THE PRIBRAM–BOHM HYPOTHESIS
A TOPOLOGY OF CONSCIOUSNESS

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ABSTRACT: A holoflux theory of consciousness as modulated energy is hypothesized and shown to support both local and non-local properties. This thesis emerges from an integral evaluation of evidence drawn from: (1) the holonomic mind/brain theories of Karl Pribram, (2) the ontological interpretation of quantum theory by David Bohm. Applying an integral methodology to superimpose and correlate seemingly disparate concepts from among these sources and others, a composite theory emerges, a "holoflux" theory of consciousness, after the term favored by Karl Pribram to describe David Bohm's "holomovement" between an explicate order and an implicate order. This Pribram–Bohm composite holoflux theory is shown to be congruent with established principles of physics, mathematics, and electrical engineering.

Extending the panpsychist paradigm that consciousness is inherent in the structure of the universe, the thesis describes a dynamic energy process bridging the explicate space–time domain with a transcendent flux domain located at the spatial center, everywhere. This center is hypothesized to be synonymous with Karl Pribram's "flux domain" and David Bohm's "implicate order."

Extending the theories of Pribram and Bohm, the holoflux hypothesis maps reality as a nondual energy, cycling mathematically, lens-like, in a process of transformation manifesting in three modes: (1) electromagnetic energy in space–time, (2) holoflux energy in a transcendent order, and (3) vibrating isospheres at the boundary gap separating the implicate from the explicate orders.

KEYWORDS: Consciousness; Cosmology; Physics; Communication; Information; Experience; Hard problem; Holosphere; Holoflux; Holonomic; Holoplenum; Electrical engineering; Pribram-Bohm

INTRODUCTION

Perhaps the most widely debated issue in consciousness studies and the mind can be found encapsulated in the phrase "the hard problem of consciousness," first articulated in an essay by David Chalmers (1995) in which he discusses consciousness as *experience*. A product of our digital age, Chalmers understandably conflates experience with information processing, but questionably suggests that it is information processing itself that gives rise to experience:

> The really hard problem of consciousness is the problem of experience. When we think and perceive, there is a whir of information processing, but there is also a subjective aspect. . . . Why should physical processing give rise to a rich inner life at all? It seems objectively unreasonable that it should, and yet it does. If any problem qualifies as the problem of consciousness, it is this one. (p. 5)

But Chalmers (1995) here places the cart before the horse if he really means to say that consciousness *arises from* information processing. That would make consciousness an epiphenomenon, something that arises *from* what he calls the "whir of information processing." What he seems to be addressing is the hard problem of mind, rather than the hard problem of consciousness. More recently, however, Chalmers (2010) has suggested that *consciousness* may not be derivative after all, that it may be seen as "fundamental" in the same sense as *space* and *time* are regarded by physicists as "fundamental."

In a similar way, other assumptions restrict the range of contemporary approaches to consciousness research, and may accordingly be similarly misleading, for example (a) the assumption that the word consciousness is limited specifically to "human consciousness," and (b) the assumption that consciousness is a phenomenon exclusive to the space-time continuum.

Understandably, such assumptions have arisen due to a widespread fascination with hardware, and in particular the hardware of the brain, fostered by an approach to science which limits itself to *measurements* which can be observed in space–time. Thus epiphenomenalism has become mainstream, reinforced by such statements as the following, found in Gerald Edelman and Giulio Tononi's (2000) conclusion to their book, *A Universe of Consciousness*, where they observe:

> Consciousness while special, arose as a result of evolutionary innovations in the morphology of the brain and body. The mind arises from the body and its development; it is embodied and therefore part of nature. . . . We have argued throughout this book that consciousness arises from certain arrangements in the material order of the brain. (pp. 215–219)

If the word *consciousness* in Edelman and Tononi's (2000) quote could be replaced with "the mind," or "human mental cognition," the observation might be less problematic, but to state that *consciousness arises from the brain* is questionable. This essay takes the opposite view, that the human mind, mental cognition, the operational processes of *the brain arises from consciousness*, that they are *not* the same thing.

Nor is consciousness necessarily limited to space, or restricted in time, nor exclusive to human primates. Descriptions of mystical and religious experiences handed down by every culture provide strong evidence that there exist modes of consciousness that *can* be explored beyond normal waking thought; all traditions offer prayer, contemplation, and the ingestion of psychotropic plant substances as doorways to experience *beyond* space and time (Bellah, 2011). Additional evidence is close at hand—the universal nightly human experience of dream states—which seem *not* necessarily to be a product of normally experienced time, space, or mental cognition.

It is evident that serious efforts have indeed been made to explore consciousness in order to discover the outlines of an architecture of consciousness through first-hand experience. In support of such efforts, and to counter the epiphenomenalist turn in consciousness studies, this paper offers a model of consciousness that builds upon the ideas of the theoretical physicist David Bohm (1980) and the neuroscientist Karl Pribram (2013).

BACKGROUND: THE PRIBRAM-BOHM HOLOFLUX TOPOLOGY

The topological model which is developed here in support of a metaverse cosmology is presented in Figure 1, the "Pribram-Bohm Holoflux Model," where the basic theory is diagrammed as consciousness transforming between nonlocal and local regions of experience and information (Joye, in press).

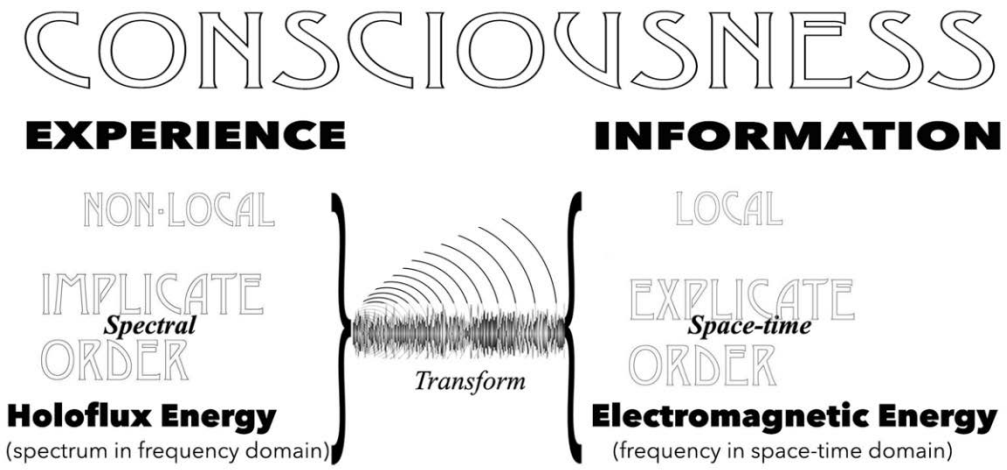

Figure 1 The Pribram-Bohm holoflux model

The Pribram-Bohm hypothesis regards consciousness as a cybernetic energy process, a holoflux transforming between two orders of being in "an undivided flowing movement without borders" (Bohm, 1980, p. 172). To the left in the diagram of Figure 1, consciousness is expressed as a spectrum of holoflux energy in Bohm's implicate order. This holoflux energy resonates with electromagnetic energy of the same frequencies to the right in the diagram, in the space-time region, or explicate order (Bohm, 1980, p. 159).

Viewed from left to right, the diagram reveals a spectrum of holoflux energy in the transcendental implicate order transforming and translated into "things" and "events" in local space-time, and conversely, viewing the diagram from right to left, information generated by "things" and "events" interacting throughout space-time is seen to be transforming (folding) back into the implicate order. The process is described as a continuous cybernetic cycle, perhaps occurring at a regular clock-rate.

SUPERPOSITION OF CONSCIOUSNESS: CYBERNETICS AND THE FOURIER TRANSFORM

Common experience would suggest that all consciousness is consciousness *of* something, such as the experience of a sound, of an image, of a sensation, of an emotion, of an interior verbal thought. These experiences seem to be superpositioned, they often occur at what seem to be the same perceptual moment. Yet each simultaneous stream of experience remains distinct, somehow integrated with all the others. But what is it that is "looking at" this stream of experiences? It is as if there is some meta-consciousness that is more than the sum of each of these individual

"experience streams," per se, but rather some other, more comprehensive level, some panoramic perspective that is able to embrace and comprehend them all, and which has the amazing ability to *fine tune* its own selected focus upon *one or more* of these streams of awareness while simultaneously dampening and filtering out the many others.

In signal analysis this stream phenomenon is explained by the *superposition principle*, formalized in 1822 by the French mathematician Jean-Baptiste Fourier, who developed the mathematics of what is now called "Fourier analysis" during his search for a mathematical relationship between space-time and frequency (Feynman, Leighton, & Sands, 1964, p. 286). Because signals are more readily superpositioned and manipulated (filtered, amplified, etc.) within the *frequency domain* than in the *time domain*, the Fourier transform equations have become primary and ubiquitous mathematical tools in physics and engineering for analyzing, synthesizing, and transmitting signals between two domains:

1. a "space-time domain (t_d)," and
2. a "frequency domain (f_d)."

Much of electrical engineering circuit design is done within the frequency domain, and only subsequently implemented with time domain components, as described here by Francis F. Kuo, chief electrical engineer at the original Bell Telephone Laboratory from which emerged the transistor, the laser, and radio astronomy, information theory, and the Unix operating system. In his textbook on *Network Analysis and Synthesis*, Kuo (1962) states:

> We see that in the **time domain** (i.e., where the independent variable is **t**) the voltage–current relationships are given in terms of differential equations. On the other hand, in the complex **frequency domain**, the voltage–current relationships for the elements are expressed in **algebraic** equations. Algebraic equations are, in most cases, more easily solved than differential equations. Herein lies the **raison d'être** for describing signals and networks in the frequency domain as well as in the time domain. (p. 13)

Norbert Wiener (1948) coined the term "cybernetics" from the Greek κυβερνήτης—"steersman, governor, pilot, or rudder" (p. 11)—during his own work at the same Bell Telephone Laboratory as Kuo, and made use of Fourier's transform to model and analyze brain waves in the frequency domain, where he discovered clear evidence of "self-organization of electroencephalograms or brain waves" (p. 181). Using Fourier analysis, an approach which later became of great interest to Bohm, Wiener (1948) was able to detect uniquely narrow frequency ranges, centered within different spatial locations on the cortex, that repeatedly exhibited auto-correlation (p. 191). Regions on the cortex were identified where specific ranges of frequencies were

found to coalesce toward intermediate frequencies, seeming both to attract and to strengthen one another, exhibiting *resonance* or "self tuning" to amplify and consolidate signals into narrowly specific ranges in the frequency domain f_d (p. 198). His research led Wiener to conjecture that the *infrared band* of electromagnetic flux may be the loci of "self–organizing systems":

> We thus see that a nonlinear interaction causing the attraction of frequency can generate a self–organizing system, as it does in the case of the brain waves we have discussed. . . . This possibility of self-organization is by no means limited to the very low frequency of these two phenomena. Consider self–organizing systems at the frequency level, say, of infrared light. (p. 202)

Three years after Wiener's (1948) publication of *Cybernetics*, David Bohm (1951) stressed the importance of Fourier's equations on the first page of his well-received 646-page textbook, *Quantum Theory*, where he encouraged a familiarity with Fourier analysis for an ontological understanding of quantum phenomena:

> It seems impossible to develop quantum concepts extensively without Fourier analysis. It is, therefore, presupposed that the reader is moderately familiar with Fourier analysis. (p. 1)

For purposes of this paper, the basic understanding of Fourier analysis is simply that *frequency vibrations* manifest within two distinct dimensions or domains: a space-time domain and a frequency domain. Until recently, physicists have focused exclusively within space-time to conduct their research, considering only space and time as having any "reality" and considering the ontological reality of the frequency domain, if at all, in the same vague category as the domain of mathematics itself (i.e., in some unspecified transcendent dimension). Whether there might somehow exist a "real" dimension *outside of* space-time, or *beyond* space-time has generally been beyond the purview of the physical sciences. Yet the experienced reality of a region of consciousness beyond space-time is supported by the vast body of first–hand reports generated by religious, mystical, or near-death experiences. In an approach to such experiences, William James (1902/2004), the "father of American psychology," writes:

> The further limits of our being plunge, it seems to me, into an altogether other dimension of existence from the sensible and merely "understandable" world. Name it the mystical region, or the supernatural region, whichever you choose. So far as our ideal impulses originate in this region (and most of them do originate in it, for we find them possessing us in a way for which we cannot articulately account), we belong to it in a more intimate sense than that in which we belong to the visible world, for we belong in the most intimate sense wherever our ideals belong. (p. 318)

Fourier's transform equations (Figure 2) between the two domains of time (t_d) and frequency (f_d) are more than simply mathematical equations, written down as functions in the abstract symbolic language of calculus (Stein & Shakarchi, 2003, pp. 134–36).

$$f(t) = \int_{-\infty}^{+\infty} X(F) e^{j2\pi Ft} dF \qquad f(F) = \int_{-\infty}^{+\infty} x(t) e^{-j2\pi Ft} dt$$

Fourier integral transform of a continuous frequency function into the time domain (t_d).

Fourier integral transform of a continuous time function into the frequency domain (F_d).

Figure 2 The Fourier transform and inverse transform (Kuo, 1962)

These two expressions indicate that any function in the timespace domain, $f(t)$, can be transformed into and expressed equivalently as an infinite series of frequency spectra functions $X(F)$ in the frequency domain. The transformation is also possible in the opposite direction, such that any arbitrary function in the frequency domain, $f(F)$ can be transformed into and expressed by an infinite series of time functions, $X(t)$. The two domains mirror one another.

Beyond purely mathematical considerations, the equations can be taken as models of an actual cosmic process (i.e., much as Newton's Law model the phenomenon of gravity) and they can be understood as mirroring the cosmos in mathematical terms. The model of consciousness presented in this paper proposes that there is indeed an ontological reality to this other region, and that this region is synonymous with Bohm's "implicate order," Pribram's "holonomic frequency domain."

KARL PRIBRAM'S HOLONOMIC MIND/BRAIN THEORY: THE FREQUENCY DOMAIN

The neurosurgeon Karl Pribram (1971) was one of the first to articulate the idea that the Fourier transform might play a role in brain/mind neurophysics. Pribram (1990) spent decades performing laboratory research to gather experimental data in an effort to solve two problems: (a) to identify the location and mechanism of memory storage (the *engram*), and (b) to discover the cognitive mechanism behind visual perception. Pribram (2013) arrived at the conclusion that the data revealed evidence of Fourier signal transformations of visual signals from the rods and cones of the eyes, and that these Fourier patterns could be detected in spatial Fourier patterns over wide areas of

the brain, as fields within the fine-fibered dendritic networks of the cerebral cortex (p. 82).

In the mid-1960s, Pribram was inspired by reports of the first optical holograms, and the empirical evidence that holograms could store, retrieve, and process vast quantities of information using resonant photons in high frequency beams. Ten years later, Pribram (1971) published *Languages of the Brain*, in which he detailed his new theory, the holonomic brain/mind theory, based upon evidence of the Fourier transform playing a key role in the mind/brain process. The theory he put forth proposed that the cognitive sensory processes of memory, sight, hearing, and consciousness in general, may all operate holographically, in a transformational process of information-coded-energies flowing back and forth between space–time and the frequency domain via a Fourier transform mechanism.

Pribram's (1971) theory was radical and controversial, challenging two prominent paradigms of modern neurophysical research: (a) the belief that consciousness is an epiphenomenon produced by electrical sparks among synaptic–clefts throughout the wiring of neurons the brain, and (b) the belief that somewhere in the physical brain, *engrams* of memory are stored, and will be eventually found. Pribram (1971) relates a story of a conversation he had at the time, while climbing with colleagues on a hike in Colorado just prior to attending a neuroscience conference in Boulder:

> We had climbed high into the Rocky Mountains. Coming to rest on a desolate crag, a long meditative silence was suddenly broken by a query from Campbell: "Karl, do you really believe it's a Fourier?" I hesitated, and then replied, "No Fergus, that would be too easy, don't you agree?" Campbell sat silently awhile, then said, "You are right, it's probably not that easy. So what are you going to say tomorrow down there?" I replied, this time without hesitation, "That the transform is a Fourier, of course." Campbell smiled and chortled, "Good for you! So am I." (p. xvii)

Pribram's (1971) hypothesis was strengthened through a growing appreciation of holography as frequency-superpositioned electromagnetic wave interference (p. 142). Pribram called his approach "the holonomic brain theory," and postulated the importance of the *frequency domain* in future research:

> Essentially, the theory reads that the brain at one stage of processing performs its analyses in the frequency domain . . . a solid body of evidence has accumulated that the auditory, somatosensory, motor, and visual systems of the brain do in fact process, at one or several stages, input from the senses in the frequency domain. (Pribram, 1982, p. 29)

In Pribram's (1990) theory, a pure frequency domain links with the neuronal tissue of the brain through modulating fields of flux within the fine-fibered dendritic webs of

the cerebral cortex regions. His paradigm was reinforced at a San Francisco conference during a lecture given by the physicist Geoffrey F. Chew, the head of the UC Berkeley physics department and a former student of Enrico Fermi. Chew presented a conceptual diagram of the Fourier transform process (Figure 3), which perfectly encapsulated what Pribram had by then become familiar with, the Fourier transform (Pribram, 2004a, p. 230). As shown in the figure, the spectral (frequency) domain, located at the left of the diagram, is directly linked to the space-time domain, depicted at the right, bridged by the Fourier transform, operating at the sub-atomic levels predicted by Planck's constant.

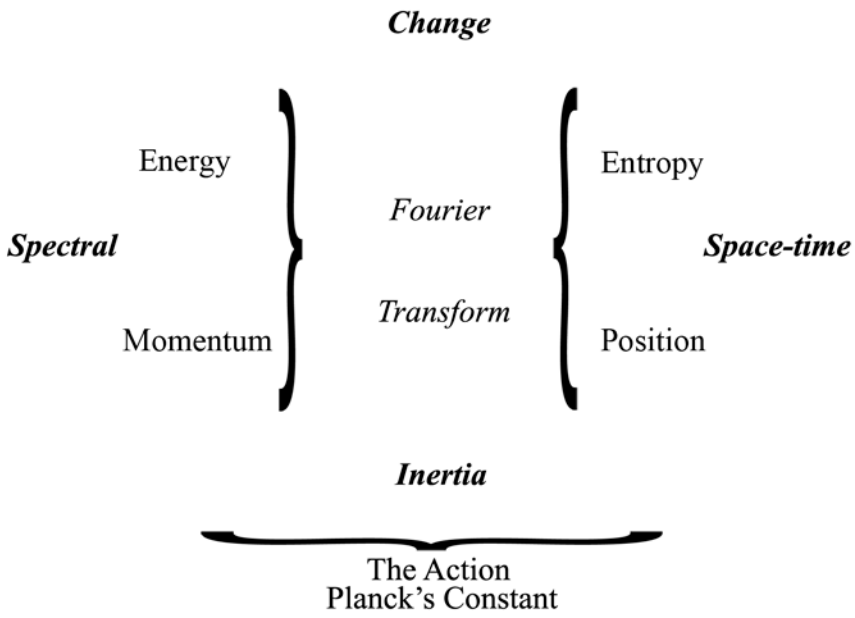

Figure 3 The Dirac Fourier transform diagram. Source: Adapted from Pribram (2004b)

Pribram (2013) asked Chew where he had obtained the diagram, and was told that he had been given the diagram by his colleague at Berkeley, the physicist Henry Stapp, who himself said he had been given it directly from the British theoretical physicist Paul Dirac (1902–1984), one of the original founders of quantum mechanics. Whatever the origin of the figure, Pribram chose to include the diagram in several future papers. In "Consciousness Reassessed," Pribram's (2004b) caption to the figure reads, "The Fourier Transform as the Mediator between Spectral and Spacetime" (p. 8).

In the diagram, the spectral domain is shown at the left and space-time to the right, with the Fourier transform between them. The diagram became foundational to Pribram's understanding. It presents a two–way Fourier transform, operational at the boundary between the two domains, located at an event horizon termed in the diagram, "The Action: Planck's Constant." It is this process of turbulent transformation at the event–horizon that David Bohm and Basil Hiley (1993) termed holomovement or holoflux (p. 382).

THE LIMITS OF SPACE: FROM THE EDGE OF THE UNIVERSE TO PLANCK'S CONSTANT

The Pribram–Bohm hypothesis holds that the dimensions of space are finite and that space exhibits a limited domain in a quantifiable range. This is consistent with the physics of string theory or M–theory, according to Bernard Carr (2007), Professor of Mathematics and Astronomy at the University of London:

> The Universe may have more than the three dimensions of space that we actually observe, with the extra dimensions being compactified on the Planck scale (the distance of 10^{-35} meters, at which quantum gravity effects become important), so that we do not notice them. . . . In particular, physics has revealed a unity about the Universe which makes it clear that everything is connected in a way which would have seemed inconceivable a few decades ago. The discovery of dark dimensions through particle physics shakes our view of the nature of reality just as profoundly as the discovery of dark energy through cosmology. (p. 10)

Carr (2007) uses the alchemical image of the ouroboros (Figure 4) to illustrate his GUT theory (Grand Unified Theory) in comparing major scale-dependent structural levels of the physical world: "The significance of the head meeting the tail is that the entire Universe was once compressed to a point of infinite density (or, more strictly, the Planck density)" (p. 13). This archetypal figure implies the interconnectedness of the entire universal process in time and space, presenting a cybernetic feedback loop operational at every scale. Mystics have intuited this ouroboric process symbolized in the images of a snake swallowing its own tail (the image has been found as early as the 14^{th} century BCE in the tomb of Tutankhamun) and it is frequently used to symbolize cybernetic feedback in control and communication theory (Wiener, 1964). While Wiener coined the term *cybernetics*, communication engineers would more commonly see this as metaphor for the "feedback loop," used everywhere in electronic circuit design.

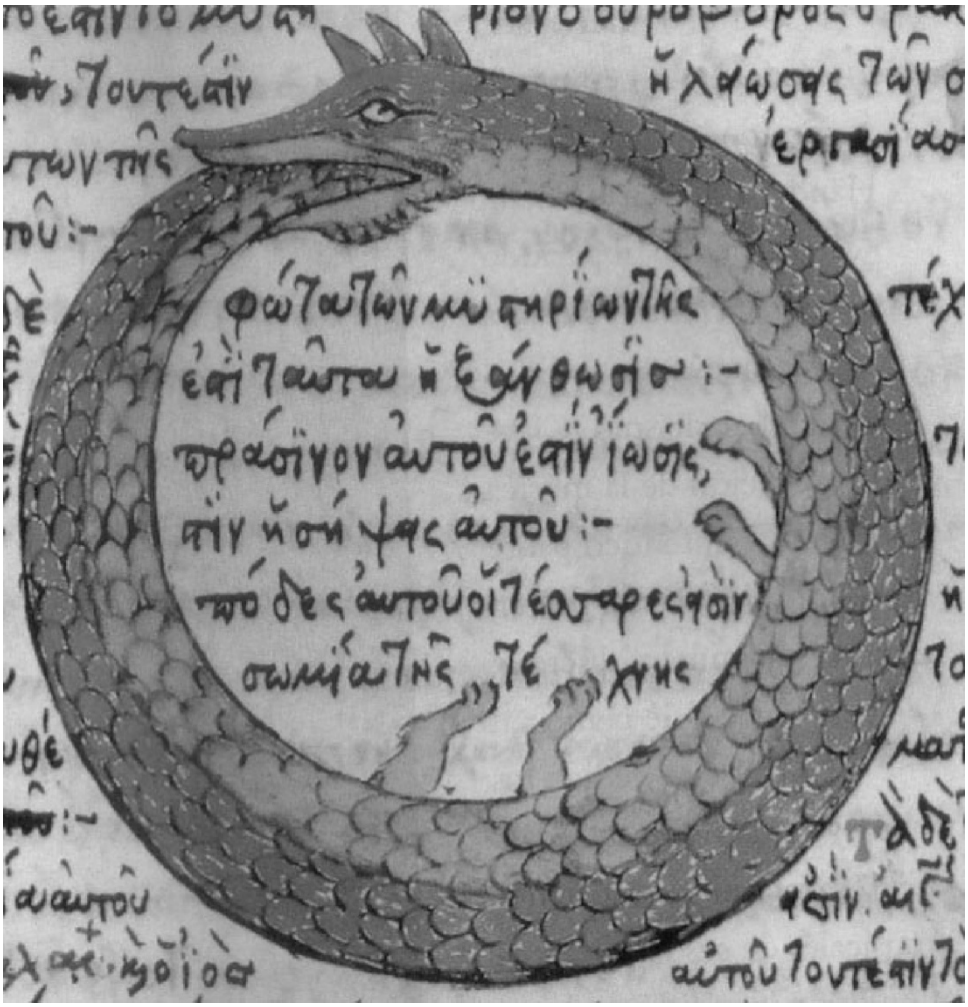

Figure 4 Alchemical Ouroboros (Pelekanos, 1478)

Stretching out this circular cosmic ouroboric serpent from head to tail, one can create an axis of scales that encompasses all of space. In Figure 5 such a scale is drawn starting with the currently estimated diameter of the universe itself at 10^{+25} m, and descending logarithmically down to the Planck length limit at 10^{-35} m. The axis thus spans a total range of 10^{+60} (60 jumps by the power of 10). The Pribram–Bohm hypothesis holds that there, at the very bottom of the linear scale (Figure 5), is to be found the transition bounding the explicate order and the implicate order (Joye, in press, p. 261). Here, at the bottom bound of the spatial scale, space reaches its *end*, according to modern physics; but it also marks the *entry point into* Bohm's "implicate order," what Pribram terms the "frequency domain" (Bohm, 1980; Pribram, 2013).

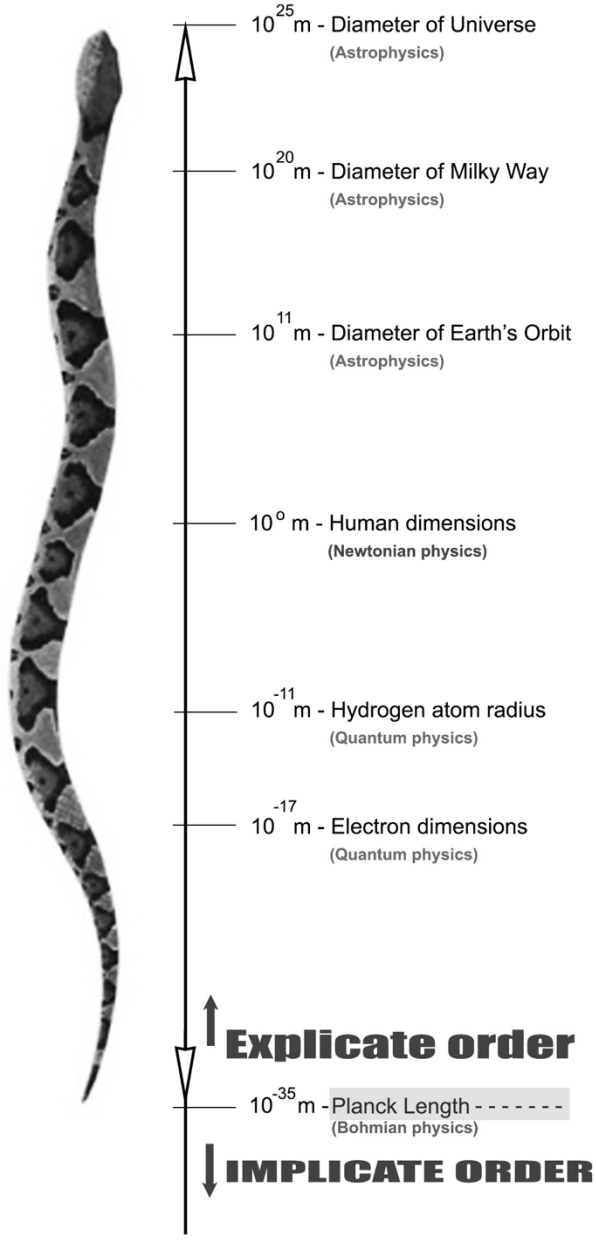

Figure 5 Scales of dimensional space and the explicate/implicate boundary

The implications of this topology are profound. Imagine moving inwardly, from any position in the universe, moving into a spherical bubble, shrinking ever smaller in scale while moving ever closer to the center at the bottom of the spatial scale, following the radial axis inward, ever shrinking downward, and then abruptly reaching the end

of the line at the Planck length limit of space, the locus of a spherical shell 10^{-35} meters in diameter, below which space has no meaning. Here a boundary has been reached, an event horizon between space and the implicate order. To understand this, one must realize that the classical Cartesian assumption that space is continuous is *wrong*; there *is* indeed a bottom to space, at least according to physics, below which space no longer has meaning. Here there is a discontinuity, as David Bohm and F. David Peat (1987) explain in describing the granularity of space:

> What of the order between two points in space? The Cartesian order holds that space is continuous. Between any two points, no matter how close they lie, occur an infinite of other points. Between any two neighboring points in this infinity lies another infinity and so on. This notion of continuity is not compatible with the order of quantum theory. . . . Thus the physicist John Wheeler has suggested that, at very short distances, continuous space begins to break up into a foam-like structure. Thus the "order between" two points moves from the order of continuity to an order of a discontinuous foam. (pp. 311–312)

PRIBRAM'S SPECTRAL DENSITY FLUX AND THE IMPLICATE ORDER

In 1979, Karl Pribram, at that time a Stanford professor, attended a conference in Cordoba, Spain, where he met David Bohm, a professor of theoretical physics at London University (Cazenave, 1984). During the conference, Pribram (2013) soon realized that David Bohm's model of the implicate order and its projection, or extrusion into space–time, could be seen as entirely compatible with his own holonomic mind/brain theory. Thus began 20 years of correspondence and dialog between David Bohm and Karl Pribram, and the two soon became personal friends.

Pribram (2013) saw in Bohm's theories how the frequency domain flux might be seen to unfold into explicate domain waves of encoded information via the Fourier transform, and he appreciated Bohm's description of how information from the explicate may fold back into the implicate in a bi-directional process. Even more intriguing was Bohm's belief that, "the basic relationship of quantum theory and consciousness is that *they have the implicate order in common* [emphasis added]" (Bohm & Hiley, 1993, pp. 381–382).

Pribram was equally impressed with Bohm's explanation of nonlocality, a major mystery in quantum physics, which Bohm explains as fundamental to the process of folding and unfolding between explicate and implicate orders, allowing for full superpositioned cohesion of frequency information within the implicate order, and even providing a plausible mechanism for Sheldrake's theories of morphogenetic fields and morphic resonance:

> The implicate order can be thought of as a ground beyond time, a totality, out of which each moment is projected into the explicate order. For every moment that is projected out into the explicate there would be another movement in which that moment would be injected or "introjected" back into the implicate order. If you have a large number of repetitions of this process, you'll start to build up a fairly constant component to this series of projection and injection. That is, a fixed disposition would become established. The point is that, via this process, past forms would tend to be repeated or replicated in the present, and that is very similar to what Sheldrake calls a morphogenetic field and morphic resonance. Moreover, such a field would not be located anywhere. When it projects back into the totality (the implicate order), since no space and time are relevant there, all things of a similar nature might get connected together or resonate in totality. When the explicate order enfolds into the implicate order, which does not have any space, all places and all times are, we might say, merged, so that what happens in one place will interpenetrate what happens in another place. (Bohm & Weber, 1982, pp. 35–36)

Bohm's topology is both supported and extended by Pribram's contention, supported by the diagram handed down from Dirac, that the boundary or event horizon between the two domains, where the action occurs, is at the Planck length, precisely where, as Pribram tells us here, spectral density in-formation translates into space-time ex-formation.

> Matter can be seen as an "ex-formation," an externalized (extruded, palpable, compacted) form of flux. By contrast, thinking and its communication (minding) are the consequence of an internalized (neg-entropic) forming of flux, its "in-formation." My claim is that the basis function from which both matter and mind are "formed" is flux (measured as spectral density). (Pribram, 2004b, p. 13)

This flux or spectral density is for Pribram real, in the same sense that space-time is considered to be real, but this flux is *outside of* or *beyond* space–time. It is in this sense that Pribram made the conceptual leap from considering the Fourier transform as simply a tool of mathematical calculation, to a dawning realization that the reality of the transform implies the ontological *reality* of a domain *outside of space–time*, a transcendent yet ontologically real domain where energy as flux is "measured as spectral density."

Dirac's original diagram can now be extended to include Bohm's two regions of the whole, the implicate order and the explicate order. Figure 6 depicts this expanded diagram.

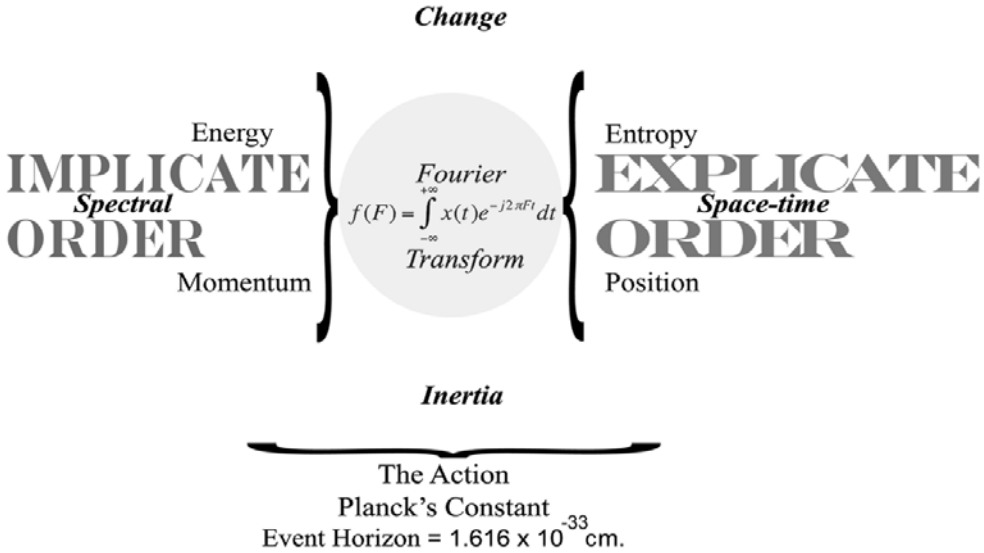

Figure 6 Dirac Fourier diagram with David Bohm's topology

An anthropomorphic view of the Pribram's diagram can be seen in Figure 7, where an iris-like lens peering out from the implicate order is maintaining a focus upon and/or projecting a holonomic universe within the explicate order of space–time. This mirrors Karl Pribram's (1991) conceptualization of a lens between the two domains, expressed here in *Brain and Perception*:

> These two domains characterize the input to and output from a lens that performs a Fourier transform. On one side of the transform lies the space-time order we ordinarily perceive. On the other side lies a distributed enfolded holographic–like order referred to as the frequency or spectral domain. (p. 70)

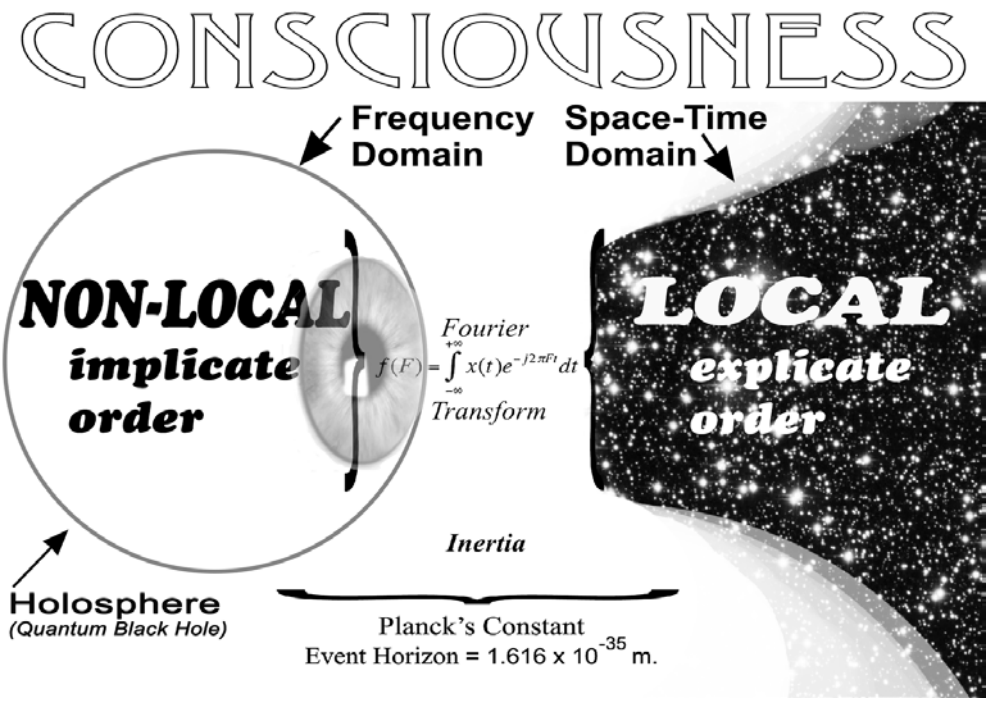

Figure 7 Topology of consciousness in Pribram's diagram

Note that the image of an iris in the diagram appears at the edge of the event horizon of a quantum black hole, or implicate order holosphere. The iris symbolizes consciousness looking *out* from the implicate order *into* space-time via a Fourier transform lensing process. This approach to a topology of consciousness as something that is looking out and seeing itself is supported here by the mathematician G. Spencer-Brown (1972) in *Laws of Form*:

> Now the physicist himself, who describes all this, is, in his own account, constructed of it. He is, in short, made of a conglomeration of the very particulars he describes, no more, no less, bound together by and obeying such general laws as he himself has managed to find and record. Thus we cannot escape the fact that the world we know is constructed in order (and thus in such a way as to be able) to see itself. This is indeed amazing. Not so much in view of what it sees, although this may appear fantastic enough, but in respect of the fact that it can see at all. . . . But in order to do so, evidently it must first cut itself up into at least one state which sees, and at least one other state which is seen. In this condition it will always partially elude itself. (p. 105)

COSMOLOGY AND THE IMPLICATE ORDER

In 1980 Bohm published *Wholeness and the Implicate Order*, and in a section in which he discusses the cosmology of the implicate order, he puts forth a solution to the problem of "zero-point" energy by regarding the Planck length as the shortest wavelength possible:

> If one were to add up the energies of all the "wave-particle" modes of excitation in any region of space, the result would be infinite, because an infinite number of wavelengths is present. However, there is good reason to suppose that one need not keep on adding the energies corresponding to shorter and shorter wavelengths. There may be a certain shortest possible wavelength, so that the total number of modes of excitation, and therefore the energy, would be finite. . . . When this length is estimated it turns out to be about 10^{-35} m. (Bohm, 1980, p. 190)

Bohm (1980) brings up the school of Parmenides and Zeno, which held that all of space is actually a plenum, and he points out that as recently as the last century this same theory was presented in the widely accepted hypothesis of the *ether* (p. 191). Bohm describes how there is a "holomovement" (p. 151) in this immense sea of "zero-point energy" (p. 190) to be understood as a "undivided flowing movement without borders" (p. 172) and he goes on to state:

> It is being suggested here, then, that what we perceive through the senses as empty space is actually the plenum, which is the ground for the existence of everything, including ourselves. The things that appear to our senses are derivative forms and their true meaning can be seen only when we consider the plenum, in which they are generated and sustained, and into which they must ultimately vanish. (p. 192)

In the Pribram–Bohm cosmology then, the interface or boundary between the space-time explicate domain and the nonlocal, nontemporal implicate domain can be viewed topologically as a holoplenum of holospheres (Figure 8). Here can be found an answer to the "hard problem of consciousness" posed by Chalmers (1995), for it is from *within* each holosphere that consciousness is "peering out" into and "projecting" the space-time explicate, and here Bohm (1980) summarizes his cosmological essay by proposing that "consciousness is to be comprehended in terms of the implicate order, along with reality as a whole" (p. 196) and stating unequivocally that "the implicate order is also its primary and immediate actuality" (p. 197).

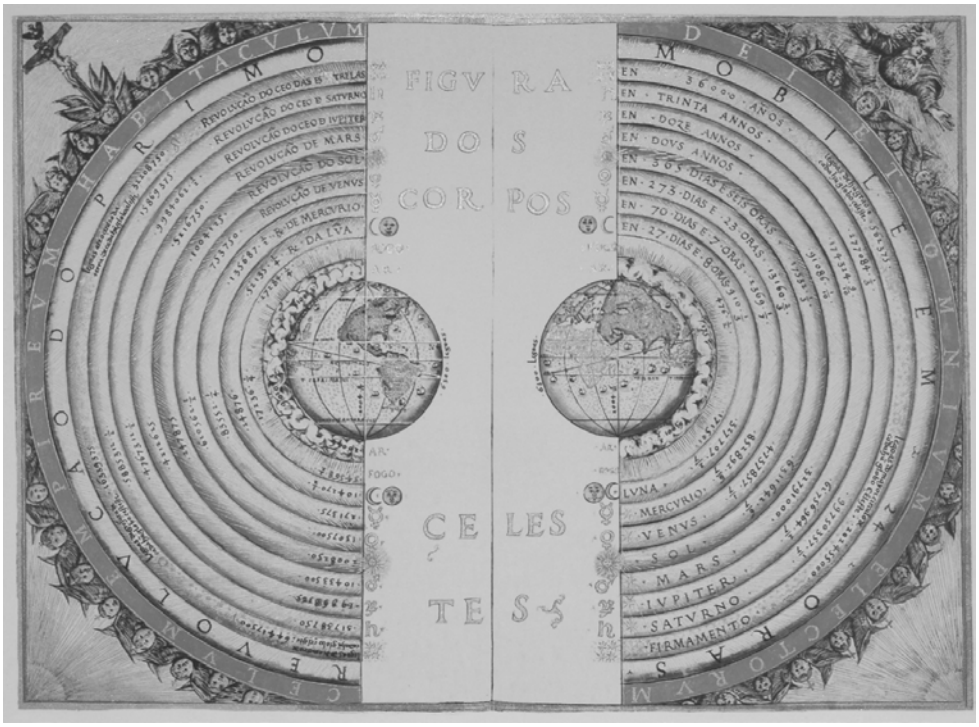

Figure 8 The Ptolemaic Geocentric conception of the Universo. Source: Velho (1568)

In the 3rd century BCE Aristotle (2004) held that the reason an apple falls to the ground is because it seeks its natural place at the center of the universe, and he set forth a geocentric model based upon the following three propositions:

1. The Earth is positioned at the center of the universe.
2. The Earth is fixed (nonmoving) in relation to the rest of the universe.
3. The Earth is special and unique compared to all other heavenly bodies.

Substituting "holosphere" for "Earth" in Aristotle's propositions, each Planck holosphere can be taken as positioned at the center of the universe, each holosphere is fixed (nonmoving) in relation to all other holospheres in the holoplenum, and each holosphere is "special" by virtue of its unique Hilbert space coordinates (Young, 1988).

CONCLUSION

Finally, it is reasonable to speculate on practical implications for this topology in terms of its possible impact on future technology. Identification of an energy field manifesting information characteristics in multiple bandwidths of radiant energy associated with biological systems would support the feasibility that, in principle, major components of consciousness might eventually be stored, maintained, and

manipulated using hardware (e.g., fiber optics and silicon, perhaps) instead of wetware (biological tissue). An intriguing implication would be that consciousness might be uploaded from wetware into such a hardware environment, and vice versa.

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