

Coherence Field Theory: Quantum Coherence as the Basis for a Model of Brain Function

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Abstract

A general definition of quantum coherence is developed from analysis of superposition, entanglement, chemical bonding behavior, and basic phenomena of classical mechanics. Various properties of atoms can be better explained if these particles are matter waves that embody a spectrum ranging from relatively coherent to decoherent states. It is demonstrated that quantum coherence so defined can comprehensively explain signal transmission in neurons and dynamics of the brain's emergent electric field, including potential support for the claim that conscious volition is to some degree real rather than an illusion. Recent research in a physiological context suggests that electromagnetic radiation interacts with molecular structure to comprise integrated energy fields. A mechanism is proposed by which quantum coherence as accelerating electric currents in neurons may result in a broadened spectrum of electromagnetic radiation capable of interacting with molecular complexes in the brain and perhaps elsewhere in an organism to influence vibrational and structural properties. Research should investigate whether a consequent energy field is the basic perceptual substrate, with at least some additive electromagnetic wavelengths of this field involved in generating image percepts insofar as they arise from the body, and electromagnetic vibrations the signature of a more diverse phenomenon by which somewhat nondimensional features of perception such as sound, touch, taste, smell, interoceptive sensations, etc. partially arise. If examination of the brain reveals this organ to be composed of a coherence field, structured at least in part by broadened spectrums of EM radiation interacting with molecular components, this has major implications for furthering our model of the matter/mind interface and possibly physical reality in total.

Keywords

Consciousness, Brain, Neuron, Quantum Coherence, Ebb Effect, CEMI, Electromagnetic Field, Electromagnetic Radiation, Superposition, Entanglement

1. Introduction: The Quantum/Classical Divide and Brain Structure

Early 21st century physics has presumed a quantum/classical divide amongst matter. Subatomic photons, electrons, nucleons, and relatively small atomic structures operate according to quantum principles, but as matter ascends upwards in size, quantum effects are dampened and objects behave classically, according to Newtonian principles of motion. A common sense explanation, but as we shall see not applicable to many cases, is that the essentially wavelike nature of matter at the quantum scale can proceed more undisturbed by interference, enabling this matter to interact at rates provisional of near-instantaneous synchrony and even retroactivity. Tiny particles or “wavicles” bind as causally integrated energy fields and coordinate across relatively large distances so they are interacting faster than light let alone the most rapid Newtonian object-phenomena. By contrast, classical behavior seemingly arises between objects macroscopic enough that massive quantities of interference, a hundred trillion or more wavicles haphazardly morphing at contact, suppress the ability of these emergent structures to act as a cohesive unit, resulting in localization parameters reminiscent of billiard balls on a pool table, with relationships and permutations subdued to the position and rate scale of conventional space and time. Large-scale interference can be identified with the phenomenon of decoherence, but it will be shown how this is true only in a limited range of circumstances.

Consciousness, even if we only consider its connection with physiological mechanisms of the brain, appears to defy this restriction of quantumlike phenomena such as near-instantaneity to the nanoscale. We experience features of our minds as fluid, holistic and macroscopic, integrated synchrony which cannot be explained classically or solely in terms of atomic structure. This paper attempts to begin reconciling quantumlike features perceived on a macroscopic scale as the structure of our minds with the quantum/classical divide attributed to nature by much recent research in physics. A concept of quantum coherence will be developed by briefly analyzing current knowledge of superposition, entanglement, conventional chemistry and classical physics as they relate to the idea of matter waves. This is followed by a Gedanken experiment based on neuron anatomy which strongly indicates that electrical signals are transmitted through the cell as currents of quantum coherence driven by fluctuating charge concentrations. It is hypothesized that these coherence currents generate a broadened spectrum of electromagnetic radiation which is substantially active in the infrared region, explaining the pervasive link between hyperthermia in neural tissue and conscious awareness. EM radiation likely interacts among and with complex molecular arrays in a host of ways simultaneously, binding matter into the variegated perceptual field of vibrational and additive structure insofar as it arises from electromagnetism of the nervous system, brain and body. Hopefully, this can establish a conduit from physics to neuroscience, beginning to bridge the gap between models of matter and mind. First, it is necessary to give a brief out-

line of quantum physics' basic concepts and some of their implications in order to derive a firm foundation for the idea of quantum coherence.

2. Basic Qualitative Features of the Quantum Model

Entanglement, superposition, chemical bonding behavior and Newtonian phenomena all have properties in common, such as simultaneity, more or less integrated structure, and waveform dynamics such as vibration, spreading and energy dissipation, but it is not readily apparent how to assemble an organized classification scheme without some analysis. Quintessentially quantum dynamics will be assessed first with an eye towards firming up the conceptual relationship between quantum and classical.

Quantum entanglement is the property by which wavicles evince remote, "nonlocal" linkages between phase or spin for instance that generate statistical correlations even among relatively large quantities. For instance, 15 trillion atoms in the gaseous state have been entangled at 176.9°C, while various experiments entangled a similar amount of atoms at room temperature [1], and two aluminum drums of a trillion atoms each have been entangled at temperatures near absolute zero, about the size of red blood cells [2]. With hot temperatures, atoms disentangle as rapidly as they entangle, a chaotic mess requiring very specific chemical structure for the effect to measurably obtain. If compact, relatively large masses such as solid objects are to holistically entangle, more atypical environments have so far proved necessary in the lab. It seems that propensity for matter to entangle in a way modelable within the scope of electromagnetism tends to depend on entropy, the disorder in a material system, with lower entropy such as is achieved by temperature reduction being provisional of entanglement between larger, more organized masses.

In a physiological context, one hypothesized function of biological structure is to lower entropy via chemical environments that stabilize and buffer, such as membrane and cytoskeletal networks or macromolecular foldings, in theory enabling intricate, sustained and relatively large entanglements. This possibility was entertained as early as the 1940's by Erwin Schrodinger in his seminal book *What Is Life?* [3], but even modern quantum biology has not yet worked out many technical details, though research conclusively shows how entanglement is a key mechanism for the transmission of light energy harvested by chlorophyll pigments to photosynthetic reaction centers. Chemical energy apparently travels through arrays of highly entangled chlorophyll as an electromagnetic wave, attracted towards reaction center hubs strongly enough for laser experiments to demonstrate 100% energy yield from UV light [4]. Electromagnetic radiation seems more prone to entanglement than atomic constituents with their much larger masses, and faster than light correlations of phase between photons separated by 15 km have been recorded [5]. Light entanglement has even been observed as retroactive in experiments where perturbing the path of a photon after it passes the point of intersection as indicated by the speed of light, 300 million

meters per second, also induces correlations.

Quantum superposition is the blending of wavicles into composite structures, allowing these numerous sources of energy to be modeled as a single unit. The most intuitive example of superposition is additive wavelength in visible light, with pure colors diversely combining to produce the entire spectrum of energies (frequencies) as shades, from 400 - 700 nm in wavelength. These conjoinments do not erase the individual wavelengths, for they can reappear upon contact with a prism for instance, but sufficient adjacency fuses them into effective homogeneity. Atoms of small molecules can also superposition, which is the case for methane (CH_4), as its hydrogen atoms blend with the central carbon atom to form a hybrid wave [6]. But as atoms increase in size, they hybridize with neighbors less pervasively, so that much of a large macromolecule's matter will be composed of relatively localized superpositions separated by distances aptly described in terms of traditional, nonquantum chemistry. As a general rule, many organic molecules contain substantial disjunction between functional units, a thermodynamism within which energy is translated into vibration or "heat" rather than causing obvious transformations to size or shape as in chemical reactions. Molecules can be thought of as standing waves comprised of energy contours, and the most significant source of energy differential emerges from influence of the nuclear field on the electromagnetic field, rendering atoms the loci of superposition, and behavior between atoms the dynamic that most delineates matter electromagnetically, granting it the kind of macroscopic heterogeneity characteristic of nature. The most significant source of disjunction in Earth's ordinary matter is caused by the interactions of atoms, in essence boundary conditions of nuclear fields.

The standard account of atomic energy distribution distinguishes matter in terms of charge: protons in the nucleus are positively charged while orbiting electrons are negatively charged. This model works well for explaining chemical bonding behavior, the attraction and repulsion forming thermodynamically stable arrangements between atoms as minimum entropy, the mutual orientation that is most energetically efficient. Superficially it is as if the constituents of a molecule are located in energy wells, a sort of spatial frame that bends around particles, giving them an average medial position as they move, in a way akin to general relativity.

But a property that makes atoms much different than classical objects is proclivity to absorb and emit electromagnetic radiation, which increases or reduces internal energies in quantized amounts as first modeled by Neils Bohr's energy levels of the hydrogen atom. That some energies are allowed and some disallowed was attributable to the behavior of electrons, with these particles elevated or depressed to higher or lower energy orbitals in a sort of quantum jump phenomenon. The logical conclusion was that electrons in orbitals have wave properties which enable them to interact with wavelengths of light by complementary mechanisms. Louis DeBroglie mathematically modeled the hydrogen atom's or-

bitals as oscillating waves of specific energy surrounding the nucleus, and Erwin Schrodinger elaborated this concept into an equation known as the wave function, eventually able to approximate every atom's orbitals. Schrodinger imagined these electron waves as oscillating in energy wells. Squaring the wave function made it interpretable as probability density, providing a means to intuitively predict cause and effect parameters of complex quantum systems by modeling evolution of variably dense waves diffused through space as an extremely precise statistical approximation. However, it remains unclear exactly what a matter wave consists of physically. What is it that underlies probability distributions of the Schrodinger equation? What is the approximative math superimposed on?

Textbooks commonly graph the probability density of atoms and molecules with a three dimensional, "x, y z" coordinate system, and each has a different shape based on how orbitals are placed so as to roughly maximize symmetry of charge since negative charges repel. These familiar shapes range from spheres to evenly spaced dumbbell shapes to doughnuts, in all sorts of combos (**Figure 1**). It must be remembered, however, that the forms used to represent probability density are more geometrical construct than physical matter, and though these images are based on valid intuitions about how electrons interact, they are somewhat arbitrary. But can any realist knowledge be gleaned from the probability concept?

First of all, we note that among the orbitals of an atom, a significant chance exists for the electron to be at any location within the main girth of a probability density. If electrons are point particles, mass would likely be almost constant and greater probability means more rapid velocity putting the electron in a position for larger percentages of time. We could think of the electrons as bees buzzing or circumambulating around the nucleus at such a fast rate that the energy density of any given region appears fixed. But this seems to contradict the ultraorganized manner in which electrons absorb and emit light, an experimentally derived fact lending itself more to the DeBroglie picture of waves in some sense enveloping the nucleus, oscillating at different frequencies or energies depending on where they are symmetrically located and what electromagnetic radiation is

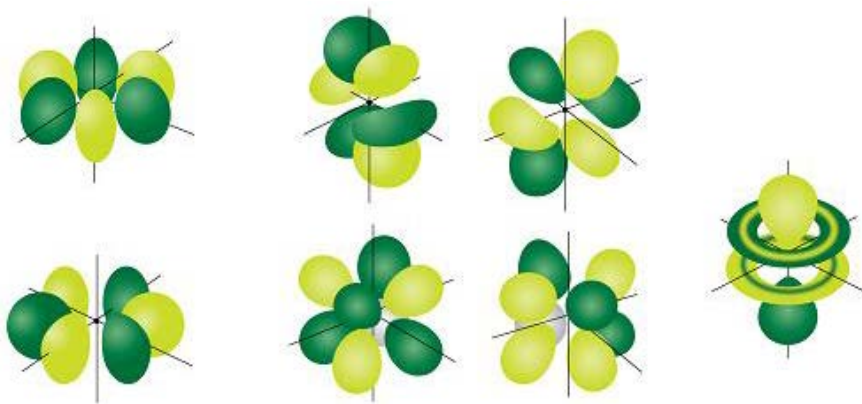


Figure 1. Probability density diagrams of atomic F-orbitals [7].

in the vicinity, more analogous to loops of vibrating string that can be plucked than particles moving in circles or ellipses through an empty expanse.

If we think of electron orbitals as containing wavicles spread out diffusely within the atom, occupying most if not all of its space, what can the probability model tell us about this situation? More probable regions must correspond to greater momentum, which would primarily be due to larger amounts of matter or “mass”, also implying less rapid velocities that put matter in a particular position for longer timespans (assuming a conventionalized notion of velocity even applies), though the spectrum of velocities must be much narrower than that of masses in order for density of matter to correlate with probability density. In this image, the majority of an electron’s motion is concentrated into oscillations of its waveform, with electron orbitals being differing centers of mass orders of magnitude denser than adjacent regions, having characteristic vibrational properties. This makes sense when we consider the way light interacts with electron orbitals, which would simply require frequencies of electromagnetic radiation that complement electron frequencies, but does not come close to resembling the textbook graphs of orbitals in three dimensions, so it is difficult to conceive what this situation looks like physically.

It seems that electrons cannot exclusively be point particles darting around the nucleus at immense velocities, either as a sort of erratic buzzing or complex circuit, and neither can they be delocalized waves as this defies spatial logic of the DeBroglie model and probability diagrams. But common to both is the idea that a contour of low, higher and highest density exists, with numerous sweet spots where momentum is optimally stable. The question then is how to theoretically frame this momentum contour. It is likely to involve oscillation, accounting for interactions with electromagnetic radiation, and also some degree of structural localization insofar as atoms constitute individual units of reactive mass. Perhaps atomic orbital arrays will one day be modeled as a density contoured, oscillating cloud of charge that on average morphs in regularized patterns, a cross between magnetized liquid and kaleidoscopic crystal agitated by radiation and the quantum spins of nucleic wavicles, with ionization or the Compton effect causing electron masses which possess the greatest degrees of freedom in motion to suddenly spike upward in energy density, momentarily assuming properties more akin to a macroscopic particle. Once we better comprehend the physical basis for applicability of spinor math to atomic structure the issue might become clearer, but this knowledge awaits more advanced observational techniques.

3. The Spectrum of Coherence

Most have become accustomed to thinking of charge as absolutely differentiated into positive and negative particles interacting in a relatively simplistic manner. A positively charged proton attracts a negatively charged electron, and cations similarly attract anions. Absolute dichotomies such as this do not mesh espe-

cially well with what we know about the actual structure of physical matter itself, despite practicality as conventions of definition in modeling. The baseline condition seems to be for electrons to exist in atoms as a waveform with complex contours rather than simply points of electromagnetic charge, and this ruled out the possibility that charge is much analogous to Newtonian gravity. With cations and anions, it is electron waveforms which bind chemically, so discrepancies between positive and negative ionic charges are actually a subtle phenomenon of electrical density contour rather than a distinction of type. Beta decay involves the breakdown of a neutron into an electron and neutrino, so nucleic wavicles such as quarks show interchangeability with electromagnetic matter. The picture which starts to materialize is one of a single, monistic energy field with features that vary widely depending on density as a property related to differentials in momentum.

The majority of an atom's volume consists in an electromagnetic field containing loci of substantially greater density that we elementarily conceive as electrons in orbitals. Generally, the less dense a region of mass within electromagnetic matter, the higher its relative velocity. This is proven by the fact that interaction between macroscopic magnets of opposite charge, including enough decoherence amongst interposing space that the field consists in classical particles with an average diffuseness near maximum for Earthbound chemistry, propagates at the fastest rate possible for electromagnetism, the speed of light.

Atomic diameter gets smaller while proceeding from left to right in the periodic table, with added protons making the nucleus incrementally larger. The standard claim is that more positive charge attracts electrons more tightly, compacting the atom. But if positive and negative charges remain equal why would the relative force exacted differ, and if an atom incorporates more electron mass into the same energy levels, why does size of the atom not expand due to more matter and perhaps more negatively charged repulsion?

A plausible explanation is that since both nucleic and electromagnetic matter have wavelike properties, slight interferences or irregularities in momentum occur within atoms from light interactions, mechanical jolting or heat asymmetries, and as the quantity of electrons and correlated complexity of atomic structure increase, the average amount of interference within an atom's energy field heightens. In the presence of electromagnetic, mechanical or heat stress, intricate orbital arrangements cause more perturbation among electron wavicles, nucleic wavicles, and between orbitals and the nucleus. This might generate asynchrony, in theory weakening the atom's structural integrity like a bent and wobbly frame, resulting in less capacity to resist external forces and a slight compression, so that greater amounts of wavicle matter acting upon roughly the same volume makes an atom's internal motions slightly more uneven and measurably shrinks its size if all else is effectively equal.

A hypothetical material system where synchrony is absolute and nothing like interference takes place produces ideal quantum coherence. In reality, states of

coherence are probably partial or at most temporary within any spatial domain that currently has theoretical significance, a fact simply proven by the possibility of time-lagging associated with classical scales and the limited synchrony of quantum scales, but a spectrum ranging from highest to lowest coherence seems to obtain. The concept of interference gives a good approximation to how relative degree of coherence resides on a scale from highest to lowest. Though only actually applicable to physiologically scaled momentums as will be explained later, interference adequately accounts for the spectrum of coherence among relatively dense and heterogeneous energy fields that we can regard as quintessentially electromagnetic.

Superpositions are the most coherent states, where interference is minimal enough that wavicles can be regarded as a single energy field modeled with one Schrodinger equation. Electromagnetic radiation of similar enough wavelength, electron mass in either orbitals or electric currents, and atoms ranging to relatively small molecules or portions of molecules are capable of superposition. The next most coherent state is entanglement, with energy fields comprised of more fragile or fleeting linkages among wavicles, the system tending to spend greater amounts of time on average decohering due to interference. Entanglement consists in temporary correlations that seem able to arise between bits of matter anywhere within the system, even rapidly and remotely enough to be observed as faster than light. Gases, liquids and solids can entangle if chemical structures and conditions are suitable, but the kinds of matter that do so faster than light across substantial distance is constrained, at least insofar as this is modeled in terms of electromagnetism. EM radiation seems to entangle orders of magnitude more readily and remotely than atoms. Less coherent still are chemical bonds, a sort of short-ranged entanglement within larger material systems that experience more electromagnetic, mechanical and heat stress. This degree of interference associated with chemistry is of course crucial in modeling energy fluctuations amongst all kinds of matter, having relevance from the micro to macro scales. Macroscopic matter typical for many Earth situations, especially those with dynamics resembling mechanical properties of organisms, involves a baseline average of so much interference from trillions upon trillions of shifting interactions between diverse wavicles that coherence can be considered negligible for many purposes. These material systems are modeled according to the laws of classical physics, with mechanical forces such as compression, tension, shear, bending and torsion that manipulate interferences in an extremely inhomogeneous way from the vantage point of an atom. Classical principles of course apply at the scale of human bodies and have been key for our species' technological development since prehistory.

Decoherence is not categorically different than the coherences modeled as superposition, entanglement or chemical bonding behavior, merely a distinction of degree. Trillions of atoms are on average in a dynamic equilibrium of asynchronous motions, the baseline state of which involves some level of decohe-

rence, but coherent states can still be induced macroscopically in many situations. The most intuitive example is how electricity travels from higher, “negative” concentrations to lower, “positive” concentrations, surpassing the rates typical of classical physics by a coherent signal velocity of electromagnetic waves that in a good conductor such as copper wire can reach 90% the speed of light. Coherence also increases at especially high temperatures such as those of the sun, where frequency of vibration as heat is so rapid that wavicles spend more of the time in a state of chemical fusion, closer to superposition on the coherence spectrum. Phase discrepancies in matter can also be accounted for using the concept of coherence, as wavicles of solids tend on average to form the short-ranged entanglements we know as chemical bonding much more densely than those of liquids, and likewise for liquids compared to gases, which inclines phases to segregate. Though coherence properties differ depending on circumstance, the majority of electromagnetic matter’s volume is more or less definable as a standing wave, and some form of coherence can hypothetically emerge at any location within the “electromagnetic sea” if convergence of force is adequate. Even in the textbook case of light and atoms, determining the range of forces which participate in stimulating matter to oscillate as a waveform or interact faster than light speed with action at a distance seems to require more than electromagnetism and nuclear physics. Modeling this relative nonlocality at the root of coherence necessitates new experimental methods and theoretical concepts.

We can harness coherence in many inorganic settings such as electrical conductivity, lasers and more, but what about the case of biological systems? Are the complex interactions of biomolecules with what can be described as extensive and diverse interferences provisional of coherence? Research has so far indicated that coherence is in effect on small scales, for instance enzyme active sites and the aforementioned photosynthetic reaction centers, but can mechanisms of coherence play a macroscopic role in living systems? Recent discoveries in neuroscience are in the preliminary stages of affirming that this is indeed the case.

4. The Role of Quantum Coherence in Neuron Signal Transmission and the Brain’s Macroscopic Organization

A primer on neuron anatomy and function will be given by way of introduction (**Figure 2**). The main structures of a neuron are the axon, dendrites and soma. The soma is a cell body housing the nucleus and additional organelles, which looks like a typical cell. At least several dendrites plus their branches sprout from the soma, long and thin protrusions that are also microscopic. The axon projects from the opposite side of the soma and is responsible for longer distance transmission of an electrical signal. Each neuron has only one axon. It is larger in diameter than dendrites but also relatively narrow and can range from microscopic to meters in length. The axon is insulated by a layer of fat called the myelin sheath to increase conductance speed, the source of white matter’s color as opposed to the grey matter of dendrites, soma and the interior of axons. Production and positioning of myelin is regulated by glia, either Schwann cells or

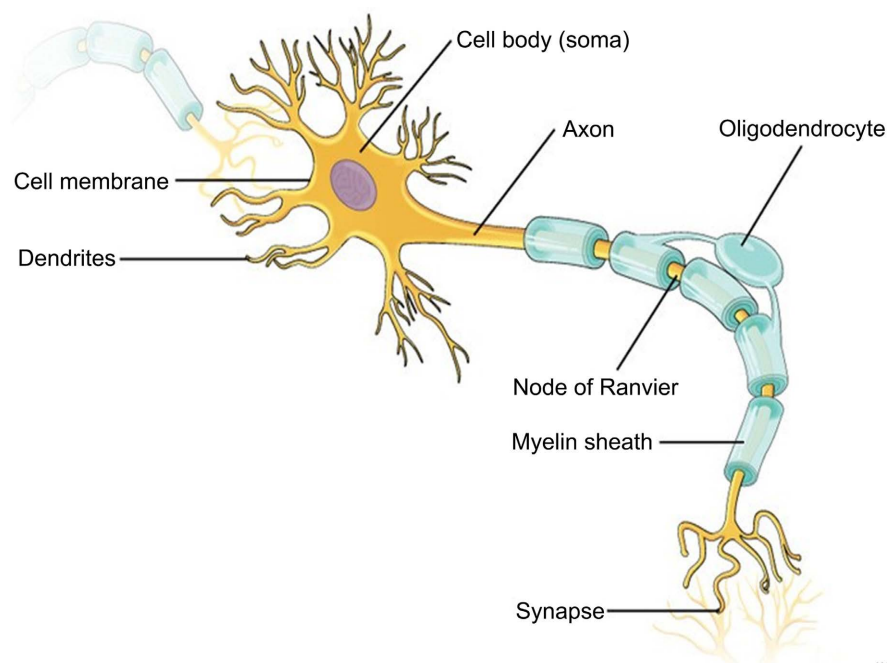


Figure 2. Structure of the Neuron [8].

oligodendrocytes, located around the axons. The synaptic cleft is on the far side of the axon from the soma, where axon and dendrites make connections for transmitting a signal between neurons. Most Na^+ ions are located outside the cell, K^+ ions inside the cell, and Ca^{2+} ions at the synaptic cleft, maintaining concentration gradients for selective diffusion when ion channels open. Cl^- channels are located at the junction between dendrites and soma to block signal transmission while the neuron is at rest. Ions are transported perpendicularly through channels in the neuron's outer membrane as a chain reaction that proceeds from dendrites, through the soma, and ultimately to the axons which integrate more distant regions of the body and brain to form a nervous system. The brain makes roughly a hundred trillion connections between eighty billion neurons.

Neuron firing begins with communication transmitted from an axon to dendrites at the synaptic cleft. Na^+ , K^+ and Ca^{2+} ions as well as a host of more complex molecules such as neurotransmitters are secreted by the axon, flowing around and through the synaptic cleft to stimulate dendrites at the proper moment. This process is called a synapse, and it triggers downstream ion channels to open in sequence, temporarily depolarizing the cell in a voltage change that travels like a blip along the length of a dendrite. This is called an EPSP (excitatory postsynaptic potential). An IPSP (inhibitory postsynaptic potential) from Cl^- influx through its channels at the base of dendrites can block signal transmission, but if cumulative EPSPs from dendrites are strong enough to overcome Cl^- blockage and traverse the soma, a signal reaches the axon hillock at the junction of axon and soma [9] [10]. With enough signal strength, ion channels around the axon hillock start letting Na^+ ions enter through the outer membrane, instigating a longer chain reaction called an action potential. This voltage

signal travels along the axon's length to the axon terminal where a synapse is again prompted at the synaptic cleft.

In an axon, numerous Na^+ channels are clustered at the nodes of Ranvier, relatively small interruptions in the myelin sheath that are evenly spaced along the axon's length. Na^+ channels are voltage-gated for sensitivity to the neuron's electrical signal, which triggers them to open and let Na^+ flow in. Each node of Ranvier is flanked by paranodes, where the myelin sheath attaches to the cell membrane. The paranodes are flanked by juxtapanodes, where voltage-gated K^+ channels allow K^+ to rush out of the axon when open. The majority of an axon is internodal space, with K^+ leakage channels that let this ion back into the cell (**Figure 3**). Because a neuron is more porous to K^+ than Na^+ , sodium-potassium pumps are located throughout the cell membrane, helping to restore ion concentrations of the resting potential by a constant ferrying of two K^+ ions into the cell accompanied by three Na^+ ions out of the cell [11] [12]. Dendrites propagate EPSPs by a similar mechanism, with Na^+ channel nodes and strategically located K^+ channels throughout. After depolarization occurs and the electrical blip travels past a given region, the neuron quickly begins to repolarize, resetting ion concentrations to presynaptic levels. Vigor of signal transmission between neurons is determined by the frequency of depolarizations rather than voltage intensity, with more rapid rates of pulse stimulating stouter responses downstream. The adage is “neurons that wire together fire together”, interweaving to form intricate networks and feedback loops.

Many aspects of neuronal function have been well-understood for decades but mysteries remain, for the transport and diffusion of ions alone cannot account for some observations about signal transmission and neuron anatomy. In theory, ions encounter less axial (lengthwise) resistance in axons of larger diameter,

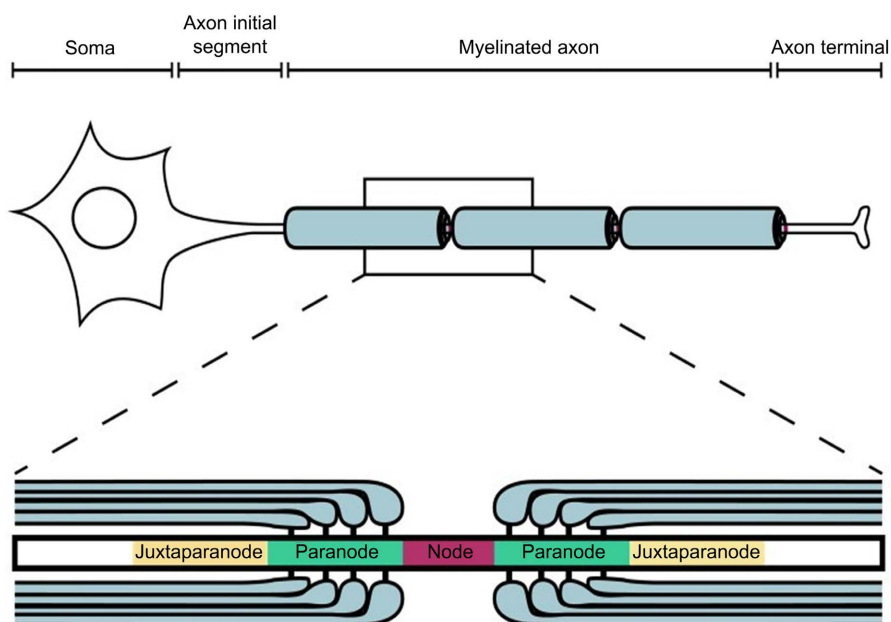


Figure 3. Nodal, paranodal and Juxtapanodal regions [11].

which should result in greater degrees of freedom for diffusion and more rapid diffusion rates. Nodes of Ranvier would then be spaced farther apart to keep the signal's voltage change constant upon reaching nodes, but they are actually spaced closer together in larger diameter neurons [13]. Computer simulations have demonstrated that widening nodes of Ranvier slightly to substantially increase the quantity of Na^+ channels does not change the rate of signal transmission with larger amounts of diffusion [14]. Neither can diffusion plausibly explain why voltage-gated K^+ channels are concentrated at the juxtaparanodes. And an action potential travels meters in milliseconds, far exceeding rates of diffusion. Signal transmission in neurons is not the product of collisions between ions, but quantum coherence in solution seems to explicate it.

Most of the solution internal to a neuron is made up of positive ions and water molecules. H_2O is of course a polar molecule, its oxygen atom being the negative pole and hydrogen atoms the positive poles, bent somewhat at the fulcrum. A solvation shell forms around each positive ion, with negative poles of water aligned on the shell's inner surface and positive poles facing outward. Thus, the solution contains a complex contour of positive and negative charge, or more precisely less and more electron waveform concentration. Nanoscale electromagnetic pressure to evenly distribute electron density within and between atoms, a process quantified in terms of momentum and strength of charge, drives a dynamic equilibrium which keeps water molecules and ions in perpetual motion. Trillions upon trillions of haphazard asymmetries are generated as the solution's baseline, decoherent condition.

When Na^+ rushes into the cell at a node of Ranvier, electron density lessens in that region, drawing nearby electron energy into the vicinity. This electric current moves towards Na^+ increase, but initialization of the current begins adjacent to the node and propagates outward into successively distant regions. Symmetry of the nodal region means that simultaneous propagation in the reverse direction will halt signal transmission's forward trajectory so the node can more quickly reset upstream. If charge is on average constant the signal slows as it travels because of electron mass' inertia, so I have named this mechanism the "ebb effect" [15].

Since electromagnetism essentially consists in a diffuse, high velocity field containing relatively small loci of dense wavelike matter that perturb it while shifting around, the initialization of flow from greater to lesser electron density as a current of electrical coherence, drawing electron energy out of increasingly distant regions of solution, includes a companion EM field fluctuation called an LFP (local field potential) that acts remotely and with effective instantaneity. (As a side note, the nuclear field is similarly instantaneous, for the nucleus possesses at least 99.9% of an atom's mass while binding atomic orbitals that have 100,000 times the volume into a synchronous unit.) Ion channels are apparently adapted for sensitivity to this EM field perturbation that accompanies the lengthwise voltage effect, a phenomenon observed by in vitro experiments with neural networks. Because the EM field's domain is linked with electron density at a specif-

ic region extends to multiple cells, perturbations via coherence currents which alter electron density overlap and form a sort of synchronous grid, integrating the neurons of neural networks via a mechanism of phase-locking between ion channels and the EM field [16]. Quantum spins of atoms in neuronal solution are not aligned as in an iron bar magnet for instance, and this creates slight asymmetries accumulating to largely cancel magnetic effects even at the cellular scale, making the field primarily electric at very basic levels of emergence, though the structure of electrical coherence currents may be momentarily synchronous enough that a spike in nanoscale magnetism is the trigger for ion channels, propagating at the speed of light. Macroscopic waves of the electric field as induced by phase-locking within tightly coupled feedback loops are what EEG (electroencephalogram) measures, and can range in length from millimeters to more than a dozen centimeters [17].

The greater a discrepancy between ion concentrations in abutting regions of the neuron, the stronger the electrical coherence current will be drawn towards more positive concentration, causing initializations to accelerate in the opposite direction and traverse longer distances. Thus, when voltage-gated Na^+ channels at a node of Ranvier open, the electrical signal along with a companion EM field fluctuation accelerate enough to traverse paranodal space. When the electrical signal reaches a juxtaparanode, EM field fluctuation perturbs voltage-gated K^+ channels to open and let the ion rush out of an axon. This rapidly increases the discrepancy in electron density between a node of Ranvier and the juxtaparanode, accelerating an electrical signal with enough force to propel through internodal space and reach the next nodal region. The next node has usually not been completely repolarized, so once the signal attains this node's sphere of influence, acceleration is resumed and EM field perturbation reopens voltage-gated Na^+ channels, a chain reaction that continues down the length of the axon. This mechanism of electrical signal transmission via currents of quantum coherence and the ebb effect, initiated and boosted by voltage-gated ion channels in the neuron's outer membrane, blows through rate barriers of lengthwise diffusion in millisecond communication between neurons [15].

Microscopic platinum sensors inserted into individual neurons have revealed a crystalline structure extending lengthwise just below the axon's membrane, wrapped around a core support framework of microtubules [18]. This crystalline structure probably restricts diffusion into the center of an axon so the ebb effect is not diminished by dilution and ion concentrations remain at efficient levels. Larger diameter axons have more volume surrounding this structure, perhaps necessitating that nodes be closer together so as to compensate for dilution.

Similar structure in dendrites indicates that they transmit an electrical signal from synapse to soma by the same mechanism. Cl^- channels block these EPSPs by increasing electron density at the junction between dendrites and soma, which causes a coherence current to propagate upstream within dendrites as an IPSP. If EPSPs are strong and coordinated enough to breach the soma, this

buildup of electron density accelerates rapidly afterwards across the soma's relatively vast expanse due to the biggest charge gradient in a neuron between the base of dendrites and the largest quantity of voltage-gated Na⁺ channels at the axon hillock.

The ebb effect has not been verified by experiment, but in theory it would be observable within any solution containing ion concentrations disequibrated enough to produce charge differentials that cause electrical currents to flow. A combination of quantum coherence, the ebb effect, phase-locking and neural networking could be sufficient to model the brain's electrical properties from the intracellular to organwide scale. Macroscopic, ultrasynchronous oscillations within the brain's electric field would correlate with consciousness because magnetic properties of atoms are hypersensitive to this supervenient field, just as electricity from a wall socket drives magnets to run many appliances. If diverse neurons and neural networks engage in a range of breadth and saturation in phase-locked synchrony depending on the chemistry of their ion channels, membranes and circuitry, this might explain the spectrum of low to high arousal, from unconscious to subconscious to maximally attentive mental states as Johnjoe McFadden's CEMI (conscious electromagnetic information) theory suggests. Intentional will insofar as it arises from the brain that may simply be neural structure phase-locked to the electric field in feedback loops [16]. Further research along these lines seems likely to resolve the combination problem, accounting for holistic qualities of volition, but what about the substance of consciousness, what are percepts such as colors, shapes, textures, feelings, etc. as physical phenomena? It turns out that the modeling of quantum coherence holds promise for progress on this issue as well.

5. The Role of Light/Molecular Interactions in Producing a Perceptual Coherence Field within the Brain

A mechanism responsible for percepts insofar as they arise from the brain must include a couple closely related features. First, it must be near-instantaneous over time so that the properties of perception are as synchronous and fluid as we experience our own minds to be. Second, it must be near-instantaneous across spatial distances so that perception is an integrated unit, as we also more or less observe. Essentially, the substance of consciousness must be holistic, and unless the miscellaneous manifestations of color, shape, texture, sound, taste, smell, feel etc. are all entirely generated by an underlying, nonelectromagnetic substance akin to aether, which is doubtful in the extreme though a nonlocal substrate transcending atomic structure does seem to exist, this combinatorial binding must be to some degree electromagnetic.

Atoms and molecules alone, while seemingly capable of being perturbed under many conditions via entanglement as induced by the nonlocal substrate, a dynamic that has to this point gone largely unmodeled, do not in themselves interact with anything like action at a distance. This means that even when mas-

sive particles or more precisely “wavicles” as defined electromagnetically correlate faster than light, thus far requiring painstakingly calibrated conditions in order to be witnessed in the lab, they are demarcated by localization boundaries which quickly become prohibitive to integration at macromolecular scales, and by the time emergence reaches the scale where mechanical forces among bodies are usually observed to take effect, atomic structure can be modeled as in the classical domain. From an atomic perspective, the consistent presence of spatial disjunction even at microscales, attributed to a quantum/classical divide, defies holistic qualities of consciousness. But electromagnetic radiation does not have nearly the same constraints. Light fills nonvacuum spaces populated by atomic structure as a wave. Photons are bosons and as such prove much more prone to additive behavior, forming ultrahybrid superpositions of diverse wavelengths. Light waves more extensively entangle via the underlying nonlocal substrate, with phase states of photons correlating across kilometers. And light itself travels at millions of meters per second through permittive and permeable environments such as Earth’s atmosphere or the aqueous solution of cells, effectively instantaneous at volume scales of a brain. So can dynamics of light waves provide an electromagnetic binding mechanism for perception’s substance?

As was mentioned, it has been known for years that photosynthetic reaction centers achieve 100% energy yield from the light-harvesting chlorophyll complex surrounding them. This is ascribed to translation of UV light into a chemical energy that takes multiple routes or “flows” through numerous molecules as a quantum wave via entangled coherence, roughly analogous to a pool of water. Thus, a mechanism by which light and molecules blend into highly distributed energy arrays has been verified. The question then is how common this is.

Early research into light/matter interactions within neurons exposed specimens to UV and visible radiation. It was found that this light could effect neural function, but primarily due to the degradation of ion channels and additional membrane mechanisms, reducing synaptic efficiency [19]. More recent experiments have focused on microtubules because a long-standing, discourse-enriched hypothesis, Roger Penrose and Stuart Hameroff’s Orch-Or (orchestrated-objective reduction) theory, proposes that the compact structure of these cytoskeletal filaments, which pervade all cells, may be conducive to cycling between a global superposition state and wave function collapse in a sort of quantum pulse, perhaps especially instantiated within the brain. Various criticisms of the model have been proffered, for instance that the organ is too hot and wet for superpositions sustained enough to correlate with consciousness, but the idea that light may be involved opens up further possibilities.

A recent experiment aimed to assess the interaction of UV light with microtubules, which can range to 50 micrometers long. It was hypothesized that tryptophan in microtubule filaments, by virtue of being an aromatic amino acid, might have theoretically significant sensitivity to UV light. Analysis showed that a solution of microtubule fragments exposed to UV light was provisional of re-

mote energy transfer between component tryptophan molecules. Anesthetics inhibited this phenomenon, hinting at correlation with consciousness. Combining the data with a model of tryptophan positioning inside intact microtubules suggested this amino acid can mediate the production of a coherent energy field in the presence of UV radiation, extending through the entire length of a microtubule. The only significant source of UV radiation in a typical cell was hypothesized as perhaps the oxidation reactions of mitochondria, so it is doubtful that UV light plays much of a functional role in the brain, but it becomes more and more apparent that atoms blend with light of complementary wavelength to produce coherent states of superposition which can span at least micrometers [20] [21]. That endogenous light within neurons could result in a similar field of quantum coherence among molecular arrays is plausible, but a viable source of EM radiation must exist.

To begin solving this problem, we can simply recognize that all electromagnetic matter is saturated by radiation with various properties depending on this radiation's wavelength. According to James Clerk Maxwell's theory, electromagnetic matter which we in the 21st century conceive as wavelike structure can be described both qualitatively and quantitatively as a field with centers of maximum density roughly approximated in concept by the largest line of force concentrations of a macroscopic magnet [22], all situated within a pervading, "non-locally" active substrate that perturbs on average at a much more rapid rate, exceeding the speed of light. This is the still loosely determined speed of entanglement. The denser that electromagnetic matter is at a particular location, the greater mass it has and the slower it moves relative to the total EM field, with atomic structure as determined by nuclei which are orders of magnitude more massive than electrons being the heterogeneous locus of electromagnetic density. When electrons which as a baseline correspond to atomic orbital structure move, they perturb spaces between them at an on average characteristic rate. This perturbation energy closely correlated with electrons or more precisely density maximums within the electrical portion of a matter field travels through a vacuum like outer space as particulate photons, at the speed of magnetism and the speed of light. Perturbation of photon streams by atoms reduces the speed in a way dependent on electromagnetic properties of those atoms, while causing photons to assume a variety of forms based on conditions of contact, ranging from particulate scattering as in the Compton effect to super positioned waves of extremely hybrid and variable wavelength which participate in making atoms vibrate or "heat".

Most if not all atomic bonds absorb and emit infrared radiation due to vibration and rotation, and many also do the same with visible light. Terrestrial vision tends to be based on a range from 400 - 700 nm because unlike ultraviolet and infrared light this portion of the spectrum is transparent to water. This allows us to detect the surface features of objects in great detail despite the fact that 25% of our atmosphere is comprised of water vapor, along with discerning the purity

and contents of liquid water by visual inspection. Infrared light is emitted by molecules, but is absorbed into vibrating and rotating atomic bonds just as readily, the main contributing factor in production of thermal energy or “temperature”, so does not radiate far before translation into chemical energy. Some animals such as the pit viper have organs for sensing infrared radiation so as to hone in on prey at close range, particularly helpful at night, but visible light is more practical for distance vision as it transmits through the air at long range and is more plentiful than ultraviolet. Despite the fact that optics regards the visible spectrum as its core reference point, infrared is much more active at local scales. Electromagnetic matter on Earth can be thought of as most essentially an infrared field punctuated by particularly concentrated electrical density contours, the atomic centers of mass induced by nuclei.

Like all Earth’s matter the brain is full of infrared light, but the capacity of this radiation to transmit macroscopic distances is constrained from local absorption by all kinds of atomic bonds, including those of aqueous solvent which limit its range to millimeters. However, a wealth of evidence suggests that brain tissue’s thermal energy, the signature of infrared radiation, strongly correlates with function. Brain tissue temperatures have been measured to exceed those of the blood by 0.5°C - 0.6°C in various mammals. In rats, temperature of the hippocampus increases 1.5°C - 38°C when actively exploring. In male finches, temperature of brain tissue increases during variance in song tempo. Feeding and social interaction produce rapid, unique, and relatively long-lasting brain temperature elevations, occurring faster and with greater magnitude than those of the arterial blood supply. In humans, somatosensory cortex temperature increases during nerve stimulation, and likewise for motor cortex and bodily movement. Many brain regions such as the substantia nigra alter their activity when temperature is varied. Rise in temperature of neuronal pathways is generally associated with sensory stimuli, and similar correlations between temperature and data obtained on resting potential, action potential, nerve conduction velocity and synaptic transmission are well-established. Anesthesia lowers brain temperature, a sign that infrared radiation may be linked to conscious awareness. The total brain varies in temperature by 1°C - 3°C in some animal models. Though much more research is necessary, a clear relationship between function and brain hyperthermia, essentially greater amounts of infrared radiation and resultant molecular vibration, seems to exist [23].

Mechanisms of function for infrared radiation have not been proven, but we do have clues. A rapid spike in temperature of two degrees microCelsius occurs during action potentials, hinting at connection between the infrared spectrum and nerve firing [23]. Do the properties of signal transmission in a neuron provide us with a viable hypothesis which if corroborated would explain linkage between the infrared field and consciousness?

As we have seen, the most comprehensive and probable model for signal transmission in a neuron regards these signals as directional currents of quan-

tum coherence regulated by changes in ion concentration at strategic locations such as the nodes of Ranvier, juxtaparanodes, dendrite/soma junctions, etc. If this is accurate, neural signals are propagated lengthwise as electricity, not primarily by diffusion, and thus achieve what can somewhat liberally be regarded as relativistic speeds that slightly increase electron mass, most likely much greater than 10% the speed of light and probably closer to 50% or higher. We know from many technological applications that electrical currents which accelerate at relativistic speeds emit EM radiation of longer wavelength, and decelerating electric current shorter wavelengths. For example, as the high energy beam of electrons in an x-ray machine, traveling at half the speed of light, collides with a metal plate, high frequency braking radiation in the x-ray portion of the spectrum is emitted, while the acceleration of alternating current in a radio antenna emits low frequency radio waves. This effect is probably caused by compression responsible for emission of higher frequency EM radiation from a denser, decelerating mass and lower frequency EM radiation from a less dense, accelerating mass, a physical process underlying the relativistic interpretation. Direct current, by contrast, does not involve sizable shifts in velocity and produces a relatively uniform magnetic field rather than broadened, “thicker” spectrums of radiation. If the binding effect of EM radiation in the brain is to be richer in structure and function than the inorganic environment and perhaps the rest of the body such that some kind of distinctive perceptual field is possible, the most likely mechanism is by way of acceleration or deceleration of coherence currents, expanding the spectrum of radiative energies as well as types of interaction between the radiative field and molecules from baseline to biologically functional levels.

Acceleration of coherence current occurs between the node of Ranvier and adjacent juxtaparanodal regions, while a relatively gradual deceleration takes place within internodal space. However, reverse propagation around each node after activation largely halts lengthwise motion, returning cellular solution to the baseline infrared spectrum of its most localized decoherence, so extra emission of EM radiation is sporadic, insufficient to enhance the total field in a sustained way. Dendrites encounter a similar dynamic of current interference that halts transmission of electrical potential and radiation emittance. Both dendrite and axon nodes are small compared to the entire neuron so any field that is generated seems unlikely to functionally interact with macromolecules.

Acceleration also takes place around the synaptic space on both the dendrite and axon terminal sides due to a gradient of relatively high to low electron density between single positive charge ion concentration (Na^+ , K^+) and Ca^{2+} near the synaptic junction. Ca^{2+} channels would have to engage in a very fast cycle, pumping this ion and its electron energy out of and into the cell fast enough that lengthwise voltage remains stable and a coherence flow's signal velocity can be sustained. Research indicates that ions travel through channels via quantum rather than classical mechanisms [4], and since the rate of a process such as this is near-instantaneous, steady lengthwise voltage and extra EM radiation sustained

enough to augment the overall field is possible, though relevant analysis by experiment needs to be performed. In this model, additional radiation from a steadily accelerating coherence current saturates molecules and membranes of the synapse from both sides. A complete understanding of this mechanism, assuming it exists, requires more detailed analysis of neuron anatomy near the synaptic junction.

At this point, it seems more possible to model coherence current behavior within the soma, between the base of dendrites and the axon hillock. An axon hillock has the largest quantity of Na^+ channels and Na^+ ions in a neuron, and dendrite/soma junctions are where Cl^- channels and Cl^- ions are concentrated. Reuptake of Na^+ within the soma, upstream of the axon hillock, remains somewhat less than in the rest of the neuron due to greater volume, which is also the case with K^+ , so a fairly steady gradient of positive ions ranging from highest concentration at the axon hillock to gradually lower concentrations while approaching the dendrites is maintained. Cl^- reuptake must be efficient enough that most of this ion's concentration cycles near the dendrite/soma junctions as a result of diffusion.

During the initialization of a resting potential, Cl^- concentrations are at their highest following an influx that halts dendritic potentials with reverse propagation of a coherence current. Cl^- concentrations then begin to diminish due to reuptake and the back propagating coherence current ceases, though electron density persists at relatively high levels. When dendritic potentials again reach the soma junction and reverse propagation is minimal, this draws higher electron density out of successively more remote regions of the soma via the ebb effect. Combined with some continuation of Cl^- influx, an increase in size and breadth of electron density occurs until this replenishing mass comes under the influence of the positive ion gradient imposed by the axon hillock. This mass then accelerates away from the dendrites with enough force to reach the axon hillock, prompting its voltage-gated ion channels to open as a consequence of the accompanying local field potential. Large amounts of Na^+ rush in, stimulating an action potential and restoring the positive ion gradient within the soma. This large influx of Na^+ to its maximum concentration sustains acceleration of the coherence current even while electron density from Cl^- influx attenuates and reaches a minimum due mostly to the dendritic potential's distributing effect. As Na^+ concentrations again attenuate at the axon hillock and within the soma, Cl^- concentration increases and regains a maximum at the dendrite/soma junctions to block EPSPs, sustaining acceleration from the opposite side, recycling the process. Thus, even in the absence of an electrical potential and EM field sufficient to trigger action potentials, acceleration is sustained by charge differentials on either side of the soma.

To summarize:

At the dendrite/soma junctions:

- 1) Cl^- influx, concentration and electron density maximum
- 2) Cl^- concentration and electron density attenuation

- 3) The ebb effect force of dendritic potentials combined with some Cl^- influx
- 4) Electron density from Cl^- concentration at a minimum, with continued influx

Instigated by the axon hillock:

- 1) Na^+ concentration attenuation
- 2) Greater Na^+ concentration attenuation
- 3) Na^+ concentration minimum
- 4) Na^+ influx and concentration maximum

The resultant acceleration of a coherence current through most if not all of the soma's volume is held at roughly constant levels. This model of course needs verification by experiment, but it seems probable that a steady source of extra EM radiation can be maintained in the soma also.

If sustained EM radiation is emitted at relatively large scales around the synapse and within the soma, we must then discern its properties. Quantum coherence currents do not have any electrical circuit or grounding to maintain or increase velocity as they travel, so these flows probably begin at roughly the same speed as average agitation from decoherence except channeled in a lengthwise direction, gradually decelerating with distance due to inertia if charge is constant. This means that initialization would produce EM radiation complementary to decoherence in aqueous solution, centered on wavelengths slightly longer than those of the boundary between visible and near-infrared portions of the spectrum. If charge differential and thus voltage suffices to accelerate the coherence current, its electrical density decreases and lower frequency light will be released. Thus, acceleration around the synapse and within the soma probably adds somewhat longer wavelengths to the spectrum. Altogether, it seems reasonable as a hypothesis that coherence currents thicken the infrared core of a neuron's spectrum to at least 1 - 10 micrometers in wavelength, maybe beyond. This spectral range of EM radiation is capable of traveling through aqueous solution at distances from 100 millimeters - 10 micrometers, with distance shrinking as wavelength increases (**Figure 4**). The soma is about 12 cubic micrometers and the synaptic space 1 cubic micrometer, with the space occupied by coherence currents themselves roughly equivalent in volume, so it seems credible to assert that this 10+ micrometer wavelength spectrum can saturate both. Whether very low intensities of visible light that more readily travel through aqueous solution could be present via coherence current deceleration and interactions with molecules is uncertain. Together with maximized reflection of this radiation from white matter, the brain's grey matter may be saturated with a substantive light spectrum capable of influencing properties of molecules. The extent to which similar mechanisms occur in conjunction with the ion channels of non-neuronal cells is also an interesting inquiry, barely broached.

Electric current accelerates from greater, "negative" electron density towards lesser, "positive" electron density in settings that are presently more amenable to measurement than neuronlike solution. Proportional counters work by injecting alpha, beta and gamma energy from radioactive substances into mixtures

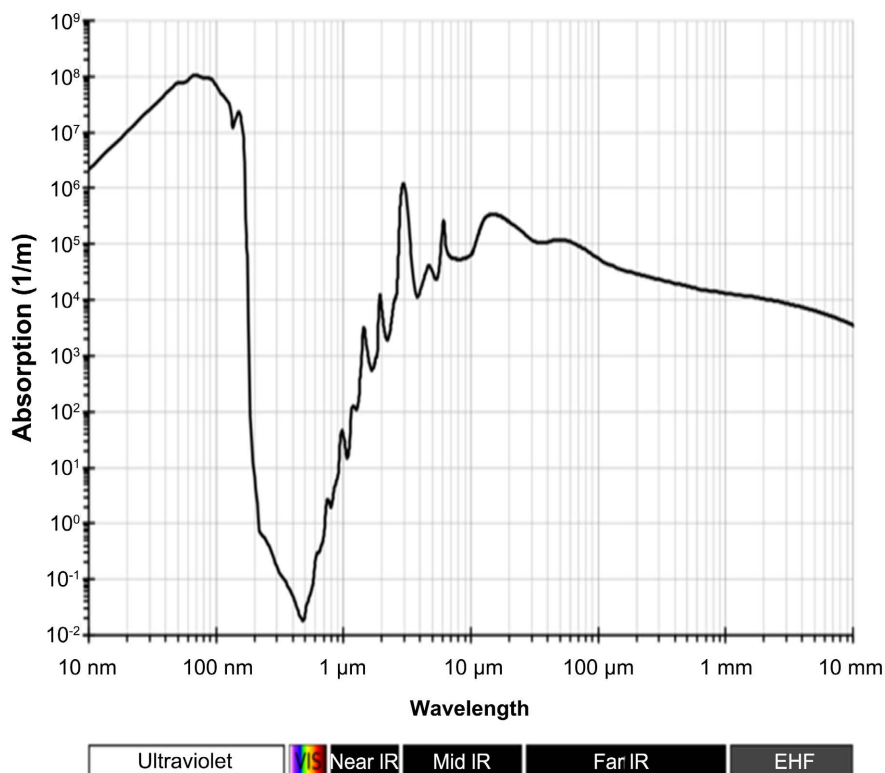


Figure 4. Absorption spectrum of liquid water [24].

primarily made up of a noble gas. Atoms of gas ionize, and free electrons thus produced are attracted to an anode within the device. As a free electron approaches the anode it accelerates, gaining enough energy to cause further ionization of from 10 - 10,000 additional electrons in a process called a Townsend avalanche. The combination of many such avalanches generates an electrical pulse proportional to emitted radioactivity, allowing its quantity to be detected.

As was postulated in the case of positive ion influx at the nodes of Ranvier and elsewhere, electric current strengthens as it approaches the proportional counter's anode. And similar to positive ions in a neuron, the ionized gas is for all intents and purposes stationary in relationship to the electron cascade. Atoms of noble gas in a proportional counter emit photons within the visible and UV range, but the level of this emission is relatively small. Electric currents necessary to operate proportional counters raise temperature considerably, so for various reasons the infrared spectrum is robust in likeness to a brain. The only difference between a proportional counter and a brain in terms of general infrared dynamics may be the intricacy, emergent organization and scale of how this radiation interacts with constituent molecules.

It is significant that electric current acceleration within an ionic mixture of uneven charge, which was proposed to occur in solution by using a gedanken experiment based on neuron anatomy, is the working principle behind proportional counters. Though it remains uncertain exactly how the phenomenon is to be modeled, for instance where these electron currents reside on the coherence

spectrum, how the theory of relativity might be applicable, and what the structure and shape of a quantum coherence flow is to quantitative precision, the physical process undoubtedly exists and is substantially associated with infrared radiation [25].

After this further proof of concept, the convincing but still very approximate picture which emerges in relationship to the nervous system and brain is of an infrared field centered at about 1 - 10 micrometers in wavelength, additively superpositioning to various degrees at different distance scales and locations, interacting with complex molecular arrangements in multiple ways simultaneously as dependent on chemical sensitivities. Percepts might be the internal structure of this infrared field as hybridized with biochemistry. If the hypotheses are accurate, vibrations of the infrared spectrum as thermally combined with those of molecules may not merely correlate with feel percepts but actually *be* the feeling itself. Elaborate biochemical differentiations of the thermal coherence field might refine the basic matter of feel percepts into a full gamut of sensations: sound, touch, taste, smell, interoception, etc. Likewise, at least a fraction of the superpositioned, additive wavelength structure of this radiative/molecular field would actually *be* imagery of the mind's eye and internal aspects of vision. The possible range of functional combinations is almost as diverse as biochemistry itself, and the potential for experimentation nearly untapped. Proving this coherence field theory could pave the way for a new paradigm in physics and the neuroscientific study of consciousness [15].

6. Conclusions: A Coherence Field Theory of Physics and Consciousness

In the domain of physiology, basic atomic structure is heterogeneously dense enough that decoherent states predominate even microscopically, with matter's motions differentiated by trillions upon trillions of wavicle asymmetries, giving rise to what can approximately be termed interference. Because of the asynchrony produced by variability in density contours, coherence tends to endogenously occur within an organic body only at quantum scales, a situation in which the physics of matter fields is equivalent to the physics of quantum fields. As biological evolution proceeded, organisms developed mechanisms for harnessing quantum coherence, in enzyme catalysis, photosynthesis, and as we have seen, electrical properties of the neuron. Technologies have also utilized quantum coherence in electronics, lasers, computers and more. But these systems, both organic and artificial, are deeply connected to principles modelable with the Newtonian physics of macroscopic objects, a maximally intuitive interpretation regarding matter as in a state of decoherence even while it moves. This assumption that decoherence exists as the default state allows humans to supplement the interface of proprioception with environment in efficient ways, and is core to human toolmaking, object fabrication, and the species' survival.

Proprioception's material basis, as was indirectly theorized by James Clerk

Maxwell and scientists of a similar bent, seems to be the probable fact that, within density contours of electromagnetic matter's approximately wavelike structure, loci of maximum energy exist, which in the present day we know are generated by interaction of nuclei with the surrounding field. Effects of nuclei on the total field are thus the source of electromagnetism, inducing loci of energy concentration within the density contour that we know as atoms. If both the position and motion of distinct instances of electromagnetic matter are hypothetically identical, greater density or "mass" implies more constituent energy and more inertial resistance against transitioning from a standing to traveling wave, whether this energy is a beam of electrons or a basketball.

Within an atom, still more finely differentiated loci of energy concentration we model as electron orbitals absorb and emit energy as photons. This is deceptive because even though absorption and emission of light by "orbitals" is rather straightforwardly quantized in the textbook case, the total electromagnetic field radiates predominantly as a wave while amongst atomic wavicles, undergoing subtle and complex energy transitions when perturbed by atoms. As per conservation laws, the energy transition at contact affects atomic wavicles as well, increasing or decreasing chemical vibrations as heat and modulating atomic wavelengths, though knowledge of how exactly this interchange work remains rudimentary. Entire atoms and molecules as defined by nuclear fields do not ordinarily move at speeds that relativistically increase mass to a degree having measurement significance, but the electrons and photons that interact within the scope of nuclear fields do. As electrons attain these speeds, their energy density as mass increases slightly. Light which electrons emit reaches lower frequencies the more these electrons are accelerating and thus subsisting in a less dense (though relativistic) state within the bounds of their coherence upon energy release, and reaches higher frequencies the more that electrons are decelerating upon energy release, a more dense state. Thus, an X-ray machine emits braking radiation as high-energy X-rays, and accelerating current within a radio antenna emits low-energy radio waves. Matter somewhat hotter than temperatures typically reached at Earth's surface emits greater amounts of ultraviolet and visible light due to more rapid vibration, corresponding with larger electron energy density—relativistic mass—as the source of higher energy radiating. This effect might be explained by the electromagnetic density contour within an atom becoming more pronounced so the proportion of diffuse, highest velocity space increases while loci of greatest density become much more compactly massive, similar in concept to a complex combination of centripetal and centrifugal forces. All matter at temperatures typically found on Earth's surface or within physiological systems radiates most heavily in the infrared portion of the electromagnetic spectrum, a phenomenon intrinsic to its baseline, relatively decoherent state of coherence. In neurons, accelerating coherence currents might be sustained in the soma and around the synapse, expanding the infrared spectrum to include longer wavelengths which altogether can saturate cells at a range of 10

micrometers to 100 millimeters. The superpositioned array of radiative wavelengths would bind with and be modified by complex molecular components, producing a plethora of vibrations such as perceptual sound, touch, taste, smell, etc., in essence feel, and in many cases perceptual images as additive structure also.

Physiological matter is dense and asymmetric, interference-laden and decoherent, so endogenous structure and motions of the underlying nonlocal substrate, which in different conditions can perturb at faster rates than the speed of light, align closely with a model that assumes the quantum/classical divide. Except for pockets of nanoscale machinery where quantum states have adapted to function with high degrees of coherence, these systems can be viewed mostly as decoherent and pervasively classical. But coherence as the underlying, more nonlocally active substrate of matter is not essentially electromagnetic or even quantum. We should not be surprised then if further research leads to proof that standing and traveling waves of coherence within the nonlocal substrate can perturb electromagnetic matter near-instantaneously at quite remote and macroscopic scales from the perspective of current physics, especially if this electromagnetic matter is much more diffuse and homogeneous than an organic body. Beginning to model perturbations of the total coherence field, relying partly on more determined analysis of this field's correlations and interactions with coherence of electromagnetic matter at the quantum scale, in organic bodies and undoubtedly elsewhere, may initiate the next scientific revolution, surpassing current models to create a liaison between quantum theory and coherence field theory.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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