Attributive Quantum Fields

Philip Carter

First published: October 15, 2010
Version 4: May 26, 2011

PO Box 206
New Denver BC
Canada V0G 1S0
quanta (at) esotec (dot) org
http://physics.esotec.org

Abstract

A brief history of the ether (aether) is presented, leading up to the proliferation of space-filling fields required by the current Standard Model of particle physics. The excessive number of fields, along with the mathematical inconsistency of Quantum Field Theory and the grossly wrong space-density calculation, lead us to conclude that Quantum Field Theory is built upon a faulty paradigm. An alternative physical model is presented whereby quantum fields are associated with quantum attributes rather than particle species. This model is shown to illuminate the mathematical process of quantum measurement while corresponding to ancient esoteric teachings concerning the classical elements and the ether.

Keywords: quantum fields, quantum attributes, quantum measurement, quantum field theory, ether, aether, gravity, dark energy, dark matter, classical elements, Platonic solids.

Contents

Illustrations

1. Introduction

In my previous paper *Framework for Unification of Physics* I argue that the quantum wavefunction is a four-dimensional gravity wave occupying a 4-brane which interpenetrates our 3-brane [1]. This model allows a natural and fundamental unification of Quantum Mechanics and Relativity, along with fresh insights into Time. According to this framework the wavefunction excites "quantum fields" in the 3-brane, giving rise to all matter and phenomena in the physical universe. This paper focuses on the nature of these 3D quantum fields.

We begin by taking a brief look at the current state of Quantum Field Theory (QFT) and the Standard Model of particle physics, which is built upon QFT. To achieve this we rely largely on testimony from experts in the field. Noting inconsistencies arising in these theories, we proceed to look for alternative paradigms.

Two independent lines of inquiry are followed, converging upon a highly suggestive reinterpretation of Quantum Mechanics and quantum fields. The first line of reasoning rests upon the formalism of Quantum Mechanics itself, offering a physical picture of processes that have previously been understood only mathematically. The second approach gathers clues from esoteric frameworks. The reader will be surprised to discover that the most direct and compelling physical model corresponds to a renewed understanding of ancient esoteric teachings regarding the classical elements and the ether.

For a full understanding of this paper it is recommended that the reader first read the paper mentioned above. Both are written for a general readership, though the concepts are intended for experts as well.

2. The Return of the Ether

The idea of an "ether" filling what appears to be empty space was common in ancient cosmologies. Indeed, the esoteric adage is that *there is no empty space* [2]. This concept came under scientific scrutiny when Isaac Newton formulated his laws of motion and gravity, which implied there could be no space-filling ether resisting the motion of the heavenly bodies. At the same time, however, Newton was uncomfortable with what appeared to be "action at a distance" across a void, manifesting as gravitational forces between masses: [3]

> **That one body may act upon another at a distance through a vacuum without the mediation of anything else, by and through which their action and force may be conveyed from one another, is to me so great an absurdity that, I believe, no man who has in philosophic matters a competent faculty of thinking could ever fall into it.**

Nevertheless, Newton's successors largely accepted the idea of action at a distance across empty space, until James Clerk Maxwell discovered his equations of electromagnetism in 1864. These equations suggested the existence of a space-filling electromagnetic field, to which Maxwell gave almost religious significance: [4]

> **The vast interplanetary and interstellar regions will no longer be regarded as waste places in the universe, which the Creator has not seen fit to fill with the symbols of the manifold order of His Kingdom. We shall find them to be already full of this wonderful medium....**

Maxwell's discovery kindled debate about the "luminiferous ether" during the late 19th century, leading to the famed Michelson-Morley experiment of 1887 which failed to detect evidence of the Earth's motion through the ether. When Albert Einstein published his Special Theory of Relativity in 1905 he considered the ether to have become superfluous, and for some decades the existence of the ether was largely discredited within physics. Einstein later changed his mind on this issue, however, as Nobel laureate Frank Wilczek explains: [5]

> **By 1920, after he developed the theory of general relativity, Einstein's attitude had changed: "More careful reflection teaches us, however, that the special theory of relativity does not compel us to deny ether." Indeed, the general theory of relativity is very much an "ethereal" (that is, ether-based) theory of gravitation.**

With the advent of Quantum Mechanics and the discovery of wave-particle duality, photons (light quanta) became understood as excitations of the electromagnetic field. When Paul Dirac formulated his relativistic theory of the electron in the 1920s he was likewise led to a field theory, with electrons modeled as excitations of an *electron-positron* field (positrons being *anti-electrons*, similar to the electron but with some properties, such as electric charge, reversed). Crucially, the existence and properties of this "quantum field" were required to address a fundamental conflict between Quantum Mechanics and Special Relativity: while Relativity embraces time as a dynamic variable, interdependent with the three spatial dimensions, time enters Quantum Mechanics as an external parameter.

Dirac's theory of the electron marked the birth of Quantum Electrodynamics (QED), the first application of Quantum Field Theory (QFT), which today lies at the heart of fundamental physics. From the beginning the theory encountered problems, however, as Roger Penrose explains: [6]

> **As it stood, and for most problems of interest, that theory was not able to provide *finite* answers – rather than the '∞' that practically always seemed to arise. It took powerful later developments… to make the theory workable.**

These later developments involved the controversial mathematical process of "renormalization" which removed the problematic infinities and allowed meaningful calculations yielding finite answers. The mathematical consistency of this scheme remains contentious to this day, however. Dirac himself was far from convinced that the mathematics was legitimate: [7]

> **[Renormalization is] just a stop-gap procedure. There must be some fundamental change in our ideas, probably a change just as fundamental as the passage from Bohr's orbit theory to quantum mechanics. When you get a number turning out to be infinite which ought to be finite, you should admit that there is something wrong with your equations, and not hope that you can get a good theory just by doctoring up that number.**

Nevertheless, physicists took QFT, along with its renormalization techniques, and ran with it. With the experimental discovery of the strong and weak nuclear forces, along with a burgeoning number of elementary particles, QFT became the central pillar upon which the Standard Model of particle physics has been built. The Standard Model went from success to success, until today most physicists don't question QFT, as explained by Roger Penrose: [8]

> **Quantum field theory constitutes the essential background underlying the standard model, as well as practically all other physical theories that attempt to probe the foundations of physical reality…**
>
> **In fact, QFT appears to underlie virtually all the physical theories that attempt, in a serious way, to provide a picture of the workings of the universe at its deepest levels. Many (and perhaps even most) physicists would take the view that the framework of QFT is 'here to stay', and that the blame for any inconsistencies… lies in the particular scheme to which QFT is being applied, rather than in the framework of QFT itself.**

Indeed, Frank Wilczek captures the general mood of modern physics that all is well with QFT and the Standard Model, which he calls the *core theory* or just the "Core": [9]

> **It would be hard to exaggerate the scope, power, precision, and proven accuracy of the Core. So I won't even try. The Core is close to Nature's last word. It will provide the core of our fundamental description of the physical world for a long time – possibly forever.**

The Standard Model builds upon the success of QED by mathematically modeling elementary particles as excitations of space-filling *quantum fields* with particular properties, a distinct quantum field being required for each species of particle along with its antiparticle. Tellingly, these quantum fields are not considered to be substantially "real", but somewhat as effervescent abstractions.

Further, in addition to the quantum fields, the Standard Model requires fields of a more substantial type, as Wilczek explains: [10]

> **Besides the fluctuating activity of quantum fields, space is filled with several layers of more permanent, substantial stuff. These are ethers in something closer to the original spirit of Aristotle and Descartes – they are materials that fill space.**

Physicists call these "material ethers" *condensates*, several of which have been proposed. Wilczek offers the image of these ethers condensing spontaneously out of empty space as the morning dew condenses out of moist, invisible air. Note that this is cutting-edge physics, not Medieval superstition.

In addition to the quantum fields and the condensates, the Standard Model requires a *metric field*, which permits the notion of *intervals* in space and time. Physicists speak of the metric field giving "rigidity" to space and time, permitting consistent measurement of both. Albert Einstein explained the need for a metric field as follows: [11]

> **According to the general theory of relativity space without ether is unthinkable; for in such a space there not only would be no propagation of light, but also no possibility of existence for standards of space and time (measuring-rods and clocks), nor therefore any space-time intervals in the physical sense.**

So let us take a rough census of the space-filling fields according to the current Standard Model: [12]

- Dark energy.
- Chiral symmetry-breaking condensate. Wilczek calls this the *quark-antiquark condensate*, since it is considered a space-filling mist of quark-antiquark pairs.
- Weak superconducting condensate (commonly known as the *Higgs* field).
- Unified superconducting condensate.
- Metric field.
- Multiple quantum fields.

Considering the three generations of elementary particles, the Standard Model counts at least thirty quantum fields. The field count is further increased by the incorporation of *supersymmetry* in modern theory, which requires the existence of a *superpartner* for every known particle, effectively doubling the number of quantum fields permeating space. Supersymmetry may also require multiple Higgs fields. Consequently, according to the supersymmetric version of the Standard Model there are more than sixty distinct fields permeating all space and time.

Please note, this is a rough estimate based on my best information. Attempts to find an authoritative source for this number have failed, I suspect because physicists are embarrassed about it, or perhaps because it keeps changing. By all accounts, attempts at "field unification" are proceeding. Nevertheless, whatever the exact number, the current Standard Model requires a *lot* of fields. Wilczek's summation of these theoretical findings could have come straight from an esoteric text: [13]

> **What we perceive as empty space is in reality a powerful medium whose activity molds the world.**

Indeed, far from being an historical relic, the ether has returned – with a vengeance! The questions we ask in this paper are:

- Do these sixty-plus fields (ethers) really exist, or are they just mathematical abstractions forced upon physics by the apparent incompatibility of Quantum Mechanics and Special Relativity?
- If these fields don't exist in Nature, what does?

3. The Success and Failure of Quantum Field Theory

Quantum Electrodynamics (QED), the first and most mature application of Quantum Field Theory, has been called the most precise theory in science. As a famous example, the theory predicts the magnetic moment of the electron to be 1.00115965246 (in appropriate units) versus the experimental result of 1.001159652193. [14]

At the same time, QFT is also responsible for the worst scientific result in history, that being the calculation of the vacuum energy, essentially the "weight" of empty space. Astronomical observations indicate that about 70% of the total mass of the universe is evenly distributed throughout space and time, and that it exerts a uniform negative pressure, something like anti-gravity, hence accelerating the expansion of the universe. This negative pressure is related to the *density* of space, which has been measured consistently by other means. Both are referred to as *dark energy*.

According to Wilczek, when the densities of the various fields are estimated according to the formalism of the Standard Model, the results exceed the experimental data by the following factors: [15]

- Quark-antiquark condensate: 10^{44}
- Weak superconducting condensate (Higgs): 10^{56}
- Unified superconducting condensate: 10^{112}
- Quantum fluctuations, without supersymmetry: ∞
- Quantum fluctuations, with supersymmetry: 10^{60}
- Metric field: ? (Unknown.)

Clearly, these results are so completely wrong, they suggest there is a problem not just with the calculations but with the paradigm. Wilczek concedes there is a problem: [16]

> **Before dark energy was discovered, most theoretical physicists, looking at the enormous discrepancy between simple estimates of the density of space and reality, hoped some brilliant insight would supply a good reason why the true answer is zero… If the answer really isn't zero, we need different ideas.**

This is not the only problem faced by the Standard Model, which requires some nineteen free parameters – values that are plugged in without explanation of their origin, such as the masses of the quarks and leptons and the so-called coupling constants. Furthermore, the three generations of particles remain unexplained and gravity is not incorporated at all. Perhaps the most serious concern, however, is the proliferation of fields, giving rise to the current theoretical efforts towards "field unification". Aesthetically, the problem goes beyond the sheer number of fields permeating space and time. In particular:

- Many of the fields are near-duplicates. For instance, the eight gluons are all similar except for their color charge. Yet each requires its own field, leading to field properties being duplicated many times over. This paints a very uneconomical picture of Nature.
- Discrete states match in the various fields. For instance, multiple particles may have an electric charge of -1 or spin 1/2. The fact that attributes match (or are consistently related) in the various fields implies a deeper order which "informs" each field (be it abstract or real).
- Some of the superpartners required by supersymmetry (along with particles predicted by other theories) are expected to be too heavy to create in the LHC, or perhaps in any conceivable accelerator. Yet theory insists these fields must exist. Why would Nature manifest fields throughout all space and time corresponding to particles that never appear in Nature, or perhaps not since the Big Bang?

Nevertheless, despite these problems, most physicists consider QFT and the Standard Model to be unassailable and are confident the problems will be overcome within the existing framework. The mathematical consistency of renormalization is not seriously questioned, as implied by Wilczek: [17]

The basic equations of QED were in place by 1931, but for quite a while people made mistakes in trying to solve them, and got nonsensical (infinite) answers, so the equations got a bad reputation. Around 1950 several brilliant theorists… straightened things out.

Not every physicist is so convinced that the renormalization schemes have "straightened things out", however. We have already seen Paul Dirac's opinion on this matter. Richard Feynman was a principle architect of the renormalization schemes applied in QED, about which he had the following to say: [18]

The shell game that we play… is technically called 'renormalization'. But no matter how clever the word, it is still what I would call a dippy process! Having to resort to such hocus-pocus has prevented us from proving that the theory of quantum electrodynamics is mathematically self-consistent. It's surprising that the theory still hasn't been proved self-consistent… I suspect that renormalization is not mathematically legitimate.

Most physicists are physicists first and mathematicians second. Roger Penrose is an exception, being a physicist who is a mathematician of the first order. Hence his views on this matter should be taken seriously: [19]

Strictly speaking, quantum field theory (at least in most of the fully relevant non-trivial instances of this theory that we know) is *mathematically inconsistent*, and various 'tricks' are needed to provide meaningful calculational operations. It is a very delicate matter of judgment to know whether these tricks are merely stop-gap procedures that enable us to edge forward within a mathematical framework that may perhaps be fundamentally flawed at a deep level, or whether these tricks reflect profound truths that actually have a genuine significance to Nature herself… Some of these appear to be genuinely unravelling some of Nature's secrets. On the other hand, it might well turn out that Nature is a good deal less in sympathy with some of the others!

British theoretical physicist Christopher G. Oakley, who wrote his doctoral thesis on QFT, offers a rather less restrained interpretation of the facts: [20]

In the way that quantum field theory is done – even to this day – you get infinite answers for most physical quantities. Are we really saying that particle beams will interact infinitely strongly, producing an infinite number of secondary particles? Apparently not. We just apply some mathematical butchery to the integrals until we get the answer we want. As long as this butchery is systematic and consistent, whatever that means, then we can calculate regardless, and what do you know, we get fantastic agreement between theory and experiment for important measurable numbers (the anomalous magnetic moment of leptons and the Lamb shift in the Hydrogen atom), as well as all the simpler scattering amplitudes.

"You *may* have eleven significant figures of agreement, but you cheated to get it, and so it does not count," I say. "What does it matter," they say. "This can't be a coincidence. What we have here has got to be the best theory ever." "It's not a theory," I say. "It's just rubbish."

So let us sum up. Despite its successes, QFT is known to be mathematically inconsistent. The grossly wrong space-density calculations provide further notice that something is seriously awry. In concert with the nineteen free (unexplained) parameters and aesthetic considerations of economy and elegance, we must consider that QFT is a mathematical abstraction which does *not* provide a true picture of Nature.

From this perspective we can concur with the ever-insightful Roger Penrose*: [21]

Despite the undoubted power and impressive accuracy of quantum field theory (in those few cases where the theory can be fully carried through), one is left with a feeling that deeper understandings are needed before one can be confident of any 'picture of physical reality' that it may seem to lead to.

* IMHO Roger Penrose deserves a Nobel Prize – not for any one accomplishment but for his ability to stay free of the herd, challenge accepted thinking and brazenly ask the truly tough questions, always with his unique blend of rigorous insight and playful open-mindedness, no matter what the consequences, and for his authoritative and prodigious efforts towards public education in science.

If QFT does not provide a true picture of physical reality, then our task is to find a paradigm that does. To unravel this puzzle we turn to the inner workings of Quantum Mechanics. There we discover tantalizing clues as to the nature of the ether, while helping unlock the mysteries of Quantum Mechanics itself.

4. Quantum Attributes and Measurement

We come to a vital piece of our argument, which requires us to dive into the inner workings of Quantum Mechanics, in particular the quantum *attributes* (observables) and the mathematical process of quantum *measurement*. For the sake of non-scientists I will attempt to lay this foundation on a simple conceptual level. Expert readers are asked to overlook the inevitable simplifications, while at the same time they also may find insights in this description. Modern formulations of Quantum Mechanics are mathematically elegant but somewhat abstract; they tend to obscure the physics, and even practicing quantum physicists may not understand the measurement process as described here.

In Quantum Mechanics the primary entity is the wavefunction (quantum state), which has encoded within it everything that can be known about that particle. Each elementary particle is endowed with certain properties, known as *attributes* or *observables*. The *static* attributes, such as mass and electric charge, are always the same for particles of the same species, whereas the *dynamic* attributes – such as spin direction, momentum, or position – typically vary amongst particles of the same species.

The term *measurement* applies to two distinct processes. An experimenter may record the statistical results of a quantum experiment, hence making a measurement. When a theorist makes a measurement, however, he or she follows a specific mathematical procedure applied to the wavefunction (quantum state). The wonder of Quantum Mechanics is that the experimental and theoretical measurements always correspond, without anybody knowing why.

Our task here is to understand conceptually what goes on in the mathematical process of measurement, in the hope that it will shine light on the physical reality underlying it. Mathematically the process is known as *harmonic analysis*. Waves combine according to the principle of *superposition*, which sums the amplitudes of the constituent waves at every point in space. Many waves can combine into a single superposed wave, which in a sense contains them all. Harmonic analysis is the reverse process of mathematically decomposing a wave into its constituent waves, or more specifically, into a weighted combination of "pure tones" (harmonics).

Each dynamic attribute (observable) corresponds to a particular *Hermitian operator*, being a mathematical procedure applied to the wavefunction. Each operator represents a unique family of pure tones (known as *eigenstates*, from the German word for *self* or *innate*) which form a complete set, meaning that any wavefunction can be represented as a linear superposition (weighted sum) of these pure tones (eigenstates). Each eigenstate is associated with an *eigenvalue*, being the value of the corresponding attribute.

To measure a particular attribute, one applies the corresponding operator to the wavefunction. In practical terms one is doing harmonic analysis, writing out the wavefunction as a weighted sum of operator eigenstates. It is instructive to depict this mathematically as follows:

$$\psi = c_1\varphi_1 + c_2\varphi_2 + c_3\varphi_3 + \ldots + c_N\varphi_N$$

- ψ represents the wavefunction, being a *complex* wave (in the 4-brane, according to the current framework).
- $\varphi_1 - \varphi_N$ represent the operator eigenstates, which are *real* waves (3-dimensional, in the 3-brane).
- $c_1 - c_N$ are expansion coefficients, which are *complex* numbers (required to write a complex wave as a linear combination of real waves).

The squared modulus of a particular coefficient $|c_n|^2$ (being the sum of the squared real and imaginary components) yields the probability of that outcome occurring, the result being the eigenvalue associated with the eigenstate φ_n. This completes the measurement process. [22]

5. What are the Quantum Attributes?

The preceding section attempts to capture the essence of quantum measurement in a minimum number of words. If you find this difficult to visualize, it may be worth reading the last few paragraphs again. If you do get the picture but are left bewildered, you are not alone; this process has perplexed physicists for generations. What does an attribute (spin, momentum, etc.) have to do with a waveform? What *are* the operators? The orthodox ontology concedes no deeper meaning; quantum measurement is simply a mathematical process which happens to give correct answers, that is all. Here is Roger Penrose again: [23]

> **It is a common view among many of today's physicists that quantum mechanics presents us with *no* picture of 'reality' at all! The formalism of quantum mechanics, on this view, is to be taken as just that; a mathematical formalism. This formalism, as many quantum physicists would argue, tells us essentially nothing about an actual *quantum reality* of the world, but merely allows us to compute probabilities for alternative realities that might occur.**

I wish to argue that the mathematical formalism in fact offers us a key insight suggesting deeper levels of Nature. While each of the quantum attributes is associated with a particular waveform family (complete set of eigenstates), the formalism of Quantum Mechanics allows a "measurement" to be made on the basis of *any* waveform family, over and above those associated with attributes observed in Nature. Nick Herbert whimsically elaborates: [24]

> **According to quantum theory any waveform, no matter how bizarre, corresponds to some dynamic attribute which we could in principle measure… For instance, the "piano" waveform connects to some presently unknown mechanical attribute – call it the piano attribute – which an electron or any other quon is bound to display in a piano measurement situation. Likewise we could test an electron for the size of its tuba attribute, its flute attribute, or its Wurlitzer organ attribute. Physicists have shown little interest in measuring such obscure mechanical properties, but should the need ever arise quantum theory can predict these results as easily as it predicts the results of spin and momentum measurements.**

The fact is that nobody has observed the piano attribute. Why? Are we not looking properly, or does the piano attribute simply not exist? Why do we observe just a small set of attributes when in principle Quantum Mechanics places no limits? Why do the waveforms associated with observed quantum attributes appear to have special status in Nature, above and beyond all other possible waveforms?

We are compelled to consider that the harmonics of the observed quantum attributes relate to objective realities in Nature, whereas the harmonics of the piano or tuba attributes do not. I will elaborate with a simple illustration. If you circle the rim of a crystal glass with a wet finger you can get it ringing with a pure tone. Strike it sharply and you will hear a variety of tones of various frequencies. These various harmonic waveforms (crystal glass eigenstates) could be represented by an operator (call it the crystal glass operator). Further, it is well known that a singer can excite the glass by matching the voice to the harmonics (eigenstates) of the glass, even causing it to shatter.

Now, if you wish to discover how a singer's voice broke the glass, what would you do? You would apply your crystal glass operator to the sound wave (that is, you do harmonic analysis). As a result you get a weighted sum of crystal glass eigenstates which together represent the sound wave. You now have the information you need to determine how the glass was broken. Since both the glass and the sound wave are real (3-dimensional), in this case the expansion coefficients are real rather than complex. A property of classical waves is that the square of a wave's amplitude relates to the *energy carried* by the wave. Hence, if you square these expansion coefficients you get a relative measure of the *excitation energies* exciting each of the crystal glass eigenstates. From this information it will become clear which eigenstate (crystal glass harmonic) was excited with sufficient energy to shatter the glass.

By analogy, the crystal glass corresponds to a quantum attribute, while the sound wave corresponds to the wavefunction. The point of this simple physical illustration is as follows:

- According to the orthodox ontology of Quantum Mechanics, the wavefunction has no objective reality and carries no energy. Rather, it is just an information-yielding abstraction. In fact, it is often called a "probability wave", whatever that exactly means. Similarly, the operator eigenstates are simply mathematical abstractions required to extract information from the wavefunction, and in principle any complete set of eigenstates is as valid as any other. Beyond this, no physical picture is given.
- According to the current framework, the wavefunction is an objective reality, being a four-dimensional gravity wave (occupying the 4-brane) which carries energy. Similarly, the operator eigenstates represent the harmonics of objectively real fields permeating our 3-brane, and only those operators corresponding to objectively real fields are associated with observed quantum attributes. The measurement process calculates the relative excitation energies of the various field eigenstates.

Hence, rather than just extracting information from the wavefunction, quantum measurement describes a real physical process – the *excitation of fields* by the wavefunction. Moreover, it is argued that during a quantum measurement something *substantial* is being excited by the wavefunction, since the resulting attributes are indeed substantial enough to affect our classical detectors.

The most direct reading of the facts leads us to the following conclusion:

- Each quantum attribute (static or dynamic) is an excitation of a substantial quantum field (ether) which embodies the harmonics (eigenstates) of the associated operator.

According to this model the wavefunction excites a number of substantial fields whose space it shares. The harmonics of each field are described by the corresponding operator. The calculated probability weightings for a particular measurement correspond to the relative energies exciting the field eigenstates.

Note that we are not addressing the more subtle question of what selects a particular outcome of a single measurement (see my previous paper [1] for some discussion on this question). In this paper we are simply noting the mathematical relationship between probability weightings and excitation energies.

6. Attributive Fields

According to the Standard Model, which embodies the principles of Quantum Field Theory, each elementary particle is an excitation of an associated field. To the contrary, here I am suggesting that quantum fields are associated not with particle species but with *quantum attributes* (hence the term *attributive* fields). That is, there is a field for momentum, a field for spin, and so on. Each particle is therefore an excitation of multiple attributive fields, with each field manifesting as a particular attribute.

How many fields are required to account for the observed attributes? To answer this question we must briefly address the notions of *conjugate waves* and *conjugate attributes*.

Conjugate waves and attributes give rise to the Uncertainty Principle. Roughly speaking, the conjugate of a waveform is the wave most "opposite" or least similar. For instance, the most regular and ubiquitous waveform in Nature is the sine wave, while its conjugate is the impulse wave, which is simply a sharp spike (known mathematically as the *Dirac delta function*, which could be considered the "least regular" wave). More generally, the conjugate of a waveform is a member of the same family of waveforms. Mathematically, a wave is transformed into its conjugate wave, and back again, by what is called a *Fourier transform;* hence the notion of conjugate waves being "opposite".

Attributes with conjugate harmonics are called *conjugate attributes*, the most common examples being *position* (spatial delta function) and *momentum* (spatial sine harmonics). A precise measurement of an attribute precludes measurement of the conjugate attribute. This can be accounted for by understanding each attribute and its conjugate as excitations of the same field, as illustrated in the following table:

Field 1	Position *Spatial delta function*	–	Momentum *Spatial sine harmonics*
Field 2	Spin direction *Spherical harmonics*	–	Spin angular momentum *Spherical harmonics*
Field 3	Energy *Temporal sine harmonics*	–	Time *Temporal delta function*
Field 4	Charge ?	–	Magnetic moment ?

This model represents the minimum number of fields accommodating the major attributes. For current purposes we will make the assumption that any exotic attributes not listed here can be accounted for in the context of these four fields. The *charge* attribute embraces all three charges (electric, strong and weak), reflecting their (partial) unification in current theory. Since charge is normally considered a static attribute it is not generally associated with an operator or specific harmonics. Please note the following:

- The two columns are seen to be conjugates of each other. That is, the attributes and harmonics in one column are conjugates of the associated attributes and harmonics in the other column.
- The attributes in the left hand column are independent of time, whereas those in the right hand column are dependent on time.

How are we to interpret these relationships? Could it be that the attributive fields can vibrate according to either of the conjugate modes, but not both simultaneously? Or would it be more accurate to say that while one measurement takes place *in* time, the conjugate measurement takes place *outside* of time? Investigation along these lines may well lead to a deeper understanding of the Uncertainty Principle.

Einstein said: "Find the simplest possible solution, but no simpler." Could such a minimal model work in the real world (let alone in theory)? Could it account for known quantum phenomena? In deference to the deep transparency and economy of this model we will proceed to ask what manner of fields might have such properties. To pick up the logical thread we must begin with some fundamental principles.

7. Discrete Space and Fields

A general problem encountered by field theories is that continuous fields lead to infinities. For instance, theorists found early on that if the electromagnetic field is considered as a continuum, and if an electron is considered a point particle (with no size), then the charge density will be infinite and the electric field will be infinite. This same principle underlies many of the problems encountered by Quantum Field Theory and has thwarted efforts to formulate a consistent theory of Quantum Gravity. If space is considered a continuum, infinities invariably arise – the mathematics is inconsistent. This had led to theoretical efforts such as *twistor* theory, *spin networks* and *quantum loop gravity* which consider space to be discrete (quantized) rather than continuous, while M/String theory avoids the infinities by way of the finite size of strings. String theory even allows space to "tear". [25]

While discrete space and torn space may be easily realizable mathematically, one has to question the consistency of such ideas on philosophical grounds. If one imagines discrete space as a foamlike structure on a Planck scale, then what exists between the various "cells" (quanta) of space? More space? Or just "nothing"? Neither answer is consistent. If space divides the quanta of space, then space is continuous. If "nothing" divides the quanta of space, then they are not divided. If something can be divided, this implies a deeper layer of space in which this division occurs. Space is fundamental; by definition it is everywhere, hence nothing can divide it.

If something can be divided (quantized), then it exists *within* space – it cannot be space itself.

A further assumption common in physics is that fields are space-filling. Wilczek describes the condensates as “materials that fill space”, almost like a liquid would fill a container [10]. Upon reflection it is possible that a field may possess a discrete structure, visualizable as filaments formed into a 3-dimensional mesh extending throughout space. The geometry of the mesh would determine the field’s harmonics while potentially explaining discrete attributes such as charge and spin. And most importantly, one might expect that a quantum field theory based on discrete attributive fields would be free of infinities.

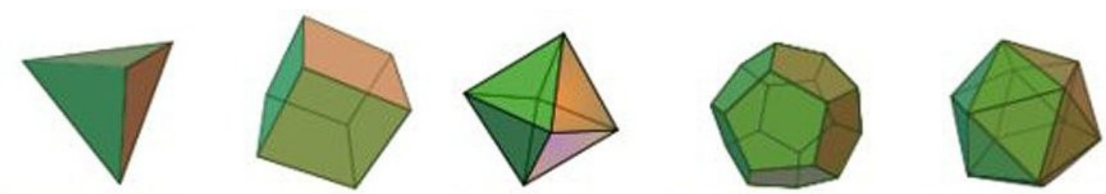
Following from the above we propose the following:

- Space is a continuum.
- The attributive fields are discrete.

So we arrive at a very specific problem. Quantum Mechanics prescribes the harmonics associated with the quantum attributes (charge excluded), which in turn prescribe the harmonics of the attributive fields. Do there exist discrete field geometries exhibiting these harmonics?

8. Platonic Manifolds on the 3-Sphere

Since the laws of physics are assumed to be the same at every point in space, the attributive fields must be the same everywhere, meaning *regular*. That is, every cell must itself be regular and every cell must be identical to every other cell. It turns out that in 3D space there are just five regular polyhedra. These were understood by the geometers of ancient Greece and today are known as the *Platonic solids.*



Tetrahedron ***Cube*** ***Octahedron*** ***Dodecahedron*** ***Icosahedron***

Figure 1: The Platonic Polyhedra

A regular discrete field in 3D space requires a regular tiling (cells fitting without gaps or overlaps) of one of these regular polyhedra. Such a tiling yields what is known as a *Platonic 3-manifold*, in which the harmonics of the parent polyhedron extend to the manifold (that is, everywhere in 3D space).

Achieving a perfectly regular tiling is dependent upon the global geometry of space, which could be any of three possibilities: *Euclidean* (zero curvature), *spherical* (positive curvature) or *hyperbolic* (negative curvature).

- Euclidean (flat) space reflects our intuitive notion of space, in which a beam of light will continue on forever in a straight line, never to return to its source, and two parallel beams will remain parallel. In the absence of dark energy, theory suggests that the expansion of a flat universe will slow to a constant rate but never cease, leading to an ultimate “heat death”.

- Spherical space is a higher analogue of an ordinary sphere in our 3D space, known mathematically as a 2-sphere since it is a 2D surface curled around upon itself in a third dimension. Similarly, a 3-sphere is a 3D space curled around upon itself in a fourth dimension. On an ordinary sphere (a 2-sphere, such as the surface of the Earth), you could travel in any direction and end up where you started. Similarly, if our universe is a 3-sphere, with a sufficiently powerful telescope you could look anywhere into space and see the back of your head. In the absence of dark energy, the expansion of a spherical universe will eventually stop and reverse, ultimately leading to a “big crunch”.

- Hyperbolic space could be considered as opposite to spherical space, that is, with reversed (negative) curvature. It can be visualized as a saddle shape. While hyperbolic space can be closed, even with the most powerful telescope you won't see the back of your head – rather, worldlines diverge. In the absence of dark energy, the expansion of a hyperbolic universe will accelerate indefinitely, leading to a relatively rapid heat death.

Mathematicians have found that just the cube and the octahedron tile Euclidean space without gaps or overlaps, while the dodecahedron tiles hyperbolic space (a closed hyperbolic 3-manifold known as *Seifert-Weber space*). It is found, however, that *each* of the spherical Platonic solids tiles the 3-sphere. [26]

Einstein employed the 3-sphere in his first cosmology of 1917. Topologists describe the 3-sphere as *simply connected*, meaning that any loop within it can be contracted to a point. It is the most regular and aesthetically pleasing universe one could imagine.

Cosmic microwave background (CMB) data are consistent with our physical universe being a 3-sphere, while Platonic manifolds on the 3-sphere have been studied in the context of identifying cosmological signatures in the CMB [27]. While such signatures may indeed be found, I suggest that the mathematical analysis of Platonic 3-manifolds will find a more fundamental application in investigating the attributive fields.

Since only the 3-sphere can be tiled by each of the Platonic polyhedra, we proceed on the following basis:

- Our physical universe is a 3-sphere.
- The attributive fields (ethers) are Platonic manifolds on the 3-sphere.

It is presumed that each of the attributive fields embodies a particular polyhedron. The task then is to match the Platonic polyhedra to the quantum attributes. To this end we find guidance from an unexpected source, being Plato himself and our old friends the esoteric adepts.

9. Esoteric Model of the Ethers

In his dialogue *Timaeus* Plato associates the regular polyhedra with the *classical elements*: Earth, Water, Fire, Air and Aether, as follows:

Polyhedron	*Faces*	*Element*
Tetrahedron	4	Fire
Cube	6	Earth
Octahedron	8	Air
Dodecahedron	12	Aether
Icosahedron	20	Water

While modern science considers this idea to be no more than fanciful musings – what Roger Penrose calls "an entirely suppositional attempted association" [28] – it may turn out that Plato was revealing deep truths of Nature. Esoteric lore holds that Plato was an Initiate of the Greek mystery school, of which Socrates was an adept. While in his public discourses he was obliged to veil the esoteric truths in metaphor and allegory, Plato would have been well aware of the deeper significance of the Elements. They are something other than the chemical elements, of course, and they transcend our ordinary notions of earth, water, fire and air. Esoterically the Elements are cosmic principles manifesting as real energy and substance on a variety of levels, the lowest pure expression being on subtle levels of our 3-brane, the physical universe.

According to the esoteric model, space consists of seven interpenetrating planes (branes) of increasing dimensionality, with each plane (brane) being subdivided into seven *subplanes*. (Note the analogy with the seven notes of a musical octave.) The subplanes could be regarded as *phases* or *vibrational states* of matter occupying the same brane or spacetime.

Figure 2 shows the esoteric description of the seven subplanes (vibrational states) of the 3-brane (the physical plane). The higher four subplanes are known as *etheric* or *etheric-physical*, while the lower three are considered *dense* physical matter, being the material phases of solids, liquids and gases. [29]

3-Brane Physical Plane	1	First Ether	"Air" Element	*Vayu*	Etheric-Physical Subplanes
	2	Second Ether	"Fire" Element	*Tejas*	
	3	Third Ether	"Water" Element	*Apas*	
	4	Fourth Ether	"Earth" Element	*Prithivi*	
	5		Gases		Dense Physical Subplanes
	6		Liquids		
	7		Solids		

Figure 2: Esoteric model of the 3-brane

Exotic phases of matter, such as plasmas and Bose-Einstein condensates, are not directly accounted for in this model. I can only suggest that under this classification a plasma be considered part of the *gaseous* subplane, while a Bose-Einstein condensate could be understood as a *liquid*.

Of greater interest to us here are the four *etheric* subplanes, corresponding to our minimalist model of four attributive fields. Each of the four ethers is associated with an Element – Earth, Water, Fire or Air. Note that while the Greek system placed Fire above Air, the more precise Vedic system considers Air the more subtle.

Figure 3 represents a convergence of these disparate modes of inquiry – physics and esoterics – into a cohesive model, with some details inserted. My justification for this arrangement rests largely on a number of suggestive correspondences – or perhaps coincidences, but fascinating coincidences nonetheless.

		Element	Geometry	Harmonics	Attributes
Etheric-Physical Subplanes	1	Air	Octahedral	Temporal Sine	Energy – Time *Time Metric Field*
	2	Fire	Tetrahedral	Tetrahedral	Charge – Magnetic moment *Electric, Strong, Weak*
	3	Water	Icosahedral	Spherical	Spin direction – Spin magnitude
	4	Earth	Cubic	Spatial Sine	Position – Momentum *Space Metric Field*

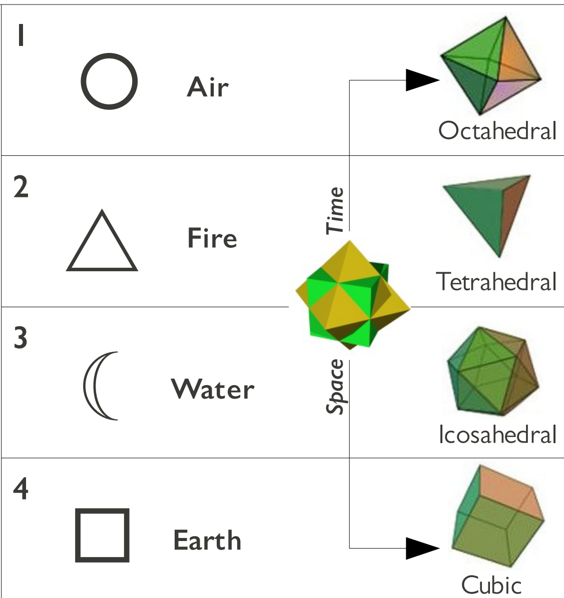


Figure 3: The four attributive fields (ethers)

It is expected that appropriate symmetries imposed on each of the four attributive fields will yield the four conservation laws: the conservation of energy, charge, angular momentum and momentum.

The *dodecahedron* Plato ascribed to the *Aether*, commonly translated as the "heavens" and misunderstood as the physical cosmos. The *Aether* of the Greek mysteries is the *Quintessence* or fifth element of the alchemists and Roman mystery schools, the *Akasha* of ancient India, the *Yesod* or "foundation" of the Kabbalists – being none other than the 4-brane. Somewhat confusingly, modern esoteric usage applies the terms *ether* and *etheric* to the four subtle subplanes of the 3-brane.

Logically, if each of the attributive fields is uniquely associated with a Platonic solid, and if the dodecahedron relates to the 4-brane, there cannot be more than four attributive fields (ethers). We will now look at these four ethers in more detail.

10. Spin and the Double Icosahedron

Measurement of *spin* in Quantum Mechanics is on the basis of the *spherical* harmonics, an illustrious family of waveforms well studied by mathematicians. These one might visualize by imagining the vibration modes of a hollow sphere. The sphere can vibrate in numerous ways, depending on the number of *nodes* in latitude and longitude. One may understand a node as a region where the sphere remains still, while regions either side are in motion. These nodes either pass through the poles or are in plane with the equator. Since there are always a whole number of nodes, spherical harmonics are *confined* waves, taking a finite number of discrete eigenstates.

We have ascribed the spin attributes to the Water ether, which Plato associates with the *icosahedron*. Indeed, mathematicians have discovered that the quantum spin states can be correlated with the harmonics of what is called the *double* or *binary* icosahedron [30]. This can be imagined geometrically as two nested icosahedra, or more technically as the icosahedral symmetry group passed to its unitary description under SU(2), which could be described as a dual complex representation of rotational symmetries. While the technical details are not important to the general reader, the key conclusion is worth spelling out:

- The quantum spin attributes can be understood mathematically as excitations of a double icosahedral 3-manifold. Hence, Plato's association of the icosahedron with the Water element is consistent with the Water ether being the attributive field underlying quantum spin phenomena.

A more subtle correlation comes from esoteric sources. The crescent symbol for the Water element is universal in esoteric traditions. It is generally taken as representing the crescent Moon, the Moon indeed being related to the Water element in esoteric cosmology. Here we offer an alternative explanation: Figure 4 illustrates what are known as *sectoral* nodes in spherical harmonics, which pass through the poles. Could the esoteric adepts have perceived the spherical harmonics of the Water ether, hence symbolizing it as a crescent or sectoral node?

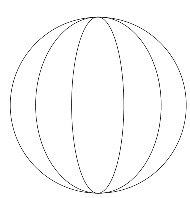


Fig 4: Sectoral nodes in spherical harmonics.

Further, if excitations of the Water ether manifest as the quantum spin attributes, one might ask if the Water ether imparts rotary motion to the macroscopic universe as well, manifesting as the orderly rotation of planets, stars, solar systems and galaxies.

11. Air and Earth: the Metric Fields

The Air ether governs the elusive properties of *energy* (hence mass) and *time*. While time is a parameter in standard quantum theory, in the current framework it becomes an operator. The Air ether is a *time metric field* since it provides the basis for the measurement of time throughout the physical universe.

According to Quantum Mechanics the energy attribute is associated with *temporal sine* harmonics. The temporal frequency of a particle, times Planck's constant *h*, yields the particle's energy, which is related to mass by $E = mc^2$. Hence, understanding the Air ether is a necessary step towards understanding the particle masses. Massless particles, such as the photon, would not excite this ether at all. Consequently a photon has no rest mass and does not experience time, in accordance with Relativity theory.

The units of Planck's constant are *energy by time*, being the conjugate attributes manifested by the Air ether. Hence, Planck's constant will be determined by the properties of the Air ether, or conversely, the properties of the Air ether will be determined by Planck's constant.

While the Air ether is a *time* metric field, the Earth ether is a *space* metric field providing the basis for the measurement of position and momentum throughout our physical universe. The Earth element is symbolized esoterically as a square, or in three dimensions a cube, apt for a metric field in 3D space.

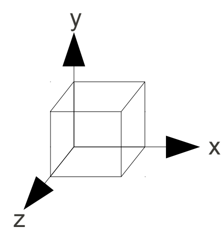


Figure 5: The cube representing a metric field

Esoterically the Earth element provides solidity and objectivity; certainly, something cannot be said to exist objectively in this world until it exists *somewhere*, until it has a location. Accordingly, the Earth ether could be understood as actually *manifesting* particles. Quantum Mechanics teaches us that the Earth ether vibrates with unconfined spatial sine harmonics. *Unconfined* means that this ether can take any frequency. Hence, there are an infinite number of eigenstates; position and momentum can take any value (though obviously with some having greater probability than others).

Plato ascribes the *octahedron* to the Air element and the *cube* to the Earth element. A beautiful correlation is found in the fact that the cube and the octahedron are *dual*. Briefly, one member of a dual pair has the same number of vertices as the other member has faces, so duals can be superimposed to yield a regular (concave) polyhedron. The importance of this dual relationship between the Air and Earth ethers cannot be overstated, since together they form the spacetime metric field. (See Figure 3, page 15.)

The laws of Relativity insist upon a deeply intimate relationship between space and time throughout our physical universe. The geometric duality of the Air and Earth ethers provides a physical, causal mechanism underpinning this relationship. Recall that the attributive fields all occupy the same space (despite being listed sequentially according to subtlety). One could perhaps imagine the Air (octahedral) and Earth (cubic) ethers superimposed regularly, corresponding cell for cell, so that each follows its own law but in lockstep with the other. Here lies a challenge for mathematicians. The model predicts the following:

- Some flavor of octahedral manifold on the 3-sphere will be found to support the harmonics of the energy-time attributes, with appropriate symmetries accounting for the conservation of energy.
- Some flavor of cubic manifold on the 3-sphere will be found to support the position-momentum harmonics, with symmetries accounting for the conservation of momentum.
- The dual geometric relationship between these fields will be found to illuminate Relativity in the 3-brane.

12. Charge: the Fire Ether

Excitation of the Fire ether manifests as charge – electric charge, strong color charge, weak color charge. These three charges power the three known forces of Nature (excluding gravity, which as we shall see later is quite another thing). It follows that the electromagnetic field is an activity of the Fire ether.

The number three arises often in the context of the charges and forces. To begin with, there are three charges and three forces. Further, a particle's electric charge is always some integer multiple of *one third* the charge of an electron. There are three strong color charges: Red, White and Blue. There are 3 x 3 = 9 (minus one "bogus boson") = 8 gluons, which mediate the strong force. There are three particles mediating the weak force – the W^+, W^- and Z^0. Perhaps it is fitting, then, that the Fire element is traditionally represented as an equilateral triangle.

Stephen Hawking famously asked: "What breathes the fire into the equations?" The esoteric answer is the Fire ether, the source of all physical forces in the universe (gravity excluded). The ancients knew it as the *Cosmic Fire* or the *One Force*, described by Hermes Trismegistus (Thoth) as follows: [31]

> **In it is the Power, the power of powers. It will overcome all Subtle things and penetrate all Solids. With it the World was created. From this One Force will come about and will emerge all wonderful Adaptations….**

One only has to think of nuclear weapons, or the boundless energy flowing from our Sun and the billions of stars, to appreciate the power of the One Force.

Since charge is a static attribute, it is not normally associated with a harmonic waveform family. Plato associates the Fire element with the *tetrahedron*. Note the following facts:

- Since all charges are quantized (discrete), the harmonics of the associated field are confined.
- The tetrahedron is the simplest projection of a triangle in three dimensions. After the sphere, the tetrahedron is the simplest solid in Nature. It is also the strongest (the Fire ether is powerful).

In the Standard Model electric charge is generalized as *hypercharge*, which can be expressed as a combination of the strong color charges – Red (R), White (W), Blue (B) – and the weak color charges – Green (G) and Purple (P) – as follows: [32]

$$Hypercharge = -1/6\,(R + W + B) + 1/4\,(G + P)$$

This is unification at its finest, and further justifies our conclusion that all charges are manifestations of the one Fire ether. The question arises: where do these numbers 4 and 6 come from? Why are they integers? Could these relate to the fact that a tetrahedron has 4 faces (and vertices) and 6 edges?

The above expression for hypercharge tells us that all charges are some combination of the five color charges. The 3-sphere can be tiled by five spherical tetrahedra, what is called the *5-cell*. Accordingly, we make the following prediction:

- The five color charges and the electromagnetic field will be understood on the basis of a tetrahedral manifold on the 3-sphere, with appropriate symmetries accounting for the conservation of charge.

13. The "Force" of Gravity

Physics counts four forces in Nature, the fourth being gravity, which has stubbornly resisted integration into the Standard Model. One of the big problems of physics is called the *hierarchy* problem – why gravity is profoundly weaker than the other forces. The answer is that they are not to be directly compared, since they are phenomena of a different order. Roger Penrose explains this distinction as follows: [33]

> **Albert Einstein deeply re-examined the very basis of Newtonian gravity and finally, in 1915, came up with a**

> **revolutionary *new* theory which provided a totally different picture: his general theory of relativity. Now, gravity was no longer to be a force at all, but it was to be represented as a kind of *curvature* of the very space (actually space-time) in which all the other particles and forces were to be housed.**

Imagine you are floating freely in space with a friend, both happily in your spacesuits. You feel no external forces acting on you until your friend reaches out and pushes you. Suddenly you feel a force. Would you consider this to be the force of gravity? Of course not; the force was applied by your friend. Or, more fundamentally, electrons in your friend's spacesuit interacted with electrons in your spacesuit – the force you experienced was in fact electromagnetic.

Yet, according to Einstein's theory of General Relativity, what you experienced was the same phenomenon as the "force" of gravity. Now imagine that you and your friend are rapidly approaching a planet – you are unaware of the gravitational field of the planet, since you are freely following your *worldline* (technically a *geodesic* or shortest distance in spacetime, which is influenced by the presence of matter). You experience a force only when the planet "pushes" you from your worldline (when you hit the ground, assuming there is no atmosphere), just as when your friend pushed you. The same applies if you are standing on the surface. The push from the planet surface (which can be traced to electromagnetic forces) is resisted by that mysterious property of matter called *inertia*. There is no "force" of gravity involved at all.

Einstein's *equivalence principle* teaches us that gravity and an accelerating reference frame are indistinguishable. The lesson is that gravity is not a force; a force arises only as a consequence of inertia, when we are deflected (accelerated) from our worldline. So long as we don't collide with anything we can float through the most serious gravitational fields and experience no force at all (disregarding tidal effects, where the gradient of the gravity field causes the worldline of your head to differ from that of your feet!).

To speak of a "force of gravity" is to speak of a "force of inertia". The real mystery is inertia, being that property of matter (mass) which impels it to adhere to its worldline through spacetime. Upon reflection, inertia is nothing more than the *conservation of momentum*. It follows that inertia is imparted by the Earth ether, the space metric field.

14. Dark Energy

Our discussion of quantum fields wouldn't be complete without addressing *dark energy* and *dark matter*, which together constitute most of the mass of the universe. Dark energy is perhaps the most enigmatic of the two; it appears to be uniformly spread throughout space and time while manifesting as a negative pressure which is accelerating the expansion of the universe. It is related to Einstein's cosmological constant and acts as a type of anti-gravity, increasing the distance between galaxies by stretching the space between them. Hence, one can perhaps understand Frank Wilczek's pessimism about a quick resolution: [34]

> **The theory of dark energy is in bad shape. It's a problem for the future.**

Within the current framework dark energy finds a natural and necessary place. Dark energy can be understood as the (negative) energy of the 4-brane, along with the energy of all the higher branes. Recall that the seven branes interpenetrate and are transparent to gravity; consequently, each brane experiences the same gravity field (within its particular dimensionality). Hence, rather than asking why 70% of the universe's mass is dark energy, we might more appropriately ask why 30% of the mass of the universe occupies the 3-brane.

Dark energy can also be understood in terms of the *shape* of space. The current model requires that our physical space be a 3-sphere, yet the universe is acting hyperbolically, its expansion accelerating. Hence the need for dark energy. A more direct explanation comes from taking Plato's advice and ascribing the dodecahedron to the 4-brane. We know that the dodecahedron tiles hyperbolic space, forming a closed hyperbolic 3-manifold known as *Seifert-Weber space.* So let us assume that the three real dimensions of the 4-brane are in fact hyperbolic. When the 4-brane is projected into the 3-brane via the wavefunction, the curvature of the complex 4-brane space is reversed, yielding our real, spherical 3-brane space. Since the wavefunction lives in the 4-brane, the expansion of the physical universe is bound to the expansion of the 4-brane, which is hyperbolic, hence accelerating.

15. Dark Matter

The universe consists of about 70 percent dark energy (constituting the higher branes), and about 25 percent dark matter and 5 percent ordinary matter (in the 3-brane). Hence, more than 80 percent of the mass in our 3-brane is dark matter. Dark matter is different; it is not evenly spread but aggregates around observable matter. Further, it appears to be normally gravitating, hence occupying our (3 + 1) spacetime.

In 2007 Richard Massey and his colleagues published the first detailed 3D maps of dark matter, obtained through gravitational lensing (detecting invisible matter through its gravitational effects on light from distant galaxies). In the abstract to their paper, entitled *Dark matter maps reveal cosmic scaffolding,* they write: [35]

> **Our results are consistent with predictions of gravitationally induced structure formation, in which the initial, smooth distribution of dark matter collapses into filaments then into clusters, forming a gravitational scaffold into which gas can accumulate, and stars can be built.**

Note the metaphor of a *scaffold*. The authors are implying, of course, that the scaffold was there first, and the dense material structures came after. As counterpoint, the following is a description from esotericist Djwal Khul of what is known as the *etheric body*: [36]

> **1. The etheric body is the mould of the physical body.**
>
> **2. The etheric body is the archetype upon which the dense physical form is built, whether it is the form of a solar system or of a human body in any one incarnation.**
>
> **3. The etheric body is a web or network of fine interlacing channels, formed of matter of the four ethers, and built into a specific form. It forms a focal point for certain radiatory emanations, which vivify, stimulate and produce the rotary motion of matter.**
>
> **4. These pranic emanations when focalized and received, react upon the dense matter which is built upon the etheric scaffolding and framework.**

The parallels should be clear. The word *pranic* is from the Sanskrit *prāṇa*, which in this context refers to etheric energy or life-force. The etheric body corresponds to what progressive biologists such as Rupert Sheldrake call *morphogenetic fields*. [37]

Esoterically, therefore, the dark matter halo surrounding a galaxy is the *etheric body* of the galaxy, which permeates the galaxy through and through. The inference is that dark matter is *etheric*. The four etheric fields are substantial and energetic; hence they have mass and they gravitate. Not all activity of the etheric fields is associated with dense physical matter; esoterics also allows *etheric* matter of many grades.

It follows that exploration of the etheric (attributive) fields will lead to an understanding of dark matter. This should be possible since the four etheric fields occupy our 3-brane, making them amenable to direct experimental investigation, when we figure out how.

A mathematical understanding of the attributive fields will herald a new era in technology and medicine, providing access to energies and processes of a deeper order, quite beyond chemical or nuclear processes.

16. Conclusion

When Paul Dirac developed his relativistic theory of the electron in the 1920s he was faced with the challenge of wedding Special Relativity (embracing time as a dynamic variable) with a flawed formulation of Quantum Mechanics (incorporating time as a parameter). The logical outcome of this mismarriage is what Roger Penrose has called "the quagmire of quantum field theory".

The current framework concludes that Relativity and Quantum Mechanics slot together naturally in a 4-brane interpenetrating our 3-brane [1]. Consequently, when time is correctly identified with the imaginary dimension of the quantum state, Quantum Mechanics and Special Relativity become two aspects of a single overarching theory. When this paradigm is formulated mathematically I predict that QFT will be consigned to the dustbin of history's failed theories, along with its requisite multitude of quantum fields, condensates and so forth, to be replaced by just four attributive fields in our 3-brane.

If you were designing a physical universe, would you not think it natural to erect it upon attributive fields? For Nature works by the law of economy and elegance, without waste or duplication. Moreover, attributive fields provide an intellectually satisfying picture to the mathematical process of measurement in Quantum Mechanics, which has baffled physicists for eighty years.

Could the day be near when, if we are asked, "What is the world made of?", we will be obliged to reply, like the Greeks, the Hebrew Kabbalists and the Seers of ancient India, "Earth, Water, Fire and Air"?

Notes and References

1. Carter, Philip J., (2010), *Framework for Unification of Physics*, http://physics.esotec.org/
2. See, for example, Vallyon (2007), Vol 3, p. 1589.
3. Quoted in Wilczek (2008), p. 77.
4. Ibid, p. 78.
5. Wilczek (2008), p. 82.
6. Penrose (2004), p. 656.
7. Quoted in Christopher G. Oakley, *The search for a quantum field theory*, http://www.cgoakley.demon.co.uk/qft/
8. Penrose (2004), p. 656.
9. Wilczek (2008), p. 165.
10. Ibid, p. 90.
11. Quoted in Wilczek (2008), p. 97.
12. Based on Wilczek (2008), p. 75.
13. Wilczek (2008), p. 73.
14. Penrose (1989), p. 199.
15. Wilczek (2008), pp. 109-110.
16. Ibid, p. 110.
17. Ibid, p. 63.
18. Quoted in Christopher G. Oakley, *The search for a quantum field theory*, http://www.cgoakley.demon.co.uk/qft/
19. Penrose (2004), p. 610.
20. Oakley, Christopher G., *The search for a quantum field theory*, http://www.cgoakley.demon.co.uk/qft/
21. Penrose (1989), p. 374.
22. For a lucid popular presentation of these concepts I highly recommend Herbert (1985), while Bowman (2008) provides a more technical presentation accessible to those with basic math.
23. Penrose (2004), p. 782.
24. Herbert (1985), p. 104.
25. See Smolin (2001) for a popular account of quantum loop gravity; Penrose (2004) for twistors and spin networks; Green (2003) for space tearing in String Theory.
26. Acknowledgments to Dr. Peter Kramer for providing much of the information regarding Platonic 3-manifolds presented here: email communications, November-December 2010.
27. See Kramer (2009a, 2009b, 2010), as well as other papers by the same author.
28. Penrose (2004), p. 8.
29. See Bailey (1925) and Vallyon (2007), vol. 1.
30. See for example Hitchen (2007) and Shi-Hai-Dong et al. (2001).
31. Quoted in Vallyon (2007), vol. 1, p. 133.
32. Wilczek (2008), p. 165.
33. Penrose (2005), p. 218.
34. Wilczek (2008), p. 195.
35. Nature 445, 18 January 2007, pp. 286-290.
36. Bailey (1925), pp. 81–82. Note that Alice Bailey's works were generally dictated by Djwal Khul.
37. See Sheldrake (2009) for a discussion on morphogenetic fields.

Bibliography

Bailey, Alice A. (1925). *A Treatise on Cosmic Fire.* Lucis Publishing Company, New York.

Bowman, Gary E. (2008). *Essential Quantum Mechanics.* Oxford University Press, Oxford.

Fontaine, David (2001). *The Five Platonic Solids.* http://davidf.faricy.net/polyhedra/Platonic_Solids.html

Greene, Brian (2003). *The Elegant Universe: superstrings, hidden dimensions, and the quest for the ultimate theory*. W. W. Norton & Company, New York.

Herbert, Nick (1985). *Quantum Reality: Beyond the new physics.* Anchor Books, New York.

Hitchin, Nigel (2007). *Spherical harmonics and the icosahedron*. arXiv:0706.0088

Kramer, Peter (2009a). *Platonic polyhedra tune the 3-sphere: Harmonic analysis on simplices*. Physica Scripta 79 (2009) 045008, arXiv:0810.3403

Kramer, Peter (2009b). *Platonic polyhedra tune the 3-sphere II: Harmonic analysis on cubic spherical 3-manifolds*. Physica Scripta 80 (2009) 025902, arXiv:0901.0511

Kramer, Peter (2010). *Platonic polyhedra tune the 3-sphere III: Harmonic analysis on octahedral spherical 3-manifolds*. Physica Scripta 81 (2010) 025005, arXiv:0908.1000

Penrose, Roger (1989). *The Emperor's New Mind.* Oxford University Press, Oxford.

Penrose, Roger (2004). *The Road to Reality: A Complete Guide to the Laws of the Universe.* Jonathan Cape, London.

Penrose, Roger (2005). *Shadows of the Mind.* Vintage, London.

Sheldrake, Rupert (2009). *Morphic Resonance: The Nature of Formative Causation.* Park Street Press, Rochester.

Shi-Hai Dong, Xi-Wen Hou, and Zhong-Qi Ma (2001). *Correlations of Spin States for Icosahedral Double Group*. International Journal of Theoretical Physics, Vol. 40, No. 2, 2001.

Smolin, Lee (2001). *Three Roads to Quantum Gravity*. Basic Books, New York.

Vallyon, Imre (2007). *Heavens and Hells of the Mind (Volumes 1-4).* Sounding-Light Publishing, Hamilton, New Zealand.

Wilczek, Frank (2008). *The Lightness of Being: mass, ether, and the unification of forces.* Basic Books, New York.