

Consciousness: ‘A Thousand Points Of Light’, The Emergence Of Self-Organization From The Noumenon Of The Conscious Universe

Richard L. Amoroso
Noetic Advanced Studies Institute
120 Village Square MS 49, Orinda, CA 94563-2502 USA
email: noeticj@mindspring.com

Barry Martin
Liberal Studies Department
John F. Kennedy University
Altadina Road, Orinda, Ca 94563-2502 USA
email: bmartin@jfk.edu

Abstract. A framework for defining the physical basis of consciousness is derived in terms of the complementarity inherent in the cosmology of a *continuous state* conscious universe as it relates to self-organized living systems. The activity of a dynamic counterpart of standard static Casimir-like modes is described by an extended spacetime Cavity Quantum Electrodynamics in terms of a 12D Topological Field Theory that integrates gravity, electromagnetism and relativistic quantum field theory to develop the noetic action principle. Inherent self-organized teleological and intentional action on the spacetime geodesic cavities of the dynamic Casimir-like modes is mediated by a specific nonlocal unitary exchange quanta defined as the Noeon, that is indicative of an *elan vital* which also becomes associated with information and processing in the microtubule, synapse and other arenas of quantum brain dynamics where ‘consciousness’ couples to biological structure and biochemical species in terms of an elaborated definition of Eccles original philosophical concept of the Psychon. Novel ideas involving the cosmological Noumenon and brain Hologscape are presented including a basic mathematical formalism for the noetic action principle.

Keywords: Biophotons; Bosonization; Casimir effect; Consciousness; Hologscape; Noeon; Noumenon; Psychon; Quantum Brain dynamics

1. Introduction

Consciousness is a quixotic term, of myriad meanings in both general and technical usage where great divergences still exist between a plethora of theories [9, 27]. Mind modeling is apparently related more to the nature of the intellectual or experimental probe rather than the actual substrate. One is reminded of complementarity and the participatory nature of quantum wave collapse: the kind of question asked determines the kind of measurement made, which in turn qualifies the aspect of reality apprehended. Furthermore, one might ask whether consciousness has a prior cause or if there is some critical condition or degree of complexification that must be met for its evanescence into biological systems? More to the point, is an 'it' involved? These are questions we intend to answer.

Neurophysiologists and cognitive theorists, query whether mind is a matter of synaptic function generating neural computation nets or forms of gravitationally mediated Bose-Einstein pumping in cytoskeletal microtubules or synapses. Philosophers celebrate versions of monism, idealism, dualism, materialism or myriads of other subtle and often myopic nomenclatural combinations and permutations of these disparate categories. Physicists conjecture the consequence of strings, M-branes, D-branes and P-branes, twistors in sheaf cohomology, or recently functors of category theory [98] dredging up vacuum zeropoint energy, quantum tunneling and nonlocal bits of teleported EPR information or symmetry rules that modulate collapse of the wave function by a required minimal conscious mass.

This wrangle with ontology, particularly the qualia of experience, known as the "hard problem" [20] gives some inkling of the difficulty in pinning down what has been called an evolutionary fluke, or derivative property of 'wetware' with no other value, according to some stubborn classicists, save vexation. Still, we have it, or rather it has us: it is a phenomena evidenced by reportable mental states, which are in themselves concepts wrought by the very mind under investigation. Somehow we process information without understanding fully just what informs us. No wonder consciousness is considered the oldest and most difficult problem facing human epistemology.

According to Bohm and Hiley [18] the idea of active information applies both objectively and subjectively. They go on to say that "in this context our proposals to use the concept of active information at the quantum level does not seem unnatural." They then refer to the electron interference pattern from a double slit experiment and argue that as "the particle reaches certain points in front of the slits it is 'informed' by the guiding action of a quantum potential to accelerate or decelerate accordingly." The fact that a particle moving under its own energy is being 'guided' by the information in the unified quantum field suggests that an electron or other elementary particle has a complex and subtle inner structure [102]. This notion of an inchoate fine structure goes against the tradition of scientific reductionism and gauge theory - matter should get simpler as we go down to more reduced levels.

Ironically, it turns out that mind is not reducible to brain as popular opinion suggests, and thence reduction of brain to matter becomes meaningless in this context because of the increasing complexity at lower levels. To say that the most elementary levels are more complex sounds like an oxymoron - complex simplicity? or perhaps complicity is more apropos. But this is no worse a transition than faced by the early atomists. Atomic structure is now found to be very rich and complex with hundreds of particles discovered. The question now might be - what is the most fundamental form of complexity in relation to awareness? This is the question we will answer by developing a principle of the *least unit of awareness*, as it relates to the cosmology of the conscious universe [2]. This meets Chalmers' challenge that a fundamental principle of awareness should be the starting point in developing a viable theory of consciousness [20].

Universal consciousness appears to be the 'mother of complexity' representing a panoply of all complex modalities. A universal system of complementarity between mind as container and consciousness as mental content represents the primary complex system and most fundamental aspect of reality. In terms of this basic premise - *that mind and consciousness represent the most fundamental principle of reality; the complementarity of which produces awareness* - we utilize the following definitional overview of *complexity, self-organization* and *consciousness*:

- COMPLEXITY

The quantitative characterization of complexity theory in a comprehensive manner has only recently begun [13, 41], partly because the interdisciplinary girth is still spreading to more and more scientific disciplines. This makes a comprehensive discussion challenging, especially for consciousness researchers who by the nature of the field of inquiry require the broadest and most inclusive classification of complex phenomena to include all the seemingly disparate systems analyzed. In this sense consciousness is synonymous with complex systems theory. Category theory can encompass mathematically such an ubiquity of complexity in a general manner [98]. This is not a flaw or a Godelian recursion, but a requirement to sufficiently envelop the full universal nature of mind in a complex conscious universe with inherent self-organized teleological principles governing its evolution.

In more generalized scientific subdisciplines complex behavior arises in physical, chemical and biological systems as well as mathematics and information theory. Here we introduce the primary cosmological manifestation of complexity. We support the standard basic definition of complexity as a 'system of intricate parts such that the analysis of its attributes must rely on not only linear but nonlinear methods as its causal relationships cannot readily be determined by standard reductionist tools that only produce precise Newtonian predictions. According to Badii [12] three fundamental components are required to define complexity.

1. Complexity is the function of both a subject and an object where the subject has the task of modeling the object.
2. The object or its representation must be divided into a hierarchy of elements and subelements.
3. Study of the interactions of the subsystems leads to a model that includes the concept of scaling of the inherent hierarchical elements.

- SELF-ORGANIZATION AND CONSCIOUSNESS

Zero complexity is attributed to entropic randomness which corresponds to the absence of self-organization. Autopoiesis as coined by biologist H. Maturana [101] is a key aspect of complexity as it as it relates to self-organized living systems [10]. It refers to the ability of a complex system to produce and maintain itself. This occurs within a hierarchy of scaling functions that mediate the interplay between modalities of the system. Defining consciousness becomes tantamount to defining complexity. What it is has typically depended on the kind of question asked and the level of analysis. Our working definition of consciousness as the primary complex system is as follows: 'Consciousness is an autopoietic self-organized scale invariant hierarchical ordering principle inherent in the physical teleology of the conscious universe.' (An overview of the conscious universe can be found in [2, 4].) Ultimately a complex autopoietic system may be synonymous with the basic elements defining the conscious universe; the salient difference being one of domain only. The basic element or 'least unit of awareness' [6] has three complementary physical or cosmological components

forming a fundamental ontology, the very existence of which is synonymous with consciousness. Together these three components form the structural components of mind as a physical noumenon; the phenomenological contents of which represent awareness.

Returning to the discussion from Bohm and Hiley [18] "nature is far more subtle and strange than previously thought...and this inner complexity is not as implausible as may appear at first sight." As an example they cite statistical laws where microscopic individual behavior is seen as much more complex than at the macroscopic level. Crowds are more predictable than the people that make them up. The number of neurons in the brain is of the order of 10^{12} which is probably higher for synapses. Is this admittedly large number sufficient for emergence or identity with mind? Wittgenstein [106] suggested that thoughts might reside in the brain like 'jottings'. What is stored in our brains is a kind of mnemonic that then could call up the whole thought in much the same way that short hand notes or 'jottings' of a conversation could remind one of the full text. The text would not be stored in the jottings - so should the mind be necessarily stored in the brain?

Bohm and Hiley [18] note that "between the shortest distances now measurable in physics (of the order of 10^{-16} cm.) and at the shortest distances in which current notions of spacetime probability have meaning (of the order of 10^{-33} cm.) there is a vast range of scale in which an immense amount of yet undiscovered structure could be contained. Indeed this range of scale is comparable to that which exists between our own size and that of an elementary particle. However it has been recently demonstrated that by introducing a millimeter scale for the extra dimensions this gap can be closed completely to the TEV level [11]. We have also found a way of filling this gap by recalculating the Planck constant in terms of the Noetic least unit. Moreover the vacuum is generally regarded as full, (Wheeler [103] and Hiley [52]) with an immense energy fluctuation revealed for example in the Casimir effect¹. "It may be further suggested that ultimately the energy of a particle comes from this source... a very important further implication of the notion of active information is that in a certain sense an entire experiment has to be regarded as a single undivided whole." The point is that there is plenty of room for any new physics or cosmology needed to describe consciousness.

It occurs to us that two factors are of paramount importance in developing a comprehensive theory of consciousness; first a deeper understanding of events around the Heisenberg matrix designated as the raster of mind [5] (which entails both the prespace or subquantum realm as well as brain biochemistry) and second, integrating the various mechanisms postulated for brain-mind information processing (which has more to do with computability than emergence or identity in the noetic formalism). A *raster*, by the way, is a grid of potentialities - one might imagine a TV screen of pixels, where the energy at the intersection of each tiny square can be represented by a tensor or scalar potential. The big question is whether the brain's neural net along with its associated quantum mechanical substrate is sufficient, as posed by the cognitive vogue; or is the addition of the teleological 'electron gun' - the noetic holophote action, introduced by the noetic interactionist theory required? In the twenties Kaluza [58] was able to write down the Riemann metric in five dimensions and meld gravity with the electromagnetic force, to unify gravity and light as spacetime curvature. This was done with a tensor field representing the state vector at each crosshatch on the grid. Another required component of the raster? We believe so and develop a form of Kaluza-Klein theory to introduce the noetic field into spacetime topology.

What is perceived as the mind depends greatly on the level of analysis. For example, a glass of water might be thought of as a stochastic ensemble of molecules or a thirst quencher. The latter might be considered a hyperspace projection of the former, thirst being a property imbued by the background of the observer at that level. That is, a higher dimensional being would 'know' what thirst is, but a being submerged in the matrix of water molecules would not comprehend what even wetness was. Einstein said that we are composed of the same material as our measuring rods; sufficient reason to satisfy the criteria of Godel's incompleteness theorem. A pertinent question then, is at what level do properties or qualia inhere? In Hindu philosophy for example [60], the Samkhya see everything arising from itself. In this sense, there are no causes different from the effect. Life begets life, consciousness gives rise to consciousness from its innate ground of being [42]. Scientific accounts must seek explanations beyond this recursion (e.g., the reason why morphine induces sleepiness is because of the dormitive power of morphine.)

A solution to the mind-body problem that escapes the specter of Godel's tautology² [74] is offered here to set

¹ The Casimir effect [19] is the strongest evidence for a polarized Dirac vacuum. This turns out to be an essential factor for noetic cosmology; the reality of a Dirac vacuum leads us beyond the naturalism of the Bigbang into the realm of a continuous state conscious universe [2].

² A proof demonstrated in terms of a system itself is inadequate by its recursive nature; an adequate proof must come from *outside*.

in place the required cosmology from which to define the 'least unit of awareness'. We propose a triune model (with partial correspondence to Popper's three worlds approach) of brain/mind that involves:

1. The local domain of quantum brain dynamics at the semi-classical limit.
2. An ubiquitous cosmological ordering principle called the noetic field which is mediated by an aspect of the unitary field defined as the noeon, and
3. Elemental intelligence, which entails fundamental nonlocal and supralocal boundary conditions that include aspects of space and spacetime cast in a higher dimensional absolute space of a post Bigbang cosmology treated in more than the four dimensions of observed phenomenological reality [2, 6].

The noetic model represents a structural - phenomenology that is a physical noumenon housing the corresponding phenomenology.

More particularly we extend and formulate a physical basis for Eccles' philosophic concept of the Psychon [31, 32] enabling us to wed Pribram's quantum holographic Gabor function [39, 84], Jibu & Yasue's Goldstone Bosons[54], and Hameroff & Penrose's microtubules [46, 47] in terms of a process called the *Noetic Effect*³ yielding a comprehensive and empirically testable model of consciousness. The Casimir effect is developed further for application to living systems not to account for spontaneous emission of biophotons [80, 81, 90], since these generalized biophotons represent only a more superficial release of life energy (after metabolic activity); but to describe the paramount quantum of conscious action which is mediated by the quantum of the noetic field - an exchange particle called the Noeon. The noeon has a Casimir-like action inherent in the topology of the geodesics of spacetime cavity quantum electrodynamics and the unitary field. It is imbedded in the spacetime metric with quark-like confinement. The noetic field is constrained through its holophote action to produce a macroscopic resonance as it arises from a much more fundamental process of complex self-organization in the conscious universe which fits the definition of a complex system above.

The noetic formalism, a dualistic-interactionist paradigm, is unabashedly not rooted in Darwinian naturalism only; but additionally in newly discovered teleological action principles inherent in the cosmology of a conscious universe [2, 6] A successful new theory must make correspondence to the data of existing 'tested' theory. Thus it is reasonably obvious that evolution exists; but it is not merely a randomized naturalism - Evolution is guided by the ubiquitous teleological action principles inherent in the conscious universe! Inevitably, and unequivocally we believe, mind depends on matter, not the other way round; but profoundly as mystics in both East and West have noted - *all spirit is matter*; and *gravitation is caused by the movement of that spirit!* Here we begin to bring these formerly philosophical assertions into the realm of scientific pragmatism. However; we do not harken back to the bad old days of an entirely objective reality (we must use quantum theory, albeit in an extended form, to employ a much deeper sense of complementarity; one that brings us into action modes of the unitary field where gravity and electromagnetism are in correspondence) [2]. However this does imply an additional causal action, one that includes transcendence - which entails a special form of determinism. There is a correspondence principle related to quantum theory in the domain where classical theory is analogous to it. This is true whenever there is a paradigm shift from one theory to another, like between Newton's and Einstein's gravity for example. Our task has been to find the correspondence between the standard models and consciousness. Our view is somewhat sympathetic with Willis Harmon's radical epistemology (though he seems to favor a more idealist metaphysic [49] in that it includes the phenomenon of consciousness and does not relegate subjectivity merely to a behavioral epiphenomenon.

Most importantly, the noetic theory is empirically testable, or alas, refutable. (Recall Pauli who was wont to say "it is not even wrong" about ideas that could not be tested.) As vacuum quantization proceeds as called for by Penrose [74-76], it is suggested that the locus of mind/matter interaction includes not only quantum entanglement in the holoscape [5], but also an essential complementarity at a more profound pre-space/nonlocal level [2] giving

³ The *noetic effect* is more complicated than can be described sufficiently here with brevity; but in way of introduction: The noetic effect is the complementary action principle inherent in the conscious universe described by a form of a topological field theory that utilizes a unified Quantum - Electromagnetic- Gravitational field that allows Casimir-like geodesics in the topology of HD spacetime to undergo ontological (energyless or non collapse) topological switching by the action of intentionality on the mind side; and inherent self-organized autopoietic processing in living systems on the cosmological side. More on this key element later.

correspondence with gravity, electromagnetism, quantum theory, cosmology and information theory. We believe that incorporating the nonlocal aspects of the unitary field, not yet adequately articulated beyond any current formalism, is necessary to any model of consciousness.

Pribram's quantum holonomic brain theory [85] and various methods for describing Bose coherence in biological systems [5, 36-38], are now sufficiently sophisticated to raise expectations for easing the age old dualistic dilemma. This paper outlines recent thinking on mind / brain interaction and proposes a radical definition of the *least unit of awareness* [6] that incorporates a mechanism for a continuous state dimensional reduction process [2] acting like a *holophote*⁴ to introduce the *elan vital* (vital force) into the inherent bilevel complementarity within the holographic Heisenberg raster of mental resolution. This laser-like pump is a continuous Psychon - Noeon - Noumenon cascade. The mechanism compliments holonomic brain theory since it is possible to integrate all aspects of quantum brain dynamics with it. Wigner's statement that consciousness is related to state reduction or wave collapse is superceded by the ontological energyless noncomputable nature of the noeon pumping mechanism. This applies only with extended modes of de Broglie-Bohm quantum theory.

Penrose has suggested that state collapse for living systems is a function of quantum gravity, while others have put forward decoherence as an observer free mechanism for collapsing the wave function and thus actualizing quantum events. However these mechanisms are postulated in terms of the standard model which even Penrose himself states in a detailed analysis is beyond the capabilities of current quantum and gravitational theory to describe [78]. 'Quantum theory is silent about these issues'. Following in the line of these currently popular views regarding quantum wave collapse Penrose & Hameroff have asked 'what minimum gravitational mass is required by an entity in order to reduce the state vector in order to have consciousness?'. This is an expected interpretation if one applies the standard Copenhagen quantum interpretation. But it is a fruitless exercise because as generally known the standard model of quantum theory is not sufficient to describe the additional degrees of freedom existing in biological system. People are more than particles on a manifold - all that standard quantum theory is able to describe. This was stated emphatically by Bohr when he founded quantum theory.

In the noetic paradigm even the prion protein has a rudimentary consciousness because the conformational changes that govern its propagation are mediated by the noetic action principle [6, 10] which does not require collapse to mediate awareness. The *least unit of awareness* is the most fundamental principle of the conscious universe inherent to any living system. Quantum collapse does occur in the outer husk of classical matter; but in the core coherence rules. Thus the need for the complementarity of the two worlds in order to develop an adequate theory of mind.

Thought called a stream of qualia is described in terms of an inherent complementarity associated with the Heisenberg matrix - the raster of consciousness as it is imbedded in the universe [5] not merely the brain as suggested by the current cognitive vogue. This Heisenberg matrix is a subspace of a HD noumenal psychosphere that embodies both the local - temporal dynamic Holonom or holoscape as it is coupled to the brain; and a nonlocal atemporal higher dimensional domain of elemental intelligence. The noetic field filling the psychosphere is mediated by an exchange particle called the noeon. This putative noeon is both the *elan vital* or spark of life and 'light of the mind'. It is in correspondence with the unitary field. The noetic formalism allows a physical description of qualia [3, 6].

1.1 WE ARE PUBLICLY OBSERVED BUT PRIVATELY EXPERIENCED

One of the key problems of conscious experience is that until now it has been observed, not as an object in the world seen from the outside but as a subjective experience felt from within only. This internal world, or interiority, cannot just arise out of matter; unless the potential for interiority already exists (or potentially exists) *a priori* in matter. We use the term 'matter' advisedly, in that quantum theory and Einstein's mass energy relation suppose that matter does not exist as hard little Newtonian nuggets of stuff, but as probabilistic wave functions which are non-local. Crick was right to insist that brain should function like anything else in the universe [22], in that mind should be consistent with the laws of physics. Perhaps this is all that Crick is right about in his 'astonishing hypothesis'. Certainly he would critically accuse us of appealing to some Aristotelian animism; but we have finally found that the extended laws of physics applied to hyperspace provide machination enough to account for mind in a manner that includes an empirically testable form of *elan vital*, a term we use for the sake of history - why not start a riot if one is long overdue.

⁴ Holophote action is like that of a lighthouse. A noeon flux enters living systems continuously with a periodic beat frequency related to the continuous state topology of spacetime [2].

The quantum foam observed at the Planck scale resides at the cut of mind / body interaction in terms of contemporary physics. The central mind is not a probabilistic generator because the choices of intentionality are not random. Stochasticity which exists naturally at this level arises in the wake of unified elcto-graviton propagation (producing strings) as the extension of our relational spacetime is continuously created and recreated in time [2, 4, 6]. The core of the mind remains coherent because for the most part it is within the realm of the unitary field. Another incorrect guess - guilt by association is not a 100% rule. Observed reality is a subspace of an HD atemporal space. The reason for the higher dimensions is so that 'our' temporality can 'surf' so to speak on the face of that HD eternity. This is where, in noetic cosmology, the necessary degrees of freedom to describe mind arise from. It is this cosmology from which the principle of the least unit of awareness can be developed [2, 6].

Non-locality is an important aspect of quantum mechanics because it lends itself to the binding problem. This so called 'binding problem' is one of the nature of unity of experience: if there are so many Newtonian objects (neurons) in the brain independently processing bits of information, the question arises as to how all of this separate activity is summated instantaneously to give a solo experience of a "me" acting. This is where noncomputability enters; the binding problem is here not a problem because of the inherent complementarity of awareness as a microcosm of the conscious universe itself. Since the brain is a natural form of conscious quantum computer, a transducer only, and not the seat of awareness, there is no binding problem. The mind is a fundamental noumenon - a thing in itself - all this extraneous fluff is so that we, as temporal residents of Plato's cave, can wear a lens darkly and observe the external world of our temporal existence!

Is the popular phenomenological view - the standard model correct? We don't think so. It is rather the result of a primitive category error in philosophy of mind that has produced the non-researchable hard problem. "What processes in the brain give rise to awareness?" This is too superficial and limited a mode for the query of what gives rise to awareness. In the history of science 'hard problems' usually only exist when the underlying principles are not well understood. Noetic cosmology by positing the question in the proper cosmological frame of reference readily dissolves the 1st person 3rd person barrier. One must ask simply 'what processes give rise to awareness?' not what processes in Siberia... The fool Nasrudin looked for his lost keys in his front yard when he had lost them in the back yard. When questioned by his friend, Nasrudin replied, because there is more light in front. Most have flocked to the safety of the popular cognitive standard model; but is this good science - to tell the universe how to answer the question?

Nor are people merely sophisticated computers; so finding a correct or sufficient algorithm will not allow replication of human awareness in a Turing machine. According to Minsky, mind is what the brain does. However, to say that the mind is a computer raises the issue of 'who' is the user. Wang [104] succinctly dismisses parallelism (AI) by saying that "since the brain is its own user it cannot be a computer." But again Wang's application is from the cognitive perspective; for in the noetic perspective the mind is the user. One often hears mention that the brain is the most complex entity in the universe. The vast potential of the brain for information processing has acted as a pied piper leading many researchers away on a spurious path of mind-brain identity. Furthermore, it turns out that aspects of the mind are noncomputable, such that there is a physical reality of mind that cannot be represented with sufficient precision to lend itself to mathematical description by current tools. Penrose [74, 75] argues that thinking might be noncomputable.

Fortunately these noncomputable aspects can be described by extended ontological theories. This again represents the complementarity of mind: the semi-classical local aspects interacting with the nonlocal unitary aspects to form a cosmology. A naturally occurring form of noncomputability observed in living systems is manifest by what is called the *vestibular ocular response*. Certain birds sitting on a branch or wire are observed to have their bodies bouncing stochastically in the breeze; but their heads remain perfectly still. A bird's brain cannot compute this. A supercomputer cannot compute this. The better the supercomputer the better the approximation only; the calculation itself is noncomputable...The needed result can only be achieved through the ontology of unity action.

2. Background Matter

Materialistic reductionism supposes that consciousness must be synonymous with brain (the vogue is to denote these as NCC's, for Neural Correlates of Consciousness) and as such can be found languishing at the bottom of the now nonexistent homuncular regress: NCC's have been finessed well beyond mere mechanics (the so called 'easy' part of the problem) of stimulatory / inhibitory action potentials, Hebbian loops, neurotransmitters, allosteric changes in receptors, enzymes and integral protein ion channels, rate changes in uptake mechanisms, alteration of enzyme-substrate binding, cyclic GMP-like messengers and what-not. Some researchers promote ion channels as the seat of consciousness [65].

Iteration of autopoietic chemical gradients have been posited as bootstrapping up information. There are ten times as many glial cells as neural cells in the brain for example, providing a huge fractal membrane of processing potential.

Cytoskeletal tubulin oligomers are a hot candidate for the processing locus, because of the general effects of a wide range of non-specific anesthetics on microtubule conformation and the subsequent loss of consciousness; plus the abundance of quantum stochasticity suggests a fertile ground for mental processing that can't be definitively argued with one way or the other at present. The cytoskeleton, a dynamic network of protein polymers was thought to act only as a sort of muscle system for the internal structure of the cell. But there is more than meets the eye here - the cytoskeleton is macroscopic enough to dampen thermal noise while at the same time small enough to undergo conformational change under the aegis of single photonic events (The Casimir radius of a microtubule is sufficient that Bosons could pass through); as an interface between the nonlocal implicate world of the quantum potential and the billiard ball Newtonian realm. Descartes' pineal gland has been dispersed and nanosized. The microtubule straddles the dualistic divide between *res extensa* and *res cogitans*, being explicitly neither and yet both. A sort of Buridan's ass - which incidentally starved to death finding itself between two equally sized piles of hay and being unable to split the difference.

Can microtubules think? Connectionist theories abound. Boolean lattices, which are known to house logic, (is this thinking?) are possible by way of binary modes - the protein dimer is in either this conformational shape, or it is in another. Coupling various allosteric forms gives rise to computation (is this thinking?) Can deterministic inputs in far from equilibrium systems become concretized as limit cycles of strange attractors: what emerges by way of collapse of limit cycles? Can microtubules concretize reproductive patterns as protein encryption?

After nearly 30 years of dormancy, sites for the integration of the two models are possible at:

1. Dipole moment couplings to tubulin conformational states in the microtubules of the cytoskeleton (Frohlich [37, 38, Marshall [66] and Hameroff [46-48] and
2. Quantum matrices in synaptodendritic ultra structure (Eccles[29-32], Beck & Eccles[17]) have intrigued theorists. In addition quantum dynamics appears to occur in the dipole and spinglass structures of ordered water molecules (Del Giudice, Preparata and Vitiello [25], Jibu and Yasue [54]), DNA entrainment (Rein [94], Chwirot [21]) and other sites of protein conformational changes.

2.2 QUANTIZATION OF MATTER

Since Democritus uttered his aphorism about atoms and the void, classical materialism has rested comfortably. Matter - we kick it, it kicks back. Quantum theory wanders out beyond the pale of particle and field, and speaks of potentialities to exist. Not only that, these are *probabilistic waves* in need of an observer. Reality then, is participatory. Quantum theory is currently an essentially statistical mechanics, describing the indivisibility of the quantum of action, and regrettably giving a leg up for spooky non-local correlates. The Uncertainty limit means that there will always be observer ignorance of the full spectrum of realizable potentialities. What lends itself to the case at hand is the uncanny wave/particle nature of *stuff*. It is the dualist's godsend. Some suggest that quantum theory is therefore dualistic; but the dualism required to describe mind is not just a wave particle dualism but a broader dualism between the phenomenological Copenhagen rendition of quantum theory and a completed ontological form of quantum theory like that suggested by de Broglie or Bohm.

This paper initially summarizes issues of mind pertinent to the Heisenberg matrix, the domain considered a key for understanding the mind/brain interaction. Here in the mind/brain gap, we invoke a dynamic raster of consciousness operating along lines similar to Pribram's quantum holonomic theory.

3. Mind And Matter

Culbertson [23, 24] has proposed an interesting SRM (spacetime reductive materialism) model, where awareness is not a localized signal but an extended pattern in spacetime. He employs Einstein's relativity and complex worldlines creating a tangled network. Here consciousness permeates all nature and mind is accounted for by movement of matter. *Matter is sentient*. The material basis of Culbertson's mind is not in isolated particles but in their worldlines. It is these tracings (what he terms elementary lines) backwards and forwards in time that create awareness. In this sense, *all spacetime events are* potentially related to consciousness.

3.1 HEISENBERG MATRIX - THE LOCAL RASTER OF MIND

Pribram's quantum holonomic brain theory [83 - 85] describes what he terms a Heisenberg domain of uncertainty where the causal, linear, Fermi events of the holoscape manifold become acausal and nonlinear. This is the raster of mind (see Fig. 3.2). This is the most problematic nexus of any mental theory - how brain states manifest as awareness. According to Pribram, mental events in the holoscape constitute the upper bound of the Heisenberg matrix; now noetic field theory considers the lower complement where matter and energy meet.

If consciousness is hard to pin down, so is matter, within which it is housed. Ironically (for the materialists), it is still as difficult to define matter as it seems to be to categorize consciousness - we believe they will be understood mutually. Mass has been a vexing problem in particle physics. What is it? If the proton has mass as demonstrated by Amoroso [8], do quarks, and so on? The development of the Higgs field as a way of accounting for mass is intriguing but may not survive when the unified field is better understood. Mass is believed to come out of coupling with the net of the Higgs field. A similar notion has been advanced for why we don't see isolated quarks. 'Confinement' means that attempts to observe individual isolated quarks are futile because the energy put into pulling them apart creates new quark triplets.

Clearly there is some correlation between brain states and mind, but to insist this is a one to one correspondence is still an open question. Thought according to the cognitive theorists is an emergent function performed solely by brain activity, but as with mathematics, there are many different functions which might not have a one to one fit. For example, the square root of a negative number has two solutions, one of them being an imaginary number. We get two values. This degenerate, or multiplier aspect of mind is evident in the many other external functions of mind, for example, in the way we use tools that extend brain states, i.e., writing, pencils, paper, calculators and books. This amplification or cloning is referred to as the permissive or transmissive function by James[53].

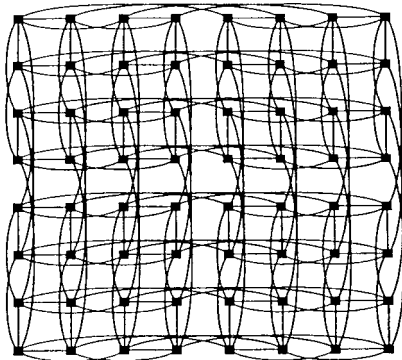


Figure 3.1. A six dimensional (6D) hypercube with 64 nodes and 6 connections per node illustrating the computer network-like aspects of the Heisenberg matrix considered to be the raster of mental processing in quantum holonomic brain theory. The 6D hyperstructure can also represent brain state correlation with the 6 compactified nonlocal dimensions $M4 + K6$ proposed for the spacetime manifold in superstring theory. The Heisenberg matrix is a complex manifold; fig 3.1 represents on tier. Computer generated by Conrad Sennelker. Reprinted from Hameroff [47]. Ultimate Computing, Amsterdam. Science Publishers.

Complex numbers provide an excellent vehicle to demonstrate the interplay of the dimensions of 4-space with those of the deeper 12 D space [2]. Penrose [76] uses a special algebra called sheaf cohomology (developed by Witten in 1985) to show how the whole Minkowski geometry of physical reality can be described by twistors, which are a special class of dual spinors. A very basic example of how spin and twistor components can give rise to matter; space and time is shown in Figs. 3.3 and 7.2. The multiplication of complex numbers (which have the imaginary component $i = \sqrt{-1}$) provides a metaphor to glimpse how the component harmonics in quantized spacetime are brought to light in reality.

If the Heisenberg matrix is looked at (Fig.3.1) in terms of quantum fuzziness, then the way is open for information processing in neural networks. The hyperstructure is not projected *in toto* into classical reality. Because uncertainty enters into the Heisenberg matrix in phase space, the global states can interfere with one another and must obey the superposition principle. If present insight into quantum gravity were correct, this intrinsic indeterminism might account for free will and decision making algorithms. Indeterminism is a property of all Copenhagen quantum systems for which the universal wave function includes in its domain the set of all compact four dimensional manifolds. Ontological indeterminism suggests that uncertainty is not a product of our ignorance or inability to know (sometimes differentiated with the prescription 'quantum ignorance') but rather an irreducible fact of nature itself.

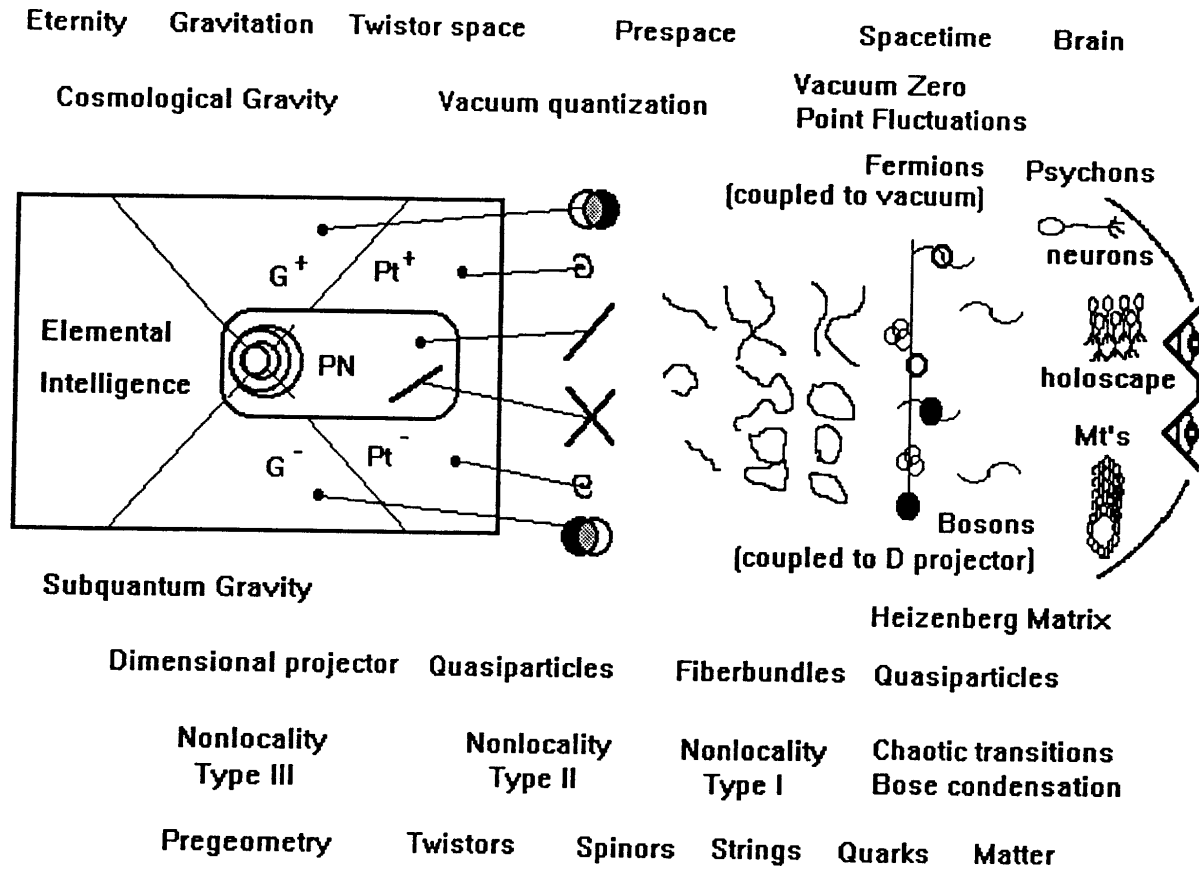


Figure 3.2. The complex noetic hierarchical structure of the conscious universe beginning at the top (macroscopic) right in the local brain at the top tier of holoscape and traveling down through the tiers of Heizenberg matrix which is the seat of mind - body interaction. Semi-classical neural network Fermion states undergo quasiparticle transitions Bose coherence as they are transformed into nonlocal domains described by quantum brain dynamics. The rich structure of this complex domain continues into the HD spacetime topology of the Dirac vacuum. The top tier of the Dirac polarized vacuum is 4D Minkowski-Riemann space, the realm described by geometrodynamics, special relativity and the standard Copenhagen interpretation of quantum theory. Next we enter the 3rd nonlocal level which borders and becomes the unitary field. Here is where Einstein's 4D realm (our observed phenomenological reality) ends. This domain is embedded in (a subspace of) a higher 12D domain that arises from the absolute space of the megaverse. This deeper realm houses the boundary conditions of elemental intelligence - the timeless realm of an individual.

What is suggested here is that at the prespace level of the Noumenon, *nature is not ontologically indeterminate but deterministic*. The ultimate controlling equations are deterministic even though their local solutions are not. That is, feeding in almost infinitely accurate data will not lead to predictable outcomes from the top down, sensitivity to initial conditions being what it is. Wave functions are not restricted to living things, nor are they 'restricted' or perhaps contained in the local sense. The reason for indeterminism is the four manifold non-classification theorem which is a kind of variant of Godel's Incompleteness Theorem. The non-classification theorem states that no algorithm exists which will classify all compact four dimensional manifolds without a boundary. An equation with symbols representing discrete elements cannot be written down. No algorithm establishes the identity of manifolds, and as such the universe might be non computable in this domain, giving reason enough for dodging the Boolean net of QBD. This is related to the measurement problem that we claim only applies to the Copenhagen interpretation. An ontological exchange of information is possible at the deeper coherent level. This is not an external measurement. One system becomes the other system so states are not destroyed. With this form of superposition all information is jointly available. Noncomputability means the action cannot be performed in the classical domain only; ontological 'being' solves this dilemma.

According to game theory first described by von Neumann and Morgenstein, then later by Nash, a mixed

strategy wins. The mix is between random and bounded behavior. Chaos provides a search technique to bump the system from fixing on suboptimal early 'solutions'. Although the human nervous system utilizes non-relativistic quantum uncertainty (at the level of the neural net) to randomize in the semi-classical limit, the question remains how the nervous system can access the quantum electro-gravity regime. Simplistically quantum uncertainty ends before this deeper unitary domain. Relativistic quantum theory applies there with a new set of transformations beyond the Lorentz [4]. These noetic transformations as we call them utilize superluminal boosts and other cosmological principles to perform noncomputable energyless transfers of information without collapse of any wave functions.

There are two ways QBD might exploit quantum gravity. One has been described by Penrose [74, 75] who suggests that if the brain were in a coherent quantum state it might be able to amplify a signal from the Planck scale (the unruly quantum foam) up to the macroscopic level. Unfortunately the known amplification of the nervous system falls short by a factor of 100 million. The second possibility is that the universal randomizer uses the inherent fluctuations of QBD in complementarity with the noeon-psychon holophote of the continuous state conscious universe[2] proposed here. A system capable of detecting single photons or Bose condensed noeons is a precondition for quantum trafficking. See Fig. 3.2 below. Penrose's conclusion is the result of making a prediction utilizing the standard model already determined to be inadequate to describe mental processes.

4. Bose Condensation

Bose condensation might be thought of as a bottom up theory which can be counterpoised by a top down holoscape. This mattress (called the Heisenberg raster, and note the pixel grid idea mentioned above) is the meating (*sic*) of the mind. For the uninitiated, quantum theory proposes two kinds of particles, namely Fermions and Bosons. Fermions are spin half, make up matter and cannot crowd into one energetic level; they are proscribed by the Pauli exclusion principle. Electrons would be an example. Bosons on the other hand have integer spins, are force mediators, and can crowd into one energy level. Photons would be an example, and lasers exploit this ability of photons to stack in single excited states and jump together. Note that under special conditions, that Fermions can behave as a 'group' in the same way as Bosons. Hence Bosonization. Super conductivity (Cooper pairs) of low temperature metals and helium SQUIDS are a good example of collective behavior, where individual electrons combine identities into one super wavefunction. Analogously, Bose condensation has been employed to account for a kind of 'whole mind wave function'.

To clarify what is happening in Einstein-Bose condensation as originated by Frohlich, the term Fermi-Quasi-particle-Bose Transition (FQB Transition) has been coined. See Fig. 4.1 below.

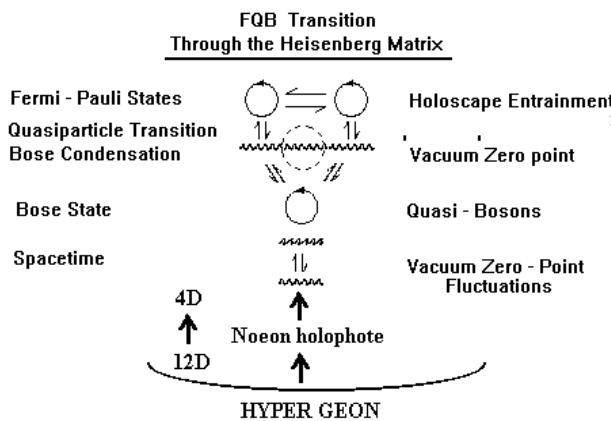


Figure 4.1. Illustrating the Fermi - Quasiparticle - Bose Transition (FQB Transition) occurring in the Heisenberg matrix raster of consciousness[5]. Entrained neuro-dynamic quanta of information are transformed into coherent Bose states through quasiparticle transitions by action of the noeon holophote. Particles exist only above the Fermi level and holes only below. Vacuum boundary conditions allow the spin flip transition. This is the process by which external sensory information is 'transduced' into the coherent noumenon of awareness. How mental quanta - noeons, become psychons as they are coupled to the raster in the local brain.

Entrained neurodynamic quanta of information in the holoscape are drawn by the pumping field holophote action through Bose-condensation to the respective vacuum zero points. *Particles* exist only above the Fermi level and *holes* exist only below. The ground state of a non interacting Fermi system is considered to be a foamy 'vacuum' which provides the boundary condition for the spin flip FQB Transition. There are many 'vacuum' states that apply to the Bose particle as it is 'pumped' up or down through the continuous holophote field of mentation and sensory processing.

MENTONS: PARTIAL LIST OF POSSIBLE MIND-BRAIN RELATED QUANTA		
1. Biophotons	B	Ultraweak electromagnetic emission from all living systems
2. Bose Condensates	B	Coherent ground state integrating memory, perception & psychons
3. Composite Fermions	F	Exchange particles related to the Quantum Hall effect
4. Corticons	B	Quanta of biomolecular vibrational fields in protein filaments
5. Electrons	F	Unit of electric charge with many biochemical interactions
6. Exchange Bosons	B	Quanta of vibrational field of water molecules (Phonons)
7. Excitons	F	Polarization waves of bound electron hole pairs transporting energy
8. Goldstone Bosons	B	Chi, coherent massless spin-zero quanta related to the vacuum state
9. Gravitons	B	Boson mediating gravitational field, also related to mind
10. Ions	F	Ca, Na, & other charged molecular particles involved in energy flux
11. Magnons	B	Magnetization quantized spin waves
12. Noeons	B	Photons of mental action, become psychons when coupled to brain
13. Phonons	B	Elastic waves on a lattice that interact with photons & nucleons
14. Plasmons	B	Collective electron waves or charge accumulation
15. Polarons	F	Electron - phonon interaction
16. Psychons	B	Eccles' interactionist unit of mental coupling to dendrons
17. Quasiparticles	F	Quasiholes & quasielectrons provide Fermion transition to Bosons
18. Solitons	F	Solitary waves in collision or Block walls separating domains
19. Spinors	F	Quantum units of spin half elementary Fermi particles
20. Strings	-	One dimensional spinor extensions at the Planck scale
21. Twistors	-	Spinor pairs corresponding to prespace projective geometries

Table 1. Mentons - A variety of quanta with possible relationships to the cosmology of mind or conscious interactions in biological systems. The Mentons mediate Bose (B) and Fermion (F) states of three types (not labeled): 1. Cellular, 2. Extracellular and 3. Transition - Transitions between states such as Fermi to Bose or transitions between cellular local and extracellular nonlocal. The quanta of the noetic mental field, the Noeon, may be quantized using the physical unit called the Einstein - which represents a mole of photons. This leads to a physical description of the Eccles Psychon as it relates to qualia when coupled to various holoscape sites. But which on the list relate to Qualia? Are these the same ones that act as the *elan vital*? Or relate to brain dynamics? It appears that there are four classes then: 1. Extraneous biophotons, 2. Quanta of the elan vital, 3. Qualia, and 4. Higher level Fermi brain dynamics and quasiparticles. But which quanta on the list actively comprise qualia?

The Psycho-Quasiparticle-Bose Transition (PQB Transition) and Quasiparticle Noumenon Transition (QN Transition) are treated in section 5.

Significant theoretical insights have recently described the Quantum Brain Dynamics (QBD, a term originating with Umezawa) of nanoscale biological structures [29-32, 47, 48]. Aspects of QBD such as biophoton emission and coherence in biological systems (often called superradiance [26, 28] provides a path for Bose-Einstein condensation [97] and can propagate energy. This occurs when a pulse of sufficient strength self perpetuates by re-emitting all the energy absorbed, and is termed self induced transparency [92]. Biophoton emission is a universal natural phenomena, occurring in all living organisms [80].

5. Holonomic Brains

The holonomic brain theory provides a top down model for macroscopic neural processes in the holoscape to couple to QBD [85]. Both processes conjoin at the Heisenberg raster. Eccles' Psychon [31] is additionally tied in with holonomic theory providing the first empirical model for dualism / interactionism or in more modern terms - complementarity.

Karl Pribram considered the mathematics of Gabor, Fourier and Heisenberg to introduce the holonomic brain theory [83-86, 14, 15]. A parallel development, the concept of coherence in biological systems was introduced by Ricciardi and Umezawa [95] followed by Frohlich [36]. Arthur Young [107, 108] proposed the 'quantum of action' as the quintessential ingredient of a cascade that feeds down or out into biological Systems by restricting degrees of freedom of the uninhibited photon.

Understand that quantum theory as conceived by Schrodinger is a deterministic description of a probability wave; it still does not deal simultaneously with the superposition of states, nor does it deal with nonlocality directly especially as it operates in biological systems. Wave mechanics results in either/or outcomes. Cats are either alive or dead. The two visual states of the Necker cube has been invoked in noetic theory to illustrate the 'choice' necessary for a conscious mind because it is an energyless action called 'topological switching' not requiring collapse of the wave function. The Heisenberg matrix, which is deeper in the fabric of spacetime than the brain, is postulated to hold both options (the two topological modes of the Necker cube) at once.

The Noeon is introduced as the putative mind field exchange particle (see Table 1.). Frohlich's posthumous paper with Hyland [38] presents a vehicle for the macroscopic integration of quantum phenomena completing the cycle at the holoscape and clarifies his view of the origin of the EEG.

5.1 FIVE KEY ASPECTS OF HOLONOMIC BRAINS IN TERMS OF NOETIC FIELD THEORY

The holonomic brain theory relying heavily on the Fourier relation and the holographic application of Fourier's theorem by Gabor in 1946 has been expanded by Pribram and his collaborators [86] to include a phase space of interaction in the brain, called the holoscape [85]. Integration of holonomic theory and the Bose-Einstein model provide a substrate for explaining recent work on quantum information processing represented as conformational changes of alpha and beta tubulin dimers in microtubule protein structure [48]. This provides a stage for the first application of these concepts to tangible brain material. However the brain, a Fermi apparatus with Bose interactions, is not the seat of awareness and viewed here as only one of five key aspects required to describe consciousness. Any model of the mind/brain interface must include the complete structure of the psychosphere, at which the current interpretation of quantum theory balks.

A. The Cosmology Of The Noetic Psychosphere

The psychosphere represents the total domain of both mind and conscious awareness as it relates to a living entity [3, 5]. It is a structural-phenomenological domain comprised of:

- A physical noumenon - the cosmological structure; and
- The associated phenomenology - the content of mental activity.

The psychosphere is comprised of a $3(4)D + 7(8)D = 12D$ hyperstructure [2, 4] that includes not only the brain holoscape, but also nonlocal domains of elemental intelligence (fig. 5.1). The psychosphere is the sum of all boundary conditions housing the mind. It is the local complex multi-tiered holoscape of brain activity in complementarity with the standard nonlocal and additional unitary elements of mental activity. The noetic field is not just coupled to the brain but all cells, atoms and molecules associated with a given living system. It is within this complex domain of the psychosphere that qualia can be described in physical terms [2,3,4,6].

The central tenets of Noetic Field Theory (NFT) suggest that consciousness is a quantifiable condition, with both the mind and thought having complementary features in the sense promoted by Bohr; but Bohr's rendition of quantum theory was too limited to apply to biological systems. It is for this reason that NFT is required to utilize an extension of every current standard model.

$$|\Psi_M\rangle = \sum_i N_i |\Psi_i\rangle$$

$$\Psi_M = \Psi|B|b\rangle + \Psi_e + \Psi_c \tag{1}$$

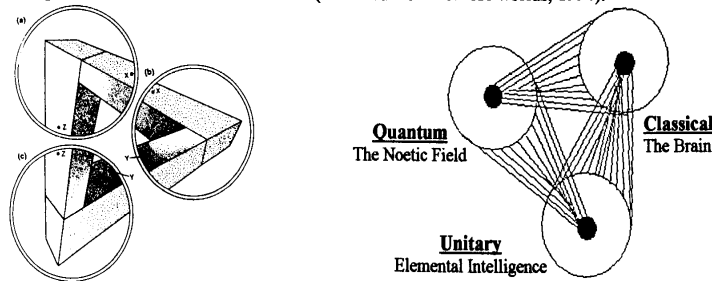


Figure 5.1. A conceptual view of the basic triune premise of noetic cosmology. The psychosphere is comprised of these domains. As is the principle of the least unit of awareness.

Equation 1a is a primitive generalization of a mental base state summed over a twistor singularity originating in nonlocal projective prespace. Equation 1b is a generalization of the three base states comprising the triune nature of the least unit of awareness in noetic cosmology. The equation shows a linear sum for illustration purposes; in reality the expanded equation would have nonlinear characteristics to handle the complex mental action modalities. An ensuing paper presents a mathematical description of noeon action in terms of the holophote pumping field and includes higher dimensional modes in the light cone of reality [6]. Research avenues for noeon particle isolation are suggested. The mantra of NFT is: If one assumes that qualia is a tensor psychon, the leading light cone singularity is modulated by a phase of the noeon psychon field...

B. The Holscape of Quantized Information

Germane to Pribram's holonomic brain theory is the Concept of the holscape, a sub - and trans-neuronal manifold which embodies polarization occurring in dendritic networks [85]. The holscape (Fig. 5.2) is the active manifold of entrained neural processing that couples phenomenal information to the phase space of the Heisenberg matrix below it. Gabor and Fourier relationships describe the activity of information processed in the holscape -neural ensembles as a Heisenberg raster of mental functioning.

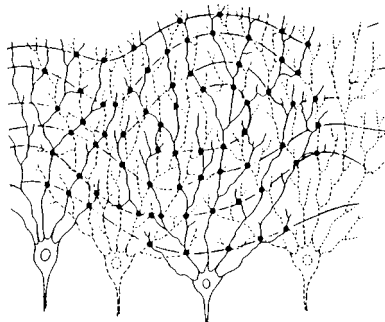


Figure. 5.2 An idealized portrait of a Holscape. In Pribram's Quantum Holographic model of mind bundles of neurons form a dendritic microprocess described by Gabor functions that carry out processing in the brain. This represents a higher level in the hierarchy than that illustrated in Fig. 3.1 Reprinted from Pribram [85].

C. Causation

Causation is a challenging term, particularly in complex Systems with feedback loops and multifactorial inputs. Furthermore, the agency of change in quantum systems is as fundamental as spacetime itself. The quantum concept of causality thus differs from its classical counterpart in that it necessarily links relationships between spacetime events, and thus has a kind of self-referencing aspect. Worse, it is essentially probabilistic at the outset, which makes cause less

tangible. Freeman [34,35] claims that chaotic dynamics can create information in the Shannon-Weaver sense. This finds its correlate as the Gabor logon. (The logon is a kind of quantum of information first defined by Gabor and later used by Pribram [85] in the holoscape.) The question remains as to whether consciousness originates from a kind of qualia (recall panexperientialism) at the level of the quantum domain. There has been general skepticism of quantum effects having any relevance to such a hot entropic matrix as the brain. When a dissipative structure (open systems such as the brain) is pushed to the limit, a new structure can emerge from the fitness landscape. As such, a new template might emerge from lower order inputs, crystallizing into higher order structures which then superimpose limit cycles back on the chaotic regime.

Frohlich's original idea was that dynamical equilibrium represented by a limit cycle could be tuned by chemical electrical stimulus and cause the collapse of the limit cycle. The triggered release of energy could then be harnessed to invoke large scale molecular events such as changes in the geography of QBD. A precondition for consciousness is the ordering and storing of information in the face of randomization in the quantum heat bath. The challenge is to see if quantum systems self organize. Bose-Einstein condensates have the unique property of making coherent wholes by summing the behavior of many component parts which feedback on their elements and create a community. This speaks to the binding problem (Hebb [50], Freeman [34, 35] Libet [63, 64]) in consciousness where many neurons create a unitary self that doesn't seem reducible to any one part. When cell membranes vibrate sufficiently to be drawn into the Bose-Einstein psychon matrix they are forming a coherent whole which resists degeneration by thermal chaos. That is, something must supply the jiggling and something must supply the ordering - one arises out of the other and then feeds back through the system. If electrical activity of the neuron provides the energy to jiggle molecules which in turn emit photons, then these photons can synchronize jiggling and further photon emissions through superradiance [26]. This is analogous to the pumping of a laser. The shift into the condensed phase depends on this molecular photon interaction. It is here where quantum wholeness radiates out over the entire structure. All this superstructure is built in to the self-organized cosmology of living system

D. Biophotons Versus Noeons: Mentons And The Elan Vital Or Random Emission?

Fritz Popp [81-82] and K. Simanonok [90] have indicated that living cells emit a weak photon radiation called biophotons. These biophotons might play a crucial role in cell regulation and consciousness. The quantum state of mind postulated by Noetic Field Theory asks what the basic 'photon of awareness' is.

Much effort has been expended to elaborate an alternative pumping mechanism for producing eigenstates high enough for coherent photon emission in biological systems. For any laser apparatus must be pumped to operate and there are obviously no xenon flash lamps in the parenchyma of the brain. In fact for many years Pribram's detractors said 'if there is a laser in the brain, why doesn't it burn a hole in the skull?' The diode laser provides a more realistic model, wherein the semiconductor is pumped by a nominal electric current. Nevertheless, this is still not the type of device we can expect to find in living tissue. Even so, coherent photon emission has been postulated to occur without a pumping mechanism [26, 28] and is called superradiance.

More recently, Oster [72] has shown that the bacteria *Listeria monocytogenes* can harness Brownian motion. According to Libehaber [62] *Listeria's* scheme for turning random thermal motion into net movement involves an optical thermal ratchet that uses light. The Frohlich superradiant pumping mechanism which is here called FQB Transition (Fig. 4.1) handles only the phenomena of local Fermi brain dynamics and macroscopic quantum effects [38] of the Heisenberg rasters top tier the so called holoscape. This deeper pumping mechanism because of its nonlocal interactions is bounded in a higher dimensional complex; it can only be described by HD vacuum quantization [2]. Some are currently working on this problem with superstring theory or twistor sheaf cohomology. The finer details of the nonlocal pumping mechanism will be presented in a forthcoming paper. Quantum recurrence ensures that quantum systems are almost periodic and can be tuned from a larger set. Photons, for example, as integer spin bosons can crowd into one quantum state and thus be stored timelessly as it were, for timed release. This Bosonization is at the heart of drawing up from the deeper prespace. Here we see amplification from 'behind' one underlying chaotic level to create coherence at a subsequent higher or derived level. This analogy is important to discuss as is the parallel drawn with the putative Higgs

field even though it may turn out the Higgs mechanism is incorrect.

There is a wide spectrum of photonic emission from biological systems much of which is infrared run off from metabolic processes. Most of these biophotons are released weakly into Newtonian space after use; while mentons, comprised primarily of noeons, which make up the elan vital and quanta of mentation are recycled within the nonlocal HD topology of spacetime.

E. The Psychon And Its Qualia

Sir John Eccles, noted for discovering the synapse, defined the term psychon [30, 31] as the basic mental unit where mind couples to a dendron in the dendritic microprocess of the holoscape. (See Table 1.) All mental events such as thoughts, desires, and intentions are composed of psychon units at the top most or most local level of mind/brain interaction. The psychon could be called a sheaf of noeons. "The mind-brain problem reduces to the interaction between a dendron and its psychon" according to Eccles [30]. About one hundred apical dendrites and their branches bundle together as they ascend from lamina V to lamina I in the cerebral cortex. This includes the hundreds of thousands of synapses terminating on them. Dendritic bundles are called dendrons. There are approximately 40 million dendron bundles in the cerebral cortex providing an enormous computation potential. Eccles further suggests that the coupling of the mental units to dendrons in the mind-brain interaction is microgranular [31]. Thus the unitary resolution of our experience of consciousness resolves from a foundation of discrete microscopic points like the dots comprising a magazine photo or more dynamically as film frames that are sequentially illuminated and projected onto a movie screen in much the same way that William James first pictured the flashlight of consciousness illuminating the darkened room of the unconscious. Individual raindrops cohere (raster) by Huygens wave train addition to yield the smoothly perceived rainbow of sentience.

Defining qualia is no simple task. One must first complete the task of presenting a comprehensive theory of consciousness, and then go to the leading edge of that theory to clarify a plethora of terms before attempting to convey any semblance of understanding of how qualia is represented physically. But having come this far lets begin the attempt!

In terms of the overview of the noetic cosmology of a continuous state conscious universe (CSCU) presented here so far there exists, as stated a number of times, a triune structural - phenomenological domain defined as the psychosphere or complete set of boundary conditions representing the autopoietic system [10, 101] realized as an individual conscious entity. Central to this domain is the localized Heisenberg matrix of the brain holoscape representing the raster resolving the entrained moments of conscious awareness. This plane of awareness is a standing wave of present reality [2] and as such is a self-organized complex system - in essence a microcosm of the entire conscious universe. The continuously evanescent mental state of information is termed qualia or the physical embodiment of mental content that changes or evolves with changes in mentation or intention. In this general framework the noetic formalism assumes that:

- Qualia are represented by tensor psychons; the leading lightcone singularity of which is modulated by a phase of the noeon psychon field.

6. Mind - Body: A Casimir-Like Role For The Noetic Formalism

Science, physics especially, accepts nothing immeasurable as real. In this section the Psychon is integrated with Pribram's neural wave equation providing an interactionist solution to the mind-body problem. Because the mind is defined as a physical entity the putative interaction is open to empirical tests. Eccles usage of the term Psychon as the unit of mental experience is expanded here. The Psychon unit as quantities of photons gives physicality and work functions to thought processes and the Noetic Effect. We define the Noetic Effect as the mind-body interaction process. The mathematical method used here to integrate the Psychon with the dendron and existing holonomic theory is a

variation of the Lagrange operator of least action utilizing not the static Casimir effect [19], but a dynamical counterpart [88].

The thrust of this treatment is to account for spontaneous particle production, in this case photons, from the zero point energy fluctuations of the quantized vacuum, as nocons, and from the zero 'vacuum' potential as Psychons. These photons (rather non-radiative scattered Bose potentials confined like quarks to the HD topology of the spacetime metric) can be constrained in a Gabor-like manner. The Casimir effect was used to account for the force between parallel uncharged capacitance plates. This Casimir force is one example of a very general phenomenon in which objects impose boundary conditions on the quantized field. The one we are most interested in is the generalization to parallel interfaces between dielectric media as occurring in the dendron. More recently Schwinger [87-89] has proposed a mechanism for the dynamical counterpart of the static Casimir effect based on the precise measurements of coherent sonoluminescence, where dielectric media are accelerated and emit light. In these experiments, a bubble in water (a hole in a dielectric medium) undergoes contraction and expansion in response to a strong acoustic field. The Casimir function utilizes a phase space similar to that of the Gabor function [85] to trap a psychon-noeon bundle and channel it into the previously described quasi states in the quantum holoscape where Bose condensates integrate in the Heisenberg matrix. Fig. 8.1, provides a conceptual model of the Noetic Effect where the triune action modalities of mind base states interplay.

Sandwiched dipole polarizations account for pulsatile interactions of neurons. The network is composed of overlapping Gabor elementary functions generating a pixel like lattice storing and processing information. The notion of perpendicularly arranged dipoles of polarization generated within dendrons [86] is intriguing. By modifying the Casimir effect [19] we can see parallels between the Eccles' Psychon and Gabor relation. Casimir outlined the influence of retardation on London-van der Waals forces between neutral atoms. Instantaneous dipoles account for interactions between electric double layers separated by large distances. The interaction energy of a neutral atom (by analogy, here the Psychon noeon sheaf) with a perfectly conducting wall (and here, the holoscape manifold) is given by the atomic dipole with its image. Retardation effects are expected when the distance from the wall becomes large, according to Quantum Electrodynamics (QED). The asymptotic expression of R contains Planck's constant and the static polarizability of the atom as the only quantities. Casimir confined the neutral atom within a perfectly conducting plane wherein the eigenstates of the electromagnetic field are described by Maxwell's equations and treated as if the atom were a quantum particle in a box. The box in our dynamic case is the change in boundary conditions in FQB Translation. The total energy interaction between the wall and the atom is given by [19]

$$\Delta_t E = \Delta_d E + \Delta_e E \quad (2)$$

Second order interactions of the atom with a radiation field give vector potentials which can be manipulated with the Heisenberg method where the electromagnetic field is treated as a matrix [19]. Perturbation of the radiation field by a charge assigns vector potentials as elements of the matrix, and uses a simplified wave equation for the oscillating dipoles. This method has been used to account for atomic spectra (helium Rydberg atoms), macroscopic conductors, long range atom surface interactions, dielectrics and liquid thin films. To understand the origin of the Casimir effect requires QED. It is well known that radiation is quantized photons, and that these emitted photons can interact with atoms. Radiation in free space can be thought of as a superposition of many modes of oscillation within a box of arbitrary size. The energy of each mode can be thought of as a harmonic oscillator and restricted with a set of discrete energy values. The level of spacing between energy states corresponds to one photon so that the emission of a photon is simply a process in which energy field frequency is increased by one unit. We have experimental work in mind looking at the Aharonov-Bohm effect [1] and quantum Hall effect.

The quantum mechanical oscillator has energy gaps given by Planck's constant times the oscillator frequency and must have a minimum, called the zero point energy. These fluctuations become apparent in the Lamb shift due to a change in atomic energy levels attributable to atomic nucleus proximity. The force arising from vacuum fluctuations has been measured by Sukenik [100] and found to be modified by proximity to a conducting plate with no electric field applied. Near a conducting plate the number of modes of the radiation field are reduced by the boundary condition such

that the electric field at the surface must be zero, so the atomic energy decreases close to the conducting surface leading to an attractive force. The van der Waal potential between two atoms, which begins as r^{-6} becomes a potential that varies as r^{-7} when the atoms are separated by distances greater than several Bohr radii.

A related prediction is that the interaction between a neutral atom and a conducting wall changes from an initial r^{-3} to an r^{-4} potential when an atom is far enough from the wall. This interaction can attract even neutral atoms to each other due to the quantum fluctuations. Classically the electric dipole moment of a neutral spinless atom is exactly zero but in quantum mechanics only the *expectation value* is zero. Probability allows that there can be a nonzero dipole momentarily. If a photon can propagate fast enough between two atoms their instantaneous dipole can be correlated and the result is an attraction or ordering between the two atoms. For distant atoms photon exchange time cannot be ignored. Sufficiently long intervals destroy the dipole correlation.

The limit, as always is set by the uncertainty principle which relates the lifetime of the excited state of the nonzero dipole energy to its energy. Beyond which neutral atoms can still interact via instantaneous polarization of the quantum vacuum. The vacuum fluctuations can be thought of as oscillators with wavelengths long enough to communicate with both atoms. It is no longer wavelengths that mediate the interaction as the distance increases. This separation introduces a $1/r$ multiplier to the potential r . The retarded force can also be considered a variance in the zero point energy, a phenomenon evident in the Lamb effect. More importantly, although QED fluctuations (Maxwell's equations within a box) can account for the Casimir force, one can handle these Casimir-Polder interactions with standard methods of quantum mechanical perturbation theory without resorting to zero point energy. In this case, the long range Casimir forces depend on the exchange of two photons leading to a format to integrate the Psychon with QBD.

Quantization of the radiation field by means of traveling waves with a period L can be written for the vector potential [19]

$$A = \sum_{k,\lambda} cC_k e(K, \lambda) \times [AK, \lambda e^{-i(\alpha t - kr)} + AK, \lambda + e^{i(\alpha t - kr)}] \tag{3}$$

where the values of the components of the wave vector k are restricted to . The elementary charge e is the perturbation parameter arising from the interaction of G of the charged particle with the radiation field. (An electron in a stationary state does not radiate). The matrix elements, with G as perturbation operator, can be written for the zero state consisting of the radiation field and atom as [19]

$$\Psi'(0;0\dots) = \Psi(0;0\dots) + \sum_{n,k,\lambda} \frac{eC_k}{mhc} \frac{(e(k, \lambda) p_n; 0)}{k_n + k} \Psi(n;0\dots 1_{k\lambda}\dots). \tag{4}$$

The electrostatic interaction between neutral atoms A and B is shown in (5)

$$Q = \frac{q_A q_B}{R^3} - \frac{3(q_A R)(q_B R)}{R^5} \tag{5}$$

The second order perturbation energy can readily be shown as [19].

$$\Delta_q E = -\frac{1}{R^6} \sum_{1,m} \frac{(q_1^x q m^x)^2 + ((q_1^y)^2 + 4(q_1^z q m^z)^2)}{hc(k_1 + km)} \tag{6}$$

As noted, the thrust of this treatment is to account for spontaneous particle production, in this case photons, from the zero point energy fluctuations of the quantized vacuum. Recently Schwinger [87-89] has proposed a mechanism for the *dynamical counterpart of the static Casimir effect* based on the precise measurements of coherent sonoluminescence, where dielectric media are accelerated and emit light. The commonality for static and dynamic Casimir effects are probability amplitudes for preserving the photon vacuum state as illustrated in equation (7) [88].

$$\langle 0_{t_1} | 0_{t_2} \rangle = \exp[iW_0] \tag{7}$$

Light emission occurs by the reversible collapse of a cavity in a dielectric medium into a vacuum. Schwinger's starting point is the action W a resultant of scalar electric (e) and magnetic (m) fields where $X(x)$ is the spacetime dielectric constant in equation (8) below [88]

$$W = \int (dX) \left[\frac{1}{2} \epsilon(X) (\partial_0 A)^2 - \frac{1}{2} (\bar{\nabla} A)^2 + AJ \right]_e + \int (dX) \left[\frac{1}{2} (\partial_0 A)^2 - \frac{1}{2 \epsilon(X)} (\bar{\nabla} A)^2 + AJ \right]_m \tag{8}$$

A and J are related by Green's function which eventually leads to the volume nature of this effect. Conditions under which volume effects dominate surface effects during photon pair production can be formulated by the differential equation [87]

$$\delta W_0 = -T \delta E = \frac{i}{2} Tr[\partial_0 \delta \epsilon \partial_0 G], \quad G = [\partial_0 \epsilon \partial_0 - \nabla^2 - i0]^{-1}, \tag{9}$$

in which θ is the toward zero approach from positive values.

The dielectric energy relative to vacuum zero point is derived as [87]

$$E = -V \int \frac{(d\bar{r})(d\bar{k})}{(2\pi)^3} \frac{1}{2} k \left(1 - \frac{1}{(\epsilon(\bar{r}))^{1/2}} \right) \tag{10}$$

where the Casimir energy is negative for a uniform dielectric medium. The energy relation of the two dielectric regions is proportional to the volumes where $1/e^{1/2}$ demarks the $e > 1$ area from the vacuum.

We propose that The Noetic Effect, through the mediation of the noeon, couples an active psychon to a dendron, the dielectric medium of the brain. This will release a Casimir energy potential for binding the psychon to a donor acceptor cavity of mixed states akin to that found in spin glasses. The release of the Casimir energy potential parallels the electromagnetic emission of photons or the scattering of photon energy into the oscillating dipole medium during cavity translation. According to Schwinger [87] the average number of photons released for cavity radius R is revealed in the equation

$$N = \frac{4\pi}{3} R^3 \int \frac{(d\bar{k})}{(2\pi)^3} \frac{1}{2} (e^{1/2} - 1) = \frac{1}{9\pi} (RK)^3 (e^{1/2}). \tag{11}$$

A key consideration about this relation is the experimental tact that the force is measurable. It is not merely speculation about quantization of zero point energies. Also, finding a likeness between parallel plates and microtubules is not much of a stretch. Arthur Young's suggestion that the photon as the principle of action is synonymous with

purposive behavior is relevant to our discussion. This teleologic aspect of light derives from the idea of least action, which in turn comes from 'wholes' and first causes. Action is the whole, of which the three parameters mass, length and time are parts. First promulgated in 1976, we see Young's idea as prescient. Young develops a hierarchy where the uncertainty of the photons, or quantum of action, is its capacity to cause something new, i.e., within light is the essence of causality [107, 108].

7. Physics Envy - More On The Noumenon

"The fundamental difficulty in bringing the study of consciousness into science... is the lack of a conceptual framework" [96]. Stapp [96] further remarks that the way quantum theory is interpreted is the key to the physics of mind-brain. Ernest Rutherford groused that "all science is either physics or stamp collecting." What is needed in physics is a deeper explanation of higher ordered dimensionalities, where various symmetries might be unified. In SU(5) for example a multiplet of particles of colored quarks, electrons and neutrinos can be rotated into one another. This kind of unification takes of the order of 10^{24} electron volts, just a wee bit less than what it takes to get to the Planck length. At this level, subatomic particles can be treated as tiny vibrating strings, strings of vibrating hyperspace. Supergravity set the Fermions among the Bosons, establishing the possibility of putting all particles into one multiplet. Supersymmetry requires a whole new way of calculating with super numbers that defy common sense. The 'sparticles' defined in this fashion can be united in 11-dimensional space. Kaluza-Klein theory, now ramped up to 11-D has enough tensors to accommodate the Yang-Mills and Einstein equations, but still fails to satisfy all the demands of the standard model.

String theory builds matter directly out of geometry, which is reminiscent of Plato's notion that matter was conceived from triangles. Penrose tiles have a knack for showing that local effects (dislocating a tile) has nonlocal effects tiles well removed from the perturbation will also adjust. The heterotic string creates particles in the same way that spacetime curvature creates gravity. As Kaku [57] emphasizes, 'the symmetries of the subatomic realm are but remnants of the symmetry of a higher dimensional space.' As it turns out, we will have to wait a long time before we harness enough energy to test string theory experimentally. (EPR had to wait about fifty years for its comeuppance.) Our proposal is more modest in that it involves what we imagine as hyperfine structure of the photon in Casimir-like arrangements. We envisage biomaterials, such as crystallized proteins or even DNA[69] which has already yielded to single electron optical fiber-like effects, as a medium for focusing picosecond pulsed lasers: here we can explore superradiance and light cone

effects. An underlying transpiration of energy provides the "laser pump" sought for holonomic brain theory and provides the vehicle for integrating all aspects of QBD into one dynamic raster of mental phenomena - The Holonom. Its rigorous mathematical description will allow for subsequent measurement. A deeper understanding of both space and the nature of time will enable us to discover the Psychon-Ouasibose-Noeon holophote. A rudimentary transformation in the continuous topological pumping provides [2] a boundary and a fabric for translation.

The Planck length is a local phenomena closed only for Fermi interactions giving rise to the measurement problem of Heisenberg uncertainty in quantum physics. This is not true for photons. The wave moment of their wave-particle duality allows them to pass through the translating staircase of quark-spinor-string-twistor boundaries. Photons may superpose and fill the boundaries of a cavity. This is the avenue that allows Noeons to be pumped in and out of prespace, and Psychons to be trapped and released from the FQB Transition of QBD. This concept when rigorously defined will have profound implications for the advancement of physics, especially the physics of mind.

8. After Thought

What distinguishes the human mind from AI is the essence of experience and quality of free agency. We would argue that simulating the mind is not the same as the mind, that is, it is not wholly an emergent phenomena. The contents of mind cannot altogether be investigated by the contents of physiology. Bergson reckoned 'that between the consciousness and the organism there was a relation that no reasoning could have constructed *a priori*, a correspondence which was neither parallelism nor epiphenomenalism, nor anything resembling them. In the dualist

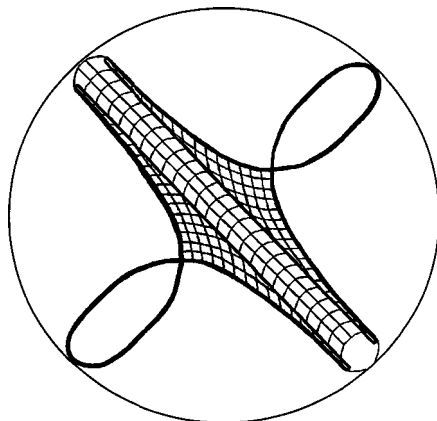
interactionist position presented in this paper *intelligence is a physical state with* field properties not born out of neuronal activity, but underpinning it. Penrose [74, 75] has postulated a threefold nature of the mind where the mental, physical and Platonic all root in physicality. What we call a triune noumenon consists of:

1. Localized Fermi brain states,
2. The generally temporal Psychon world of conscious thought (at the semi-classical limit), and
3. The structural-phenomenological Noumenon of nonlocal atemporal connectivity and integration.

The absolute bound of individual intelligence comes from a hyperstructure with temporal, atemporal, local and nonlocal components and is denoted the Psychosphere. The Psychosphere contains the Holonom of immediate consciousness comprised of sensory phenomenology, thought and attention [5]

A few general features in terms of this field model are: 1 coupling locus, 2. content - both qualitative and quantitative, 3. flux dynamics, and 4. external interactions. In terms of the noetic field and the dynamics of the four qualities of intelligence there are enough parameters to define the complementary aspects of thought in a continuous state conscious universe.

This would be a snapshot of the Holonom - the triune aspects of mental function including the mental states originating in the Psychon world, the entrained neurosensory processing of the holoscape and field couplings to the nonlocal domain of the noumenon of intelligence. See Fig.8.1



NOUMENON OF CONSCIOUSNESS

Figure 8.1. Conceptual representation of the noumenon of consciousness generating the noetic effect of mind - brain interaction a psychotaxic response of noumenal elements on quantum biological processes at the microtubule or other nanoscale structures. In this case a snapshot of the psychosphere revealing the holoscape manifold where a Psychon, which is governed by the conservation laws of the least action principle binds to its dendron. In 2D with scale and dimensionality suppressed. Perceptive readers will note that the loops are a mathematical function called the Folium of Descartes. This noumenal element is scale invariant and can illustrate both spacetime topology and Heisenberg matrix elements. The background circle represents the bound of elemental intelligence. The central baton a present moment of spacetime extension or local segment in the holoscape raster. The folium loops are noeon energy rotating at the speed of light; one loop oriented toward the future and the other the past so that the present is a virtual reality - a standing wave of the future past [2].

When Heisenberg collaborated with Pauli back in the fifties with the hope of unifying all of physics he (Heisenberg) leaked information to the press that they had succeeded. Pauli was furious, since they were a long way off from such a boast. Only the details were missing protested Heisenberg. Pauli sent Heisenberg a blank sheet of paper saying "...this is to show the world that I can paint like Titan. Only the technical details are missing."

We realize that by saying that the fundamental stuff of the universe is not matter and energy, but ultimately geometric information, this appears monistic or idealistic. Not so; the psychosphere is a subspace of a megaverse. Noetic cosmology is squarely in the dualist/interactionist camp of complementarity between mind and body. We believe quantum theory, gravitational theory, electromagnetic theory, cosmology and information theory are all incomplete, and can only be completed with the unification of nonlocal effects in higher dimensions. In the words of Heraclitus: *physis kryptesthai philei* - nature hides itself. An ontology kindred to Bohm's pilot wave concept for hidden variable action might find new life here: the wave function having a physical meaning, guiding particles, not from 3-space, but from nonlocal $N + D$ configuration space or twistor space. More of the details will be offered in forthcoming papers.

References

- [1] Aharonov, Y. and Bohm, D., (1959), Phys. Rev., 115, 485-491.
- [2] Amoroso, R.L., 2002, The cosmology of a continuous state universe, in R.L. Amoroso, G. Hunter, M. Kafatos & J-P Vigier (eds.) Gravitation and Cosmology: From the Hubble Radius to the Planck Scale, Dordrecht: Kluwer Academic.
- [3] Amoroso, R. L. , 1999, An introduction to noetic field theory: The quantization of mind, The Noetic Journal 2:1, pp. 28-37; Amoroso, R.L., 1997, A brief introduction to noetic field theory. Proc. Scientific Basis of Consciousness, ECPD, Belgrade.
- [4] Amoroso, R.L., 2000, The parameters of temporal correspondence in a continuous state conscious universe, In R. Buccheri & M. Saniga (eds.) Studies in the Structure of Time: From Physics to Psycho(patho)logy, Kluwer Academic, Dordrecht.
- [5] Amoroso, R.L. and Martin, B.E., (1995), Modeling the Heisenberg Matrix: Quantum Coherence and Thought at the Holographic Manifold and Deeper Complementarity, in J. King & K.H. Pribram (eds.) *Scale in Conscious Experience: Is the Brain too Important to be Left to Specialists to Study?*, Lawrence Erlbaum.
- [6] Amoroso, R.L., 2001, The Physical Basis of Consciousness: A Fundamental Formalism, Part 1 Noesis, XXVI, pp. 65-74, Bucharest: The Romanian Academy.
- [7] Amoroso, R.L. 1995, The Extracellular Containment of Natural Intelligence: A new direction for strong AI. Informatica 19.
- [8] Amoroso, R.L., Kafatos, M. and Ecmimovic, P. , 1998, The origins of cosmological redshift in spin exchange between Planck scale vacuum compactification and nonzero rest mass photon anisotropy, in G. Hunter and S. Jeffers eds., Causality and Locality in Modern Physics, Dordrecht Kluwer Academic.
- [9] Amoroso, R.L. , 2000, Philosophical Tension: A Structural-Phenomenological Approach to Physicalization in Terms of the Continuous State Conscious Universe, Noesis vol. XXV - Proceedings of the Romanian Academy, pp.93-107.
- [10] Amoroso, R.L., 2002 , The Fundamental Limit and Origin of Biological Systems, submitted
- [11] Arkani-Hamed, N. , Dimopoulos, S. & Dvali, G., 1999, Phys. Rev. D 59, 086004.
- [12] Badii, R., 1992, Complexity and unpredictable scaling of hierarchical structures, in T. Bountis (ed.) Chaotic Dynamics, Theory and Practice, New York: Plenum.
- [13] Badii, R. & Politi, A., 1997, Complexity, Hierarchical Structures and Scaling in Physics, Cambridge: Cambridge Univ. Press.
- [14] Barrett, T.W. (1969a.) The cortex as interferometer: The transmission of amplitude, frequency, and phase in cortical structures. *Neuropsychologica*, 7, 135-148.
- [15] Barrett, T.W. (1969b.) The cerebral cortex as a diffractive medium. *Mathematical Biosciences*, 4, 211-350.
- [16] Baym, G. and Pethick, C. (1991) *Landau Fermi-Liquid Theory'*. New York: Wiley.
- [17] Beck, F. and Eccles., J. (1992) Quantum Aspects of Brain Activity and the Role of Consciousness. Proc. Nat. Acad. Sci.
- [18] Bohm, D. and Hiley, B., (1993), *The Undivided Universe*, Routledge, 1993, p.35
- [19] Casimir, H. and Polder, D. (1948), The influence of retardation on the London-van der Waals forces. *Phys Rev.* 73:4, 360-372.
- [20] Chalmers, D. 1996, *The Conscious Mind*, Oxford University Press.
- [21] Chwirot, W.B. (1986), New indication of possible role of DNA in ultraweak photon emission from biological systems. *J. Plant. Physiol.* 122: 81-86.
- [22] Crick, F. ,(1994), *The Astonishing Hypothesis*. New York: Scribners
- [23] Culbertson, J.T., (1976), *Sensations, Memories and The Flow of Time*, Cromwell Press
- [24] Culbertson, J.T., (1983), *Consciousness: Natural and Artificial*, Libra Press
- [25] Del Giudice, E., Preparata, G. and Vitiello, G. (1988), Water as a Free Electric Dipole Laser. *Physical Review Letters*. V.61,9:1085-1088.
- [26] Dicke, R.H. (1954), Coherence in spontaneous radiation processes. *Phys. Rev.* 93, 99-110.
- [27] Drăgănescu, M., 2002, Theories of Brain, Mind and Consciousness: Still Great Divergences, *Noetic Journal* 3:2, 125-139.
- [28] Eberley, J. (1972), Superradiance revisited. *AJP*, 40, 1374-1383.
- [29] Eccles, J.C. (1993), Evolution of complexity of the brain with the emergence of consciousness. *Rethinking Neural Networks: Quantum Fields and Biological Data*. Pribram, K.H. ed. Hillsdale: Lawrence Erlbaum.
- [30] Eccles, J.C. ,(1992), Evolution of consciousness. Proc. Nat. Acad. Sci. USA. 89, 7320-7324.
- [31] Eccles, J.C. ,(1989), A unitary hypothesis of mind-brain interaction in the cerebral cortex. Proc. R. Soc. Lond. B 240, 433-451.
- [32] Eccles., J.C. (1985), New tight in the mind-brain problem: How mental events could influence neural events. *Complex Systems-Operational Approaches in Neurobiology, Physics and Computers*. H. Haken, ed., 81-106, New York: Springer-Verlag.
- [33] Englert, Scully, and Walther, (1994), The duality of matter and light. *Sci. Am.* 12,86-92.
- [34] Freeman, W. J. ,(1993), The emergence of chaotic dynamics as a basis for comprehending intentionality in experimental subjects. K.H. Pribram, ed. *Origins: Brain and Self Organization*. Hillsdale: Lawrence Erlbaum.
- [35] Freeman, W. J. ,(1991), What are the state variables for modeling brain dynamics with neural networks? *Nonlinear Dynamics and Neuron Networks*, H.G. Schuster, ed., 243-255, New York: VCH Publishers.
- [36] Frohlich, H. ,(1968) Long-range coherence and energy storage in biological systems. *Int. J. Quantum Chem.* 2: 641-649.
- [37] Frohlich, H. (1983), Evidence for coherent excitation in biological Systems. *Int. J. Quantum Chem.* 23:1589-1595.
- [38] Frohlich, H. and Hyland, G. ,(1995), Frohlich Coherence at the Mind-Brain Interface.
- [39] Gabor, D. 1946. Theory of Communication. *J. of the Inst of Electrical Engineers*, 93, 429-441.
- [40] Gabor, D., (1948), A New Microscopic Principle. *Nature*, 161, 777-8.
- [41] Goertzel, B. 1998, Mind as a complex system, *Noetic Journal* 1:2, 122-133.
- [42] Goswami, A. 1993, *The Self-Aware Universe: How Consciousness Creates The Material World*, New York: Putnam.
- [43] Green, M.B., Schwarz, J.H. and Witten, E. (1988), *Superstring Theory'*. Cambridge Univ. Press.
- [44] Griffin, A., (1993), *Excitations in a Bose-Condensed Liquid*. Cambridge: Cambridge Univ. Press.
- [45] Hagan, S., Jibu, M., and Yasue, K. ,(1993), Consciousness and anesthesia: An hypothesis involving biophoton emission in the microtubular cytoskeleton of the brain. K.H. Pribram, ed. *Origins: Brain and Self Organization*. Hillsdale: Lawrence Erlbaum.
- [46] Hameroff, S., (1994), Quantum coherence in microtubules: A neural basis for emergent consciousness. 1, 91-118.

- [47] Hameroff, S., (1990), Computational connectionism within neurons: a model of cytoskeletal automata. *Physica D*. 42: 428-449.
- [48] Hameroff, S. and Watt, (1982), Information processing in microtubules. *J. Theor. Biol.* 98, 549-61.
- [49] Harmon, W., 1991, A re-examination of the metaphysical foundations of modern science, Sausalito: The Institute of Noetic Sciences.
- [50] Hebb, D.O., (1949), *The Organization of Behavior; A Neuropsychological Theory*. N.Y.: Wiley.
- [51] Heisenberg, W., (1949), *The Physical Principles of the Quantum Theory*. New York: Dover.
- [52] Hiley, B.J., (1991), 'Vacuum Holomovement' in *The Philosophy of the Vacuum*, ed. Saunders, S and Brown, H., Oxford U. Press.
- [53] James, W., (1960), *On Psychical Research*, ed. Murphy, G. and Ballou, R.V, Viking Press, NY.
- [54] Jibu, M. and Yasue, K. (1993), The Basics of Quantum Brain Dynamics. In: K. Pribram, Ed. *Rethinking Neural Networks*. Hillsdale: Lawrence Erlbaum.
- [55] Kafatos, M., Roy, S. & Amoroso, R.L. 2000, Scaling in Cosmology & the Arrow of Time, In R. Buccheri & M. Saniga Eds. *Studies in the Structure of Time: From Physics to Psycho(patho)logy*, Kluwer Academic, Dordrecht.
- [56] Kafatos, M. and Nadeau, R., (1990), *The Conscious Universe*. New York: Springer-Verlag.
- [57] Kaku, M., (1995), *Hyperspace*, Anchor Books.
- [58] Witten, E., 1981, Search for a realistic Kaluza-Klein theory, *Nuclear Physics B* 186, 412-428; Overduin, J.M. & Wesson, P.S., 1997, Kaluza-Klein gravity, *Physics Reports*, 283, pp. 303-378.
- [59] Kido, et al, (1995), *Science*, 267, March 3, p. 1262.
- [60] Larson, G.J., (1975), 'The Notion of Satkarya in Samkhya: Toward a Philosophical Reconstruction', *Philosophy East West*, pp.31 -41.
- [61] Leon, R. et al, (1995), *Science*, 267, March 31, p. 1966.
- [62] Libchaber, (1995), *Physical Review Letters*, Feb. 27.
- [63] Libet, B., (1994), A testable field theory of mind-brain interaction. *J. of Consc. Studies*. 1, 119-26.
- [64] Libet, B., (1990), Cerebral processes that distinguish conscious experience from unconscious mental functions. In: *The Principles of Design and Operation of the Brain*. Ed. J.C. Eccles and O. D. Creutzfeldt, *Experimental Brain Research Series* 21, 185-205. Berlin: Springer-Verlag.
- [65] Lipton, B., (1995), *Fractal Evolution*. Personal communication of book in progress.
- [66] Marshall, I.N., (1989), Consciousness and Bose-Einstein condensates. *New Ideas in Psychology*, 7:75-83.
- [67] Mattuck, R.D., (1992), *A Guide to Feynman Diagrams in the Many-Body Problem*. N.Y. Dover.
- [68] Maturana, H. and Varela, F., (1988), *The Biological Roots of Human Understanding*. Boston: New Science Library.
- [69] Meade, T.J and Kayyem, J., (1995), *Agew. Chem. Int. Ed. Engl.* ,34,3, pp.352-54
- [70] Nakamura, K., (1994) *Quantum Chaos*. Cambridge University Press.
- [71] Nozieres, P., (1964), *Theory of Interacting Fermi Liquids*. New York: Benjamin.
- [72] Oster, H., (1995), *Science*, 267, March 17, p. 1593
- [73] Peat, F.D., (1988), *Superstring and the Search for the Theory of Everything*. Chicago: Contemporary Books.
- [74] Penrose, R., (1994a.), *Shadows of the Mind*. Oxford: Oxford University Press.
- [75] Penrose, R., (1994b.), Interview. *J. Consc. Studies*. 1, 17-24.
- [76] Penrose, R., (1979), Twisting Round Space-time. *New Scientist*, 31 May.
- [77] Penrose, R. and Rindler W., (1986), *Spinors and Space-time*. Cambridge: Cambridge Univ. Press.
- [78] Penrose, R., 1996, On gravity's role in quantum state reduction, *Gen. Rel. & Grav.* 28:5, 581-600.
- [79] Plotnitsky, A., (1994), *Complementarity*. Durham: Duke Univ. Press.
- [80] Popp, F and Gu, O., (1994), Biophoton emission as a potential of organizational order. *Science in China B* 37, 9.1099-1112.
- [81] Popp, F.A., Li, K.H., Mei, W.R, Gale, M., and Neurohr, R., (1988), Physical aspects of biophotons. *Experientia*, 44, 576-585.
- [82] Popp, F.A., Ruth, B., Bohm, J., Bahr, W., Grass, P., Grolling, G., Rattenmeyer, M., Schmidt, H.G., and Wulle, P., (1981), Emission of visible and ultraviolet radiation by active biological systems. *Collect. Phenomena* 3, 187-214.
- [83] Pribram, K.H., (1960), The Intrinsic Systems of the Forebrain. In: J. Field, H. Magoun, and V. Hall (Eds) *Handbook of Physiology, Neurophysiology* 11:1323-24 Washington: American Physiological Society.
- [84] Pribram, K.H., (1971), *Languages of the Brain*. Englewood Cliffs: Prentice Hall.
- [85] Pribram, K.H., (1991), *Brain and Perception*. Hillsdale: Lawrence Erlbaum.
- [86] Pribram, K.H., Nuwer, M. and Baron, R., (1974), The holographic hypothesis of memory structure in brain function and perception. In R.C. Atkinson, D.H. Krantz, R.C. Luce, & P. Suppes eds. *Contemporary Development in Math. Sci.* USA 89, 11118-20.
- [87] Schwinger, J., (1993), Casimir light: The source. *Proc. Nat. Acad. Sci. USA* 90, 2105-6.
- [88] Schwinger, J., (1992), Casimir energy for dielectrics. *Proc. Nat. Acad. Sci. USA* 89, 4091-3.
- [89] Schwinger, J., (1994), Casimir energy for dielectrics: spherical geometry. *Proc. Nat. Acad. Mathematical Psychology*. 41:6467. San Francisco: W.H. Freeman.
- [90] Simanonok, K., A theory of consciousness via endogenous light, *Noetic Journal*, 3:1, 57-68.
- [91] Sivakami, S. and Srinivasan, V. (1983), *J. Theoret. Biol.*, 102, 287.
- [92] Sargent, M., Scully, M. and Lamb, W., (1974), *Laser Physics*. Reading: Addison-Wesley.
- [93] Schull, J., (1990), Are species intelligent? *Beh and Brain Sci.* 13, 63-108.
- [94] Rein, G., (1992), *Quantum Biology*. Palo Alto: SIME Quantum Biology Research Labs.
- [95] Ricciardi, L.M., and Umezawa, H., (1967), Brain and physics of many-body problems. *Kybernetik*, 4, 4, 48.
- [96] Stapp, H., (1991), Quantum propensities and the brain-mind connection. *F of Phys.* 21, 1451-77.
- [97] Stehl, R., (1994), *Order Chaos Order* Oxford: Oxford University Press.
- [98] Struppa, D.C., Kafatos, M., Roy, S., Kato, G. & Amoroso, R.L., Category Theory as the Language of Consciousness,
- [99] Stuart, C., Takahashi, Y. and Umezawa, H., (1978), *J. Theor. Biol.* 71: 605.
- [100] Sukenik, C, Boshier, M. Cho, D. Sandoghdar, V. and Hinds, E., (1993), *Phys. Rev. Lett.* 70, 560.
- [101] Varela, F., 1978, *Principles of Biological Autonomy*, New York: Elsevier.
- [102] Vigier, J-P, 1997, Possible consequences of an extended charged particle model in electromagnetic theory, *Phys. Let. A*, 235:5, 419-31.
- [103] Wheeler, J.A., (1968), 'Superspace and Quantum Geometrodynamics' in *Battle Recontres*, .C.M. DeWitt, & J.A. Wheeler, (eds.) New

York: Benjamin.

[104] Wang, H., (1995), 'On Computabilism and Physicalism : Some Subproblems' in *Nature's Imagination*, ed. Cornwell, J., Oxford U. Press.

[105] Wigner, E., (1967), *Symmetries and Reflections*. Bloomington: Indiana Univ. Press.

[106] Wittgenstein, L., (1967), *Zettel* (trans. Anscombe, GEM) Basil Blackwell, Oxford.

[107] Young, A., (1976), *The Reflexive Universe*, Robert Briggs Assoc.

[108] Young, A., (1984), *The Foundations of Science: The Missing Parameter*, Robert Briggs Assoc.

The cosmopsychist need not think of the conscious Universe as having human-like mental features, such as thought and rationality. Indeed, in my book I suggested that we think of the cosmic consciousness as a kind of "mess"™ devoid of intellect or reason. However, it now seems to me that reflection on the fine-tuning might give us grounds for thinking that the mental life of the Universe is just a little closer than I had previously thought to the mental life of a human being.