-mass carrying particles in the massive body, and occupy the surrounding space. So if we calculate the energy added to space, due to these fields, and add that to the background energy of space, we would arrive at a new mass-equivalence per unit volume of space. This has the effect of increasing the "density" of space near massive objects. Density is the term *p* in the equation $c = \sqrt{\frac{\mu}{p}}$. Which has the direct result of slowing the propagation of light as density increases. Where μ is the transverse modulus of space. So gravity curves the propagation of energy through space in the direction of the more massive object, and particles are made of energy propagating in a confined topology. So in space, energy and mass are made of the same stuff. So both energy and mass are affected in the same fundamental way by gravity, which is a gradient in the energy, therefore the mass-equivalence, or "density" of space. But $p = \frac{m}{V}$ and $m = \frac{E}{\left(\frac{\mu}{p}\right)}$, so we have to integrate to find an accurate *p* for any specific region of space. And we may have a similar requirement regarding the transverse modulus μ of space.
Momentum, while beign a "motive" force, is also a resistance to a change in motion, therefore when momentum is confined, it creates "inertia". The light wave (energy) does not want to change its direction or velocity, but if it is deflected, it imparts a force to the deflecting item, it pushes back. The energy does this when traveling linearly, and it does the same thing if confined in a particle. It resists a change in motion, but the properties of space provide for a confienment force, both by limiting the velocity of light, and by "circularly" confining the energy in fermionic particles. The resistance to change

in motion is the foundation for inertia in particles, and is a property which gives energy in space a "mass-equivalence".

Note: Chandrasekhar Roychoudhuri has made some very interesting and enlightening observations regarding a "Complex Tension Field", "CTF". In his work: "*Next Frontier in Physics—Space as a Complex Tension Field*" in the Journal of Modern Physics 2012, 3, 1357-1368.

How can we verify our assumptions? We could calculate the change in energy density in space, caused by mass in the vicinity, and calculate the density gradient of space, then the curvature of light caused by that gradient, then the gravitational displacement, or force, which would be the result. When we have it all correct, we should arrive at the gravitational constant of the universe. But there are still many issues to address before we can be prepared to undertake these calculations.
The gravitational constant can be expressed in the form: $F = G\left(\frac{m1\ m2}{d^2}\right)$. So we can calculate the gravitational constant with two known masses, separated by a known distance: $G = \frac{d^2F}{m1\ m2}$. When we do so, we arrive at a value 6.674080E-11 N m^2/kg^2. And then by substitution $G = \frac{d^2F}{\left(\frac{E_1}{c^2}\right)\left(\frac{E_2}{c^2}\right)}$ where, in the formulae above, *G* is the gravitational constant, *d* is distance, *F* is force, *m* is mass, *E* is the energy equivalence of the masses, and *c* is the speed of light.

But now, before we proceed, we need to talk about the nature of particles. When we normally envision an object we call a "particle", the mind conceives of a small physical object, perhaps a tiny sphere, which is solid inside, and has a clearly defined "surface'. **But this is NOT what subatomic particles are!!!** Subatomic "particles, like the electron and proton, are confined waves (circulating fields) of energy. They have a center, about which the energy circulates, and they have a region of exclusion, (Pauli exclusion) wherein no other "particle's" region of exclusion may exist. But the particles are made of fields, with a very high field density, high energy density, near their center. These fields extend off into space, infinitely, becoming weaker with distance from the exclusion area, the center region of the particle. Electron double slit interferometry, occurs precisely because this is how particles are made. But all of the energy of the particle is not confined to the small "exclusion region" of the particle. The remainder of the particle's energy resides in space around the particle, reaching off into space, and the density of that energy decreases with distance from the particle.

The only way we have of measuring these fields, created by the reaction of energy with space, is by the influence these fields have on "particles". That is part of our measurement limitation.

When we measure momentum, at the particle level, we are sensing the action of the energy in one wave reacting with the energy in another. In such reactions momentum is conserved because energy is conserved. All energy in space has momentum.

So again, let's discuss Quantization

We should not assume that everything is quantized a priori, but that there are causes for each aspect of quantization, so that we can fully understand the nature of the universe. So let us look at the natural forces of quantization. Quantization can take on many forms. The resonant nature of the confined waves which make up particles is a natural source for quantization. Maintaining resonance, within the limits of the properties of space, is a natural consequence of the existence of particles, and atoms, in a confined and resonant form. But let's think about the nature of the fields of particles, and their

confinement. If particles are as we have envisioned, and have fields which extend off into the universe, then they have a form of quantization, which is dependent on the fields being founded in, and attached to, the waves, the energy, in the fermionic particle. So if this is the behavior of the energy, waves, and fields, in the fermions, then is this also a description of the energy, waves, and fields, in "photons"? If this does also describe the waves and fields of photons, then photons are "particles" by the nature of this quantization, and not just waves. If this is how photons work, then photons have a center of action. They would display a point as a center of action, at least in the plane perpendicular to the longitudinal axis of motion of the photon. But what if the nature of the relationship between the fields, and waves, in fermions, is due to their confinement? What if the nature of the relationship between the fields, and waves, in fermions, is because they possess a different "spin mode" caused by confinement. Then light could be just waves in space, and not particles, or "photons". Of course the quantized emitters, as particles, or atoms, would only be able to emit discrete amounts of energy and discrete frequencies of light, due to their resonant nature, making the waves in space appear to be quantized in energy and frequency. Likewise the absorbers would only be able to react to certain frequencies, and make energy changes in discrete jumps which correspond to the allowable resonances, also contributing to our perception that light is made of particles, even if it is not. We have already discussed how light can exhibit the property of spin angular momentum and still be a continuous wave in space. So, until we have sufficient information, we will need to reserve the possibilities that light may be either inherently quantized, and consist of particles, "photons", or may just appear to be quantized and consist of only waves.

So now Let us discuss Gravity

We have suggested that gravity is caused by the bending of light, the propagation of energy in space. We have proposed the mechanism which causes light to slow in areas of space with a higher energy density. We have also discussed the contribution that the fields of particles have to the energy density of space. So now let us get more specific in the determination of the effect of energy density, and the force of gravity.

First, let us come to a better understanding of light by studying the effects of gravitational bending of light. The concept is that gravity is caused by changing the speed of light in space. We have suggested that changing speed of light could be caused by the increase in energy density of space around massive objects, which changes the density of space so that in the formula $c = \sqrt{\frac{\mu}{p}}$, the term p for density, slows the speed of light. So now let us talk about how the bending occurs. It seems that all frequencies of light, or EM radiation, are bent the same amount by gravity in space. But if light were really "point particles" with no spatial extent, then no bending could occur. Some of the point particles, closer to the gravitational source would move slower, but would not change direction unless the point particles are "coupled" to each other. And we know that there is a non-interferance property of "photons" which precludes the possibility that "photons" are coupled to each other.

Interestingly, if light has a spatial extent in the transverse direction which varies with frequency (energy) then gravity might bend different frequencies of light, different amounts. But the indication is that, in the case of the effect of gravity on light, all frequencies of light, display the same transverse spatial force, so that all frequencies of light are bent the same in gravity.

But we have ingnored one aspect in this analysys so far. If we view light as indivisible quanta, “photons” which have more momentum at higher frequencies, as we know they would in nature, then the transverse “size”of these indivisible quanta must be larger, and related to their momentum, in order for gravity to bend all frequencies of photons the same amount. So that with more momentum, gravity acts on a quanta of larger area, in order to achieve the same deflection. But then we have a new set of problems in the description of these quanta of light “photons”, and that is the nature of their quantization. If the quantization is inherant in light, in other words if light is comprised of indivisible quanta, then there is no known mechanism which can cause such quantization. Photons are generally regarded as being a large number of wavelengths long, and this length may be any arbitrary number of wavelengths according to some experimental data. So energy density cannot account for photon quantization, because the energy of the photon is spread out over a many wavelengths, and according to some experimental data, may be any arbitrary length.

However, if we view light as just waves in space, we can see that these waves could bend the same amount for different frequencies, provided the fabric of space has a specific set of properties, which couples the energy in these waves, which makes slowing of part of the wave cause bending. We have discussed a tensor model for space which could display these properties. So that when we examine the response of light to gravity, it becomes more compelling to view light as waves, rather than particles.

It is assumed that light curves according to the formula: $\theta = \frac{4GM}{rc^2}$, where θ is the angle, *G* is the gravitational constant of the universe, *M* is the mass of the body curving light, *r* is the distance from the center of mass of that body, and *c* is the speed of light in free space. Note that this is the total angle of deflection as the light passes the massive body. Of course the incremental angle must be calculated in a more rigorous manner.

So lets talk about Charge

The elementary charge, the charge displayed by the electron, and proton, are interesting, in part due to the required “topology” of these fermionic particles, which possess the topology (or topologies) which create charge. Understanding charge is not a trivial process. For charge is another of the manifestations of the topological reaction of energy with space. The fine structure constant is a fundamental physical constant characterizing the strength of the electromagnetic interaction between elementary charged particles. But the fine structure constant is also a manifestation of the properties of space. The fine structure constant simply tells us how space and the topology of charged fermions react to the topological electromagnetic fields in other charged fermions. So to fully understand charge and the fine structure constant we must piece together the topologies of charged particles, and the reaction of space to these topological fields, and how the reaction of space causes the forces between these entities that we measure.

So the relationships that we can readily identify, and which are commonly understood are:

$$\alpha = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{\hbar c} = \frac{\mu_0}{4\pi}\frac{e^2 c}{\hbar} = \frac{k_e e^2}{\hbar c} = \frac{c\mu_0}{2R_K} \quad \text{and} \quad e^2 = \frac{2h\alpha}{\mu_0 c} = 2h\alpha\varepsilon_0 c$$

where α is the fine structure constant, ε_0 is the electric permittivity of free space, *e* is the elementary charge, *h* is

Planck's constant, $\hbar$ is the reduced Planck's constant $\hbar = \frac{h}{2\pi}$, c is the speed of light, μ_0 is the magnetic permeability of free space, k_e is the Coulomb constant, and R_K is the von Klitzing constant.

Action at a distance

When we come to better understand the spatial nature of the fields of particles, we can then see that ***action at a distance is an illusion of our physical universe***. The particles of our universe ***exist in a configuration which is spatially extended.*** We normally sense interactions as if these particles are very small "corpuscular", and very localized particles, when in nature they each are actually occupying all of space, especially within their "light-cone", and probably even more spatially extended than that suggests. They have a "center of action, due to their topology and configuration, which give us the appearance of "a physical solid". So that we can "touch" physical objects. But this is a very small part of the complete picture of nature. The fields which comprise particles are extended and in direct contact. The fields are "touching" each other *at any distance* of separation. So that our limited concept of "action at a distance" is not required for a definition of the forces of nature. The nature of space, and therefore the nature of these fields, defines the reaction we can experience from the particles of nature. Most of those reactions are observable and quantifiable, especially if we understand what we are looking for.

Concepts like "action at a distance", "point particles", and many of our commonly perceived assumptions, are engendered by our limited experience, by the "filtering" which fermions perform on the information of nature, which we are able to perceive.

A side note about using mathematics in physics: We often "simplify" our equations as much as possible, so that we can more easily see relationships. Simplification provides us with a "shortcut" for communicating these relationships. However, *in physics, as in life*, if we take every shortcut which seems available, we find ourselves having more trouble, and often have to work even harder, because we have to execute "work-arounds" *to accommodate for the limitations that the "shortcut" imposed*. Often, in physics the shortcut *is imposed upon us* because of partial "filtered" information. In this case it is good for us to attempt to envision the possibilities. But we must be careful to envision all the possibilities which are in agreement with experiment, and to explore each of these possibilities, to find the one which best fits the evidence.

I will encourage every serious reader to not be constrained, coerced by prevailing thought, or intimidated by established dogma, into accepting the existing theories, but to do the work of evaluating the foundations, so that we may build strongly the new physics, born of human understanding.

It seems to me that for about 100 years we have, in general, been *suffering the consequences of an interpretation*. A concept was developed, and we have tried to fit everything into that concept. ***It is like the only tool we have is a hammer, so we have to treat everything like a nail.*** Much of this has caused us to call everything a "particle". I deeply feel that this leads to unintentional misrepresentation of what is actually going on. Starting with the assumption that everything is quantized, current theory has shaped our thinking in some ways which are good, but in many ways which simply cloud our thinking. This dogma has been instilled in so many of our concepts, that it is really difficult to recognize what we are allowing ourselves to be influenced by.

Hopefully, in the not too distant future, we will recognize the importance of what many physicists have pointed out, that it appears that nature is quantized only in specific ways, and that quantization is the simple result of linear and non-linear properties of space and the reaction to energy propagation. Quantization is most often caused by a resonant system, as many have said, and the explicit properties of the correct field equations, in specific circumstances. To quote my friend John Williamson, "*when we get it right, quantization will be a result we get out, and does not need to be put in a priori*".

So as the current physics looks at nature, for them the zoo of "particles" continues to grow. It seems that when we finally understand what is going on, we will call these things more accurate names, we will view them for what they really are, transient states in the process of decay. Dynamic, and controlled by the properties of nature. Hopefully we will one day say goodbye to "virtual particles", because the process is not virtual, and the components are probably not well described as "particles". Why do we want to describe the incredibly transient configuration of energy in a decay as a "particle"? These transient states are constantly changing, they really have no stable properties, and they are morphing configurations of energy simply obeying the laws of nature. The definition of a particle has now become so broad that it encompasses everything which has an EM field.

So I feel that our clarity of thought is not only clouded by the interpretations of 100 years ago, but also by the *language* extant today, which has developed from that set of interpretations.

It is good to have a name to call things, and I understand how and why QM decided to give the name "particle" to everything it finds. But sometime in the future, I hope we dispense with nomenclature which is ***designed to foster a particular view of nature***, and call things by names which are closer to what they actually are. **We have many more tools than just hammers.**