Electromagnetism in terms of Space and Time
A Model Enabled by Including the Human Subject

Ben Werner[1], Cadell Last[2], Gael Van Weyenbergh[3], James Redenbaugh[4]

Abstract: A description of electromagnetism in terms of space and time has remained unknown. Historical attempts have posited extra dimensions of space, yet the underlying philosophical barrier is the exclusion of the human subject. The virtual/imaginary status of electrostatic and magnetostatic fields suggests that we are composed of a wave oscillating at a human scale of space and time. We infer this wave is a rotation of awareness between the positive mass/energy forming an object of the senses and the negative mass/energy forming the unconscious idea of the object, through a virtual/imaginary dimension. Building a model from this starting point, we recognize the electrostatic and magnetostatic fields as tension/torsion between an object and the unconscious idea of the object, when there is an offset between either the object or the idea of the object between the present moment and either the past or the future. This model illustrates the identity of the speed of light with the speed of time. In review, we offer a framework for the synthesis of the objectivity of physics and the subjectivity of the humanities, wherein emotions are fractal electromagnetic waves. We predict applications of this model that are simultaneously technological and psychological, enabling humanity to function as a collective organism through virtual emotional resonance.

Keywords: electromagnetism, electromagnetic, electrostatic, magnetostatic, spacetime, emotions, fractal, psychology

Overview

A common perspective may be that general relativity explains light. This would be understandable, given how intrinsic light is to general relativity: the theory is rooted in an invariant speed of light; "$E=mc^2$" tells us that mass and light are the same thing; and black holes are the singularities in spacetime wherefrom light cannot escape. General relativity tells us that gravity is curved spacetime, but it does not tell us what light is. No doubt this frustrated Einstein - indeed the first attempts at unified field theories were about trying to explain the electric and magnetic fields in terms of spacetime [1][5]. One hundred years later, this approach to unified field theory seems to have been forgotten, and the problem is now framed in terms of reconciling general relativity with quantum theory. This makes sense, given a view that the frontiers of our knowledge are at the macro and micro limits of the universe. The general consensus is that at the human scale, physics explains things perfectly, *for all practical purposes*. The laws of electromagnetism (Maxwell's equations) connect the quantum scale, the human scale,

[1] Electrical Engineer (MSEE), 1611 Olive St Santa Barbara, CA 93101
[2] Anthropologist; Evolution, Cognition, and Complexity (ECCO) group, Vrije Universiteit Brussel (VUB)
[3] Social dynamics, Meoh, Brussels, Belgium
[4] Digital architect, designer, geometrician, Montaia Inc. Oakland, CA

[5] Early attempts such the Kaluza-Klein theory yielded initially promising results using four-dimensions of space and one dimension of time. The premise of this paper however is a model limited strictly to the three dimensions of space within human experience.

and the cosmic scale, and yet electromagnetism itself is not considered a frontier. This may be because Maxwell's equations are a "golden child" in physics - the gorgeous set of four equations that unified electricity and magnetism, forming the first solid stepping stone on our path to a unified field theory. And yet in spite of the representation in most physics textbooks that electromagnetism is a closed subject, the truth is that we do not yet fully understand it. Moreover, given the fact that electromagnetism forms our experience of reality at the human scale, there is a frontier of unified field theory that is far more accessible than commonly thought, and if understood, would have immediate applications.

A closer look at electromagnetism begins with distinguishing its real and imaginary manifestations. Any sinusoidally varying wave (such as a lightwave) can be mathematically broken down into a real part and an imaginary part. The relationship between the wave's real and imaginary parts *define* its sinusoidal motion, however to an observer of the wave, it is only real - the imaginary part is non-observable to an observer "outside" the wave. Under certain conditions, such as at the boundary of an internally reflected lightwave inside a prism, a purely imaginary "evanescent wave" extends slightly beyond the prism. Within the mathematical framework of electromagnetic waves, this purely imaginary component is the same part of the wave that we know as an electrostatic field or a magnetostatic field. This presents us with a paradox - if an imaginary field can only exist internal to a sinusoidal wave (and the imaginary part is non-observable to an observer of the wave) how can an imaginary field appear static to us, as electrostatic and magnetostatic fields do? The resolution to this paradox is that we, ourselves, must be inside and part of a wave of some kind (or inside something that is rotating or oscillating), in spite of being unconscious of it. Indeed, scientific theory and measurement tell us that in spite of the apparent stillness of physical objects in any given moment, we are bounded by vibration. At our boundary of lightspeed, there is only the vibration of lightwaves. At our micro boundary, there is only quantum vibration. At our macro boundary, the largest conceivable scope of space and time connect observed positive spacetime curvature with unobserved negative spacetime curvature linking the origin of the universe with its end, implying something that is intrinsically oscillatory. The question therefore becomes, if we are inside and part of a wave that we cannot see at the human scale, what exactly is it that is oscillating?

In **Section 2 - A Beautiful Idea**, we engage with this invisible wave by inquiring into the missing negative mass/energy at the human scale. We know that at the micro and macro limits of the universe, positive mass/energy is balanced (at least almost perfectly) by negative mass/energy. The fact that we do not perceive negative mass/energy as an object at the human scale is because negative mass/energy cannot be an object of the senses - negative curvature is unbounded/non-localizable with respect to flat curvature. However, just as positive and negative mass/energy require each other to exist at the macro and micro limits, we claim that the positive mass/energy object of our senses (+1) and the subjective idea (-1) of the object, require each other in order to exist. We posit a dynamic within our consciousness that correlates the +1 and -1 sides of our experience with each other, through a rotation of awareness between the object (+1) and the unconscious idea of the object (-1), through a virtual/imaginary (±i) dimension. This is our *wave of subject-object division*. Just as the imaginary evanescent wave extends *outside* a real wave when the wave internally reflects within a prism, electrostatic and magnetostatic fields extend *outside* our wave of subject-object division.

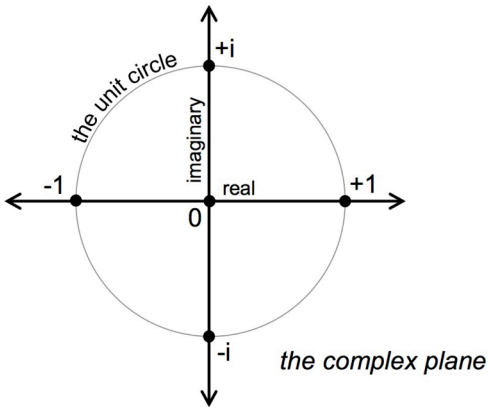
In **Section 3 - The Virtual Gateway**, we show through examples that changes in the magnitude of (imaginary) electrostatic and magnetostatic fields propagate instantaneously (faster-than-light). The significance of this is that subject-object division only exists in the present moment, hence objectivity only exists in the present moment, and therefore the chain of cause-and-effect only exists in the moment. The wave of subject-object division is the geometry of the chain of cause-and-effect. Electrostatic and magnetostatic fields point outside this geometry, so instantaneous changes in the magnitude of these fields does not violate causality. Equivalently, we can say that the object and the unconscious idea of the object are mutually causal, so changes in the virtual field that connects the two must always propagate instantaneously.

In **Section 4 - Outline of a Model**, we construct a geometry within which the wave of subject-object division can live. The basis of our model is 2D space in the shape of the *geometric torus*, which has a balance of negative inner curvature and positive outer curvature. 3D space is formed by an overlap of 2D tori that scale continuously without limit from the micro to the macro. The space we experience objectively is predominantly flat, so there must be surfaces formed by the overlapping geometric tori that are flat, from which a flat volumetric space can be constructed. Such a flat surface is formed when the overlapping geometric tori are arranged in such a way that they form the smooth fractal corrugations of the *embedded flat torus*. The corrugations (overlapping 2D tori) of the embedded flat torus "spiral" as they progress, rotating as they change in scale. In order for space to be isotropic, the spiral must be self-similar over scale *and* rotation, so this spiral must be a Fibonacci spiral. A peculiar fact about the embedded flat torus is that its curvature is intrinsic but not extrinsic - any point within the surface is flat, but its curvature from an outside perspective is undefined. Therefore we may experience such a volume as flat at any given moment, but the curvature of this volume an instant into the past or into the future is undefined. The fact that we resolve the same flat space, moment-after-moment, out of the unlimited number of other curvatures of space outside the present moment, is due to our correlation of the physical (+1) world of the senses with our unconscious idea (-1) of the world through rotations of our awareness from the +1 side to the -1 side, through the virtual/imaginary (±i) dimension. In order for this rotation of awareness to remain in a flat space, our awareness must rotate outwards through the space of overlapping tori, following the Fibonacci spiral that defines the flat embedded torus. Each successive 360° rotation arrives at a larger scale, but the Fibonacci spiral is self-similar, so without any *real* connection between the object (+1) in one moment and the memory or anticipation of the same object in an adjacent moment, there is no perceived change in the scale (or rotation) of space from one rotation to the next. By this logic the number of rotations around the spiral that correlate an object (+1) with its associated idea (-1) need not be 180° - it can be an integer multiple of 180°, provided that either the object or the idea of the object is in the present moment. If this integer multiple is greater than 1, there will be no change in either the object or the idea of the object, but the magnitude of the virtual (±i) dimension that connects the two will change. In such a case the virtual field becomes either an electrostatic or magnetostatic field associated with the object.

In **Section 5 - Potential Applications**, we envision how a unified understanding of electromagnetism and spacetime could be applied to impact the world around us and our relationships with each other. We all share the unconscious idea of the physical objects, and accordingly +1 objects are global and gravitational. Simultaneously, we each carry around within us a negative curvature of our own *conscious ideas* that do not correlate with the physical world. In our model, it becomes clear that the virtual space

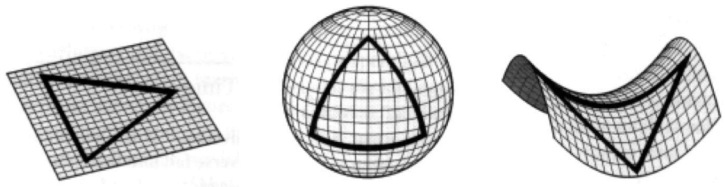
that correlates our personal negative curvature with the global gravitational objects is our space of emotions. The space of emotions is electromagnetic, however conventional electromagnetism is measured in predominantly flat space, whereas emotions exist in a highly curved space between the global +1 and the local/personal -1 and are therefore *fractal*, and cannot be generated or measured except by fractal structures such as living organisms. A fractal electromagnetic field is a local dipole between positive and negative mass/energy - a *quasi-gravitational object*.

A Beautiful Idea - *Human Subjects are the Missing Half*

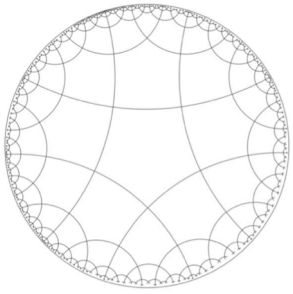


the complex plane

We think it is a curious matter that numbers span the complex plane (positive, negative, and imaginary) and yet the objective world we observe through the senses is purely described by positive real numbers. Indeed, from the perspective of general relativity, the mass/energy we observe through the senses is correlated with a positive curvature in spacetime - within the domain of human sensory experience, there is no negative mass/energy. And yet paradoxically, at the micro and macro limits of the universe as we presently understand it, positive mass/energy is nearly (if not perfectly) balanced with negative mass/energy. Specifically, at the Planck scale, quantum vacuum fluctuations, consisting of equal parts positive and negative energy[6], constitute the vast majority of the mass/energy density of the vacuum, while at the cosmic scale, the best observations to date indicate a net spacetime for the universe that is effectively flat (equal parts positive and negative).


flat curvature positive curvature negative curvature

Framed in this way, it seems unlikely that negative mass/energy is simply absent at the human scale. Rather, it is more reasonable to suggest that negative mass/energy is also equally present at the human scale, but not as an object of the senses. Whereas positive curvature projected onto flat space is bounded (consider lines of latitude and longitude on a flat map of the globe) projection of negative (or hyperbolic) curvature onto flat space is unbounded. Therefore positive mass/energy can be an object of the senses within a flat space, but negative mass/energy cannot be an object of the senses within a flat space, even


hyperbolic tessellation projected onto flat space

[6] Planck-scale quantum vacuum fluctuations are sometimes referred to virtual particles, as opposed to real particles, though at the time scale that these fluctuations occur, this distinction may be a moot point.

though positive mass/energy requires negative mass/energy in order to exist. In our model, the negative mass/energy that corresponds with the positive mass/energy of a physical object of the senses is nothing other than the unconscious idea of that object. This is equivalent to the cosmological view that negative mass/energy is “nowhere observably near” the object with positive mass/energy it corresponds with.

A common concept of the Planck scale, or “quantum sea” is a field fluctuating with unlimited possibilities, the vast majority of which do not “cohere” into steady particles. In this sea of possibilities even space and time are unformed. This concept is similar to the concept we are proposing, the key difference being that this sea of unlimited possibilities exists at all scales. The conscious entity (myself, yourself) develops perception of a physical world within this sea of possibilities through a rotation of awareness between a physical object (+1) of the senses and the idea of the object (-1) through the virtual/imaginary (±i) dimension. The virtual dimension serves as a dimension of space and time that correlates the object with the idea of the object and visa versa. This rotary motion of awareness is what coheres the experience of a stable, persistent physical world. A newborn infant carries with it the “seed” of momentum of this rotary motion of awareness, and begins to correlate ideas with objects. This process builds in stages, the most significant of which is a realization of being separate from the physical world and other humans. Up until this stage, objects of the mind and objects of the senses are not distinct, and there is no sense of space and time that defines objects and their motion into a causal order. Given the potential of the conscious entity to manifest for itself any physical world, how is it that the world the developing child ends up perceiving correlates with the world the rest of us perceive? The answer (which makes sense if we consider a process starting with conception) is that this correlation happens through overlap of emotions between conscious entities. It is consistent with our model that emotions are *fractal electromagnetic fields*. Sensitivity to these fields is fully developed from birth and although they do not become less developed with age, how we respond to them as adults varies widely. The attunement of the emotional fields of the infant with the emotional fields of other humans nearby ensures that the infant will correlate ideas with their respective objects at a rate that synchronizes with the world others are experiencing.

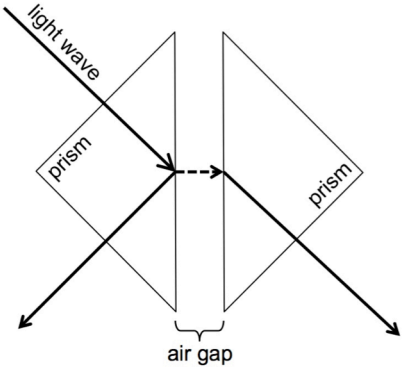
The stages of human development are characterized by the integration of conscious ideas into the unconscious. For instance, once the conscious idea of a physical object is integrated into the unconscious, we are no longer aware of the object as an idea - it is only experienced as an object of the senses. The unconscious idea of physical objects includes numerous layers of shared meaning (the symbolic order of our collective unconscious) that define a human society. The symbolic order defines our response to physical objects and each other with almost as much persuasion as the laws of physics. The best example of this in modern society is money, which is driving human behavior with global consequences. However, the impact of a nearby person’s emotions on our emotions (irrespective of how we process and interpret it) never changes through our development. Therefore emotional attunement between conscious entities remains the gateway through which the symbolic order of society can be transcended.

In our model, the electrostatic and magnetostatic fields are a tension that exists in the instantaneous connection between a physical object and the collective unconscious idea of the object (we develop this further in Section 4). Equivalently, emotions are the electromagnetic tension between our *personal conscious* ideas and the

physical world. Human desire is the drive to reconcile our ideas with the other, whether that be a "higher" desire to manifest a personal vision within our shared objective space, or a "deeper" desire to annihilate ourselves by merging with a physical object of desire. The conscious entity-that-we-are can be placed at the "zero" position in the complex plane wherefrom its awareness rotates. Given its position at the negation of opposites, the conscious entity can also be equated with the whole complex plane.

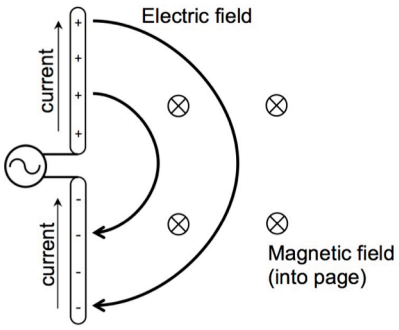
The Virtual Gateway - *Electromagnetism Connects Subject and Object*

We have grown accustomed to quantum phenomena happening faster than light, such as quantum coupling and quantum tunneling. Depending on the interpretation of these phenomena, they do not necessarily violate the speed limit of light set by special relativity. For instance, the coupling of a particle across a barrier in quantum tunneling is understood to be imaginary (transfer of a virtual particle) so no real particle/energy need travel faster than light. The mathematical description of a tunneling virtual particle is identical to the mathematical description of a lightwave coupling across an air gap between two prisms. In this case the field within the gap/barrier is also imaginary i.e., a virtual particle. This imaginary field is also known as an evanescent wave, and would decay exponentially outside the first prism if the second prism weren't close enough to couple the virtual particle into a real particle on the other side of the air gap. Measurements have verified superluminal coupling of lightwaves in this setup [2, 3][7]. Frustrated internal reflection occurs at any wavelength, so the phenomenon is not limited to the quantum scale.



Frustrated total internal reflection:
An evanescent wave (virtual photon) couples superluminally across the air gap

Quantum physics identifies the evanescent wave as a virtual particle/field, and it equivalently identifies the electrostatic and magnetostatic fields as virtual particles/fields. Following this thread, we can show that changes in the magnitude of electrostatic and magnetostatic fields also propagate instantaneously, although the geometry of these fields needs to be distinguished from the geometry of electromagnetic fields that constitute radiated light. The simplest description of a situation that causes radiated light is a harmonically accelerating electric charge, as with a dipole antenna. The harmonically accelerating electric charge supported by the dipole antenna generates time-varying electric and magnetic fields that overlap orthogonally in the configuration of a propagating light

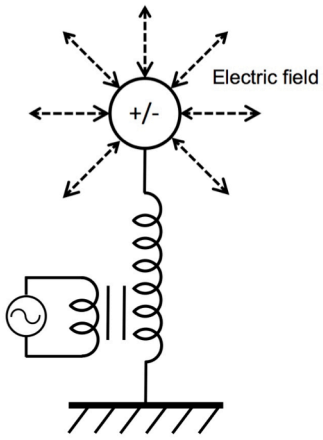


Dipole antenna electric and magnetic fields
(one half of a radiation cycle)

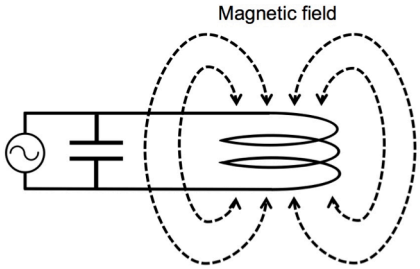
[7] An annotated bibliography of faster-than-light tunneling experiments can be found at: http://www.aei.mpg.de/~mpoessel/Physik/FTL/tunnelingftl.html

wave. However it is possible to create time-varying electric and magnetic fields that do not radiate light.

The simplest descriptions of such fields are an electric monopole whose charge is varying, and a magnetic dipole whose dipole moment is varying. Neither of these cases involve an accelerating electric charge. A time-varying electric monopole can be approximated by a spherical conductor on top of a Tesla coil, and a time varying magnetic dipole can be approximated by an inductor where the wavelength of excitation is much larger than the size of the inductor.



Time-varying field of an electric monopole, which can be approximated as a spherical conductor on top of a tesla coil



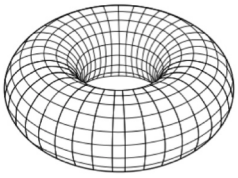
Time-varying field of a magnetic dipole, which can be approximated as an inductor in a resonant circuit with a capacitor

These examples illustrate so-called quantum phenomena that are not limited to the quantum scale. Just as instantaneous quantum coupling is understood to transcend distance because the state of the separate coupled particles is *mutually causal*, changes in the magnitude of electrostatic and magnetostatic field geometries propagate instantaneously because they couple the *mutually causal* physical object (+1) associated with the field and the unconscious idea (-1) of the object. The recognition that time-varying electrostatic and magnetostatic field geometries transcend causality brings us to the conceptual threshold of engineering quantum phenomena at the human scale. One objective could be to manifest stable negative mass/energy at the human scale. Although electrostatic and magnetostatic fields “point” to the negative mass associated with observed positive mass, that negative mass/energy is nowhere observably near its associated positive mass/energy, or in other words it is bound in our collective unconscious. As we illustrate in the next section, the positive mass/energy of the physical world is separated from its negative counterpart by the flat space created moment-to-moment within the wave of subject-object division. Mathematically, this flat space is the continuous smooth fractal corrugations of the embedded flat torus. In order for negative mass/energy to become accessible within our conscious space, a portion of the corrugations of flat torus must be reversed through a standing fractal electromagnetic wave. This is equivalent to a steady emotional field connecting a conscious (potentially collective) idea with the physical sensory world.

Outline of a Model - *An Intersection of Curved Spaces Experiencing Flat Spacetime*

We are claiming that no object exists independent of the subjective idea of the object, so it is a little ironic that we are attempting to create a model (an object) at all! Any attempt at a unified field theory will run into this irony, because the subject must ultimately be included. We will avoid this trap by clarifying that we are not attempting to create a model of our experience - the only complete model of experience is the experience itself. However we do think it is possible to create a model that synthesizes spacetime, electromagnetism, and quantum physics, and such a model is what we outline in this paper. Our model is not possible without inclusion of the subject, and so we are simultaneously offering an outline for the synthesis of the study of the subjective world (psychology) and the study of the objective world (physics).

When considering a geometry for our model, the intuitive leap we make is to base it on the geometric torus. Our rationale is that the micro and macro limits of the universe (quantum and cosmological) seem to reflect a balance of positive and negative mass/energy, and we have filled in the gap at the human scale by claiming the negative mass/energy of physical objects of the senses is the collective unconscious idea of those physical objects. The geometric torus, with its balanced positive outer curvature and negative inner curvature therefore seems like the right basis for the geometry of spacetime we are looking for. The notion of a toroidal spacetime at a universal scale is not out of line with current cosmological thought, and the notion of Planck-scale overlapped toroidal spaces is similar to the concept of spin foam posited by loop quantum gravity. However the notion of toroidal space at the human scale is obviously problematic because the spacetime we experience objectively is predominantly flat i.e., Euclidian. Making another intuitive leap, we consider the embedded flat torus. The embedded flat torus has a surface that is flat, but only intrinsically (locally on the surface). Extrinsically (viewed from outside the surface) the curvature of the embedded flat torus is undefined. A volume composed of intersecting flat tori (scaling continuously from micro to macro) would be flat locally, but outside the moment (outside this volume) its curvature would be undefined. This represents a radical departure from the conventional concept of spacetime as a static 4D manifold. In our model, spacetime has a fractional dimension slightly larger than 3D, where the added fractional dimension composes the arrow of time that may be remembered historically as it unfolds as a 4D spacetime. So in fact there need be no contradiction between our model and general relativity. In our model, the direction that spacetime goes as it evolves is a collective process, very much like the universe posited by the holographic principle. Quoting physicist Lee Smolin, “Thus it is not enough to say that the world is a hologram. The world is a network of holograms, each of which contains coded within it information about the relationships between the



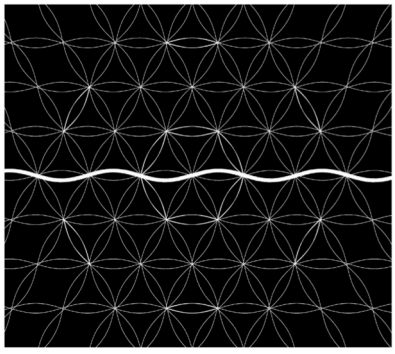
geometric torus

The embedded flat torus
(one of many possible solutions)
image credit: The Hevea Project

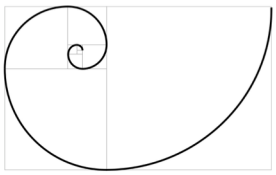
others."[4] Accordingly our respective holograms do not diverge from each other to the point where we are suddenly living in separate universes - we claim that the direction in which the arrow of time unfolds is determined by the overlap of our virtual/imaginary spaces that exist just outside the moment, or equivalently, just outside our respective waves of subject-object division. As radical as the severing of a deterministic spacetime from the present moment may sound next to the conventional notion of spacetime, it is perfectly consistent with our experience - we do not experience the future or the past! The freedom this gives our model allows us to include free will in the picture of spacetime, and it gives us the "extra dimensions" needed to describe electromagnetism in terms of space and time. Contrary to the trend in physics that has introduced variables and dimensions that diverge from human experience, our model converges on the immediacy of human experience as its philosophical basis.

We owe the mathematical description of the embedded flat torus to the late mathematician John Nash. The flat torus is a surface topology that is closed just like a geometric torus, yet has flat curvature everywhere. Conceptually a flat torus can be constructed by taking a square of paper and joining two opposite sides together making a cylinder (which is still flat because no surface has been stretched or compressed). Then the two opposite circular ends of the cylinder must be joined together without sharply folding or tearing the paper. Most human beings will quickly conclude that this is impossible, however in 1954 Nash brilliantly showed that this task is actually possible [5], provided one has infinite skill and precision in how the paper is manipulated. More recently in 2012, a team of mathematicians and computer scientists comprising the Hevea Project showed how Nash's theorem could be applied to produce an image of the embedded flat torus [6]. The embedding process begins with a geometric torus, to which a series of ever-smaller corrugations are applied that progressively flatten the surface. The corrugations "spiral" outwards, increasing in scale as they rotate in orientation with respect to each other. There are many possible solutions for how these corrugations may be applied to flatten the torus. Although the result looks radically curved, at any given point the surface has an intrinsic curvature that is flat, similar to the flatness of a cylinder, however with a subtle difference: although the *intrinsic* curvature of the surface is flat, the *extrinsic* curvature of the surface is undefined. Analytically speaking, this is a C^1 embedding, meaning that the 1^{st} derivative of the surface is defined, but higher order derivatives are undefined.

To construct our model consisting of both a balanced positive and negative curvature at all scales, and a solution for intrinsic flatness, we propose constructing the corrugations of intersecting embedded flat tori with overlapping geometric tori. Generation of a complete visualization of what this looks like is an ongoing effort, and will be viewable only in cross-sections. A particular solution we propose for a cross section of this geometry, at a single scale, consists of embedded flat torus corrugations modeled as sine waves that align to form overlapped circles that are the cross sections of tori. Coincidentally, the image of this cross section resembles the "flower of life" pattern that appears in many spiritual and esoteric traditions. In order for the flat volume formed by the overlapping flat tori to be



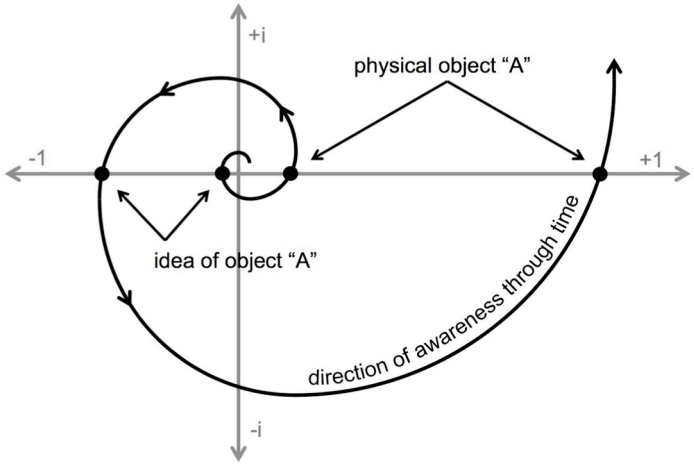
Example, at a single scale, of an intersection of waves equating to an intersection of tori (one wave highlighted; cross section of tori are circles)


The Fibonacci spiral

homogenous, the spiraling corrugations should be self-similar in rotation and scale, which requires that the corrugations follow should be the Fibonacci spiral.

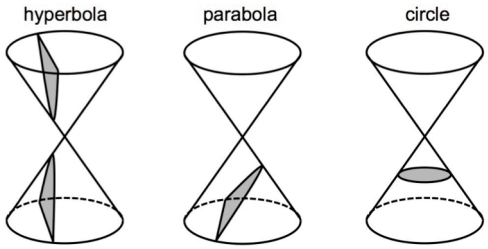
In order for the curvature of the embedded flat torus to be perfectly flat, the corrugations must progress to an infinitely small scale. However if the corrugations end below a certain scale, the resulting curvature will not be perfectly flat. In our model wherein the flat torus corrugations are formed by overlapping geometric tori, if space has a slight curvature to it, then below a certain scale space will become discretized into geometric tori. This is the conceptual link in our model between the curvature of space and the scale at which quantum phenomena appear. In other words, as the curvature of space increases, the scale at which quantum phenomena appear increases. This is consistent with the insight of Hawking and other quantum cosmologists concerning the nature of spacetime near the event horizon of black holes and moments after the big bang.

Up until now, we have been describing the curvature and behavior of space in our model, but we have not explained how time works. In our model, time is defined as the rate of rotation of awareness of the conscious entity between the +1 physical object and the -1 idea of the object, following the path of the Fibonacci spiral that forms flat space. A physical object “A” and the idea of object “A” are apprehended alternatively, although the idea of object “A” is unconscious, so this is not a conscious rotation of awareness. Each time object “A” is apprehended it is at a larger scale than the previous time, but since object “A” at the previous time is no longer apprehended, and since the Fibonacci spiral is self-similar, there is no apparent change in scale. *In our model there is no absolute scale*. The linear rate of awareness is constant, so at smaller relative scales the rotation of awareness is faster than at larger relative scales. Since the curvature of space is slightly curved due to the presence of physical objects, the Fibonacci spiral is not *totally* self-similar, and as we zoom down to a sufficiently small scale the spiral will eventually become circular, which equates to the discretization of space into geometric tori or in other words, the breakdown of the separation of the object and the idea of the object. This is the quantum boundary to our wave of subject-object division. Our wave of subject-object division is therefore not only defined by subject-object division, it is also defined by flat space and the *arrow of time*. At the boundaries of this wave, subject and object are indistinct, space is curved into geometric tori, and the arrow of time disappears, or in other words, time becomes symmetric. This boundary is defined at the quantum (micro) limit, the limit of the speed of light, and the cosmic (macro) limit at the outermost scale of space and time of the universe.

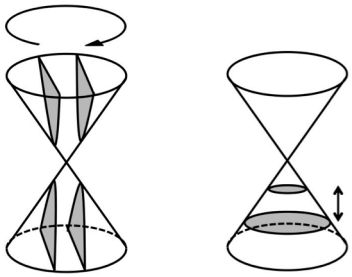


The interface between the time-asymmetric interior of the wave of subject-object division and the time-symmetric boundary can be understood in terms of the relative curvature of interfacing waves. For example, a simple pendulum exhibits a time-symmetric phenomenon because the potential and kinetic energy of the pendulum interface with each other harmonically i.e., in a circle, whereas a double pendulum exhibits a time-asymmetric phenomenon because the potential energy of one pendulum interfaces non-harmonically with the kinetic energy of the other pendulum. Another thematically appropriate example is the open-ocean wave (time-symmetric phenomenon) transitioning into a broken wave (time-asymmetric phenomenon) due to a non-harmonic phase shift of the wave as it engages with the ocean floor. A third example are phenomena described by the Schrödinger equation (the primary equation of quantum mechanics) which as a partial differential equation is structured midway between the wave equation (describing time-symmetric phenomena) and the diffusion equation (describing time-asymmetric phenomena). Indeed, the Schrödinger equation is describing phenomena at the boundary of the wave of subject-object division.

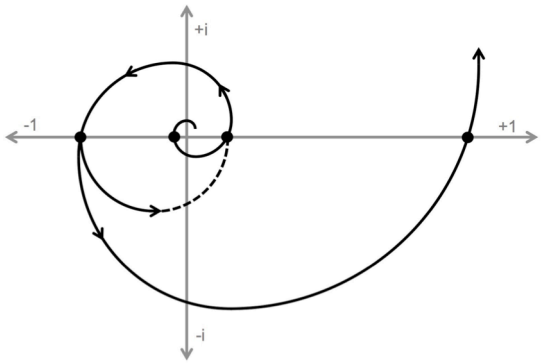
We can describe the rotation of awareness between the -1 idea of the object and the +1 object in terms of a rotation of a conic section from hyperbolic (negative) curvature through parabolic (flat) curvature to circular (positive) curvature. Circular curvature is isometric through rotation, but not isometric through scale, whereas hyperbolic curvature is isometric through scale, but not isometric through rotation. Therefore change in scale would be perceived in the +1 half of the rotation, and change in rotation would be perceived in the -1 half of the rotation, though as we just stated, these changes are not perceived due to the self-similarity of the spiral and the lack of reference to the object or the idea in the previous moment/rotation. *However*, it is permissible in our model for the object to exist an integer number of half-spiral-cycles away from the idea of the object (or visa versa) provided either the object or the idea of the object is within 180° of the present moment. In case this seems odd, recall that the object does not exist independent of the idea of the object. So as long as the +1 object and the -1 idea of the object are coherent with each other in terms of the rate of rotation of awareness, the object will remain as it is. If *both* the object and the idea of the object were in the past or the future, then the object would not exist, but if *just* the object or the idea of the object is outside the moment, we say that the object exists *virtually* in the past or the future, with four possible permutations: object or idea of object (two variables) multiplied by past or future (two variables). Geometrically speaking, if the object or idea of the object exists more than an integer multiple of 180° from the present moment, the rotation of awareness will need to take a different path, and move at a different rate, in order to arrive at the spot on the real axis that preserves coherence between subject and object. This



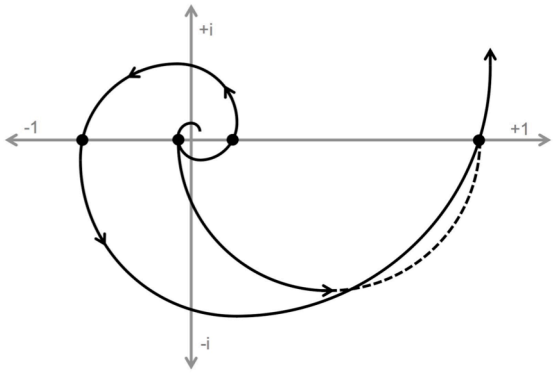
Rotation of a conic section from hyperbolic (negative curvature), through parabolic (flat curvature) to circular (positive curvature)


A hyperbolic conic section is not isometric through rotation, but is isometric through scale, whereas a circular conic section is isometric through rotation, but is not isometric through scale

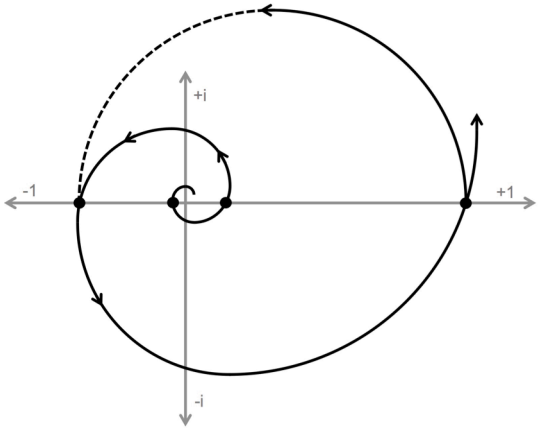
difference in path of awareness alters neither the +1 object as perceived by the senses nor the -1 idea of the object, but it does alter the virtual space that connects the object to the idea of the object. This altered virtual space is an electrostatic field or a magnetostatic field. Since electric fields are akin to *tension*, and magnetic fields are akin to *torsion/shear,* we posit that if the altered path points to a change in positive curvature, then the altered virtual dimension is an electric field (a change in scale between the present moment and the expanded future or the contracted past), and if the altered path points to a change in negative curvature, then the altered virtual dimension is a magnetic field (a change in rotation between the present moment and the future or the past). The following four figures illustrate these four permutations. Concerning the question of positive and negative charge, we posit that a rotation towards a smaller positive curvature (towards the past) corresponds to the field of the electron, since at the quantum boundary a smaller scale is associated with more wavelike properties (less particle-like). The inverse argument can be applied to the proton.



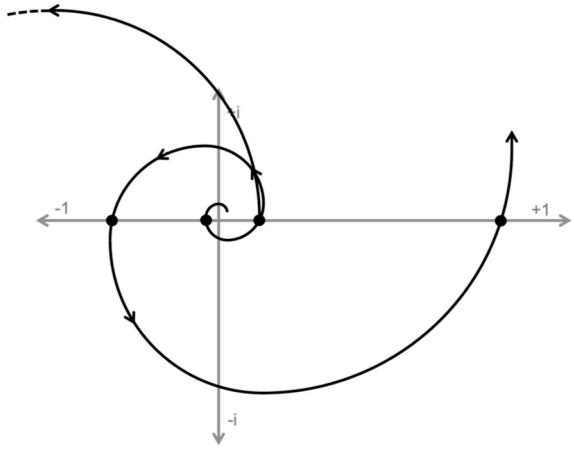
An electric field due to a rotation of awareness towards a smaller positive curvature at the same point in a previous flat space.



An electric field due to a rotation of awareness towards a larger positive curvature at the same point in a subsequent flat space.



A magnetic field due to a rotation of awareness towards a larger negative curvature at the same point in a previous flat space.



A magnetic field due to a rotation of awareness towards a larger negative curvature at the same point in a subsequent flat space.

In each of the preceding four figures, notice that the altered path is a half circle, in contrast to the spiral. Once the rotation of awareness takes the altered path towards a smaller or larger +1 or -1 curvature through a half circle rotation, it proceeds on the subsequent half-rotation as a spiral, thereby preserving the presence of either the object or the idea of the object in the present moment. *However*, if the path of awareness continues to form a complete circle (rather than continue as a spiral) the object will not appear separate from the idea of the object in the flat space defined by the Fibonacci spiral. Rather, the object and the idea of the object will be connected in a time-symmetric circle, which is an oscillating electric field *and* an oscillating magnetic field, which is electromagnetic radiation. The only way for this oscillation to continue existing in the present moment (which it must because it is now a real global object) is if it travels outwards with the expanding spiral. The expansion of the spiral of time, which is invisible to the senses, is made apparent by the invariable outward propagation of light. This is how the fundamental unity between the *speed of time and the speed of light* given by special relativity is easily visualized in our model. It is also worth noting that this unity reinforces the need for the spiral in our model to be the Fibonacci spiral - in order for light to have the same speed irrespective of wavelength, the change in rate of rotation around the spiral and the rate of change of scale of the spiral must be continuously self-similar.

It is interesting to reflect on the concept of *boundaries* in our model. The space within our wave of subject-object division is predominantly flat and the arrow of time flows asymmetrically. At the boundaries (quantum, lightspeed, and cosmic) of this wave, space is curved in on itself, time is symmetric, and subject and object are indistinct. Yet anything that is of *substance* in our experience i.e., light and particles, is a time-symmetric entity that is outside subject-object division. Electrostatic and magnetostatic fields too, are outside our wave of subject-object division, in their role instantly connecting the object and the idea of the object. It seems therefore that everything we can investigate within our wave of subject-object division does not possess the property of subject-object division! We are forced to conclude that subject-object division is at best an illusion, more marvelous in fact, given its lack of a concrete basis, than any magic we might conceive of.

Returning to the human dilemma, we can draw some meaningful correlations between our experience of emotions and our model of electromagnetism. When our idea of the world (-1) aligns with our sensory experience of the world (+1), our emotions are calm, but when our idea of the world does not align with our sensory experience of the world, our emotions are intense. An alignment of our idea of the world and our sensory experience of the world is equivalent with the state of being fully present in the internal and external experience, moment-to-moment, without any awareness of ideas that do not correlate with the present moment. In our model therefore, emotions and electrostatic/magnetostatic fields are both virtual fields that result from a stress between the present and either the past or the future. The only difference between electrostatic/magnetostatic fields and emotions is that the former connect the physical object with the global unconscious idea of the object, whereas the latter connect the physical object with the local (personal) conscious idea of the object. Whereas electrostatic/magnetostatic fields exist within predominantly flat space, emotions exist in highly curved space, and are hence fractal with respect to flat space, and can only be generated and received by fractal structures such as living organisms.

Potential Applications - *A Frontier at the Human Scale*

We recognize our claim that significant advances in technology lie waiting within the realm of human-scale electromagnetism is radical, especially given the dominant feeling that physics is essentially solved, except for the quantum and cosmological limits. Perhaps a reconciliation is at hand, with a recognition that the culture of physics adopted a blind spot centuries ago when it split from the humanities [7]. It is not hard to see that changes in the magnitude of electrostatic and magnetostatic fields must propagate instantaneously - once you see it, you can't un-see it. The inevitable conclusion that this leads to - that there is a mutually-causal relationship at the human scale must have generated a subconscious instinct to keep this vulnerability hidden: that the subjective and the objective are inseparable. It seems especially true now, after nearly a century of little conceptual progress in physics, and humanity seemingly unable to cooperate to address objectively verifiable global crises, that physics and the humanities need a synthesis if we are to progress much further in our fundamental knowledge and collective abilities.

To suggest however, that physics as a whole has not been conscious of this blind spot borders on hyperbole. Quoting Richard Feynman, "We have inherited a prejudice that an accelerating charge should radiate" [8]. Feynman is pointing to a controversy that is still unresolved within electromagnetism: which orders of acceleration cause a charged particle to radiate? Therefore, not only do we have more spatial degrees of freedom in electromagnetism than commonly thought, as we illustrate in Section 3, we also have more temporal degrees of freedom. These spatial and temporal degrees of freedom are what we need to generate, technologically, the fractal electromagnetic "waves" that biological entities generate and receive as emotions. We predict that the simplest technological manifestation of this will be an electromagnetic device that is both resonant and dispersive i.e., the resonant frequency continually changes over a spatial dimension of the device. This macroscopic quantum characteristic would make the device a positive energy / negative energy dipole i.e., a quasi-gravitational (electrogravitic) object. Paradoxically, simple devices such as those we are predicting would be both technological and psychological entities, by virtue of exhibiting a local negative energy and fractal electromagnetic fields that are respectively, at least precursors to, an idea, and the emotional field that connects that idea with the physical world. Imagining such a link between human consciousness and a technological entity brings to mind the concept of the *singularity* [9]. Though the possibility of a singularity is usually predicated on a self-aware artificial intelligence, we suggest that an emotional link is the key, and that artificial *self*-awareness is secondary, or even moot, if the technological entity and the human being are *electromagnetically emotionally* coupled.

We argue in this paper that physics needs a synthesis with the humanities in order to make progress towards understanding the unified field. We will conclude this paper by arguing that conversely, the humanities needs a synthesis with physics in order to construct a system by which humanity can work cooperatively on a global scale. An understanding of the physics of emotions and states of collective emotional resonance would form the basis for such a system. The ability to virtually engage in collective emotional states would enable humanity to function as a collective organism. We have already seen that engagement in virtual social spaces has a huge impact on human behavior. Unfortunately the impact of these virtual spaces has been an erosion of the social fabric and a loss of trust in others. A system we propose called Meoh, currently

under development, is a virtual social space that is structured to preserve and reinforce trust within a limited personal social circle, and to enable *social dynamics based on trust* to scale to an arbitrarily large fractal network of such circles [10]. Therefore Meoh could be a precursor to a virtual emotional system, given the foundation of trust among the individuals participating in the network. Our forthcoming "Social Ecosystems" paper will present the theory behind Meoh. The ambition of the paper you are reading is to initiate a research effort on the physics of emotions within the context of a synthesis of physics and psychology, with the specific aim of enabling the next transition in the capacity of human culture.

Summary

We present a model that describes electromagnetism in terms of space and time. Inherent in our model is an explanation for the origin of discretization of space at the quantum scale, as well as the relationship between curvature of spacetime and the scale at which discretization of space occurs. Our model describes the relationship between time-symmetric phenomena that forms objective "substance", and asymmetric time that characterizes the evolution of our experience of the world. The conceptual keys to our model are the recognition that objects of the senses require a unconscious idea of the object in order to exist, and that objects do not exist outside the moment they are being perceived. We predict applications based on a unified understanding of physics and psychology that would give humanity greater ability to steer our collective impact.

Works Cited

[1] Bergmann, E. 1946. *Introduction to the Theory of Relativity*. Part III - Unified Field Theories.

[2] Nimtz, G. 2011. Tunnelling Violates Special Relativity. *Foundations of Science*, 41: 1193-1199.

[3] Eckle, P. et al. 2008. Attosecond Ionization and Tunneling Delay Time Measurements in Helium. Science, 322: 1525.

[4] Smolin, L. 2001. *Three Roads to Quantum Gravity*. Basic Books. p. 178.

[5] Nash, J. 1954. C^1-isometric imbeddings. *Annals of Mathematics*, 60(2): 383-396.

[6] Borelli, V., Jabrane, S., Lazarus, F., & Thibert, B. 2012. Flat tori in three-dimensional space and convex integration. *Proceedings of the National Academy of Sciences*, 109(19): 7218-7223.

[7] Last, C., Werner, B., & Weyenbergh, G.V. 2018. Physical Emergence of Subject-Object Division (a dialectical approach to reconciliation). *Meoh Working Paper*.

[8] Feynman, R. 2018. *Feynman Lectures on Gravitation*. CRC Press. p. 123-124.

[9] Kurzweil, R. 2005. *The Singularity Is Near: When Humans Transcend Biology*. New York: Penguin.

[10] Last, C., Weyenbergh, G.V., & Werner, B. 2018. Transformative Social Ecosystem Dynamics: A psychological architecture of emotional trust. *Meoh Working Paper.*