Quantum Spacetime and Consciousness

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Abstract

A higher-dimensional spacetime model is proposed, accounting for nonlocal quantum phenomena while embracing Special Relativity as a limiting case. The Aspect and Megidish experiments are explained within this spacetime framework. Time is understood as spatial motion relative to higher dimensions, offering the degrees of freedom demanded by nonlocal effects along with a consistent milieu for Kaluza's 5-dimensional Einstein-Maxwell theory. Special Relativity and quantum mechanics converge in the higher dimensions to yield the origins of mass while providing a geometrical mechanism relating mass and spacetime curvature (gravity). Part Two introduces a consciousness model within the higher-dimensional spacetime framework, integrating elements of physics, psychology, philosophy and metaphysics. Evidence from dreams is shown to correspond to both the physical model and the consciousness model. A theory of perception is presented on the foregoing basis.

Keywords: consciousness, quantum mechanics, wavefunction, relativity, nonlocality, entanglement, space, time, spacetime, mind, perception, qualia, dreams, branes, imaginary dimensions, higher dimensions

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Introduction

> That there is consciousness in the universe is undeniable. That science in general, and physics in particular, do not address this most striking of all observable phenomena is glaring. Consciousness, so central to our existence, remains a mystery. – *A. Zee* [1]

It should be no coincidence that neither consciousness nor the foundations of quantum mechanics enjoy a consistent theoretical basis within physics. This is not just a question of our theories being inadequate – there are no theories. While quantum mechanics is a phenomenally successful effective theory, it remains unexplained, as does consciousness. It might not be surprising, then, if the solution to one holds the key to the other.

This paper develops a logical structure, a consistent conceptual framework embracing essential principles of both physics (as currently understood) and consciousness (as we experience it). As philosophers have pointed out for millennia, it is a truism that consciousness is the only thing we ever directly experience. How ironic, then, that the one thing we can ever truly know is the thing we know least about, while quantum mechanics undresses the material world – so called reality – leaving it but a ghostly apparition.

I think it would be fair to say that most people who have seriously studied the foundations of quantum mechanics and/or consciousness would agree that a fundamental reorientation of perspective is required. The consensus would be that there is something we don't understand which is preventing us from seeing the big picture. It follows that this new perspective will be something outside of our current worldview. So we should be prepared for the unexpected, perhaps something shocking. In reading this paper, then, I would ask the reader to be prepared for the unexpected, to expect to be challenged, both intellectually and philosophically. The frontiers of knowledge do not yield to timidity, and this is not easy ground.

Part One erects a spacetime structure, what I call *Quantum Spacetime*, which can account for observed quantum phenomena while extending Special Relativity into higher dimensions. Part Two presents a consistent theory of consciousness in the context of Quantum Spacetime. In developing this theory of consciousness I introduce some ideas from esoteric philosophy – justified, I trust the reader will agree, by the consistent insights they bring.

This work is presented as an honest effort to make sense of the nonsensical. Known facts (both experiential and mathematical) and logical consistency are the essential guides, wherever they may lead. The reader is invited to follow these logical threads, whether as a serious inquiry or as a philosophical frolic, to ruminate upon them, and to come to his or her own conclusions.

Part One
Quantum Spacetime

1.1 The Magical Wavefunction

Following from Bell's theorem, experiments have demonstrated that the quantum wavefunction does not abide by the laws of Special Relativity, which limit signals to light speed [2]. What Einstein called "spooky action at a distance" is indeed a property of the wavefunction. Even while extended or divided in physical space, it appears to behave as a holistic entity, as if fully existent in one location. Moreover, so called *entangled* particles respond to each others state regardless of separation in space or time. To address these anomalies we begin by developing an appreciation for the phenomena as demonstrated. Referring to the first definitive demonstration of quantum nonlocality by Alan Aspect et al., philosopher of physics Tim Maudlin describes what he calls the *quantum connection* as follows [3]:

> There are at least three features of the quantum connection which deserve our close attention…
>
> 1. The quantum connection is unattenuated…
>
> The quantum connection [in contrast to a force like gravity] appears to be unaffected by distance. Quantum theory predicts exactly the same correlations will continue unchanged no matter how far apart the two wings of the experiment are. If Aspect had put one wing of his experiment on the moon he would have obtained precisely the same results. No classical force displays this behavior.
>
> 2. The quantum connection is discriminating…
>
> Gravitational forces affect similarly situated objects in the same way. The quantum connection, however, is a private arrangement between our two photons. When one is measured its twin is affected, but no other particle in the universe need be… The quantum connection depends on history. Only particles which have interacted with each other in the past seem to retain this power of private communication.
>
> 3. The quantum connection is faster than light (instantaneous)…
>
> The Special Theory [of Relativity] confers upon light, or rather upon the speed of light in a vacuum, a unique role in the space-time structure. It is often said that this speed constitutes an absolute physical limit which cannot be broached. If so, then no relativistic theory can permit instantaneous effects or causal processes… The quantum connection appears to violate this fundamental law…
>
> We cannot simply accept the pronouncements of our best theories, no matter how strange, if those pronouncements contradict each other. The two foundation stones of modern physics, Relativity and quantum theory, appear to be telling us quite different things about the world.

Further violating common sense, while the Aspect and similar experiments have focused on entanglement over spacelike separations, a team of Israeli researchers have demonstrated a more general prediction of the quantum formalism, being entanglement over *timelike* separations, meaning entanglement of quantum systems that have never coexisted. E. Megidish and colleagues describe the effect as follows [4]:

> In conclusion, we have demonstrated quantum entanglement between two photons that do not share coexistence. Although one photon is measured even before the other is created, full quantum correlations were observed by measuring the density matrix of the two photons, conditioned on the result of the projecting measurement. This is a manifestation of the non-locality of quantum mechanics not only in space, but also in time.

The upshot is that the wavefunction appears to enjoy a spacetime very different from that described by Special Relativity, impelling us to reconsider the very structure of space and time. Confounding the issue, the wavefunction is a *complex* wave – its phase is given by complex numbers. For the sake of nonmathematical readers, a brief explanation is in order. A complex number is composed of both a *real* number and an *imaginary* number, an imaginary number being some real multiple of the *imaginary unit*, denoted **i** and defined as *the square root of minus one*. Because both positive and negative numbers

square to positive numbers, there is no real number that squares to minus one, meaning that imaginary numbers find no correlate in our real 3+1 spacetime. Since physical space and time are measured in real units, imaginary numbers are considered "unphysical", as mathematical abstractions having no ontological status in the universe. Quantum mechanics directly challenges this interpretation of imaginary numbers, however. The originator of the transactional interpretation of quantum mechanics, John G. Cramer, addresses the problem of *complexity* as follows [5]:

> One of the serious objections to Schrödinger's early semiclassical interpretation of the SV [state vector]… is that the SV is a complex quantity. Complex functions are also found in classical physics, but are invariably interpreted either (1) as an indication that the solution is unphysical, as in the case of the Lorentz transformations with $v > c$, or (2) as a shorthand way of dealing with two independent and equally valid solutions of the equations, one real and one imaginary, as in the case of complex electrical impedance. In the latter case the complex algebra is essentially a mathematical device for avoiding trigonometry, and the physical variables of interest are ultimately extracted as the real (or imaginary) part of the complex variables. Never in classical physics is the full complex function "swallowed whole" as it is in quantum mechanics. This is the problem of complexity.

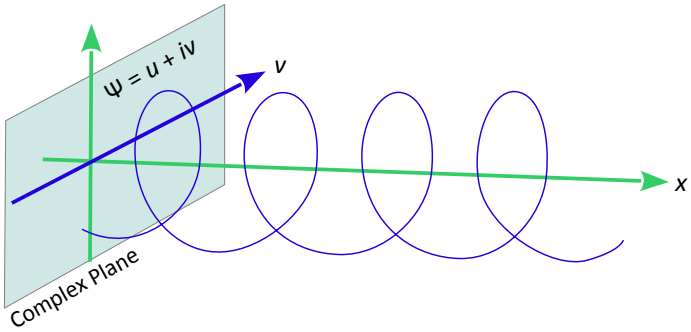

Figure 1 • The complex wavefunction (pure momentum state)

Figure 1 depicts the most regular wavefunction, known as a pure momentum state, which takes the form of a helix with the major axis oriented in some direction x in real space [6]. The key point is that the general wavefunction, while considerably less regular than this, will share the same dimensionality. While the wavefunction is located in our 3-space, the dimensions u and v (forming the complex plane) are not conventionally ascribed to spatial dimensions in Nature, the wavefunction being considered an abstract entity, an unphysical probability wave providing "knowledge of the system". In 2011 this interpretation came under pressure with the publication of a theorem by Matthew Pusey, Jonathan Barrett and Terry Rudolph (PBR) requiring, given mild assumptions, that the wavefunction be an objective entity, a "physically distinct state" [7]. On this basis, the problem boils down to explaining how an *objective* wave might be extended in a *complex* space while working the *magic* of nonlocality and entanglement.

1.2 Special Relativity and Minkowski Spacetime

The structure of 3+1 spacetime, as encoded in Special Relativity, comes into clear view in the context of Minkowski spacetime, illustrated in Figure 2. The 3D illustration omits the z dimension, of course, while the 2D version includes just one spatial dimension, x, which could be pointing in any direction in space. One can view the graphics statically, as representing a particular *event* in space and time (defined by the origin), or one might visualize the time dimension flowing constantly downward, from the future to the past. Units are chosen so that the speed of light c is equal to one (e.g. seconds and light-seconds), with the consequence that the diagonal lines/surfaces represent light speed – the worldline for light – forming what is called a *light cone* or *null cone*.

The time and space dimensions are entwined in the *Minkowski metric*, being the formula for *displacements* in 3+1 spacetime. The metric appears with two signatures (sign conventions), rendering both timelike and spacelike displacements real. Displacements *s* and *l* are zero on the light cone (hence the term *null* cone, where the time component of the metric equals the resultant spatial component). Hence are time and space entwined by the Minkowski metric, giving them almost equal status. Significantly, however, time enters the metric with opposite sign to the spatial dimensions, and while one can move in any direction in space (or not move at all), time flows irrevocably in just one direction.

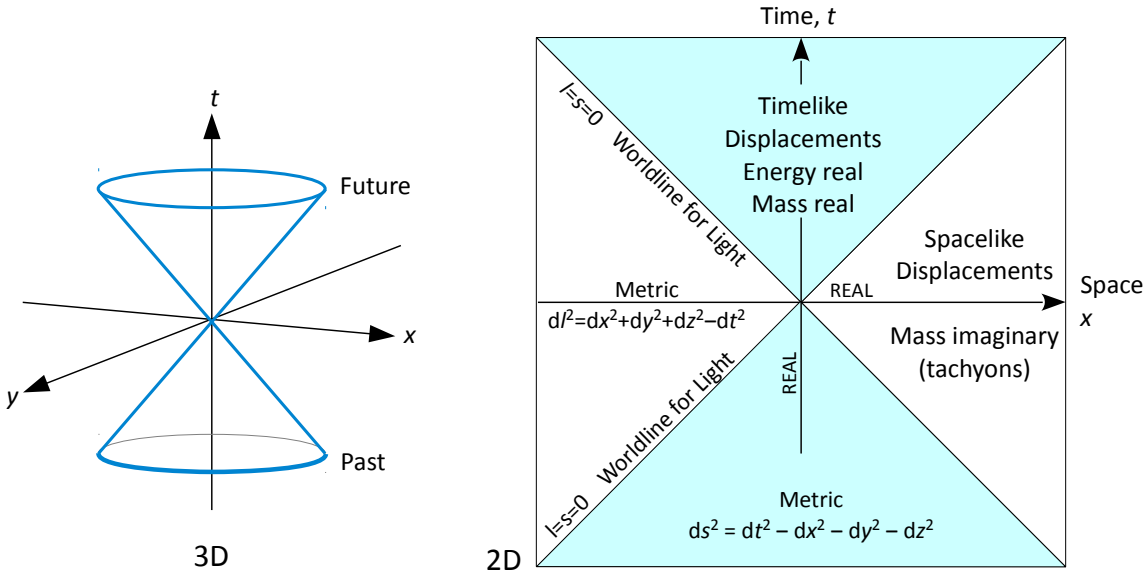

Figure 2 • Minkowski spacetime

Special Relativity restricts displacements to within the light cone, imposing light speed as an upper limit, while the light cone encompasses all possible causal relationships between an event at the origin and an event in the past or future. Consequently, attempts to explain nonlocality on the basis of faster-than-light particles (tachyons) have inevitably run into causal paradoxes.

The timelike displacement *s* is generally interpreted as *time experienced*. Since photons adhere to the light cone, where $s = 0$, it follows that photons don't experience time. Special Relativity has been tested to very high precision – any theory of space and time must include it as a limiting case.

1.3 The Transactional Interpretation of Quantum Mechanics

The transactional interpretation (TI) is not a new formulation of quantum mechanics but an alternative interpretation of the standard formalism, while making identical predictions [8]. While appearing like science fiction and having consistency problems of its own (potentially resolvable under the current framework), TI resolves many long-standing paradoxes in quantum mechanics. Originator John Cramer was inspired by the *absorber* theory of John Archibald Wheeler and Richard Feynman, describing electromagnetic interaction as a time-symmetric process; the electromagnetic wave equation has two solutions, known as *retarded* and *advanced*, which correspond to electromagnetic waves traveling forward and backward in time. It turns out that the relativistic version of the Schrödinger equation (which governs the evolution of the wavefunction in time) also has advanced and retarded solutions, suggesting that the wavefunction propagates both forwards and backwards in time.

According to TI, each quantum event involves a *transaction* between an *emitter* and an *absorber*. The emitter sends out an "offer wave", which at some time in the future is received by any number of absorbers, each of which sends a "confirmation wave" *back in time* to the emitter. The emitter receives the confirmation waves at the same instant that it emits the offer wave! Cramer describes the interaction as a "handshake" between the emitter and absorber, occurring in what he calls "pseudo-time". Glossing over details, when certain criteria are met a transaction is completed between the emitter and an absorber and the wavefunction collapses, manifesting the associated event.

Despite its paradox-resolving powers, reaction to Cramer's theory has been muted. What is this "pseudo-time", and how can anything travel forward and back in time? Indeed, I would suggest that philosophical questions have presented the greatest obstacle to TI being taken seriously by the community – physics simply cannot provide a philosophical or cosmological context for it. Let us keep in mind, however, that timelike entanglement has been demonstrated in the laboratory, for which effect some form of pseudo-time is logically required, while serving notice that we should take TI seriously.

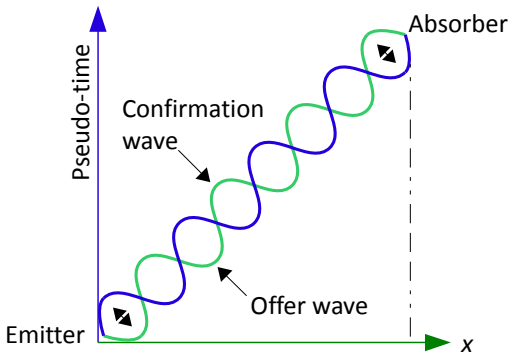

Figure 3 • The wavefunction as a standing wave in pseudo-time

Cramer points out that the offer and confirmation waves can be represented as a 4-vector standing wave, as illustrated in Figure 3. The correct picture is to see these standing waves in *motion*, each oscillating as indicated by the small arrows. It follows that this entire picture, encompassing the space and "pseudo-time" dimensions, is changing *in time* (but obviously not in physical time). Expressed another way, according to the standing wave representation of TI, pseudo-time is in fact a dimension of space.

1.4 Propagation of the Wavefunction

One further detail will allow us to connect the dots. On the basis of both quantum and relativistic principles it has been shown that the wavefunction propagates according to the following formula [9]:

$$WV = c^2 \qquad (1)$$

where W is the *phase* velocity, associated with the propagation speed of the wavefunction, and V is the *group* velocity, associated with the particle's classical velocity. Particle velocities never exceed light speed c, while wavefunctions never propagate at velocities less than c. The formula implies that a lightlike wavefunction (such as that representing a photon) propagates at the speed of light, while the wavefunction of a massive particle at rest propagates at infinite velocity (action at a distance). For this reason the propagation of the wavefunction is generally considered unphysical.

1.5 A Spatial Context for the Wavefunction

The demonstration of timelike nonlocality logically requires that time is more fundamentally a dimension of space. While our classical universe appears consigned to constant motion along that spatial dimension (manifesting as the arrow of time), the quantum world seems not so constrained – the wavefunction reaches across time as it reaches across space.

The solution to this quandary lies in the dimensionality of the wavefunction itself. If indeed the wavefunction is an objective wave (PBR theorem), it follows that it must be extended in an objective space of corresponding dimensionality. Clearly, since the wavefunction is a complex wave, it will not fit into our real 3-space, yet it is localized and extended in our 3-space. There is only one way out of this impasse: we postulate the existence of three superimposed (interpenetrating) spaces, as follows:

- A 5-space, having three real plus two imaginary dimensions.
- A 4-space, having three real plus one imaginary dimension.
- A 3-space, having three real dimensions (representing our empirical universe).

These spaces may be thought of as *branes* (more precisely, *D-branes*) as conceived by string theory, and in accordance with string theory our model requires the branes to be transparent to gravity while confining other fields. Corresponding dimensions of each brane coincide (they are the same dimensions appearing in different branes), and each brane sees the same gravitational fields and waves according to its particular dimensionality. Since matter fields are confined to a particular brane, the higher-dimensional branes remain empirically unobservable.

Figure 4 introduces a graphical device depicting the proposed spatial configuration. While shown delineated vertically for clarity, keep in mind that the three branes are in fact superimposed – they each include the same dimensions up to their particular dimensionality.

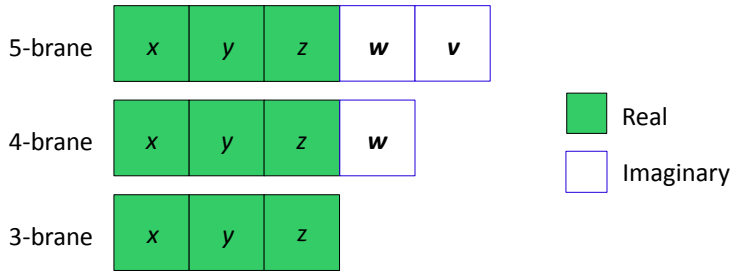

Figure 4 • A spatial model of the universe

An imaginary spatial dimension is considered an actual "direction" in the universal spatial fabric, orthogonal to the real dimensions and measured in imaginary units. The reader might find this a challenging concept at first, representing a radical departure from conventional thought. Nevertheless, the fact remains that if Schrödinger's equation and the PBR theorem are both correct, then imaginary dimensions must exist have ontological status in Nature. We will develop our intuitive appreciation for imaginary dimensions in the course of this paper – for now the reader is encouraged to think of them simply as spatial dimensions measured in imaginary units.

The local spatial geometries of the 4-brane and 5-brane are described by what I will call *Minkowski 4-space* and *Minkowski 5-space*, extending the principles implicit in Minkowski 3+1 spacetime into higher dimensions. On this basis we surmise the spatial metrics as follows. Notice that these are spatial metrics only, without reference to time:

(N.B. Throughout this work, imaginary coordinates are set in bold, while differential and interval symbols are generally omitted: the glyphs x, y, z, $\boldsymbol{w}$, $\boldsymbol{v}$, are applied as logical symbols and may denote an interval, a displacement, a coordinate, or a dimension, depending on context.)

3-brane: $s^2 = x^2 + y^2 + z^2$ (2)

4-brane: $s^2 = x^2 + y^2 + z^2 + \boldsymbol{w}^2$ (3)

5-brane: $s^2 = x^2 + y^2 + z^2 + \boldsymbol{w}^2 + \boldsymbol{v}^2$ (4)

The spatial metric for the 3-brane is of course the familiar Pythagorean theorem, being the distance metric for Euclidean 3-space. Experts will note that Minkowski 4-space corresponds to so called Euclidean spacetime, where time is rotated on the complex plane into "imaginary time", $\boldsymbol{\tau} = \mathbf{i}t$. Imaginary time has many important applications in physics and plays a crucial role in Feynman's path integral formulation of quantum mechanics. Significantly, however, here we understand the fourth (imaginary) dimension as spatial, $\boldsymbol{\tau} = \boldsymbol{w}$, as shown in Figure 5.

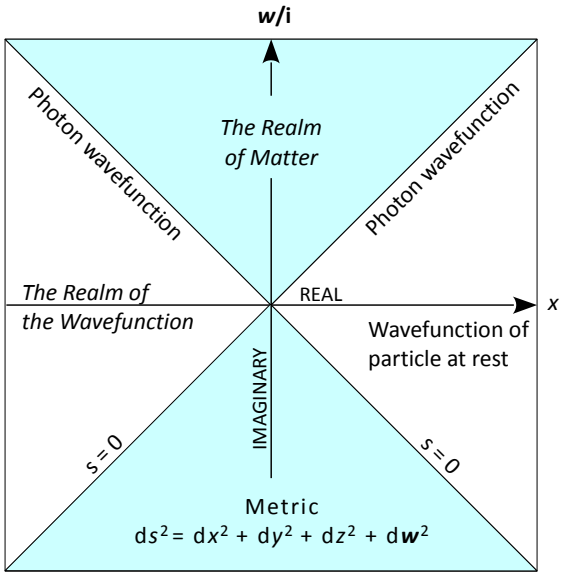

Figure 5 • Minkowski 4-space

Minkowski 4-space (the 4-brane) provides a natural environment for the complex wavefunction, as the reader may demonstrate by substituting Figure 5 for the complex plane in Figure 1. The imaginary dimension $\boldsymbol{w}$ corresponds to the *pseudo-time* of TI. Accordingly, the wavefunction may be understood as a standing wave extended in Minkowski 4-space, confined to the "spacelike" region on or outside its null cone, anchored in space for its entire existence, from the moment of emission until the moment of absorption, while physical time (the present moment, $\boldsymbol{w} = 0$) passes over it.

Keep in mind that there is no time dimension in Minkowski 4-space itself – all four dimensions are spatial, implying that the metric can be interpreted only as a measure of spatial distance. The null cone being defined by $s = 0$, there is zero distance between any two points on the null cone, presenting what appears to be a paradox:

- Every point on a null cone represents a single location in Minkowski 4-space, given by the origin.

It follows that entities extended or separated in real 3-space can occupy one point in Minkowski 4-space, given appropriate orientations or displacements in the $\boldsymbol{w}$ direction. Coming to terms with this paradox, as

we shall see, requires a radical reconception of both space and consciousness. For now, the reader is asked to contemplate the logical consequence that, while extended in three real dimensions, a lightlike wavefunction adheres to its null cone and therefore occupies one location in Minkowski 4-space, there being no distance separating any parts of it. In a nutshell, here is revealed the mystery of the holistic wavefunction: the solution lies not in the wavefunction itself, but more fundamentally in the hidden structure of space.

The wavefunction of a massive particle at rest propagates at infinite velocity, or horizontally in Figure 5, and therefore does not adhere to a null cone in Minkowski 4-space. Consequently, it is required to be oriented in the $\boldsymbol{v}$ direction to meet a null geodesic in the 5-brane ($x^2 + y^2 + z^2 + \boldsymbol{w}^2 + \boldsymbol{v}^2 = 0$). According to this model, the evidence demands that the following principle holds:

- All wavefunctions adhere to null geodesics – lightlike wavefunctions adhere to a null cone in the 4-brane, while massive particle wavefunctions (de Broglie waves) adhere to a null surface in the 5-brane. A wavefunction cannot exist separate from a null surface. It follows that, while extended in three real and two imaginary dimensions, each wavefunction technically occupies just one location in the 5-brane, defined by the origin of a null surface.

The structure of Minkowski 5-space, representing the local spatial geometry of the 5-brane, is illustrated in Figure 6. Just one real dimension (x) is shown, pointing in some direction in real space, the $\boldsymbol{w}$ and $\boldsymbol{v}$ dimensions being imaginary. The plane corresponds to Minkowski 4-space, which intersects the 5-dimensional null surface at the 4-dimensional null cone. Analogous to the null cone in Minkowski 4-space, the null surface represents a single location in Minkowski 5-space. According to the 5-dimensional metric, the null surface is projected in the $\boldsymbol{v}$ direction only from the "spacelike" regions of Minkowski 4-space – a fact providing insight into the divergent properties of matter and the wavefunction.

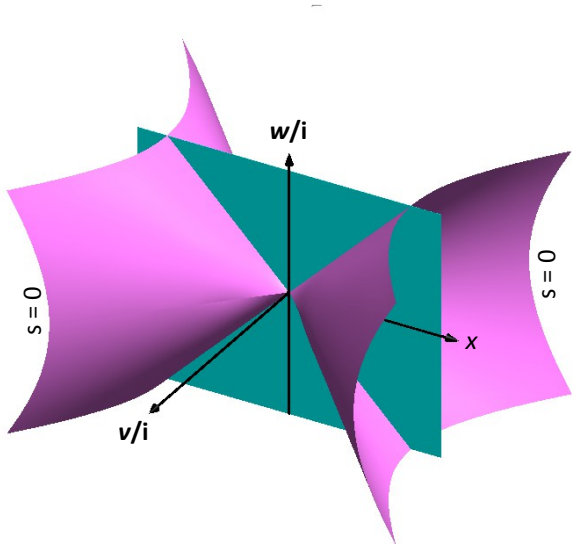

Figure 6 • Null surface in Minkowski 5-space

As a direct consequence of this model, two distinct wavefunctions, on separated null cones in Minkowski 4-space, can be projected onto one null surface in Minkowski 5-space – that is, by a suitable displacement in the $\boldsymbol{v}$ direction they become one entangled wavefunction in the 5-brane. It follows that there are two levels of quantum nonlocality, corresponding to *locality* in the 4-brane and the 5-brane. Turning this around, a more accurate picture would be to consider highly unified structures in the 5-brane being

projected into spatially separated structures in the 4-brane, then again into still greater diversity in the 3-brane. It is suggested that the holistic structures in the 5-brane can in principle provide a mechanism upholding causality within the system while avoiding the causal paradoxes typically dogging faster-than-light schemes.

1.6 The Aspect Experiment in Minkowski 4-space

To test out these ideas, let us see what we can make of the Aspect experiment in the context of Minkowski 4-space. For the sake of expediency, just the bare facts are presented here. Entangled photons, produced at the same time by the same source, are known to always share the same polarization, the light waves taking some preferred axis normal to the axis of propagation. Aspect et al. sent pairs of entangled photons in opposite directions through polarizers to detectors situated some twelve meters apart. By cleverly measuring the polarization of the photon pairs at opposite wings of the experiment, Aspect demonstrated that *Bell's inequality was violated,* establishing quantum nonlocality as an empirical fact of Nature [10].

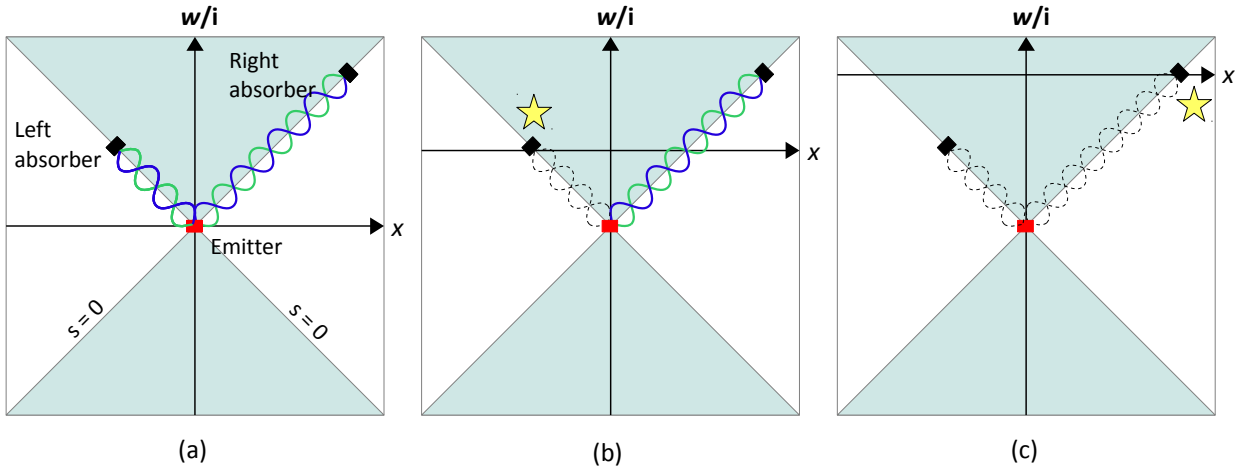

Figure 7 • The Aspect experiment in the 4-brane

Figure 7 depicts the Aspect experiment in the context of Minkowski 4-space. Three stages of the experiment are shown, advancing in time from left to right. Note that the two wings are of different lengths to emphasize that one photon will always be absorbed before the other.

a. The left diagram illustrates the moment in time when the photon pair are created. Since spatial distance on the null cone is zero, the complete offer waves and confirmation waves occupy the same location in Minkowski 4-space. This picture therefore manifests spontaneously, with both wings constituting one holistic wavefunction. Until the transaction is complete, the entire wavefunction is confined to its null cone (birth cone) in Minkowski 4-space, while physical time ($\boldsymbol{w} = 0$) passes over it.

b. The center diagram illustrates the moment when the first photon is absorbed. Since time has passed, the dimension $\boldsymbol{w}$ has moved downwards along with the wavefunction (the x axis, the present moment, has moved up). It is observed that the photon's polarization will either match the polarizer axis, passing through to be absorbed by the detector, or will be *normal* to the polarizer axis, to be absorbed by the polarizer. Of relevance here is that this process occurs across *both space and time* (from our perspective in the 3-brane), spontaneously throughout the spatio-temporally holistic wavefunction. Upon absorption, just this one wing of the wavefunction spontaneously collapses, being the process of state reduction, which is not our primary focus here [11].

c. The third diagram illustrates the moment in time when the second photon is absorbed. The same process occurs as for the first photon, with the exception that the polarization of the second photon has already been determined by the first measurement according to conservation laws. Therefore, the measured polarization of the pair will always correlate.

Another way of understanding this phenomenon is to imagine that the wavefunction is animated by the passage of time over it and can change its state only when so animated. When time (the moment, $\boldsymbol{w} = 0$) passes off a wavefunction or branch of a wavefunction, that branch collapses to some eigenstate while the superposed (uncollapsed) record remains etched in space, eternally frozen into the receding $\boldsymbol{w}$ dimension. Having passed into cosmic history, into the past, no longer animated by the moment, the first branch cannot change its state, effectively fixing the polarization of the second branch.

Let us take stock of how our understanding is measuring up to the three features of the quantum connection as presented by Tim Maudlin:

- The quantum connection is *unattenuated* because in Minkowski 4-space there is no distance between any two points on the null cone.
- The quantum connection is *discriminating* because it occurs only between wavefunctions on the same null cone (or on those which are entangled).
- The quantum connection is *instantaneous* because there is no distance between any two points on the null cone, and therefore no distance for the quantum connection to travel.

1.7 The Megidish Experiment in Minkowski 5-space

Representing the first demonstration of entanglement over timelike separations, the Megidish experiment further challenges our understanding of Quantum Spacetime while demanding that we look still more deeply into the mechanisms of nonlocality. According to the formalism, wavefunctions may be born entangled by emission from a common source, or they may become entangled by a process known as a *Bell State projection* measurement. The Megidish experiment invokes each of these processes [12].

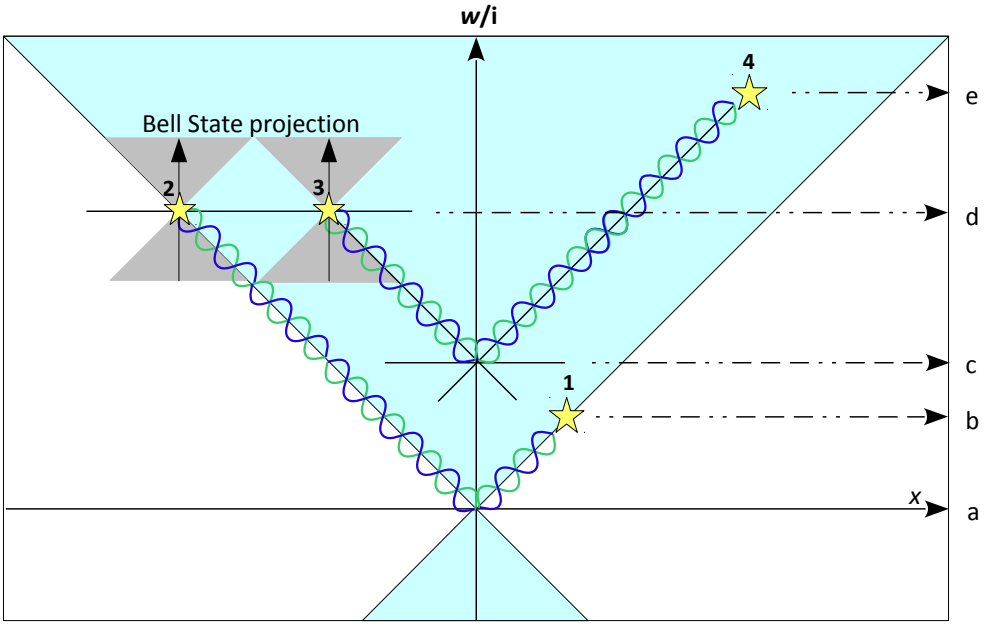

Figure 8 • The Megidish experiment in Minkowski 4-space

Figure 8 illustrates the experiment in the context of Minkowski 4-space. The general principles are analogous to the Aspect experiment and don't need to be repeated here. One might imagine the *x*-axis moving upwards, from *a* to *e*, corresponding to a physical timeline, as follows:

a. A photon pair is created in a maximally entangled state – photons 1 and 2.
b. A polarization measurement is performed on photon 1.
c. A second entangled photon pair is created, photons 3 and 4.
d. A Bell State projection measurement is performed on photons 2 and 3, entangling them.
e. Polarization measurement of photon 4 demonstrates correlation with photon 1.

Photon 1 and 4 are thus shown to be entangled, even though they never coexisted.

The experiment can be understood according to the same general principles underlying the Aspect experiment, with one glaring exception: What is a Bell State projection measurement, and how does it entangle separated particles? According to the formalism there are four possible Bell states (maximally entangled states), and the measurement essentially asks which of the four states the two particles are in, which leaves them entangled in one of the Bell states. Our explanation of the Megidish experiment consequently boils down to understanding how separated particles can become entangled through Bell State projections.

A vital clue is that the Bell State projection measurement protocol involves the *simultaneous* measurement of photons 2 and 3. The measurement process collapses each wavefunction to an eigenstate of the measurement basis, relocated in Minkowski 4-space onto null cones originating at the events. Because these null cones have the same $\boldsymbol{w}$ coordinate (the measurements are simultaneous) they are *spacelike separated* – that is, each origin is outside the other null cone. This turns out to be crucial, as the reader may demonstrate by referring to Figure 6. Only spacelike separated particles in Minkowski 4-space can be projected to each others null surface in Minkowski 5-space. We propose the following:

- Bell states are established when a wavefunction null cone is projected on the $\boldsymbol{v}$ dimension to intersect a wavefunction null surface in Minkowski 5-space.

Since the null surface represents one location in Minkowski 5-space, the two photons become entangled. One can extend Figure 8 to five dimensions by visualizing a null surface extending out of the page from one of the null cones, with the other null cone (defined by its origin) projected out of the page to intersect the null surface, thus entangling the two photon pairs.

It would appear that the projection of two wavefunctions onto some third null surface does not suffice to entangle them; if this were the case, timelike separated wavefunctions could be put into Bell states, hence violating causality. Rather, a wavefunction null cone must be projected onto the null surface of the other, requiring that they be spacelike separated. Since there is no classical causal connection possible between spacelike separated wavefunctions, causal paradoxes can be avoided.

Rather than thinking in terms of wavefunctions, it can be useful to view entanglement in terms of null cones and null surfaces in Minkowski 4-space and 5-space. In general, two wavefunctions may be considered entangled if the null cone/surface of one (defined by its origin) intersects anywhere the null cone/surface of the other.

1.8 The Emergence of Time

The arrow of time demands that the imaginary dimension $\boldsymbol{w}$ be in motion relative to the three real dimensions, with each moment of time in our 3-space corresponding to a slice of the 4-brane at some coordinate $\boldsymbol{w}$. Generalizing:

- Time is spatial motion relative to a higher (imaginary) dimension. Both time and energy originate in spatial motions of the imaginary dimensions $\boldsymbol{w}$ and $\boldsymbol{v}$ relative to each other and to the three real dimensions.

While time in our physical world is motion of our 3-brane relative to the imaginary dimension $\boldsymbol{w}$, time in the 4-brane corresponds to the motion of all four dimensions relative to the imaginary dimension $\boldsymbol{v}$. Moreover, these spatial motions require that the 5-brane itself includes a time dimension, understood as motion of the 5-brane relative to some higher dimension (call it $\boldsymbol{u}$, which is itself static and not otherwise relevant to our current discussion).

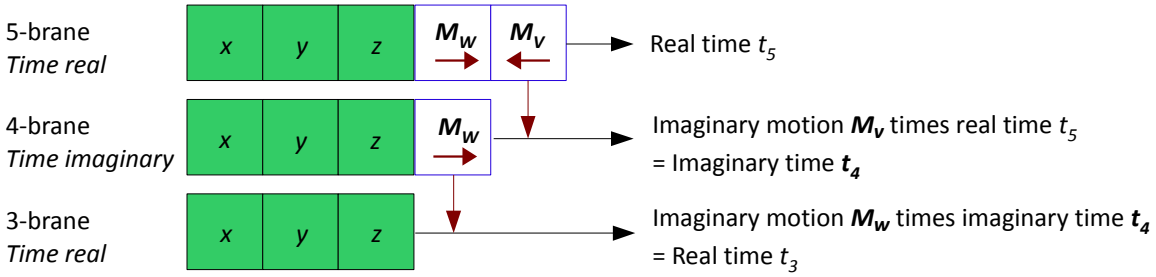

Figure 9 • Time and motion in the three branes

The spatial motions $\boldsymbol{M_W}$ and $\boldsymbol{M_V}$ are considered primary, a priori (more will be said on this later). Since motion has units of space over time, if we assume time in the 5-brane (t_5) to be real, these motions in the 5-brane are required to be imaginary. That is:

$$\boldsymbol{M_V} = \boldsymbol{v} \,/\, t_5 \qquad (5)$$

$$\boldsymbol{M_W} = \boldsymbol{w} \,/\, t_5 \qquad (6)$$

Symmetry principles governing this primordial basis for objective reality would suggest that these spatial motions are polarized, opposite yet in balance. By setting appropriate units we can therefore write

$$\boldsymbol{M_W} = -\boldsymbol{M_V} = \mathbf{i} \qquad (7)$$

If an observer in the 4-brane could see the $\boldsymbol{v}$ dimension passing by (which he can't because it exists only outside his brane), what would he see? He would see displacements in imaginary space occurring in real time, so the resulting motion (time $\boldsymbol{t_4}$) is experienced as imaginary. In terms of the primordial motion $\boldsymbol{M_V}$ we can express an interval of time $\boldsymbol{t_4}$ as

$$\boldsymbol{t_4} = \boldsymbol{M_V}\, t_5 \qquad (8)$$

Substituting equation (5) we get

$$\boldsymbol{t_4} = \boldsymbol{v} \qquad (9)$$

This implies of course that an interval of time is equivalent to a spatial distance on a higher dimension, in accordance with the current framework.

From this model it becomes clear how so called "imaginary time" (which is in fact motion of the imaginary dimension $\boldsymbol{w}$) becomes rotated on the complex plane into real time as we experience it in our world. If we in our 3-brane could observe the $\boldsymbol{w}$ dimension passing by, we would see displacements in imaginary space occurring in imaginary time – consequently we experience the motion as *real time* in our 3-brane. Expressed in terms of the primordial motion $\boldsymbol{M_W}$, an interval of time t_3 is given by

$$t_3 = \boldsymbol{M_W t_4} \tag{10}$$

There we have the rotation. Substituting equation (6) we can write

$$t_3 = \boldsymbol{w\, t_4} / t_5 \tag{11}$$

From (7) and (8) the factor $\boldsymbol{t_4}/t_5$ reduces to $-\mathbf{i}$. We can thus express an interval of time t_3 as

$$t_3 = -\mathbf{i}\boldsymbol{w} = \boldsymbol{w}/\mathbf{i} \tag{12}$$

Finally, when we substitute (12) into the spatial metric for Minkowski 4-space (3) we get

$$s^2 = x^2 + y^2 + z^2 - t_3^2 \tag{13}$$

which is of course the spacelike metric for Minkowski 3+1 spacetime, the heart of Special Relativity (see Section 1.2).

Note that an observer occupying the three real dimensions of the 4-brane will also experience the motion of the $\boldsymbol{w}$ dimension as real, analogous to time t_3 and with displacements given by (10). But there is a very big difference – the 4-brane observer is experiencing the motion within his own brane, while we are experiencing the motion of our entire 3-brane relative to the $\boldsymbol{w}$ dimension, which remains *outside* our 3-brane. This distinction turns out to have important consequences.

The alert reader might legitimately complain that we have not solved the problem of time at all, but have just pushed it further back to unexplained spatial motions. While these motions can indeed find a consistent explanation, a genuine understanding will require insights from the second part of this paper.

1.9 Kaluza and the 5-brane

Kaluza's 5-dimensional Einstein-Maxwell theory is essentially General Relativity formulated in a 4+1 spacetime (four real spatial dimensions plus one real time dimension) whilst yielding both Einstein's gravity and Maxwell's electromagnetism in *3+1 spacetime*. Accordingly, the fourth spatial dimension, while real, is treated differently from the first three dimensions. Kaluza imposed a restriction on the coordinates, known as the *cylinder condition*, effectively preventing the fourth spatial dimension from appearing directly in the laws of physics. As a result of this mathematical sleight of hand, all fields (including electromagnetic and gravitational fields) are confined to the first three spatial dimensions [13].

Let us consider the elegance of this result. We are not just talking about the prediction of phenomena, but the derivation of fundamental physical law from the geometry of higher-dimensional spacetime! Nevertheless, despite efforts to compactify the extra dimension (Kaluza-Klein theory), Kaluza's theory has yet to find a consistent context in physics – why don't we observe the fourth real dimension? Here we take a different approach: rather than trying to shoehorn Kaluza's theory into our physical world, where clearly it does not belong, we acknowledge that it must apply to some other space having properties suggested by the theory itself. Nor can it apply to the 4-brane, since in Kaluza's theory the fourth spatial dimension is real, in contrast to the imaginary fourth dimension of Minkowski 4-space. To address this question we must introduce an important principle [14]:

- Two imaginary dimensions may combine as a cross product to project an orthogonal real dimension, in accordance with standard algebraic rules.

Figure 10 illustrates the algebraic rule, the cross product of two orthogonal imaginary dimensions projecting a mutually orthogonal real dimension, the magnitude being defined by their product, which is real. Accordingly, it is proposed that the imaginary $\boldsymbol{w}$ and $\boldsymbol{v}$ dimensions together project a fourth (negative) real dimension into the 5-brane, as schematically illustrated in Figure 11. Note that the

imaginary algebra forces upon us the notion that spatial dimensions are polarized – what experts might understand as *handedness*. If we assume the dimensions $\boldsymbol{w}$ and $\boldsymbol{v}$ to be of the same spatial polarity, the algebra dictates that the fourth real dimension be *negative*. It follows that the 5-brane can be considered a 5-space, two dimensions being imaginary, or it may be considered a real 4-space, the fourth spatial dimension being in some sense negative in relation to the first three dimensions. This demarcation will prove important to what follows.

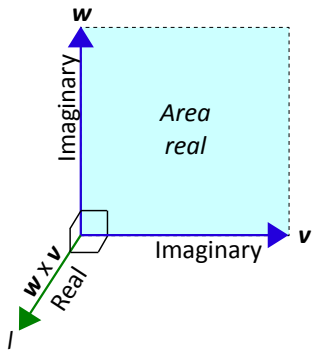

Figure 10 • Cross product of imaginary dimensions

The cylinder condition imposed on the fourth spatial dimension has drawn criticism that Kaluza's theory is arbitrary and contrived, there being no justification for preventing the fourth dimension from appearing directly in the physics of 3+1 spacetime. After all, what makes one real dimension different from any other? Here we find an answer in the negative polarity of the fourth real dimension. The model suggests that positive real fields cannot spread into negative real dimensions, nor into imaginary dimensions. They are each of a different spatial order.

Note that while the dimensions $\boldsymbol{w}$ and $\boldsymbol{v}$ are of like polarity, their *motions* are polarized (equal and opposite). Since both dimensions are in motion, the projected fourth real dimension must also be in motion. The motion of real space in real time equates to *real energy*, explaining the vast reservoir of energy constituting the electromagnetic field as derived by Kaluza. Here we find important insights into the mysterious relationship between energy and time.

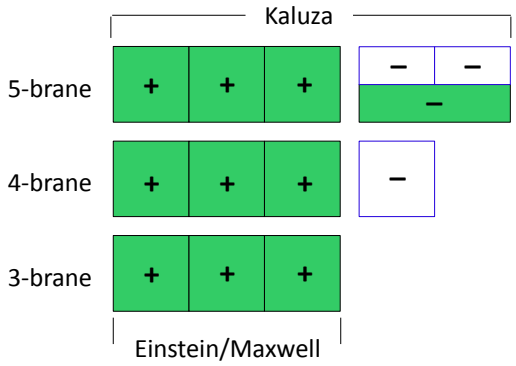

Figure 11 • A spatial context for Kaluza

1.10 Relativity and the Origin of Mass

General Relativity formulates gravity as curvature of 3+1 spacetime, which is notoriously difficult to visualize. Equivalently, the reader may find it easier to visualize curvature of the 4-brane, all four dimensions at least being spatial. While equating the gravitational field with curvature of spacetime (hence of the 4-brane), General Relativity offers no mechanism by which mass might generate that curvature. Since spatial curvature is relative to a higher dimension, we can surmise that the 4-brane is curved relative to the dimension $\boldsymbol{v}$. (Experts will note that a curved space can be defined mathematically without reference to a higher dimension; the fact remains that the curvature can always be understood in terms of a higher dimension.) Having already concluded that only massive particle wavefunctions are oriented in the $\boldsymbol{v}$ direction, we arrive at a geometrical mechanism linking mass with curvature of the 4-brane while forming deep conceptual links between quantum mechanics and General Relativity.

Figure 12 attempts to illustrate the orientations of various wavefunctions in Minkowski 5-space. The colored null cone corresponds of course to Minkowski 4-space, the general perspective being similar to Figure 6, though here the 5D null surface is omitted for clarity.

- Wavefunction A is a lightlike (photon) wavefunction adhering to the null cone in Minkowski 4-space, defined by $x^2 + y^2 + z^2 + \boldsymbol{w}^2 = 0$ ($\boldsymbol{v}$ is constant).
- Wavefunction B reflects a massive particle at rest, adhering to the base of the null surface in Minkowski 5-space, defined by $x^2 + y^2 + z^2 + \boldsymbol{v}^2 = 0$ ($\boldsymbol{w}$ is constant).
- Wavefunction C represents a massive particle in motion. While depicted here as straight, the wavefunction curves along the hyperbolic null surface defined by $x^2 + y^2 + z^2 + \boldsymbol{w}^2 + \boldsymbol{v}^2 = 0$.
- Wavefunction D (in black) is the projection of wavefunction C onto the $\boldsymbol{v}$ dimension.

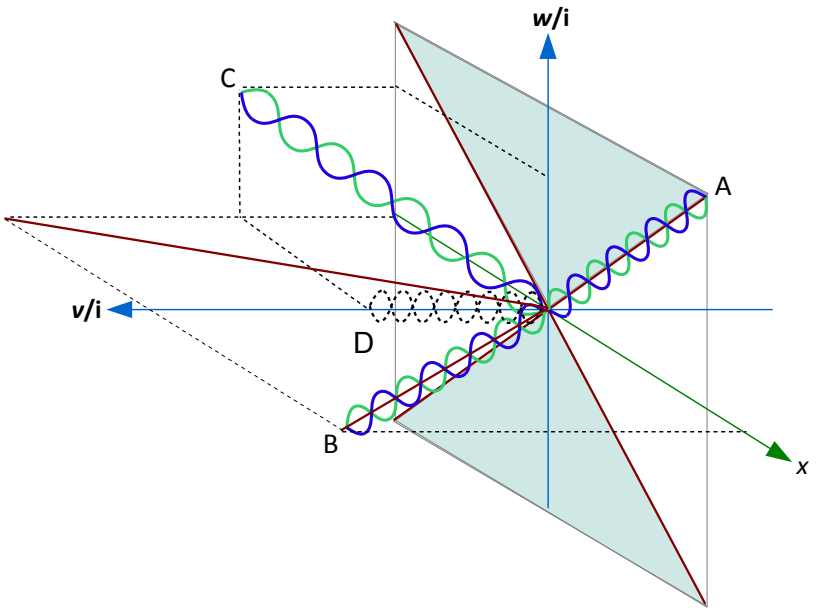

Figure 12 • The wavefunction in Minkowski 5-space

On this basis we introduce the following proposal:

- Mass is proportional to the frequency of the wavefunction relative to the $\boldsymbol{v}$ dimension.

Recall that the $\boldsymbol{v}$ and $\boldsymbol{w}$ dimensions are in motion relative to each other and to the real dimensions. The

wavefunction is a standing wave, anchored in space from emission until absorption, while time (the present moment) moves over it in the 4-brane and 5-brane. According to this model, the motion of time ($\boldsymbol{v} = 0$) relative to the wavefunction generates the phenomenon called *mass*.

Note that the projection D will have a higher frequency (shorter wavelength relative to the $\boldsymbol{v}$ dimension) than will the projection of the stationary example B, implying that the mass of a particle increases with velocity. Beginning with the metric for Minkowski 5-space (4) along with the wavefunction propagation formula (1), it is a trivial exercise to demonstrate that this model yields the correct Lorentz transformation according to Special Relativity.

1.11 The Gravitational Wavefunction

An objective wave implies an excitation of some objective field or medium. A radio wave is an excitation of the electromagnetic field; sound waves are excitations of the atmosphere; ocean waves emerge from the motion of water. What, then, is the wavefunction waving? Or, more precisely, what sort of objective field or medium could be extended in both real and imaginary dimensions?

It seems reasonable to assume that objective fields or media can be either real or imaginary; they cannot be both, just as one cannot represent imaginary quantities in a real space or real quantities in an imaginary space. Real and imaginary dimensions are of a different order. Moreover, since the wavefunction is the primary entity underpinning all matter, the wavefunction must precede matter – that is, it cannot be in any way "material".

These arguments may seem redundant, however, in the face of the fact that a lower-dimensional projection of the 5-dimensional wavefunction is required to appear also in the 4-brane and 3-brane. Since matter fields are confined to branes, only a gravitational wave can perform the magic of the wavefunction by passing freely through and between branes. That is, for the current framework to be consistent, it is required that the wavefunction be a gravitational wave. It follows that the appearance of the holistic gravitational wavefunction on each dimension of each brane establishes explicit causal structures throughout Quantum Spacetime.

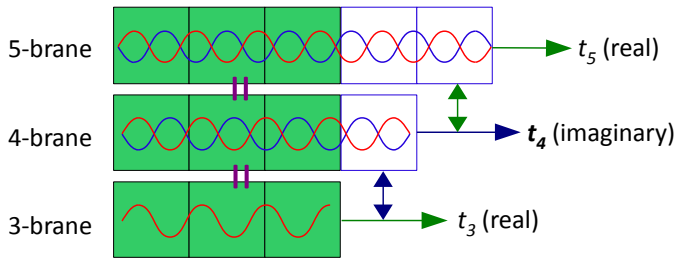

Figure 13 • The domain of the wavefunction

A consequence of weighty philosophical proportions drops out of this model, as follows:

1. According to quantum mechanics, the wavefunction, or quantum state, is the fundamental entity underlying all physical matter throughout our universe.
2. The wavefunction appears simultaneously in the 3-brane, 4-brane, and 5-brane.
3. It follows that everything existent in our physical universe is also represented (in some sense) in the 4-brane and 5-brane.

We will follow up these ideas in Part Two. Meanwhile, for most of us, this will require some thought.

1.12 The Imaginary Fallacy

Authorities have assured me that the imaginary numbers are just a mathematical convention, having no ontological status in the universe. Somewhat like negative numbers, they simply extend the number system. Mathematically, this analogy does not stand up to scrutiny. While negative numbers reflect the principle of *handedness* or *polarity* (one can move in either direction along a number line), nowhere on the real number line are imaginary numbers to be found. Rather, one has to move orthogonally *off* the real number line to find the imaginaries. Moreover, complex numbers are regarded as more fundamental than real numbers – the complex number system is *complete* (any operation on complex numbers will land you back in the complex numbers), while the reals are not. Similarly, the imaginary numbers could be considered more fundamental than the real numbers – the product or quotient of two imaginary numbers yields a real number, for instance, whereas going from the reals to the imaginaries requires taking the root of a negative. If mathematics indeed reflects Nature, and vice versa, then it would appear that imaginary quantities (hence dimensions) have a fundamental place in the constitution of the universe [15].

We visualize complex dimensions symbolically, of course, in the form of the *complex plane* (known also as the *Wessel* or *Argand* plane), representing the imaginary dimension graphically *as a real dimension* – simply because an imaginary quantity cannot be represented in our real space. Soon we forget that we are looking at a symbolic representation, transposed to two real dimensions, not the actual complex space. This is what I call the imaginary fallacy, as follows:

- No representation in real space can reveal imaginary space as it is.

Understanding this principle is crucial to grasping the essential logic of the current framework. To understand the geometry of space including imaginary dimensions we have to trust the math and not believe our eyes. When we look at a graphical representation of Minkowski 5-space, for instance, our eyes see the null surface spread out in (real) space, while the metric tells us that it occupies just one location in the 5-space. If we trust the metric, we might imagine the wavefunction at just one point in Minkowski 5-space, undulating hyperspherically in all five dimensions (two being imaginary), projecting worldlines upon null geodesics where the resultant real and imaginary components always correspond. Approaching this picture requires a good measure of abstract thought. If we could actually perceive this, what sort of beautiful thing would it be? It would appear that we are missing the perceptual or conceptual apparatus to *experience* imaginary space. Or are we? This question is further explored in Part Two.

1.13 The Many Worlds of Quantum Spacetime

It seems clear that our universe cannot be explained in the context of physical spacetime alone. The problem goes beyond the lack of a viable unifying theory; our 3+1 spacetime appears to offer insufficient degrees of freedom to explain known phenomena. No wonder, then, that many theoretical physicists are invoking other universes to explain the mysteries of our own. Many varieties of multiverse exist, including those distributed in space and in time. Then there is Everett's *Many Worlds* hypothesis, where exponentially increasing numbers of parallel universes are perpetually splintering off into being. In each case the universes are "laterally" distributed, separated, isolated islands in the vast expanse of infinity and eternity. Taking a leaf from Darwinian evolution, our universe is considered a product of cosmic natural selection, or perhaps just sheer good luck – a statistical fluke, allowed by the laws of chance, by which the free parameters of physics are laid down.

It is not hard to spot the fallacy in such a position. Broadly speaking, two types of law are found in physics: structural laws, embodying a coherent logical system or structure; and input parameters, which are numbers. In principle, one could explain all the free parameters of the standard model of particle physics, and perhaps even of string theory, and still know nothing about the mechanism behind quantum

nonlocality. One would assume the mechanism of nonlocality to be highly specialized and therefore similar (if not identical) to that found in other universes, just as the principles of Euclidean geometry should be no different in other 3+1 spacetimes. Regardless of how many universes might exist, nonlocality remains a property of our universe that demands an explanation in terms of our universe. If we can't solve nonlocality in our universe, it is difficult to imagine how we could solve it in others.

To use a crude analogy, one could try to explain unlikely occurrences on a chess board by speculating that the board is one of a vast ensemble. By the laws of probability, eventually you will find a board where these unlikely things will occur. That is the multiverse position. The other approach, of course, is to stack more chess boards above the first and play 3-dimensional chess – then these unlikely occurrences are revealed to be logical consequences of the 3-dimensional game (structural law).

In Part One I have attempted to sketch out the essential logical structure of what could be called "3D physics", extending quantum mechanics and relativity theory consistently into higher dimensions, with our 3-brane taking its place as the lowest of three interpenetrating worlds. Special Relativity and the quantum wavefunction reach up into this space to their meeting place, where they encounter mass and gravity woven into the higher-dimensional geometry of spacetime. According to this model, there are indeed "other worlds", but they are not far away in space or time. They are right here, in and around us, the three branes together forming a coherent, holistic structure and system. To understand the physics of our physical world, we must therefore understand the physics of the system. That is, to solve physics, and hence consciousness, we must include the 4-brane and 5-brane.

Part Two
Consciousness and Perception

2.1 The Experience of Phenomenal Space

Before approaching any theory, it is essential that we clearly describe or define the phenomenon we are attempting to explain. What philosophers call phenomenal consciousness or phenomenal space is simply our *experience* of consciousness, as we experience it. Empiricist philosophers including Kant and Descartes have described phenomenal consciousness as the space, time, and content of our minds (where the content includes intuitions and feelings).

Descartes famously distinguished between two types of substance: *res extensis*, so called objective reality, extended in physical space; and *res cogitans*, phenomenal consciousness, our conscious experience, being somehow *outside* of physical space. Nevertheless, our phenomenal consciousness is wrought through with the experience of space. While our perceived picture of the world is a construct of our consciousness, located in phenomenal space, to our mind's eye it appears spread out before us as an objective, three-dimensional continuum in which we ourselves appear as objects. Our picture of the world represents an angular distribution of vectors converging at a point, intuitively understood as the viewpoint of the observer. Here is the paradox of objective experience: How can our perceived picture of the world, extended in phenomenal space, appear in every way as an objective space around us, filling the world through and through, even so that we take it to *be* the world? What is the relationship between physical space and phenomenal space?

The idea of *space* is implied by the notion of *individuality* or *identity*. Even such primitive entities as numbers can be reduced to elements of a space – the number line, upon which two numbers at the same location are the same number. It can similarly be argued that mathematical thought itself is built upon spatial precepts, however abstract, as are logic and reason generally. Operations cannot take place without operands, which require a sense of individuality, which in turn requires the notion of space (individuation). The problem is that, while we may find neural correlates to consciousness in physical space, conscious experience itself is nowhere to be found there. Philosophers of mind call this the *space problem* [16].

2.2 Objective and Subjective Space

Our phenomenal experience includes a variety of spatial types or qualities. Most obviously, our picture of the world, derived from sensory input, appears in our consciousness extended in three dimensions. Similarly, when we dream, visualize a scene, or recall an event, our experience takes place in a three-dimensional phenomenal space, this time independently of the physical senses. The important point is that, whether derived from the senses or not, from the point of view of the observer this three-dimensional space is an *objective* space, meaning that it contains differentiated objects.

The terms *objective* and *subjective* are conventionally applied to our experience of the world through the senses (objective) and of phenomenal consciousness (subjective). As philosophers of every persuasion have noted, however, upon closer analysis this demarcation breaks down: our experience of the "objective" world is ultimately subjective – we experience the world in our mind. Whether we look upon a scene visually, or close our eyes and visualize the scene internally, the scene appears in the same space – phenomenal space, our conscious experience. From the point of view of the observer, then, the terms *objective* and *subjective* must be applied in a different sense:

- Objective consciousness is the experience of objective space, extended in three real dimensions, containing differentiated objects.

- Subjective consciousness is the experience of subjective space, which is unextended, containing qualities (qualia).

Consider living in a two-dimensional space. As you look around with your two-dimensional eyes, what do you see? Nothing, because there is nothing there. Since nothing has any height, volume, or substance in your two-dimensional world, it could hardly be called objective. Moreover, nobody knows how to visualize a four-dimensional space. Human consciousness seems to pick out three real dimensions as special, what we will call *objective* space, whether experienced in the world, in a dream or in a musing.

Beneath the objective modes of consciousness lies truly subjective experience, *qualia*, having no representation in objective space at all. Qualia have no shape, size or measurable attributes. What is the shape of joy? How much does sorrow weigh? Even while they permeate our conscious experience, nowhere do joy or sorrow appear as objects extended in space. Yet, even emotions are differentiated by some abstract notion of space – in the vernacular, for instance, we speak of being in a "good space" or a "bad space". So we are obliged to ask: What manner of space might include joy and sorrow?

Our conscious experience consists of our objective and subjective consciousness evolving together in time. In objective space we perceive or imagine objective (spatially extended) worlds. In our thought-space (conceptual space) we perform logical operations – we discriminate, plan, calculate, analyze, criticize, reason, theorize, verbalize. In our feeling-space (subconscious mind) we experience emotions of all flavors – loves, hates, joys, fears, compulsions, impressions from the past, none of it rational. Ultimately, each of these modes of conscious experience reduces to purely subjective experience – qualia, distributed in space and time.

Lurking beneath our conscious experience, we must not forget that conscious *experience* implies an *experiencer*, an observer. What is the nature of the observer? Where is the observer located in space and how does she access her consciousness spaces? A viable account of consciousness must address each of these questions.

2.3 Mind and Matter

In a penetrating series of essays titled *Mind and Matter*, Erwin Schrödinger addresses the inability of science to include or account for the phenomenon of consciousness, arguing that science has seen success only at the cost of removing the observer. The following excerpts summarize his core insights into the process of *objectivation* [17]:

> Without being aware of it and without being rigorously systematic about it, we exclude the Subject of Cognizance from the domain of Nature that we endeavor to understand. We step with our own person back into the part of an onlooker who does not belong to the world, which by this very procedure becomes an objective world...
>
> So we are faced with the following remarkable situation. While the stuff from which our world picture is built is yielded exclusively from the sense organs as organs of the mind, so that every man's world picture is and always remains a construct of his mind and cannot be proved to have any other existence, yet the conscious mind itself remains a stranger within that construct, it has no living space in it, you can spot it nowhere in space.

Schrödinger points out the paradoxical consequences of this split:

> The material world has only been constructed at the price of taking the self, that is, mind, out of it, removing it; mind is not part of it; obviously, therefore, it can neither act on it nor be acted on by any of its parts.

We all experience the effects of mind on matter, and of matter on mind. Every act of volition is mind influencing matter. Every physical sensation is matter influencing mind. If consciousness resides outside of 3+1 spacetime, then how can it interact with the physics of our world? The problem of causal interaction

is characteristic of dualistic theories of consciousness: if consciousness is something other than a physical phenomenon, how can "immaterial" consciousness influence physical matter (the brain), or vice versa? More explicitly, how can our conscious experience, taking place in phenomenal space, be causally related to events taking place in physical space? What is the relationship between the objective and subjective layers of reality? How can they be related at all?

2.4 Quantum Spacetime and the Esoteric Model

Having laid out the problem we approach these questions from the perspective of Quantum Spacetime. Might the branes and imaginary dimensions of Quantum Spacetime provide a context for our conscious experience? To address this question we draw the readers's attention to a fascinating convergence of previously disparate fields of inquiry. In its true form, esoteric philosophy represents a synthesis of consciousness exploration since antiquity, wherein clear universal threads emerge from the consistent experience of the adepts (scientists of the invisible) down through the ages. Structural correlations between esoteric cosmology and Quantum Spacetime suggest that we consider what insights the adepts might bring.

The idea of three interpenetrating worlds, realms, or "planes" forming the lower strata of Creation is standard in the esoteric literature. The adepts of ancient India knew these realms as *tripura* (Sanskrit: "the three worlds"), while in modern times they can be found consistently delineated in Theosophy and in the works of A.A. Bailey, among many lesser known authors. The three worlds constitute what is known as the *lower triad* of a sevenfold system, the four higher planes being considered abstract and formless. Regarded as a coherent unit, the lower triad remains divided (in a certain sense) from the higher planes while encompassing the totality of the objective universe and the human personal nature. Each of the three worlds is considered an *objective* world, materially isolated from the others while remaining accessible to consciousness. Figure 14 presents some essential properties of the three worlds according to the esoteric model, correlated with the three branes of Quantum Spacetime [18].

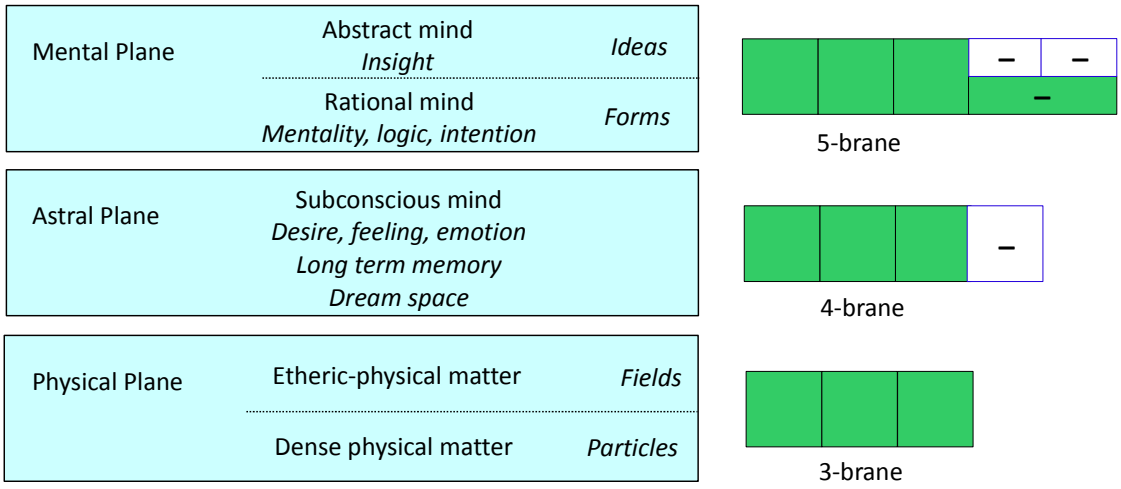

Figure 14 • Quantum Spacetime and the Three Worlds

- The physical plane corresponds to our 3-brane and is divided into two realms, which may be loosely understood as *fields* and *particles*. The etheric-physical realm is central to the process of state reduction, or collapse of the wavefunction, which is not of primary interest here [19].

- The astral (emotional) plane corresponds to the 4-brane and is home to the subconscious mind. According to the esoteric adepts, we experience the 4-brane in our dreams.
- The mental plane corresponds to the 5-brane, and like the 5-brane is divided into higher and lower regions: the abstract mind and the rational (objective) mind, characterized by Plato's *Ideas* and *Forms*. The higher (imaginary) realm is considered formless, while the lower (real) realm contains (thought) forms.

We will explore these correlations in more detail in what follows. But first we must take an important diversion, for based on these insights we are now in a position to determine a fundamental principle regarding the ontology of space and consciousness.

2.5 Relativistic Motion in Dreams

Lucid dreaming (being aware one is dreaming while within a dream) has been practiced down through the ages and has recently become a legitimate field of research within the science of psychology. A remarkable feature of the dream state, coming into clear view from reports of lucid dreamers, is its universality. Like our physical experience, dreams possess certain characteristics that don't vary between times, traditions or individuals – that is, the "physics of the dream space" does not change. One such property is the experience of *motion* in the dream space, described here by dream researcher Robert Waggoner [20].

> Almost all movement or flying in the dream begins, proceeds, and ends in the same way – with the manipulation of the mind. Any way is the right way, because there is basically one way, and that way is through manipulating awareness.
>
> In lucid dream space, you are as close to any place as you expect to be. The apparent fifty-foot flight is only a mental act away. So, too, the long-distance flight to that hill over there – you and the hill are only separated by an act of focus and intent.

The beauty of such testimony is that it can be corroborated directly from the reader's personal experience of dreams. One does not need to be a lucid dreamer – even our recollection of ordinary dreams might convince us of these basic principles. First, we can agree that dream space appears to us as an *objective* space, a three-dimensional space somewhat resembling our physical world, but exhibiting very different physics! Let us consider the physics of the 4-brane (astral plane) in the context of our dreams. Recall that the 4-brane includes an objective space of three real dimensions plus an imaginary dimension. The imaginary dimension doesn't appear directly in our objective dream environment, but manifests in the properties of *motion* relative to the real dimensions. Recall the metric for Minkowski 4-space:

$$s^2 = x^2 + y^2 + z^2 + \boldsymbol{w}^2 \qquad (3)$$

Accordingly, the distance between any two points in the 4-brane can be reduced by increasing the imaginary coordinate $\boldsymbol{w}$. Keeping this in mind, let us consider some further advice from Waggoner regarding our moving about in dreams [21].

> Emotions energize the area of focus. If you want to get somewhere in a hurry, just add some emotional energy to it. Emotion shortens the distance between the experience and the experiencer, between the dreamer and the desired.

Most dreamers will recognize the truth of these statements; in the dream space we don't move about by exerting bodily force, but by a movement of consciousness, while emotion has powerful spatial effects. The alert reader will already have connected the dots. Since emotion shortens distances in the dream space, and $\boldsymbol{w}$ reduces distances in Minkowski 4-space, we are brought to the following proposal, representing an explicit convergence of physics and consciousness:

- The imaginary dimension $\boldsymbol{w}$ in the 4-brane can be identified with the emotional consciousness, the subjective or subconscious mind.

Through the recollection of dreams (or better yet, lucid dreaming), the reader might gather personal insights into the mysterious dual nature of the imaginary dimensions:

- Imaginary dimensions are dimensions of space, woven into the geometry of space.
- Imaginary dimensions are dimensions (qualities) of consciousness.

2.6 The Identity of Space and Consciousness

The identity of space and consciousness is a central tenet of the esoteric tradition. Consider the following declarations, each from an esoteric author of the modern era:

> Space is Consciousness. [22]
>
> Space is included in the idea of consciousness, and its utilization of matter. [23]
>
> There is but one indivisible and absolute Omniscience and Intelligence in the Universe, and this thrills throughout every atom and infinitesimal point of the whole finite Kosmos which hath no bounds, and which people call Space, considered independently of anything contained in it. [24]
>
> Consciousness is the Continuum-Fabric of Space, which is all-pervading, everywhere. [25]

Beginning with our model of Quantum Spacetime, in conjunction with our direct experience of the dream space, we have arrived at a startling convergence of space and consciousness in the 4-brane. Could this be true also of the 3-brane? Does not our "objective" experience of the world all take place within our phenomenal consciousness? Therefore, would it be true to say that our picture of the world, laid out before our mind's eye in three real dimensions, and our objective consciousness itself, are identical?

The following identities are fundamental:
- Space = consciousness.
- Real space = objective consciousness (extended, containing objects).
- Imaginary space = subjective consciousness (unextended, qualia).

The same principles apply to the idea of *motion* or *change*:
- Real motion = the motion of matter or form in objective space.
- Imaginary motion = the movement of consciousness in subjective space.

Space can thus be understood as dual in nature, exhibiting both a *consciousness* expression and a *geometrical* expression. When gazing upon the world, we experience an objective space in our consciousness and we infer that the world *is* this objective space. While the space we experience is actually phenomenal space, within the mind, we seem to share a consistent experience of this objective space, suggesting that it exists independently of any one of us. That is, our conscious experience in phenomenal space itself appears to be taking place *within* a space, what we call the *world*. What are we to make of this?

The adepts address this question directly with what they call *the law of analogy* or the *law of correspondences*, succinctly expressed by the Hebrew Kabbalists as "As above, so below". Similarly, in the Greek mystery schools it was taught that "As is the macrocosm, so is the microcosm". That is, a human being is a "little universe" and is constituted like the universe. Our consciousness includes the same dimensions as does the universe, and only thus can we experience the universe and participate in its life. The logic is pristine, of course, so we infer that the three dimensions of the world are the same dimensions constituting our objective consciousness, *as they manifest in each of the three worlds (branes)*.

2.7 The Physics of Perception

At school we learned that we see not the world itself, but photons reflected or emitted by the world, which impinge upon the retina of the eye and "somehow" produce a picture in the mind. As Kant observed, the world itself remains inaccessible to us. Similarly, each of the physical senses can be reduced to an action of the electromagnetic force. When you caress the cheek of your beloved, in fact no contact occurs – what you experience (according to physics) is electrons in your hand repelling the electrons of your beloved, again by the exchange of photons.

In Quantum Spacetime the picture is very different. Let us examine visual perception from our understanding of the wavefunction and the transactional interpretation of quantum mechanics. Consider one photon, previously emitted from some object, being absorbed by the retina. According to TI, since the photon is absorbed by a photoreceptor cell in the retina, it is the retina that returns a confirmation wave back in space and time, completing the "handshake" with the emitter. This implies, of course, that visual perception is a bidirectional process. While we generally consider the eye a passive, receptive instrument, the theory of *extramission* (emanations coming from the eyes) has been espoused by many philosophers, including Euclid, Ptolemy, and Plato. Here again is the ever-insightful Erwin Schrödinger [26].

> Dear reader, or better still, dear lady reader, recall the bright, joyful eyes with which your child beams upon you when you bring him a new toy, and then let the physicist tell you than in reality nothing emerges from these eyes; in reality their only objectively detectable function is continually to be hit by and to receive light quanta. In reality! A strange reality! Something seems to be missing in it.

Aristotle, characteristically contradicting his teacher, espoused the theory of *intromission* whereby vision results solely from light entering the eyes, the view held by canonical physics today. While many of us sense truth in the theory of extramission, science can't begin to account for it, so we turn a "blind eye". But let us look more closely at a photon being absorbed at the retina in Quantum Spacetime:

- From the time the photon was emitted until the moment it is absorbed, there was no photon, but a wavefunction spanning space and time in the 4-brane and 5-brane.
- The wavefunction adheres to a null cone defined by the emitter in Minkowski 4-space, technically placing the emitter and absorber at one location in Minkowski 4-space (s=0).
- While oriented in four dimensions ($x, y, z, \boldsymbol{w}$), the photon wavefunction is a standing wave extended over (and presumably oscillating on) all five dimensions: $x, y, z, \boldsymbol{w}, \boldsymbol{v}$.
- The wavefunction is composed of both retarded and advanced waves, propagating forward and backwards in time respectively.

Taken together, these properties reveal the wavefunction to be a nonlocal (both spacelike and timelike), bidirectional, multidimensional information conduit. The wavefunction contains and propagates information on real (objective) levels, such as its frequency and extension in 3+1 spacetime, as well as on imaginary (subjective) levels, the dimensions $\boldsymbol{w}$ and $\boldsymbol{v}$.

The process of visual perception is illustrated schematically in Figure 15. For present purposes the physical visual mechanism and associated neurobiology are considered a coherent (entangled) quantum system having the capacity to process information from the absorbed wavefunction and present it to our corresponding consciousness spaces, and vice versa. Note that the neurobiological wavefunction is depicted as horizontal, implying action at a distance, which is commensurate with the role of slow moving massive particles (ions) in the transmission of nerve signals. While our physical brain is extended in three real dimensions, keep in mind that the brain is fundamentally wavefunctions, all of which are extended in five dimensions, allowing the brain to interact with corresponding structures in the 4-brane and 5-brane.

When the photon is absorbed by the retina, the photon wavefunction becomes entangled with our visual mechanism, allowing information to flow in either direction between the emitter and the subjective dimensions of the perceiver. Thus, this entire picture is extant in the corresponding branes at the moment the photon is absorbed.

Figure 15 depicts the causal structure connecting the world (on the left) with our subjective experience of the world (on the right). While we might presume that the real dimensions of the wavefunction provide us with a picture of the real dimensions of our world, this is not the case, since the real dimensions of the wavefunction cannot be directly apprehended by our subjective (imaginary) dimensions of consciousness. Rather, a more subtle process is involved, encoded into the spatial metrics of the 4-brane and 5-brane. Here we approach the boundary between the objective and subjective layers of reality, the interface between mind and matter.

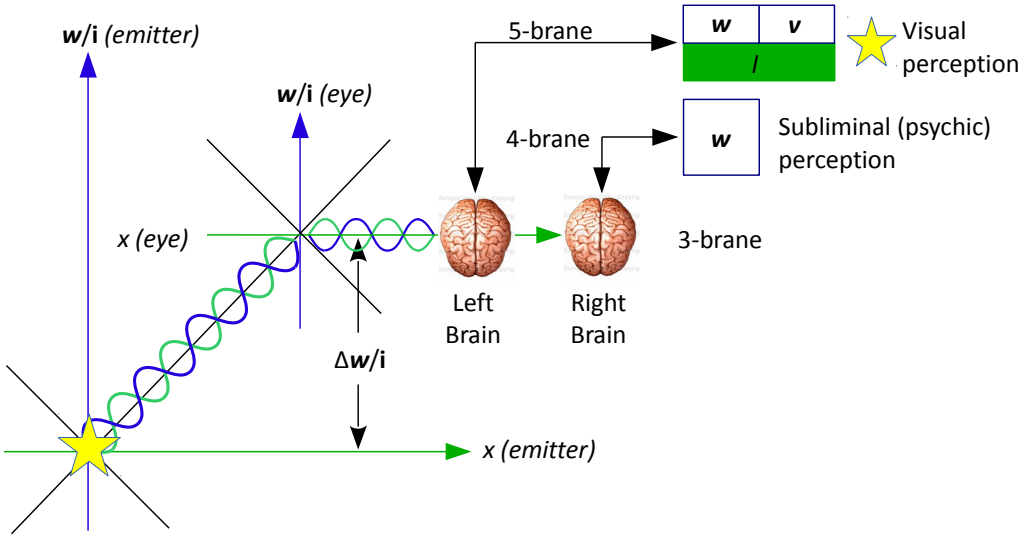

Figure 15 • The process of visual perception

When the transaction is completed, the wavefunction collapses to some eigenstate on a null cone defined by the absorption event's coordinates in spacetime (in the eye), which we know is on the null cone of the emission event, defined by

$$x^2 + y^2 + z^2 + \boldsymbol{w}^2 = 0 \qquad (14)$$

If we take $\boldsymbol{w} = \boldsymbol{i}w$, it follows that

$$w^2 = x^2 + y^2 + z^2 \qquad (15)$$

implying that w gives the *real distance* between the two events. In the 3-brane, this is equivalent to saying that if we know the time taken by a photon to reach us at light speed we can deduce the distance traveled, being the distance to the source. In the 4-brane, however, the interval $\Delta\boldsymbol{w}$ between the two events provides a *subjective* measure of the *real* distance between them, representing an explicit relationship between objective and subjective principles.

It is proposed that the interval $\Delta\boldsymbol{w}$ is indeed registered by one's personal $\boldsymbol{w}$ dimension – the subconscious mind – as a subliminal sense of distance or depth in the visual field. The reader is invited to examine her own conscious experience for evidence of this phenomenon. With one eye or two, our visual depth of field appears to extend beyond mere optics, being more a *sense* or *feeling* than a visual perception. This becomes most apparent when we are startled by some unexpected event – a sudden happening in our

midst provokes a very different emotional response than would the same event at a distance.

We now extend our reasoning to multiple photoreceptor cells and the dimension $\boldsymbol{v}$. Just four null cones are depicted in Figure 16, each representing the location of a receptor cell in Minkowski 5-space, distributed along the real dimension x at the same moment ($\boldsymbol{w}$ and $\boldsymbol{v}$ are constant) . To make sense of this requires that we introduce the following important ideas:

- The observer may be identified with the origin of a null surface in Minkowski 5-space.
- The observer can perceive only what is located on his null surface.
- Hence there is no distance between the observer and his perception.

In practical terms this means that, at any given moment, everything you perceive is at one location in Minkowski 5-space, with you, the observer, at the center. It follows that, in order to enter the perception of the observer, the photoreceptor null cones must be displaced (Bell State projected) on the $\boldsymbol{v}$ dimension to intersect the observer's null surface in the 5-brane. Thus, in Minkowski 5-space, technically there is no distance between the observer and his perceived experience. As illustrated in Figure 16, the displacement $\Delta\boldsymbol{v}$ is directly related to the spacing between receptor cells Δx, representing once again an explicit relation between a subjective principle $\boldsymbol{v}$ and an objective principle x, this time equating to *real spatial extension*.

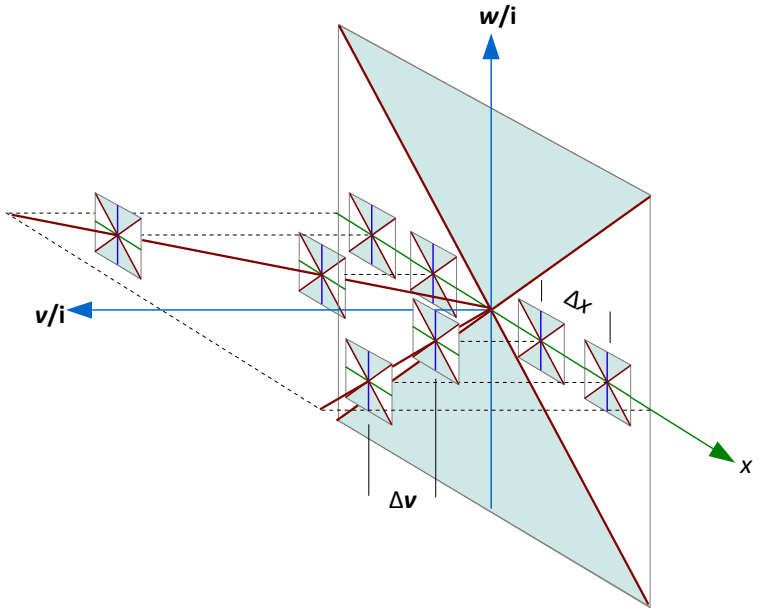

Figure 16 • Subjective perception of spatial extension in 5-space

If we assume that the biological mechanism, which provides the three-dimensional design for the eye, also provides corresponding neurobiology extending this principle to an angular distribution over two linear dimensions, it follows that for every location in real space, relative to an observer's null surface (viewpoint), there exists a corresponding $\boldsymbol{w}$ and $\boldsymbol{v}$ coordinate which together encode the perceived geometry of objective space as a *subjective experience*.

Figure 17 is meant to provide an intuitive sense for the relationship between the observer and the real and imaginary dimensions. Relative to the observer's null surface, the resultant real contribution to the metric and the resultant imaginary contribution always correspond, implying that our visual perception is a balance, in some sense, of objective and subjective elements. Expressed differently, our subjective experience reflects the objective, and vice versa.

A consequence of profound philosophical relevance emerges from this model. Since the observer's null surface is defined by five coordinates in Minkowski 5-space, it follows that the observer himself must be located in Minkowski 5-space – in the 5-brane, the mental plane. As we shall see, the esoteric adepts say exactly that.

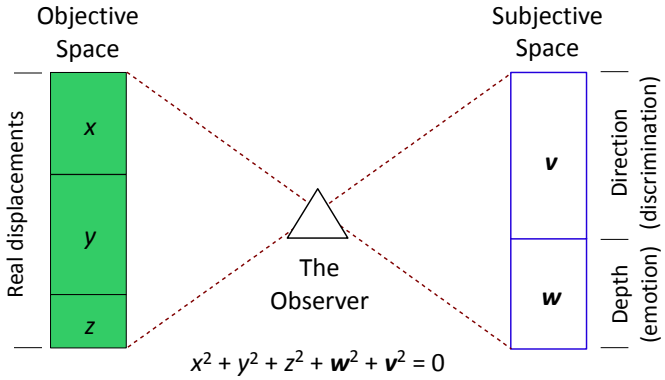

Figure 17 • The observer and his null surface

The process of perception, explicitly relating objective and subjective space, is reversible according to a phenomenon known esoterically as "the form-producing faculty of the mind".

- Just as the perception of real (objective) space can be encoded subjectively in imaginary dimensions, subjective consciousness can project corresponding three-dimensional forms into objective space.

Mental activity projects forms into objective space in the 5-brane, known as *thoughtforms,* while emotional activity projects forms into objective space in the 4-brane, as we know from our dreams. All this is made possible by the mediation of the 5-dimensional wavefunction, being ripples in the fabric of spacetime, adhering to the observer's null surface and set in motion by the movement of consciousness, which is itself a spatial motion, hence *energetic*. Hence the esoteric axiom that *energy follows thought*.

2.8 Physics in the 4-brane

Evidence for the form-producing faculty of the mind is no further away than our dreams. Our ability to conjure up anything in our dream space, or to change our environment through an action of the mind, is a universal characteristic of dreams. To understand how this works we begin by revisiting spacetime in the 4-brane, as depicted in Figure 18. Clearly, the 4-brane is a very different world from our 3-brane. While the 4-brane includes an objective space of three real dimensions, coincident with our 3-brane, it includes also a fourth (imaginary) dimension which is in *motion* relative to the real dimensions, along with a time dimension which is also imaginary.

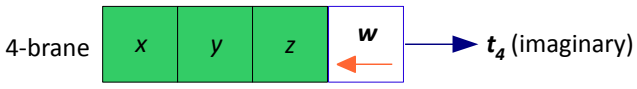

Figure 18 • Spacetime in the 4-brane

In section 1.8 we noted that because the imaginary dimension $\boldsymbol{w}$ is moving in imaginary time, the resulting motion is *real*. Since motion reduces to energy, this implies that the motion of the dimension $\boldsymbol{w}$

relative to the real dimensions of the 4-brane manifests as *real energy* distributed universally throughout every point of real space in the 4-brane, filling objective space with energetic potential. The esoteric adepts call this the *astral light* due to its translucent, shimmering, "starry" appearance when in its primordial state – before being modified by minds. It has been described as an ethereal, energetic, "plastic" material that can form itself into any shape or appearance imaginable. It is of note that there are no shadows in our dreams because in the 4-brane the Sun doesn't shine – rather, everything is illuminated from within by the radiance of the astral light.

By the process described in the previous section, the mind projects thoughtforms into objective space in the 5-brane. These same wavefunctions appear also in the 4-brane, where directed mental and emotional attention will energize them sufficiently to excite the astral light into action, manifesting objective three-dimensional forms representing the mental thoughtform *embellished by the subconscious mind* (***w*** in the 4-brane). From an experiential perspective, Robert Waggoner describes the process as follows [27]:

> The dream-space largely mirrors your ideas, expectations, and beliefs about it. By changing your expectations and beliefs, you change the dream space. Realizing mental space responds best to mental manipulations, you let go of physical manipulations and use the wings of your mind…
>
> The mind, emotions, and mental action precede the effect.

A key characteristic of the dream state is its instability. Consider that the dimension ***w*** is in motion not only as it manifests in the 4-brane itself, but as it manifests in your subconscious mind (your personal 4-brane), explaining the endless activity of feelings and emotions along with the incessant change and instability of the dream environment.

Following from our previous conclusion that distances in dreams can be shortened by invoking the dimension ***w*** through directed emotion, in accordance with the spatial metric for Minkowski 4-space, we can now make a more general observation concerning motion in dreams. Since time in the 4-brane is imaginary, motion through objective (real) space in the 4-brane equates to real displacements over imaginary time – that is, motion is imaginary, meaning *subjective*. It is no wonder, then, that one moves about in the 4-brane by a movement of the mind.

Because time in the 4-brane is imaginary (subjective), your experience of motion (change), and hence your sense of time, depends on your state of mind. Many of us have experienced being frozen to the spot in dreams, corresponding to the mind being frozen (as when terrified), analogous to being frozen in time. On the other hand, dream researchers have reported evidence that the sense of time in the lucid state is similar to that in the waking state, which is consistent with the thesis that lucid dreaming entails the objective (rational) mind in the 5-brane (which lives in *real* time) in some sense taking control of the subjective (subconscious) mind in the 4-brane, and therefore taking control of the dream [28].

Lucid dreamers report the experience of having a *dream body* in the dream space, somewhat resembling the physical body. The adepts call this the *astral body*, being a localized embodiment of the subconscious mind, generally coincident with the physical body in real 3-space. Like all things astral, the astral body is protean; when our consciousness is focused in the 4-brane, as in dreams, the astral body adopts an appearance corresponding to our view of ourselves – explaining why we generally appear younger or better looking in the 4-brane. Our perception of objective forms in the 4-brane mirrors the corresponding process in the 3-brane, as described above, implying that the observer has access to sensory apparatus in the astral body as he does in the physical.

2.9 Physics in the 5-brane

The esoteric adepts regard the 5-brane (the mental plane) as the most complex and intricate of all the planes of being, which is appropriate for a world that stands between Creation and the Uncreated, between form and formlessness, between time and eternity. Being the first of the three worlds constituting Quantum Spacetime, the 5-brane represents the cornerstone of objective reality.

First of all, note that the 5-brane includes an objective space, coincident with those in the 3-brane and 4-brane, and thus must be considered an objective world. As explained in the context of Kaluza's Einstein-Maxwell theory, the 5-brane may be considered a 5-space, two dimensions being imaginary, or as a real 4-space, the fourth real dimension being in some sense *negative*. Thus, the 5-brane is effectively two worlds, bordering the divide between the subjective and objective realms of reality. The subjective realm is characterized by the native (subjective) consciousness implicit in the $\boldsymbol{w}$ and $\boldsymbol{v}$ dimensions, while consciousness in the objective realm is characterized by the fourth real dimension l, constituting the real cross product of $\boldsymbol{w}$ and $\boldsymbol{v}$.

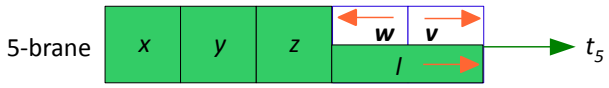

Figure 19 • Spacetime in the 5-brane

The 5-brane is animated by the spatial motions of the imaginary dimensions $\boldsymbol{w}$ and $\boldsymbol{v}$ relative to each other and to the three real dimensions. It follows that the composite real dimension l is also in motion – *real* motion (real space over real time), which equates to the primordial appearance of *real energy*. Similarly, Kaluza's theory derives the *electromagnetic field* extending throughout the first three dimensions of a 4-space. Analogous to the astral light in the 4-brane, this real energy manifests spontaneously throughout objective space in the 5-brane, constituting a subtle universal field supporting the creation of objective thoughtforms in response to excitation by the wavefunction.

The fourth real dimension l is known as the *objective* mind, the rational, logical mind dominating our normal waking state. Being real, it is characterized by a sense of extension, as when performing logical operations in consciousness, for instance. (Note that two bits are required to do logic, just as two subjective principles constitute our logical mind.) By the form-producing faculty of the mind, the objective mind endlessly projects thoughtforms into objective space in the 5-brane – a process known as *thinking*. It can indeed be said that "thoughts are things" in the 5-brane, and you see them with your mind's eye (being the senses of the *mental body*, which localizes the objective mind in the 5-brane).

While the imaginary dimensions $\boldsymbol{w}$ and $\boldsymbol{v}$ present themselves as a cross product to manifest the lower mental world and objective mind, they also present themselves in their native imaginary states, yielding a second, entirely different kind of world in the 5-brane. Since the imaginary dimensions are moving in real time, the resulting motions are imaginary, meaning *subjective* – the movement of consciousness. The resulting imaginary (subjective) energy cannot support the manifestation of real forms in objective space. Consequently, objective forms do not manifest in this realm; rather, what could be considered *subjective* forms are projected into *objective* space – ghostly, immaterial, pristine, transcendental, pure potentiality, unhindered by matter – the contemplation of which is known as *abstract* mind or *causal* mind. The causal mind is considered the *root* of the mind. Buddhists know it as the *substrate* consciousness.

The higher, imaginary levels of the 5-brane are known in modern esoteric cosmology as the *causal world* due to the fact that everything in our objective universe can trace its origin back to some primordial cause issuing from these realms. This is Plato's transcendental realm of Ideas and Archetypes, as described here

by philosopher Richard Tarnas [29]

> Platonic Ideas are objective. They do not depend on human thought, but exist entirely in their own right. They are perfect patterns embedded in the very nature of things. The Platonic Idea is, as it were, not merely a human idea but the universe's idea, an ideal entity that can express itself externally in concrete tangible form or internally as a concept in the human mind. It is a primordial image or formal essence that can manifest in various ways and on various levels, and is the foundation of reality itself…
>
> The human mind and the universe are ordered according to the same archetypal structures or essences, because of which, and only because of which, true understanding of things is possible for the human intelligence.

Mathematical readers may have noted that the spatial structure of the causal world, Plato's transcendental realm of Ideas and Archetypes, provides a context for fractal geometry invoking complex functions, such as the Mandelbrot and Julia sets.

2.10 Esoteric Model of the 5-brane

Having reduced physics to a series of three interpenetrating branes brought to life by the motion of two imaginary dimensions, we are left to consider the origin of these mysterious "motions" powering all manifestation in the three worlds of Quantum Spacetime. An answer comes from esoteric philosophy and is offered as a consistent hypothesis. Having ventured beyond time and form, we find ourselves hopelessly outside the domain of empirical guidance, so we are left to the powers of reason along with some insights from those who have explored the higher branes – in their consciousness – down through the ages.

First, as noted above, the motions of the $\boldsymbol{w}$ and $\boldsymbol{v}$ dimensions in the 5-brane are imaginary (imaginary space over real time), meaning *subjective*. They therefore represent the movement of consciousness, implying some sort of subjective conscious process – but *what* consciousness, or whose consciousness?

According to the esoteric tradition, cosmogenesis rests upon a principle of great logical elegance and simplicity, sometimes called *the law of generation*, as follows:

- The interaction of two polarized principles manifests a third principle of a different order.

Such processes can be observed throughout Nature. The chemical atom, for instance, could be considered a different order of matter to the isolated nucleus and electrons that compose it. An electric cell or battery provides another simple example; the potential is not realized until the electrodes are allowed to interact, closing the circuit while manifesting currents and associated fields, processes of a different order. Such a threefold system is known esoterically as a *triad* and is considered fundamental to all manifestation.

According to the esoteric tradition, all things reduce to one thing – bare subjectivity, understood here as imaginary space – known in the Greek mystery schools as the *Logos*. This one thing presents itself as two polarized principles which in turn yield a third, completing what is known as the *primary triad* consisting of three *Logoi* or conscious creative principles. The *Third Logos* is described as *active intelligence* and is considered the fountainhead of the lower triad, the three worlds.

The esoteric doctrine of the three Logoi – the primary triad – is reflected of course in the theological *Trinity*, though in a heavily veiled and anthropomorphized form, missing the cosmological perspective and logical precision of the esoteric model. Our purpose here is not to unveil the mysteries of the primary triad itself, but to extend our understanding of the Third Logos, as reported by the adepts, in the context of Quantum Spacetime.

Being a subjective principle, the Third Logos itself manifests in the 5-brane as a triad, in accordance with the law of generation. The transcendental consciousness of the Third Logos presents itself as two polarized principles, manifesting as the imaginary $\boldsymbol{w}$ and $\boldsymbol{v}$ dimensions of the 5-brane, which in turn yield a third

principle of a different order – the real dimension *l* (interpreted mathematically as a cross product). To emphasize the universality of this esoteric teaching, we include here both Eastern and Western terms for these three principles underpinning objective reality as understood by the adepts [30]:

- *Kundalini* (Sanskrit), *Magnes* (Greek): "cosmic magnetism" (negative, feminine).
- *Fohat* (Tibetan), *Dynamis* (Greek): "cosmic electricity" (positive, masculine).
- *Prana* (Sanskrit), *Energia* (Greek): "universal life-force" (neutral).

Kundalini (Magnes) and Fohat (Dynamis) are regarded as subjective, *within* Nature everywhere. Prana (Energia) is different; it is an objective energy which interacts directly with physical matter, including the physical body. At a more fundamental level, Prana *becomes* physical matter. Note that while Kundalini (dimension $\boldsymbol{w}$) and Fohat (dimension $\boldsymbol{v}$) are polarized relative to each other (their motions are polarized), both dimensions (and hence the Third Logos herself) are considered spatially negative (feminine).

The esoteric model divides the mental plane into seven *subplanes*, dimly recalled by the Christian tradition as "the seven heavens" together constituting "the realm of the Holy Spirit". The observer is known in Sanskrit as *Ahamkara*, "I am the doer", or *Jivatman*, "living self", or in modern esoterics as the *Reincarnating Ego*, and is placed at the lowest *abstract* level of the 5-brane, in accordance with our model of Quantum Spacetime. This is where "you" – the observer, the watcher, the thinker – exist in cosmic space, suspended by your null surface between subjective and objective layers of reality, between consciousness and matter. According to the adepts, the observer is localized in the causal world by the *causal body*, which is not a body at all (there being no objective forms in this realm), but a highly structured Idea or Archetype which persists life after life [31].

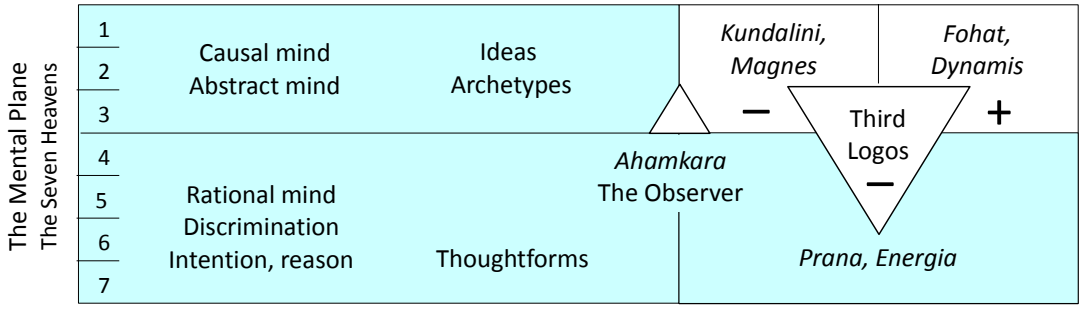

Figure 20 • Esoteric model of the 5-brane

The Sanskrit word *prana* refers to the energetic (spatial) aspect of the fourth real dimension *l*, while the consciousness aspect is known to the adepts as *manas*, meaning "mind, mentality, discrimination, intention". The Tibetan adept Djwal Khul defines *manas* as follows [32]:

> Manas is electricity.
>
> Manas is that which produces cohesion.
>
> Manas is the intelligent will or ordered purpose of an existence.

Note that, according to Djwal Khul, *manas* is both an objective energy (electricity) and a principle of consciousness (intelligent will). According to Kaluza, the geometry of spacetime in the 5-brane manifests electromagnetism obeying Maxwell's laws, while physicists will recognize "that which produces cohesion" as the electromagnetic force (cohering atoms and molecules, hence matter). So the scientist and the esotericist could agree that electromagnetism manifests in the 5-brane [33]. What the scientist never imagined, however, is that Kaluza's electricity is the electricity of the mind, cohering thoughtforms in the

5-brane, as made clear by Djwal Khul (the emphasis is his) [34]:

> The fire of Mind is fundamentally *electricity,* shown in its higher workings, and not considered so much as force in matter.

The experience of the Third Logos as it manifests on the abstract levels of the 5-brane has been described with remarkable consistency down through history by the genuine mystics and adepts of our race. It has been variously described as a breath or a wind (*Pneuma*: Greek, *Ruach*: Hebrew, *Spiritus*: Latin), or as fire or brilliance (*Shekinah*: Hebrew, *Shakti*: Sanskrit), all invoking the image of subjective consciousness moving in abstract space. The adepts of the Roman mystery schools simply called it *Motion,* bringing a fresh perspective to the opening lines of *Genesis*:

> And the earth was without form, and void; and darkness was upon the face of the deep. And the Spirit of God moved upon the face of the waters.

Motion is a universal characteristic of the Third Logos, as described in the esoteric literature and in scripture across traditions, while *water* is an esoteric symbol for *subjectivity*. Hence do esoteric philosophy and the current framework converge upon a seminal conclusion:

- Our objective universe issues from a subjective principle (consciousness), manifesting as space, in motion (time).

Plato writes in his dialogue *Timaeus*:

> Time and the heaven came into being at the same instant… Wherefore he resolved to have a moving image of eternity, and when he set in order the heaven, he made this image eternal but moving according to number, while eternity itself rests in unity; and this image we call time.

Correctly understood, esoteric cosmology is imbued with a logical elegance and sophistication far beyond that of contemporary physical cosmology, or anything concocted by modern minds. Until a more consistent explanation for the origin of time is at hand – or for the origin of the objective universe – I think it fair to let this hypothesis stand.

2.11 The Astonishing Mind

The observer, the thinker, the experiencer, the Self that stays with us throughout our earthly life, never descends from its lofty perch on the abstract levels of the 5-brane, from where it projects its null surface – its conscious perception – into the three worlds. From this observer-centric perspective, let us revisit our perception of the physical world, the 3-brane, in the context of Quantum Spacetime. How exactly do we erect our picture of the world in our mind?

An important insight comes from psychophysics experiments showing that our consciousness embellishes our perceptions, that "in vision, we do not perceive the world as it actually is, but as the brain computes it most probably to be" [35]. While generally it is assumed that the *brain* is responsible for "computing" our perceptions, such effects can be more readily accounted for by considering the nature of our subjective layers of consciousness, which possess memory (the records remain etched in space in the higher branes) and therefore expectations (habits).

Figure 15 (section 2.7) depicts the perception of a single photon, representing a snapshot of the process in the corresponding branes at the moment the photon is absorbed by the retina. Notice that a bidirectional causal connection is established between the emitter (which could be far away in physical space and time, such as a star) and the subjective dimensions (consciousness) of the observer. Among the many possible types or qualities of information transferred, the photon's location in the visual field is presented to the

subjective consciousness as displacements on the ***w*** (depth) and ***v*** (direction) dimensions, as previously described, while the photon's frequency (which is imaginary as well as real) invokes the subjective quality (quale) of *color* in the imaginary dimensions. (It follows that color is a universal property of subjective space, independent of any one of us, which implies that our experience of color is universal, assuming our biological equipment is in order).

Now we extend this picture to millions of photons, corresponding to the millions of photoreceptor cells in the retina. The spatial location (relative to the observer's viewpoint) and the frequency (color) of each photon are encoded in the ***w*** and ***v*** dimensions of the observer's null surface, which are themselves imaginary and therefore unable to directly represent extension in objective space. Our *direct* perception, therefore, is purely abstract and subjective (qualia), and certainly not a "picture of the world" extended in three real dimensions. For that picture to come about, one final vital step must be taken: the qualia must be distributed in real space and time.

The perception encoded in the imaginary dimensions of the observer's null surface is presented (as a cross product) to the observer's objective mind, the real dimension *l*, which applies its powers of memory and discrimination to *recognize* and *understand* what is perceived, to place the perception in context. This conceptual activity of the objective mind (*manas*) manifests as a *thought*, a mental conception, which includes both spatial and noumenal components. Nature takes over from here – the thought seed is projected into objective space by the form-producing faculty of the mind, generating a thoughtform *spatially coincident* with the physical scene in three real dimensions, but *entirely in the 5-brane*, where it is perceived by the senses of the mental body – that is, with the mind's eye. This mental perception we call "the world".

Several important ideas are included in the above:

- When we look upon the world, what we perceive is not in fact the world, but our particular conception of the world, derived from subjective impressions of past and present stimuli.
- When we look upon the world, what we in fact perceive is our own thought construct projected on our null surface into the objective dimensions of the 5-brane, *coincident* with the world and *superimposed* upon of the world. That is, our perception of the world is in fact a perception of *our own mental creation in the 5-brane*, appearing before us in response to sensory stimuli in the 3-brane. Behold the astonishing power of your mind.
- Notice, this does not mean that only our perception of the world exists. According to the adept Patanjali, *the world exists for the sake of the Self*. The world *exists*, but our *perception* of the world is our own, and ours alone.

Let us conclude this section with some words from the wise, representing those who have come to this understanding through the direct observation of consciousness, without the aid of physics:

> The observer is the observed. – *J. Krishnamurti*
>
> Mind is a mirror; it reflects whatever is placed before it. – *Esoteric axiom*
>
> The Self has pure vision, but he looks upon the world through the window of the mind. – *Patanjali*
>
> Samsara, the transmigration of life, takes place in one's mind. Let one therefore keep the mind pure, for what a man thinks, he becomes. – *Maitri Upanishad*

Figure 21 attempts to provide a symbiotic picture of human consciousness in Quantum Spacetime. By its appearance in all three branes, the holistic gravitational wavefunction establishes a coherent causal structure throughout the three worlds.

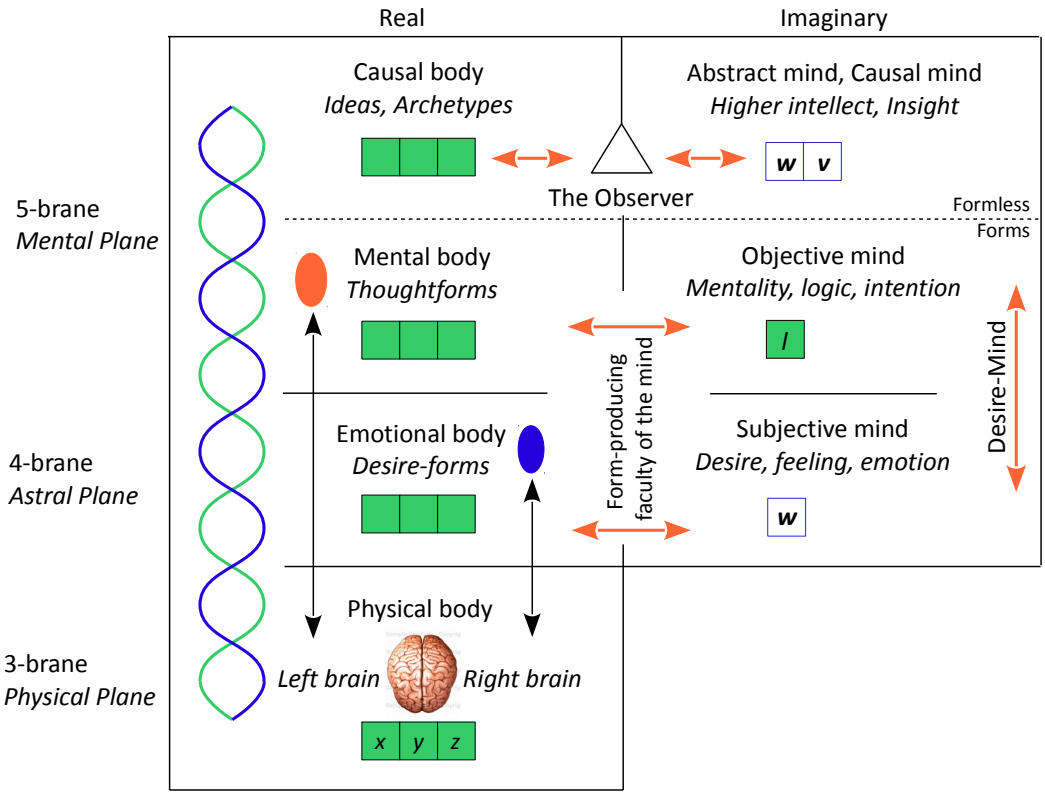

Figure 21 • Consciousness in Quantum Spacetime

Conclusion

During a public lecture introducing his book *Time Reborn*, the thoughtful physicist Lee Smolin made a pertinent comment. Upon mentioning the parallels between his own work and that of theologian colleagues, he expressed his concern about "unconscious leakage" between the two disciplines [36]:

> I worry about unconscious leakage from theological issues to scientific issues, brought about because the people who invented this way of doing physics were quite religious – people like Isaac Newton, he was deeply religious. So if there is a parallel to religious dilemmas and theological dilemmas, it's not an accident.

I wish to argue that science, and in particular physics, have indeed been hindered by deeply entrenched philosophical and theological predispositions, tracing their roots back to the early centuries of Christianity and before. Philosophical thought since antiquity can be demarcated into two lines, as demonstrated by the contrasting philosophies of Aristotle and his teacher Plato. While Plato upheld the transcendental realm of Ideas and Form as "real", our material world being but a shadow of reality, Aristotle would have none of it – for Aristotle, physical matter was real, the "inner worlds" being but ghostly reflections. Their philosophical divide boils down to this: Does matter come from consciousness or does consciousness come from matter? Which comes first, consciousness or matter?

The early centuries of Christianity were broadly characterized by two theological schools reflecting these contrasting positions – the *orthodox*, who took the Aristotelian line, and the *gnostics*, whom scholars have described as "Platonists gone wild". The gnostics were the esoteric Christians, those who understood the

Christian Revelation in terms of *consciousness* while claiming direct knowledge of the Platonic realms. Going beyond even the idealism of Plato, the gnostics considered physical reality just one of many realms, and a "corrupt" shadow of the real. The orthodox took the opposing view: *this* is God's Kingdom, and Christ will return *physically* with his angels to redeem the faithful.

The relationship between the orthodox and the gnostics was not a happy one. History records a fierce theological battle between these two schools of thought, culminating in the destruction of the gnostics and their writings. My point is this: these events still live on in our racial memory, and following two millennia dominated by orthodoxy we tend to unwittingly adopt the orthodox view, while considering the gnostic (Platonic) position "absurd" or "irrational", or just downright "spooky". We might even join the orthodox theologian Tertullian in ridiculing such ideas (circa 200 CE), as reported here by the scholar of Christian history Elaine Pagels [37]:

> Tertullian ridiculed the gnostics for creating elaborate cosmologies, with multi-storied heavens like apartment houses, "with room piled upon room, and assigned to each god by just as many stairways as there are heresies: The universe has been turned into rooms for rent!"

Now, I fully expect that upon first hearing of "inner worlds", objective worlds sharing our physical space, many physicists would respond very much like Tertullian. So we are faced with a remarkable situation in science: while it is legitimate to speculate about an infinite number of universes arranged "laterally" in space or time (the multiverse), or an infinite number of universes splintering off into unknown abstract dimensions (many worlds), it is not considered legitimate to speculate about a few other worlds arranged "vertically" in space, worlds in which we actually participate, worlds that are causally related to our physical dimension by precise laws, worlds that render physics in this world comprehensible.

Giordano Bruno was burned at the stake by the Roman Inquisition in the year 1600, just four centuries ago, damned by his heresy that the stars are distant suns. It was already enough to endure the Copernican Revolution and learn that not Earth, but the Sun, was the center of the universe. Bruno was going too far – even our Sun had lost its privileged place. But Bruno proved to be correct, of course, and we have learned to accept that even our solar system constitutes a minuscule cell in an incomprehensibly vast universe. Moreover, many physicists and cosmologists have expanded their thinking to include an infinity of (apparently physical) universes. Even the extra dimensions of string theory are considered physical (in some obscure sense), so at least "physical reality" retains its privileged place in the universe.

Now we are being asked to take the next step in opening our minds to deeper levels of abstraction, where even our physical dimension loses its privileged position in the Cosmos. The central message of this paper is that, in order to solve physics, we must learn to think more like gnostics, to think in terms of inner space and not just outer space, to think vertically as well as horizontally. If we wish to understand our universe, it is reasonable that we should look inside the universe rather than outside of it. To discover the mysteries of space we must look inside space. Only when our philosophical predispositions give way to direct experience and pure reason can the mysteries of physics and consciousness be unfolded.

Notes

1. Zee (2007), p. 279.
2. Bell's theorem itself is not discussed here; readers will find a clear description in Maudlin (2011)
3. Maudlin (2011), p. 21-23.
4. Megidish et al. (2011).
5. Cramer (1986), p. 653.
6. Penrose (2004), p. 509.
7. Pusey et al. (2011, 2012).
8. Cramer (1986).
9. de Matos (2010).'
10. For clear descriptions of Bell's theorem and the Aspect experiment, see Maudlin (2011).
11. State reduction is treated in the context of this framework in Carter (2012).
12. Megidish et al. (2011).
13. Overduin et al. (1998).
14. Readers asking if our positive real dimensions might also be projected from imaginary dimensions will find speculations along these lines in Carter (2012)
15. Nahin (1998), p.66; Penrose (2004), pp. 1034–35.
16. McGinn (1995), Smythies (2003).
17. Schrödinger (1958).
18. Bailey (1925), Vallyon (2007).
19. See Carter (2012).
20. Waggoner (2009), p. 31.
21. Waggoner (2009), p. 36.
22. Da Free John (general teaching).
23. Bailey (1925), p. 281.
24. Blavatsky (1888), p. 23.
25. Vallyon (2007), p. 1370.
26. Schrödinger (1958). p.123.
27. Waggoner (2009), p. 31-32.
28. LaBerge (1990).
29. Tarnas (1993), p. 10.
30. Vallyon (2007), pp. 134-137.
31. Vallyon (2007, Bailey (1925).
32. Bailey (1925), p. 308.
33. Readers asking how electromagnetism manifests in the 3-brane are directed to Carter (2012).
34. Bailey (1925), p. 310.
35. Smythies (2003).
36. Smolin (2012).
37. Pagels (1989), p. xxix.

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