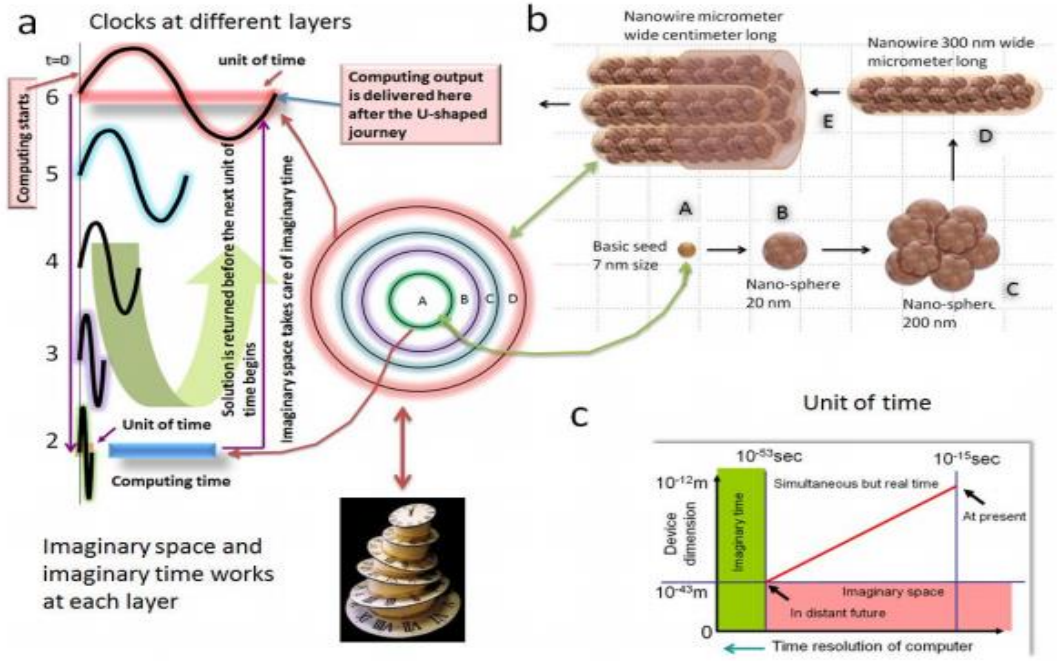
FRACTAL GEOMETRY ENABLES INFORMATION TRANSMISSION THROUGH RESONANCE – NEW RESEARCH SHOWS HOW.

THE RESONANCE PROJECT FOUNDATION

Perhaps nowhere else is the fractal architecture of nature more demonstrable and evident than in the brain. With more neurons than there are stars in the Milky Way galaxy (and 10 times as many glial cells, like astrocytes.. meaning star-shaped cells), and with myriad interconnections among each such brain cell, it does not take much of a stretch of the imagination to see how incredibly complex information processing events could be undertaken by this remarkable cellular system. Yet even after well over a hundred years of research in neuroscience, perhaps since Santiago Ramón y Cajal detailed some of the first investigations of the microscopic structure of the brain in the late 19th century, the neural correlates of consciousness remain elusive.

Given the fractal architecture of the brain, it is most likely that neuronal processes occur across a scale of magnitude, from neuronal networks, to single neuronal membranes, and within – to the information processing systems of macromolecules. Indeed, these observation have led many researchers to posit that the neural correlates of consciousness involve not just the electrical activity of neurons and glia, but of subcellular molecular assemblies like microtubules and DNA.



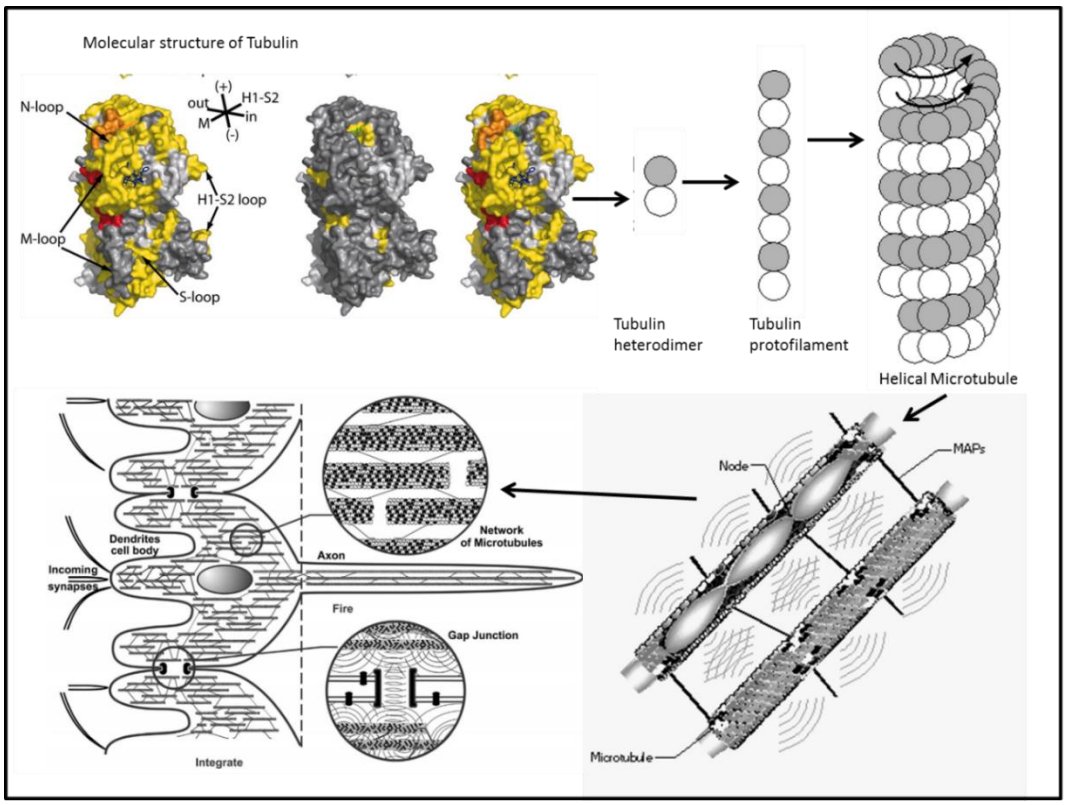
Fractal time: each fractal layer has a corresponding unit of time required to perform a computation. More basic subunits of the fractal architecture cycle at a faster rate, and thus have shorter computational times. The nested architecture is such that a range of frequencies are present – from large to small: fractal frequencies. Image from *Information* publication, Bandyopadhyay *et al.*

Anirban Bandyopadhyay is a preeminent researcher in the burgeoning field of moletronics (molecular based computers, wherein Bandyopadhyay largely utilizes hybrid supramolecular inorganic / organic systems). With actual empirical measurements and working devices, Bandyopadhyay has demonstrated organic molecular systems capable of massive parallel processing (the hallmark of quantum computations) and even beyond - to instantaneous calculations based on structural fractal geometry and frequency – what he calls a "chain of resonance" for scale free "reply back" computations. Remarkably, he has demonstrated a form of nanoscale information processing that utilizes pattern recognition, much the same way that the massively parallel brain circuitry functions. The basis of the brain-like computations demonstrated by Bandyopadhyay and his team closely parallels the theories of consciousness described by Nassim Haramein, in which resonance chains of fractal systems link information exchanges across scale, from the biological resolution all the way to the infinitesimal scale of the vacuum fluctuations of Planck harmonic quantum oscillators.

Molecular Computations found in Biomolecule

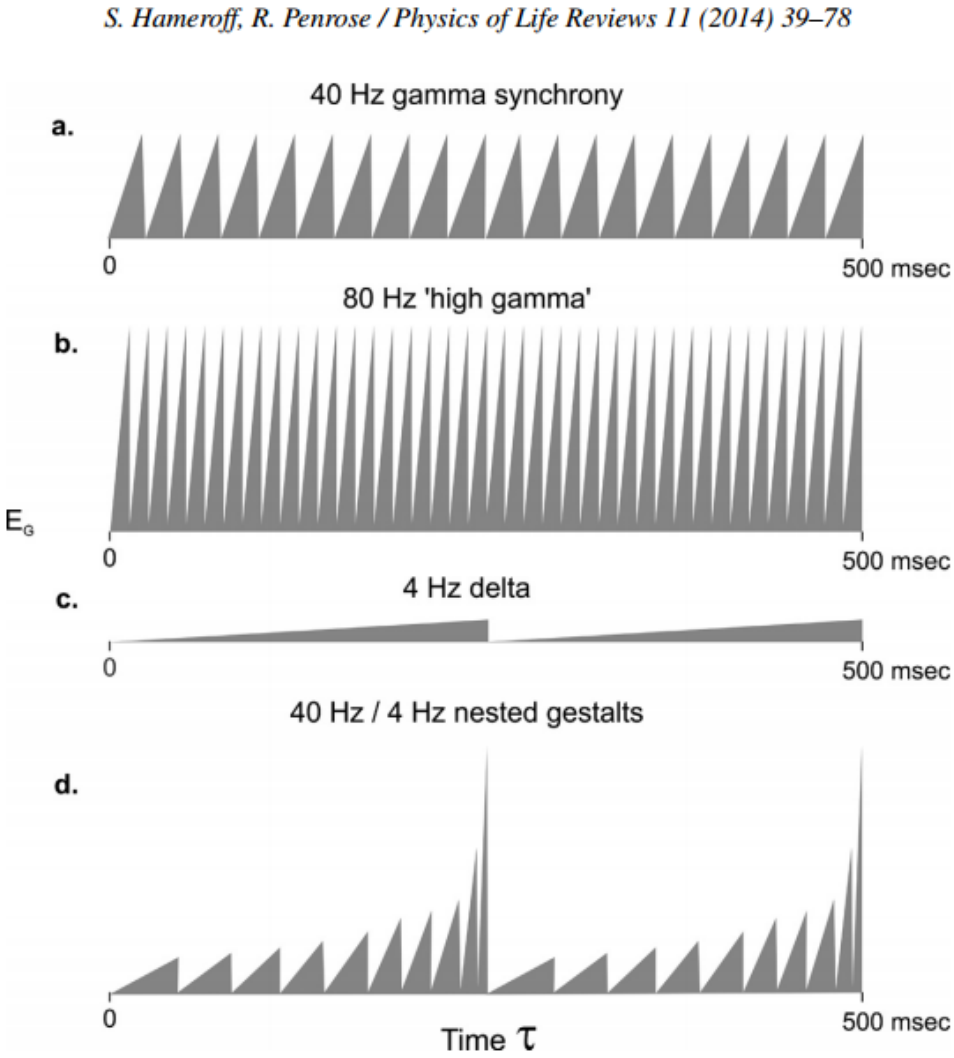
Research, undertaken at the National Institute of Material Sciences in Tsukuba, Japan, with a team led by Bandyopadhyay, has demonstrated how microtubules – long cylindrical tube-like filaments – could function as memory storing molecules. Bandyopadhyay and fellow researchers used a specially constructed device, in beyond state-of-the-art engineering, in part consisting of a scanning tunneling microscope, as well as an atomic force microscope, to probe the electrical properties of a single microtubule nanowire isolated from a brain cell. They confirmed previous observations showing the ability of microtubules to conduct current, and remarkably, they demonstrated that the past conducting-states may be recorded in the protein nanofilament by the orientation of the tubulin subunits – allowing an average sized filament to process and store approximately 500 memory-bits.

What's more, by "writing" a particular conducting state into a tubulin subunit (using a scanning tunneling microscope), recording the state, or "reading", and then erasing and re-reading the state (a process similar to what a computer performs on a RAM drive) Bandyopadhyay was able to demonstrate that microtubules may function with zero hysteresis loss – that is, the "memory" of a past event is not lost with each successive function, but instead is retained (Multi-level memory-switching properties of a single brain microtubule). This is the underlying basis of memory devices within computers, which switch conducting states to form the 0 or 1 states that comprise bits of information. However, unlike the electronic memory devices in computers, which function as a binary system, microtubules may be able to function as multi-bit processing systems, able to adopt multiple conformations, each with distinct conducting states, enabling the processing of multiple bits in a single computational unit.



Implications for Theories of Quantum Consciousness

This research has significant implications for theories of consciousness, especially the theory of quantum consciousness espoused by neuroscientist Stuart Hameroff. Bandyopadhyay has measured specific frequency peaks of macromolecular assemblies like microtubules and DNA, and has shown how these form resonant bands across different sizes, from single nucleic acids or tubulin dimers, to whole neuronal networks. These frequencies could be tied to electrical oscillations of the brain that are correlated with conscious awareness, specifically a new kind of electroencephalographic signal (EEG) of 40 Hz / 4 Hz nested gestalts (gamma and delta oscillations, respectively), referred to as "beat frequencies". Gamma frequencies have been correlated with consciousness, ostensibly through the action of neuronal synchronization, and the periodic wave structure of the gamma-delta "beat frequencies" are very reminiscent of the alternating interference bands of quanta occurring in double slit experiments. Seeming to link the brain synchronization of consciousness with underlying quantum mechanical behaviors of microtubules. With these quantum vibrations microtubules can become entangled across neuronal networks via interconnecting channels, called gap junctions, which physically link neurons together. This is the theory of consciousness developed and espoused by quantum biologist and chief anesthesiologist at the University of Tucson, Stuart Hameroff, and Emeritus professor of mathematics at the University of Oxford, physicist Roger Penrose. The latest findings strongly support their model of quantum-based mechanics within the brain engendering consciousness, which has received extremely harsh criticisms from academics since its inception in the 1980's, as is typical of any revolutionary paradigm.



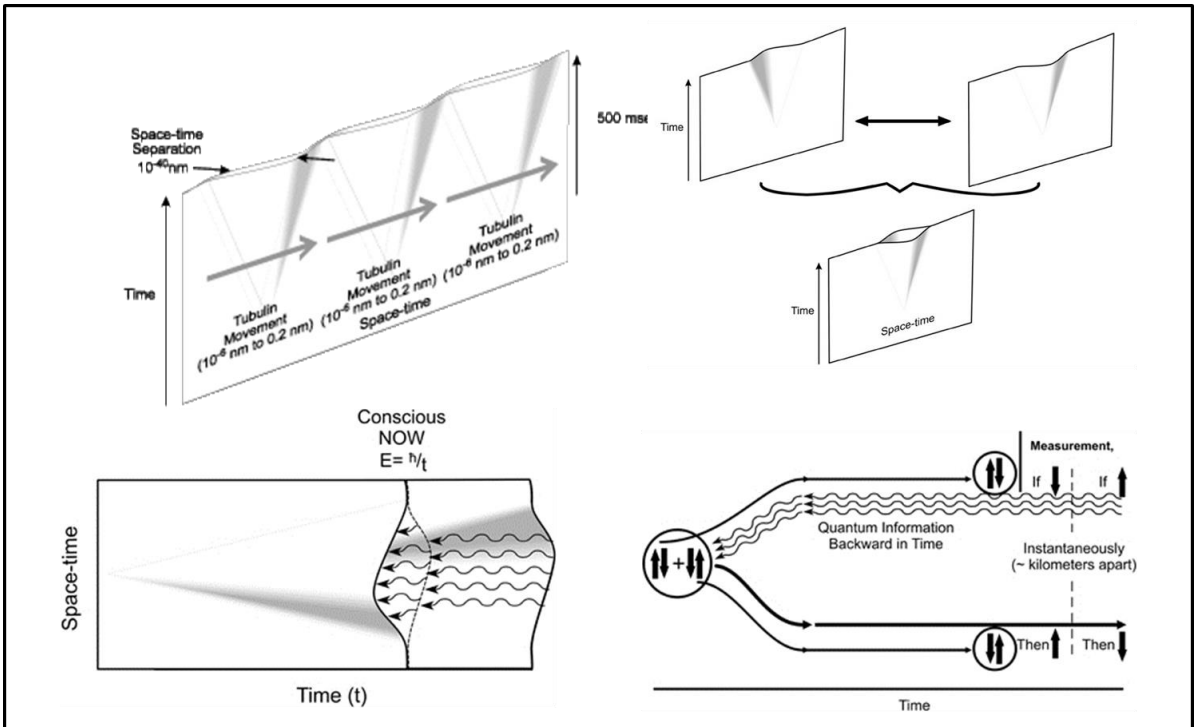
Observations from anesthesia

Furthermore, research performed at the University of Pennsylvania, conducted by Roderick G. Eckenhoff, suggests that anesthetic compounds work in part by disrupting the normal function of microtubules, ostensibly by dispersing the electric dipoles necessary for consciousness. It was Stuart Hameroff's anesthesiological studies in the 1970's that led him to suggest a role for microtubules in the generation of conscious awareness, after observing changes in microtubule dynamics when exposed to anesthetic compounds. If there is a molecule that stops conscious awareness, then seeing what specific changes occur in the cellular environment when exposed to such a compound will be a major clue to what structures are involved in the generation of awareness. Hameroff's revolutionary idea was to take the theoretical mechanisms of consciousness from the cellular-synaptic level, to the nanometer scale of large biomolecular networks, where quantum mechanical behaviors could potentially occur (following in the wake of Herbert Fröhlich who had proposed that long polymer biomolecules could achieve quantum coherent solition waves through metabolic energy pumping, resulting in nonlocal entanglement – later termed Fröhlich condensates).

A NEW KIND OF PHYSICS

One of the key features of Hameroff's and Penrose' theory is called Orchestrated Objective Reduction (Orch-OR), in which it is theorized that the state vector (the wavefunction that describes a particle) of delocalized free electrons within tubulin undergoes an observer-independent reduction (an objective versus subjective collapse of the wavefunction). As the electron exhibits more and more nonlocal attributes, what is referred to as a superposition, the underlying spacetime geometry bifurcates, and the degree of separation between the spacetime "bubbles" – measured in Planck lengths – reaches a critical distance, at which time the spacetime geometry becomes unstable and collapses.

This mechanism is referred to as the Diósi-Penrose criterion of gravity-induced quantum collapse. Each such bifurcation and collapse represents an indeterminable quantum computation, and the coordination of a multitude of such events through quantum entanglement (the orchestrated part of OR) allows for massively parallel quantum computations within the brain. As Hameroff and

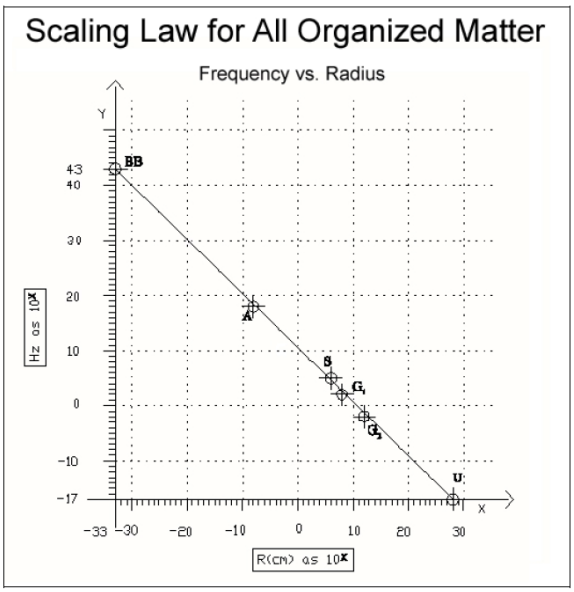


Theoretical models for the role of spacetime in the generation of consciousness in: top – quantum gravity of Orchestrated Objective Reduction; and bottom – bi-directional movement of time.

Penrose suggest, this is what produces conscious awareness. Since, reduction of the state vector is due entirely to this stochastic mechanism, and is therefore in-determinate, it bestows a characteristic of unpredictability to consciousness.

THE HARAMEIN SCALING LAW

Microtubules are truly remarkable macromolecular structures of the biological system, so it is no wonder that a number of researchers have taken a keen interests in them. In the paper Scale Unification, Haramein and Rauscher, along with biologist Michael Hyson, present their findings on a universal scaling law for organized matter. There are a number of organized systems of matter that obey the Schwarzschild condition of a black hole, and when they are plotted on a graph for frequency vs. radius, a trend line emerges, in which structures from the cosmological to the sub-atomic size show a definite scaling ratio. What's remarkable, is that microtubules were found to lie dead-center on the trend line, occupying the equiposition between the ultra-large, and the ultra-small - the macrocosmos and the microcosmos.



"It is of interest that the microtubules of eukaryotic cells… lie quite close to the line specified by the scaling law and intermediate between the stellar and atomic scales" – Haramein *et al*, Scale Unification, 2008

THE FRACTAL MANIFOLD

According to this finding, microtubules may have a harmonic relationship with polarizable structures of the quantum vacuum (which they show is in a Φ (phi) ratio! A fractal-like scaling relationship). John Wheeler first described these fluctuating vacuum structures as mini Planck black holes. Similarly, Haramein shows how the vacuum oscillators may in fact be white hole / black hole systems. So whereas the Diósi-Penrose criterion utilizes a bifurcating "bubble" geometry of spacetime, Haramein's solution shows how it may be the action of polarized white hole/ black hole spacetime structures, the oscillation of which functions as the computational element in analogy to the gravitationally-induced collapse of the Hameroff-Penrose mechanism.

"The universality of this scaling law suggests an underlying polarizable structured vacuum of mini white holes/ black holes." – ibidem

Furthermore, Haramein *et al* describes a fractal manifold structure of spacetime, far from the smooth and flat spacetime architecture envisioned by the Standard Model. This is highly pertinent to the nature of consciousness, because fractal systems are produced by / and underlie chaos dynamics. One of the key features of chaotic systems is that they can be extremely sensitive to even small changes, because of the nonlinear interactions that result from feedback operations and high global coherency within the system. As such, there is an indeterminate nature to fractal / chaotic systems, much like trying to predict the weather. So that in contrast to the objective reduction mechanism proposed by Hameroff and Penrose, the chaotic dynamics of the quantum vacuum foam fluctuations could be the source of the seeming unpredictability and self-volition so characteristic of our consciousness (keep in mind that in the technical semantic, chaos does not mean disordered, quite the contrary, it just implies certain key characteristics, such as a degree of unpredictability).

THE TECHNOLOGY OF BIOLOGY

Bandyopadhyay's pioneering work and research has possibly generated an entirely new mechanism of computation (which is almost non-computational in nature, as it doesn't require classical or even quantum circuits) based on the organic fractal architecture of the biological system. And will perhaps soon lead to the first organic synthetic intelligent systems (synthetic biological AI). Moreover, it strongly supports Haramein's theory of the physics of consciousness in which the vacuum fluctuations of the fractal spacetime manifold form the basis of information processing, and through resonant information exchanges and feedback mechanisms across

the dimension of scale create an intelligence and awareness that serves as an ordering (negentropic) force in physical systems, and perhaps the foundations of consciousness in the biological system.

IN BETWEEN A ROCK AND A HARD PLACE? FIND THE MIDDLE WAY

As more and more nonlocal quantum mechanical phenomena are discovered within the biological system, Hameroff's and Penrose' theory (as well as other researchers who are investigating this new frontier of science) is accumulating tangible empirical evidence, so that models of quantum consciousness are transitioning from beautiful theoretical constructs – to demonstrable facts. What's remarkable about Hameroff's as well as Haramein's model of consciousness is that they find the middle ground between two extremes: the spiritual / metaphysical perspective on one side, in which consciousness is primary and cannot really be explained scientifically; and on the other side the scientific / materialist perspective, in which consciousness is an epiphenomenological state that emerges from the complexity of neurons and plays no part in the dynamics of the Universe at large. Instead, what we call consciousness may not only arise from the dynamics of discrete physical events of the quantum spacetime manifold, but play an intrinsic role in the ordering and dynamics of the Universe as well.

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How quantum brain biology can rescue free will - http://www.quantumconsciousness.org/documents/fnint-06-0009321.pdf

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Moletronics: future electronics - http://www.sciencedirect.com/science/article/pii/S1369702102052276