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Unified Physics and the Information Network of Awareness

THE UNIFIED INFORMATION NETWORK OF SPACEMEMORY AND ITS FUNCTIONALITY IN BIOMOLECULAR DYNAMICS AND AWARENESS.

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Outline

- ***Quantum Gravity and the Holographic Mass*:**
  - QGHM demonstrates the intrinsic interconnected nature of spacetime (holographic mass of proton) and fundamental information properties (Planck Spherical Units).
    - Outputs exact proton radius. Derives Schwarzschild solution from geometric considerations of Planck units (information that was available before GR). Precise confinement force arises from the quantum gravitational properties.
  - Demonstrates how matter is intrinsically connected and how information/memory is recorded on structures of spacetime (gravitational surface horizons).

- **The Copenhagen Interpretation meets reality:**
  - Models of Realism, Determinism, and nonlocality – de Broglie-Bohm Pilot Wave Theory, Yves Couder and macroscopic quantum analog systems.
  - Implications for understanding self-ordering dynamics, synergistic organization, and the fallacy of inherent indeterminacy and stochasticity.

- **Susskind-Maldacena conformal field theory (CFT) correspondence theorem:**
  - EPR=ER, and conversely ER=EPR.
    - Considering QGHM and EPR=ER it is understood how matter is strongly correlated through the multiconnected (quantum entangled) architecture of spacetime.

- **Quantum coherency in the biological system:**
  - Important for demonstrating the action of EPR=ER – nonlocal phenomena in the biological system.
  - A "Machian Principle" of consciousness. It is the information processes of the entire universe (all frames of reference, the global wavefunction) interacting and integrated across all loci that engender the foundational characteristics of awareness.
  - Information is not only correlated across spacetime with the biological system, but systems are strongly correlated within the biological system. Important for understanding the holistic nature of the organism and of awareness (hard binding problem, subjective-objective dichotomy).
  - Water. The strong coherency of the cytoplasm, cerebral spinal fluid, interstitial water, etc…

- **The microtubule information network:**
  - Delineation of microtubule function in memory and information processing – membranes, mitochondria (the mitochondrial reticular matrix), synapses, gap junctions.

Abstract

It is demonstrated how strong correlation of the dipole moments (of charge and spin) of residues in biological polymers, such as deoxyribonucleic acid and microtubulin, are involved in the information processing of awareness, particularly memory, and are entangled across spatial and temporal domains (spacetime). Coherent electromagnetic emissions may modulate the electronic properties and thus behaviors of supramolecular systems, representing a significant signaling and regulatory mechanism functioning in tandem to the strong correlation of the spin and electromagnetic dipoles of polarizable structures in biological macromolecules. Strong coherence across macromolecular structures of the biological system and extension through spacetime via entanglement resolves the "hard binding problem" associated with the generation of conscious awareness by the brain, as it is not only the result of supposed computational activity of neuronal networks, but the integration of information from multiple reference frames across the entanglement network of spacetime. The entanglement network of spacetime, herein referred to as the *unified spacememory network*, emerges as a component of some of the recent elaborations of quantum spacetime architecture in the holographic mass solution to quantum gravity and unification. This is taken in consideration with the Susskind-Maldacena conformal field theory holographic equivalence conjecture that demonstrates the correspondence of micro-wormholes of Planck-scale dimension with quantum entanglement, resolving the *information loss paradox* and providing a physical and ontological explanation for nonlocality observed in quantum behavior. Together, these concepts describe an architecture of spacetime that is built from information and quantum entanglement through a micro-wormhole network. It is shown how the *unified spacememory network* is pivotal to engendering fundamental characteristics of awareness that are actively utilized in the macromolecular information systems of the biological organism.

Keywords

Entanglement; Quantum Spacetime Geometry; Microtubulin; Consciousness; Quantum Brain Biology; Ontology of Awareness; Memory; Spacememory;

Introduction

The scientific delineation of the mechanisms engendering awareness particularly within the biological organism, of which the higher expressions like self-awareness in species such as *Homo sapiens*, often referred to as consciousness, represents a particularly complicated issue in science as it has not been at all clear how to reconcile a process of the characterization of the "objective" external world with the supposed "subjective" internal experience of awareness. However, what exactly can be distinguished as objective versus subjective when we know from theories such as Special Relativity that all frames of reference are relative, or subjective. For instance, two different observers, who will necessarily be occupying two spacetime frames of reference, will disagree on the simultaneity of any event if they are experiencing different accelerations or gravitational forces. Even if an event occurs at time C, one observer will record it as occurring at time A and another at time C depending on their frame of reference, and SR dictates that they are both correct. In this sense, absolute objectivity is illusionary, and indeed we will work to demonstrate that there is no real dichotomy between an internal subjective experience and an external objective reality – they are both based purely in information.

As the previous example indicates, an approach to the systematic description of consciousness that is fully coherent with the known processes of physics, chemistry, biology, neurology, information theory and other scientific fields has been elusive. This is exemplified in unresolved issues that have not achieved a consensus solution, such as the *hard/ binding problem* and the *subjective/objective dichotomy* of consciousness science [1].

The predominant paradigm for the explanation of the mechanisms engendering consciousness has been the neurocomputational model, in which the brain is tantamount to a complex computer. In this model, it is assumed that at a sufficient level of complexity of the computational networks (consisting of myriad synaptic connections of neurons) a subjective internal experience emerges as a simulacrum of the external objective world, based on sensory inputs of the organism. While there is obviously computational like behavior within the central nervous system of higher animals, this is most often correlated with autonomic responses and it is not at all clear how this would result in an internal experience and sentient awareness of the organism.

As such, the neurocomputational model suffers from major deficiencies in its ability to describe basic and fundamental processes and phenomena of consciousness. One of the major issues involved is that the neurocomputational paradigm is far too simplistic. Attempts to reduce the synapse to a single bit (functioning as the true/false state of Boolean logic), is helpful in some regards, but overlooks the complexity of the biological system and this specific multidimensional structure.

For instance, it is no trivial matter that the dendritic network, from the macrocellular level to the molecular level of the presynaptic active zone and post-synaptic density are highly fractal in its cytological architectonics. Subsynaptic spines are often seen forming, absorbing, and reforming during learning processes. This is accomplished through actin polymerization, a macromolecule with a highly fractal architecture, already suggesting a scale-free characteristic of the complexity of the neuron and neuronal synapse in particular, where the general “dendritic aborization and anfractuous pattern” of the synaptic network is recapitulated at subcellular scales, and again at macromolecular scales. The actin polymers giving rise to the subsynaptic (and synaptic) structures are attached to a highly anfractuous macromolecule – the microtubule system, found branching throughout the entire cellular cytoplasm, connecting various organelles and membrane structures. Again, generally recapitulating at the macromolecular level the form and pattern found at larger cellular and tissue-level scales.

Note that this complexity of structure is not encoded in the genetic machinery, but instead arises through epigenesis. Fractal morphologies are often a natural result of such non-deterministic epigenesis because structure is formed following dynamics of chaos theory. It is the supposition of the authors that chaos dynamics represent a prime domain where non-random influences can have significantly large effects – shaping the outcome of what is otherwise a largely unpredictable process.

The scale-free complexity associated with the biological system in general, and the neuron in particular, means that within each cell there is a veritable macromolecular brain, at least in terms of structural complexity, and perhaps to a certain degree functional complexity as well – a fractal hierarchy. This means that the extremely simplistic view of the synapse as a single digital bit is misrepresenting the reality of the situation – such as, if we were to utilize the parlance of the neurocomputational model, each “computational unit” contains a veritable macromolecular brain within it. There is no computer or human technology yet equivalent to this. Note as well that there is no mechanistic description of how the interaction of millions to billions of synapses produces a “conscious moment”, perception,

awareness, or memory. The activity of synapses and action potentials are strongly correlated with brain processes, and therefore obviously involved with perceptive phenomena, but the *how* has not been adequately delineated. Problems in this arena are known under such monikers as the “hard binding problem”, the “subjective/objective dichotomy”, among others.

As such, it may be unwarranted to dismiss the macromolecular structures within the cell, and particularly the neuron, as having no correlation with perceptive processes leading to mental activity. Indeed, because these macromolecular structures are at the scale where quantum mechanics is considered to be the predominant model applicable to the physics underlying the general and specific behavior, the more phenomenal behavior associated with nonlocality [2],means that phenomena such as entanglement may be involved in the “binding” process – leading to wholistic brain function across myriad complex information processing networks, and entanglement of those networks with the environment – the latter resolving issues related to the “subjective/objective dichotomy”.

Moreover, when evaluated with the salient explanans of unified physics, so that quantum mechanical phenomena as well as spacetime geometry, particularly of quantum states are evaluated, solutions to the “hard binding problem” and the Cartesian “subjective/objective dichotomy” are readily accessible. From this we hope to present a coherent, logical, unified, and naturalistic explanation of consciousness and conscious related phenomena, as well as the relation of awareness to the natural evolution and development of physical systems. While this is a heuristic approach, all of the theoretical tenets within the unified model are readily testable (falsifiable), and experiments have been outlined and will be performed. Essentially by testing the sentience capabilities of a field-dependent artificial device and strong correlation through signal nonlocality [3] – the hypothesis herein will be subjected to experimental scrutiny and possible falsification. This will have direct applications to strong AI devices and methodologies, as well as human-to-machine technological interfaces.

It is often presumed that the more phenomenal attributes of quantum theory are not possible within the biological system, because there is too much “noise” as a result of high temperature and rapid dispersion of molecules, and therefore too much interactivity or “measurements” leading to constitutive decoherence. This presumption may be a gross misrepresentation of the actual state of the cell, where there is an extremely high degree of communicability and strong correlation among molecular systems, from the atomically ordered water comprising the cytoplasm to the myriad molecules undergoing specific reactions and interactions synchronized spatiotemporally to an extreme degree of precise orchestration. The naïve view of molecules jostling and bouncing around randomly within the cell is erroneous. There are strong ordering influences that occur in the interfacial layers of water with hydrophilic surfaces of the phospholipid membranes, cytoskeleton, and other biomolecules [4], as well as ordering dynamics that occur via electromagnetic transmission/reception (photon exchange) and correlative spatial resonance within the molecular network of the cell [5], [6].

To this end we will address the problematic issue of the stochasticity and uncertainty inherent to the predominant quantum mechanical model known as the Copenhagen Interpretation, and how its intrinsic indeterminism and randomness is deficient in describing the rise of complexity and organization observed in physical systems. Quantum mechanical models that employ realism and determinism will be emphasized, such as the De Broglie – Bohm Pilot Wave theory, which utilizes fluid dynamical descriptions of actual waves in space to describe the behavior of quanta. This lends great insight into understanding how phenomenal quantum mechanical behavior, such as strong coherence,

entanglement, tunneling, ballistic conduction, etc… is utilized within the biological system. Finally, applying the solutions of unified physics, wherein relativistic and macroscale phenomena are unified in the description from quantum-level events to the cosmological-scale, we elaborate on the physics operating in the biological system and in physical systems in general which may be key to engendering fundamental characteristics of awareness to higher-order sentience.

I. Preliminary Examination of Definitions and Assumptions within Consciousness Science

Perhaps the greatest assumption within consciousness and cognitive science is that awareness arises specifically from the activity, ostensibly computational in nature, of the neuronal tissue of the nervous system of complex animals. On closer examination however, this basic assumption that has predominated the field of consciousness science is not only untenable, it is observationally and demonstrably false. For instance, numerous organisms that do not contain neurons, and much less a central nervous system, are capable of learning, memory, and adaptive behavior; see for instance [5], demonstrating memory and learning in plants. A striking example of this is manifest in some remarkable behavior documented in single celled organisms, particularly in unicellular eusocial protists such as *Physarum polycephalum*, which have been shown to possess volitional and learning behavior [6]. Note that *Physarum polycephalum* forms dendritic networks of pseudopodia: lending credence to the postulated importance of fractal self-similarity in physical systems, particularly filamentary-like connection networks like that seen in cytoskeletons and cellular nervous and circulatory systems, that optimize and maximize information transmission and communication (integration).

Even in some of the smallest of living organisms, such as bacteria, there is directional behavior demonstrable in orchestrated behavior and communication through such mechanisms as quorum sensing. The obvious argument of course is that these are purely pre-programmed, automatic responses to environmental or internal stimuli, and any resemblance of intelligent behavior is merely a simulacrum or “blind intelligence”. Yet, this same line of reasoning can be, and has been extended to human behavior as well. And although it is maintained by such proponents that human consciousness is illusionary, this is a highly dubious supposition to maintain, and perhaps is sustained as a viable philosophical purview by the absence of an adequate description defining when a system or entity is in fact conscious or aware.

We offer the following defining characteristic of when a system is technically aware or conscious: **when a system displays stand-alone volition / goal-oriented behavior.**

Stand-alone volition, or goal-oriented behavior is best ascertained when the behavior is unpredictable by an outside agent, and hence is not *pre-programmed*. Moreover, fully autonomous and independent stand-alone volition will exhibit goal-oriented behavior that is not predictable even from adaptable pre-programming, i.e. there is at least some informational aspect of the system that is non-computational. Notice that this definition does not say anything about the nature or constitution of the system. Indeed, the system could be what we

would consider as *artificial*. This universality of the propensity for awareness regardless of the particular constitution of the system raises another important consideration: the basic elements necessary for the exhibition of awareness, if not for awareness itself.

The following are key elements that are necessary for the exhibition, and possibly the emergence, of awareness itself:

1. **Diversity of Parts** (complexity)
2. **Information Processing** (sensitivity to states)
3. **Memory** (recording of information)
4. **Communicability** (reception and transmission of information)
5. **Integration** (emergence of system as entity)

Consider element 1; diversity of parts – a facet of complexity. A primary presumption within the neurocomputational paradigm of awareness is that when a system is sufficiently complex it surpasses some specific threshold and consciousness emerges, in part, from the intricacy of the system. Indeed, there must be a modicum of complexity, for it is the interaction of diverse constituents of a system that allow for a sensitivity to states or conditions within and outside of the system (part of information processing). However, while this is an important point and a key facet of any *emergentist* theory, it is important to perhaps give a fuller consideration of the fractal nature of physical systems, in which there is a scale-free invariance of complexity. This is an important element to consider because if it is theorized that consciousness emerges when an information processing system reaches a sufficient level of complexity, what does this mean for emergentism if the complexity of the computational systems is a scale-free invariant characteristic?

Even considering the fundamental unit of information, a Planck voxel – compared to the hadron scale there is a veritable universe within a single proton. Nowhere is this scale-free invariance of complexity (fractality) more evident than in the biological system, where cells can contain a molecular information processing and communication system that is a veritable molecular brain. This is a key element of how unicellular organisms can exhibit learning, memory, and goal-oriented behavior, yet obviously not contain a nervous system comprised of a multicellular network.

I. The Unified Spacememory Network

It is obvious that the Copenhagen Interpretation cannot be the last word. The universe is filled with subsystems, any one of which can play the role of observer. There is no place in the laws of quantum mechanics for wave function collapse; the only thing that happens is that the overall wave function evolves unitarily and becomes more and more entangled. The universe is an immensely complicated network of entangled subsystems, and only in some approximation can we single out a particular subsystem as THE OBSERVER. – Leonard Susskind [7]

In previous work [8], we discussed the quantum geometry of spacetime comprised of discrete quanta at the Planck scale. The extremely large energy levels of vacuum quanta at this scale results in sufficiently strong gravitational forces that spacetime is highly curved in a multiply-connected geometry at the

Planck scale. This quantum wormhole architecture, also known as quantum spacetime foam, which we refer to as the spacememory network, is directly related to the structure and behavior of elementary particles. Following upon the similar idea first espoused by John Archibald Wheeler in his theory of quantum geometrodynamics, particularly “mass without mass”, we find that it is the extremely high energy of quantum vacuum oscillators that curves spacetime at the micro-scale to a singularity, and it is this curvature that appears as physical particles. In the paper Quantum Gravity and the Holographic mass [9], it is demonstrated how the mass and radius of the proton is a direct result of this fundamental spacetime architecture.

Moreover, the multiply connected geometry that arises from this extremely high curvature and fluctuations at the Planck scale results in micro-wormhole connections between elementary particles. As described by Leonard Susskind and Juan Maldacena in their ER=EPR Holographic Correspondence conjecture [10] for entangled black holes, the micro-wormhole connections between particles may be responsible for producing quantum entanglement, quantum coherence, and other nonlocal phenomena. Since the same spacetime geometry of maximally entangled states is produced in solutions to black holes in general relativity, it is understood that black holes in maximally extended spacetime may have the same ‘Einstein-Rosen bridge equals Einstein-Podolsky-Rosen correlations’ (ER=EPR) conjecture, a result that Susskind points out resolves the AMPS firewall of the information paradox. Furthermore, this correspondence is highly suggestive that indeed elementary particles are gravitational singularities, or micro-black holes, and exhibits a type of unification between the relativistic and quantum domains.

When considering the multiply connected geometry of space and time at the fundamental level, and possible memory and hysteresis that arises from properties of spacetime analogous to those observed in quantum hydrodynamic analog systems [11], we refer to this spacetime architecture as *spacememory*.

Evolutionary development and trans-temporal molecular communication via the spacememory network

Discussion continues in the full paper which is to be published imminently.

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