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The Pribram – Bohm Hypothesis Part II: The Physiology of Consciousness

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The Pribram–Bohm Hypothesis
Part II: The Physiology of Consciousness

Shelli R. Joye, Ph.D.

Abstract: A physiology of consciousness is elaborated, based upon implications of the Pribram-Bohm hypothesis (developed in Part I of this series). The model presented here is in sharp contrast to the prevailing conviction among neuroscientists that consciousness will eventually be discovered to be a physiological epiphenomenon of neuronal electrical impulses firing in the brain. In contrast, the Pribram-Bohm theory holds that consciousness, inherent in what Bohm views cosmologically as "the Whole," manifests as a dynamic conscious energy resonance bridging the explicate space–time domain with the nonlocal, transcendent flux domain termed the "implicate order."
Presented in Part I, the Pribram-Bohm hypothesis posits a relatively infinite ether-like ground of innumerable quantum black holes, or "holospheres," centrally located at every point in cosmological space. Being nonlocal, the implicate order is clearly a singularity, yet topologically accessible at each and every point within space, connected everywhere below the Planck length of 10^{-35} m. Bohm suggests that within the implicate order, consciousness is the *primary awareness* as contrasted with human mental cognition, a derivative in the explicate order (space–time). It is into these centers of the implicate order that information *from* space–time flows, and within which this information is eternally (non-temporally) stored. In this topology, consciousness is *looking out from* the implicate order center, everywhere, while simultaneously projecting form *into* the explicate order, space–time universe. Within such a topology of consciousness, human physiology would have evolved with structural aspects that provide feasible wavelengths (frequency bands) within which modulated information might be processed and stored isospherically in resonance with holoflux consciousness in the implicate order. Physiological candidates discussed as carriers of human consciousness processing and information storage (memory) include infrared radiation among erythrocytes in the blood stream, and the waveguide potential of microtubules for ultraviolet radiation throughout the neuronal system.

Keywords*:* consciousness, cosmology, psychology, physics, communication, information, experience, hard problem, holosphere, holoflux, holonomic, holoplenum, electrical engineering, Pribram-Bohm

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Introduction

"The Pribram–Bohm Hypothesis Part I: The Cosmology of Consciousness" developed the theory that the ground of consciousness, consciousness itself, manifests as a continuously-transforming flow of energy in a two-way inward/outward flow between two domains whose boundaries are omni-present. This energy flux was described as being encoded with both information and meaning, flowing alternately between the explicate domain of space–time and the nonspatial, nontemporal transcendent domain which David Bohm termed the implicate order, a domain that exists within the center, everywhere, of space–time. To express the interconnectedness of this energy flux, spanning a wholeness that embraces both space–time phenomena as well as transcendent phenomena, we have selected the term *holoflux*, from the root term holism, defined here as:

> *The fundamental interconnectedness of all phenomena, and within this fundamental interconnectedness not only is each entity, relationship, experience and phenomenon a whole, in its own right, but all wholes are held together by a great unifying force. (Collister, 2010, p. 69).*

The Holoflux Theory of Consciousness

The holoflux theory of consciousness rests upon two fundamental paradigms: Karl Pribram's (2013) holonomic brain theory and David Bohm's (1980) ontological interpretation of quantum theory. These theories have been shown to be congruent, supported and knit together by established principles of electrical communication engineering. As described in Part I of this discussion, the holoflux theory proposed here can be categorized as a cosmological ontological process structured upon these propositions:

- A CENTERED COSMOS: In agreement with the theory of general relativity, the holoflux theory is founded upon the notion that the universe has a center, and that center is everywhere.

- HOLOFLUX: Dark energy of the implicate order, outside of space–time; Karl Pribram's (2013) theorized flux within David Bohm's (1980) implicate order; it is an energy of sentient awareness that views the outwardly explicate world of space–time from within an implicate order.

- QUANTUM BLACK HOLES: Quantum black holes, *Planck holospheres* of the Bohmian implicate order; gateway portals into the implicate order, they are bounded by spherical shells each of Planck length diameter 10^{-35} meters.

- THE HOLOPLENUM: An invariant *holoplenum* of close-packed holospheres, or *Planck isospheres*, underlying and from which is projected the explicate order; the holoplenum fills a continuum of isospheres everywhere in the physical universe from the center of each position in space–time; the concept had been intuited by Leibniz (Rescher, 1991) in his theory of the monads.

- RESONANCE: Holoflux frequency resonance complementarity connects the explicate order (the outside world), with the implicate order (the inside world); holoflux resonance occurs everywhere between the implicate order (frequency-phase flux in the implicate order, f_i) and isospheres of the explicate order in spherical shells. These holo-shells would manifest at corresponding distances, λ_i, from each central Planck

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holosphere, to maintain the relationship, $f_i \lambda_i = c$, where c is the speed of light in a vacuum, $3x10^8$ m/sec.

- CYCLIC PROCESS: A flowing movement, an *electromagnetic-holoflux* movement of energy continually cycles between the implicate order and the explicate order; the flow can be mathematically modeled through Fourier transforms and the Bohm quantum potential wavefunctions.

- A COSMIC CLOCK: Granular units of Planck time (t_P), vibrate at a "clock-cycle" rate of 5.39106×10^{44} cycles per second synchronizing the flow between alternating manifestations of implicate and explicate frequency information; in Cartesian coordinates, this can be pictured as a square wave, a Planck-time clock.

- BOHM'S QUANTUM POTENTIAL FUNCTION: Conceptional computations within the implicate order are "expressed" in space–time (the explicate order) via the effect of Bohm's quantum potential function, Q, a concept pioneered in de Broglie's "pilot wave" paradigm of 1927.

- A FOURIER LENS: The Fourier-type mathematical transform can be seen to act as a lens through which the implicate "views" or "cognizes" the explicate order of space–time; this Fourier lensing is the process by which the implicate order observes, retrieves, and projects information generated within the explicate order.

A diagram of these nine propositions is presented in Figure 1, "Solving the Hard Problem of Consciousness," in which congruent concepts of five contemporary pioneering philosophers of consciousness studies are contextually positioned.

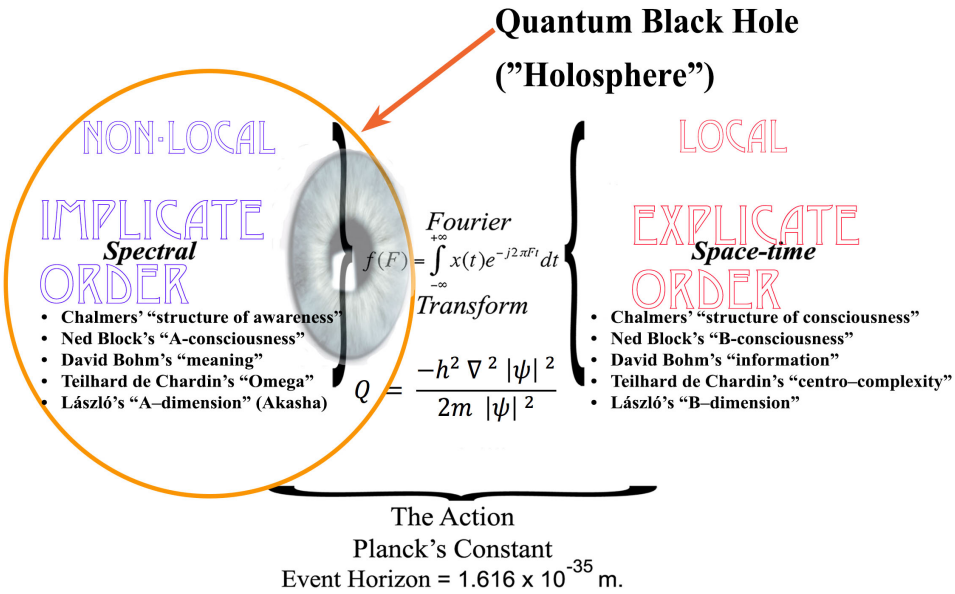

Figure 1. Solving the hard problem of consciousness (Joye, 2016, p. 344). Author's figure.

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- David Chalmers' (1995) "structure of awareness" is posited to be synonymous with the implicate order, and his "structure of consciousness" accordingly is shown within the explicate order.

- Ned Block's (1995) "A-consciousness" lies in the implicate order, and his "B-consciousness" in the explicate order.

- David Bohm's (1980) "meaning" lies in the implicate order, and his "information" in the explicate order.

- Pierre Teilhard de Chardin's (1956) "Omega" lies in the implicate order, and his "centro-complexity" in the explicate order.

- László's (2014) "A-dimension" lies in the implicate order, and his "B-dimension" lies in the explicate order.

The Cosmological Process as a Quantum Potential Plasma Display

As described in a previous essay, "The Pribram–Bohm Hypothesis Part I: The Cosmology of Consciousness," the holonomic process underlying the Bohmian "Whole" operates through means of a holoplenum of quantum black holes, or Planck holospheres, located spatially at the center, everywhere. Surrounding and radiating outward from each central Planck holosphere throughout space are spherical shells of quantum potential, infinitely thin information–encoded shells of energy, each separated from an inner shell by the quantum exclusion radial distance of one Planck length. These isospheric shells of Bohmian quantum potential extend out to the diameter of the universe itself.

Thus can be visualized topologically an almost infinite series of nested isospheric shells, spread out, at discrete quantum radii from their respective central Planck holospheres, each bounding Bohm's nondual implicate order.

The global panoramic intersection of these holospheric shells manifests as the projection of a the holonomic universe into space–time. The cumulative effect of this projection, as regarded by human physicists observing from significantly higher scalar dimensions, is described as "matter." The phenomenon can be understood as a *process of projected creation*, an omnipresent, on-going holographic extrusion of information *from* the implicate order *into* the explicate order, where the various structures of the cosmos (galactic clusters, stars, etc.), the complex unfoldings *into* space–time, are perceived by the human eye and mind to be three–dimensional, when they are actually holographic projections *from* the implicate order, from the center outward.

Another way of visualizing the projected illusion of space–time reality from the holoplenum is by expanding upon the metaphor of a flat–panel plasma display (such as the one you may be viewing as you read this).

Consider the human visual threshold for detecting separate images, which lies somewhere between 10 to 12 images per second; the industry standard in the motion picture industry is 24 frames per second (Dorf, 1997, p. 1538). This standard ensures that the presentation of a sequence of projected images will appears to a human viewer as smooth and continuous motion.

By contrast, if the entire universe flashes in and out of existence at a clock-cycle rate limited only by the Planck time constant of 5.3×10^{-44} seconds, equivalent to a "frame" rate of almost 10^{44} "frames per second," the cosmos would *appear* to be smooth and continuous in all respects even to

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an electron, certainly to any human observer of the cosmos, even at quantum dimensions.

The approximate image resolution of a "holoplenum display" obtained by dividing one inch by the Planck length, yields a maximum resolution of 1.584×10^{34} holopixels per inch. At such hyper-fine resolution, even a Higgs boson in the 10^{-17} meter dimensional range would appear to be moving smoothly through space.

Holonomic Information Storage: The Bekenstein Bound

In *Wholeness and the Implicate Order*, Bohm (1980) articulates and developed a "quantum potential" (p. 77) function which projects the explicate space–time universe out from within an enfolded sub-quantum implicate order. Bohm's quantum potential function is congruent with de Broglie's "Pilot wave" theory of 1927, as both are based upon a conviction that there exist "hidden variables" in sub-quantum regions not accessible to observational exploration using current material science technology (and far beyond the capabilities of the CERN Large Hadron Collider).

The de Broglie (1927) pilot wave theory and Bohm's (1980) quantum potential are mathematical attempt to map sub-quantum effects issuing from an implicate order in a domain of "hidden variables" far below the observational capabilities of contemporary material science.

Both theories posit a cybernetic processing of information, simultaneously being cycled from the space–time world and enfolded into the nondual frequency domain where the accumulating information is processed nonlocally within the implicate order. Driven then by the implicate order, a pilot wave of quantum potential nudges the configurations in space–time into an altered, slightly new configuration, much as a small tugboat might influence an enormous freighter. If the cosmos operates at its maximum possible clock cycle, as discussed previously, this pilot wave might be seen to operate at the extreme clock cycle rate of the Planck time constant, or 10^{44} Hz.

Somewhere, however, such a cosmic process would require a memory storage repository in space–time. Regarded as a cybernetic process, the sequence of information feedback and action can be metaphorically imaged in the alchemical Ouroboros, the classical symbol for consciousness, depicted as a snake in a circular configuration eating (or chasing) its own tail. This process can be viewed as the cyclic transfer of information coming in (from the tail) and the resulting action (by the head). A cybernetic feedback loop thus needs data, information, as input. Where then might data be accumulated and retrieved in space–time at these most fundamental sub-quantum levels, in a Bohmian holonomic universe consisting topologically of the distributed plenum of Planck holospheres, each surrounded by a series of nested quantum isospheres?

One possibility is to consider the information storage potential of an isosphere encoded with granular "bits" of data. In 1970, Jacob D. Bekenstein, then a graduate student working under John Archibald Wheeler (who himself coined the term "black hole") proposed a novel idea. Bekenstein proposed that there must be an absolute maximum amount of information that can be stored in a finite region of space, and that the Planck constants in quantum theory can be used to determine this limit (Wheeler, 1990). Twenty

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years later, Bekenstein's theory was extended into what is called the *holographic principle* by Leonard Susskind (1995), which describes how information within any volume of space can be encoded on a boundary of the region. A description of this configuration is presented here by Wheeler (1990) himself, as first related to him by Bekenstein:

> *One unit of entropy (information), one unit of randomness, one unit of disorder, Bekenstein explained to me, must be associated with a bit of area of this order of magnitude (a Planck length square). . . . Thus one unit of entropy is associated with each 1.04 x 10^{-69} square meters of the horizon of a black hole. (p. 222)*

This proposed upper limit to the information that can be contained upon the surface of a specific, finite volume of space has come to be known as the "Bekenstein bound" (Bekenstein, 1973). Symbolically depicted in Figure 2 is a topological depiction of the arrangement of information bits, or "qubits," stored on the bounding surface of a spherical volume or isosphere.

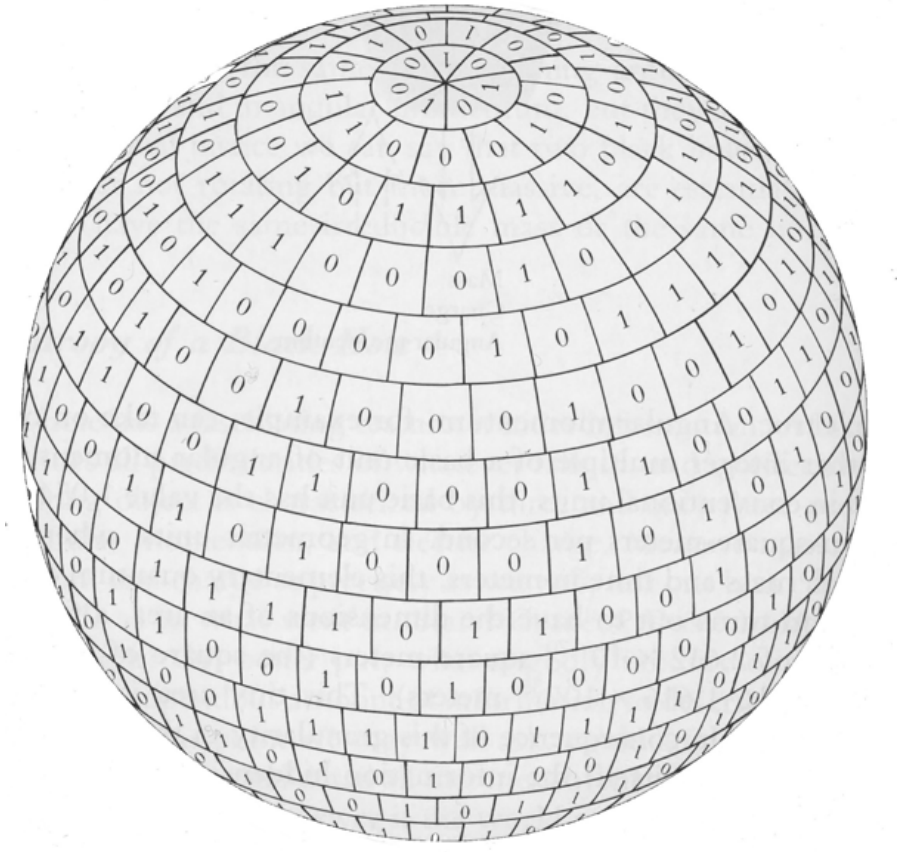

Figure 2. Planck length qubits on the surface of an isosphere. From *A Journey Into Gravity and Spacetime* (p. 220), by J. Wheeler, 1990, New York, NY: Scientific American. Copyright 1990 by Scientific American.

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This same topological approach to data storage can be applied to human physiology. Using a well-known biological structure as an example, it is possible to calculate the maximum memory storage capacity of a isosphere the size of a single erythrocyte, the ubiquitous red blood cell found throughout the human body. Using Wheeler's approach to determine the number of Bekensteinian equivalent data bits (qubits) on the surface of an isosphere, and using the average diameter of a typical human erythrocyte of 8.1 microns, (or 8.1 x 10^{-5} m), the maximum possible storage capacity on the surface of a single red blood cell can be calculated (Romanes, 1964, p. 137). To obtain this limiting number of bits, the surface area on a spherical shell 8.1 microns in diameter must be divided by 1.04 x 10^{-69} square meters (which is the Bekenstein unit of entropy, or approximately the square of the Planck length of 1.616199 x 10^{-35}). The surface area of this erythrocyte-bisected sphere according to this calculation is $4\pi r^2$ or $4\pi(8.1 \times 10^{-5})^2 = 4\pi(6.561 \times 10^{-9}) = 8.24 \times 10^{-9}$ square meters. Dividing this by the qubit area of 1.04 x 10^{-69} square meters yields an estimated maximum storage capacity of 8 x 10^{60} qubits of storage space for potential information encoding. This is an extremely large data storage capacity, considerably larger than, by contrast, the entire projected capability of the National Security Agency's Utah Data Center, which has been designed, when completed, to have a maximum data storage capacity of twelve exabytes or 12 x 10^{18} bytes (Hill, 2013, para. 7).

Unfolding an Implicate Order into Space–Time: Waveguides and the Topology of Human Consciousness

The basic topology of the Pribram–Bohm hypothesis has now been delineated. The ontological understanding of quantum physics which Bohm sought emerges in this model of a sub–quantum, omni-present holoplenum of Planck holospheres, each enclosing a contiguous transcendent region of non-spatial, non-temporal dimensions termed by Bohm "the implicate order" (Joye, 2016).

What are the implications of this model for human consciousness, cognitively operational at temporal and spatial scales vastly larger than those found at these sub-quantum Planck boundaries?

To answer this we must first complete the Pribram–Bohm cosmological topology of consciousness, and to do this the concept of isospheres, shells within shells, must be considered. Moving outwardly, radially, from the interior bounding event horizon at each central Planck holosphere, can be identified isospheric shells of the implicate order, extruding into space at exact Planck length (quantum) intervals.

This series of concentric shells, each one separated from the next by one Planck length, are isospherical loci of the implicate order (see Figure 3); they extrude into space and they intersect in space with other shells bounding other Planck holospheres in the space–time holoplenum. It is the cumulative interference effect of the intersection of individual isospheric shells which project images at higher scales, holographically, into three dimensional space.

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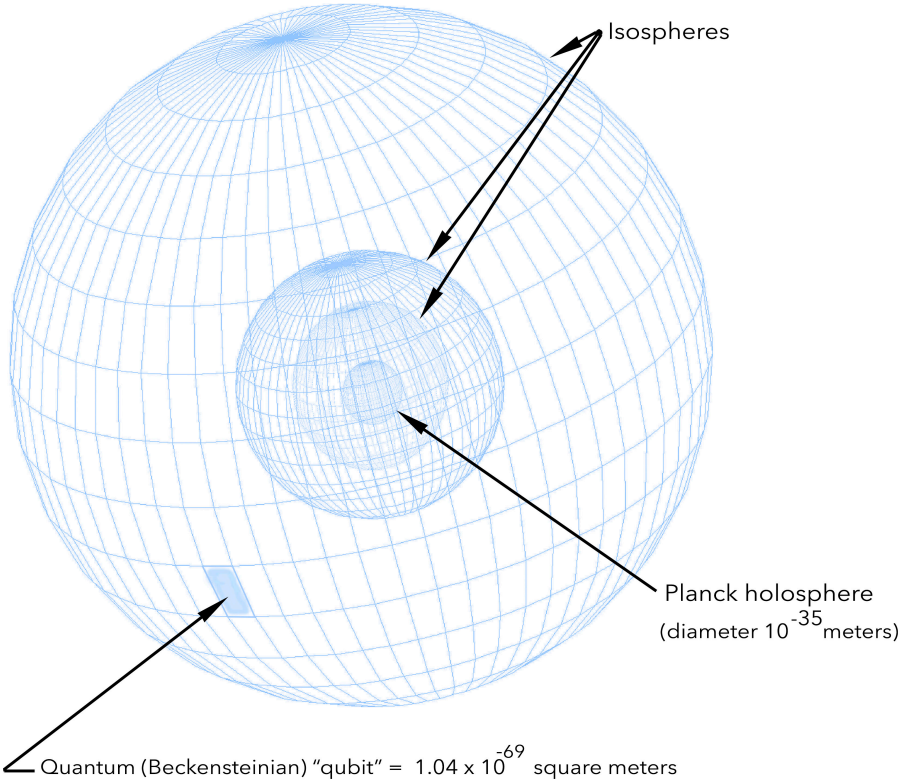

Figure 3. Topology model of isospheres surrounding a Planck holosphere. (Joye, 2016, p. 333). Author's figure.

Each isospheric shell, as Bekenstein (1973) determined, has a potentially enormous storage capacity in "qubits" of information encoded on the event-horizon bounding each shell, depending only upon the radius of the shell within the range of 10^{-35} m to 10^{27} m. Accessible simultaneously in both the implicate order and the explicate order, such encoded information provides the data to guide evolving forms as they project into the explicate via the pilotwave mathematics of Bohm's (1980) "many-dimensioned quantum potential" (p. 80). As part of this process, in-formation becomes ex-formation as the implicate order unfurls into the explicate. The plasmoidal forms appearing in space–time as electromagnetic flux energy are mirrored by and resonate within the implicate order as the dark energy of frequency–phase holoflux.

Within this cosmic geometry of the Pribram–Bohm hypothesis can be identified a framework for omnipresent two-way portals, potential bridges between the explicate and the implicate. Here, the deep consciousness of the universe flows in a cyclic, cybernetic, perhaps fractal movement in time and space, moving through an endless, bi-directional process, consciousness involving itself in a dance of transformation.

How then does this topology support human consciousness, thought and perception in space–time? How can electromagnetic frequency plasma in space–time resonate with holoflux plasma in the implicate order? First of all, the energies must be within the same frequency range in order for maximum interactive resonance to occur. Where the frequencies overlap as they superimpose and interpenetrate one other, resonance occurs.

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Resonance is a naturally occurring phenomena characteristic of physical objects or plasma fields extended in space–time. The resonance effect is seen when objects or complex signal systems exhibit remarkable frequency sensitivity to particular external frequencies, flowing in, through, and around the system, frequencies which approach the "natural resonant frequency" of the object or signal system; perfect resonance occurs where the input frequency and the natural frequency are identical (Feynman, Leighton, & Sands, 1964, p. 78). This principle of resonance governs all cybernetic feedback loops, and is a key factor in the design of antennas in electromagnetic transmitting and receiving systems. The goal of antenna design is to construct an antenna that is maximally resonant within a specific narrow frequency range of incoming (external or internal) electromagnetic radiation; when the input frequency and the natural frequency of the antenna coincide or move significantly close to one another, resonance occurs. This simplest and most common antenna design is the dipole antenna, which depends directly on the size (wavelength) of the incoming electromagnetic wave. A dipole antenna is designed to be physically half the size of the incoming wavelength, as stated in a textbook of antenna design:

> *A fundamental form of an antenna: length is approximately equal to half the transmitting wavelength. It is the unit from which many more complex forms of antennas are constructed. It is known as a dipole antenna. (Blakeslee, 1972, p. 580)*

This same half-wavelength effect governs the design of network communication waveguides applied to fiber-optics in the Internet, where the antenna is the fiber channel itself acting as a waveguide. The waveguide is highly efficient for two reasons, first, as its name implies, the waveguide guides the electromagnetic wave within its channel with maximum efficiency, and secondly, it shields the signal in the channel from external electromagnetic waves. The inner diameter of the hollow waveguide is designed to be equal to exactly half the wavelength of the electromagnetic energy signal shielded by and flowing through the waveguide channel.

Waveguides have been used for over a century both commercially and in research to channel and guide vibrating energy of specific limited frequency ranges; the fiber–optic networks hosting the global internet operate on this principle, channeling electromagnetic radiation at fixed laser frequencies (Dorf, 1997). It was discovered late in the 19th century that circular metallic tubes, or hollow metal ducts, similar to A/C ventilation ducts, but much smaller, could be used to channel and guide either sound vibrations in air, or electromagnetic energy in air or vacuum. Without the waveguide, the vibrational energy field is transmitted in all directions, visualized as magnetic lines or arrows emerging from a point at the center of an expanding sphere. This energy disperses outwardly, the magnetic vectored arrowheads pushing into the inside of an infinitely expanding sphere. A waveguide, however, constrains the magnetic component of the wave–front of vibrating energy to one specific linear direction, in parallel with the center of the waveguide, and thus, conceptually, the confined wave itself loses very little power while it propagates along the central axis of the waveguide, like a stream of water emerging from the pinprick of a large, taut, water balloon (Dorf, 1997).

The most common type of fiber optic cable used in the Internet has a core diameter of 8–10 micrometers and is designed for use in the near infrared (Gowar, 1993, p. 64). The

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electromagnetic signal wavelength that runs through the global fiber optic network is powered by highly efficient carbon dioxide lasers, and has a wavelength of 10 micrometers. Coincidentally (or not?), the average human blood capillary diameter is also 10 microns, and blood capillaries are at all times full of carbon dioxide.

Dimensional analysis and a cursory examination of human physiology would immediately suggest two candidates for waveguide systems within the human body: (a) within the blood capillary system, and (b) within the microtubule system. The corresponding resonant frequency for electromagnetic waves using such waveguides correspond to wavelengths matching the inner diameter of these structures. For blood system capillaries, this corresponds to radiation with a wavelength of 9.3 to 10.0 microns, the average inner diameter of a capillary. For microtubules, the radiation wavelength would be found in a range of 40 nanometers, the inner diameter of the microtubule waveguides. Figure 4 depicts the location of each of these potential waveguide frequency bands within a wider section of the electromagnetic spectrum.

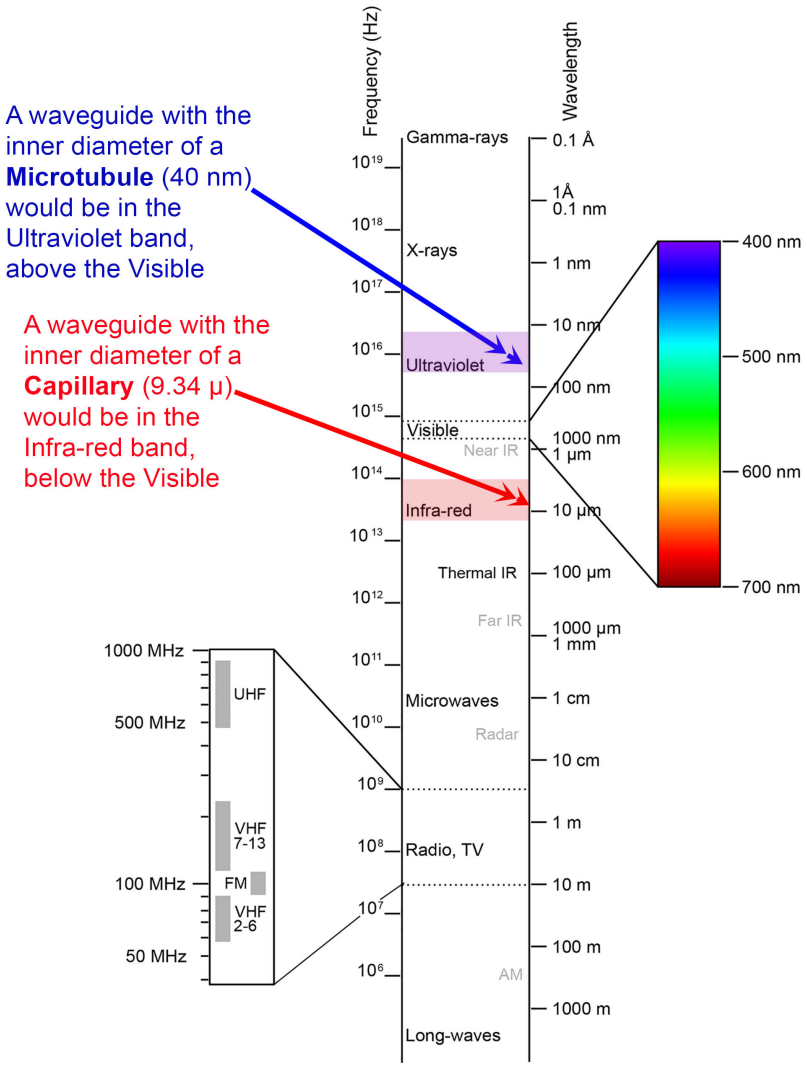

Figure 4. Microtubules and capillaries as waveguides (Joye, 2016, p. 181). Author's figure.

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That our blood might act as an electromagnetic plasma within the capillary system should not be surprising— the opening page in a textbook on plasma physics reads, "It has often been said that 99% of the matter in the universe is in the plasma state" (Chen, 2006, p. 1). Jibu and Yasue (2004) go further by indicating how Quantum Brain Dynamics (QBD) suggests that life itself can be seen to be the equivalent of "the unity of water" in the human body, or as "a single molecule" resonant within the human blood system:

> *All H_2O molecules bound together in a QBD vacuum domain form a single, extensive molecule of water in a macroscopic domain. That is, water throughout the entire region of the cerebral cortex is thought to be composed of many macroscopic water molecules whose sizes are all comparable to the coherence length of the QBD vacuum, that is, about 50 microns. This remarkable feature of water in living matter might provide us with quantum field theoretical support for the idea that life is nothing but the unity of water as a single molecule in living matter. (p. 293)*

A further implication of quantum brain dynamics supports the model of a locus of consciousness beyond that of the nervous system and brain. This runs counter to the widespread assumption that consciousness is simply an epiphenomenon of brain activity. The supporting pattern can be found in the QBD manifestation of a "single, extensive molecule of water" (Jibu & Yasue, 2004, p. 293), dipolar in geometry like an antenna, generating a complex magnetic field through the circulation of hydrogen ions and carbon dioxide in warm blood plasma.

In such a model, the entire blood system of within the human body can be considered to act as an extensively polarized "super cell" of nonlocal electromagnetic plasma energy, which can then be differentiated from the neuronal brain body of consciousness, itself generated by sequential electrical impulse-driven patterns flowing in the nervous system. Moving charges generate magnetic fields, and ionized human blood flow is no exception: flowing blood plasma results in creation of a magnetic field, and this is in accord the conjecture of QBD (Dorf, 1997, p. 27).

The circulatory system can be seen as a magnetic plasma composed primarily of ionized red blood cells (erythrocytes) and water molecules, flowing together in complex vortices of blood plasma around every cell and through every capillary of the body (McCraty, 2003). Each erythrocyte is a flexible, annular, bio-concave disk shaped like a doughnut (in geometry, a torus), having a thin webbed center where the hole in a pastry doughnut would be located. The typical outside diameter of a red blood cell is approximately 9 microns, close to the infrared wavelength of 9.6 microns generated by the human body (Turgeon, 2012). The adult human body contains approximately 6 grams of iron, of which 60% is stored throughout the 10^{12} erythrocytes, each of which contains approximately 270 million atoms of ionic iron embedded within transparent hemoglobin in a toroidal locus (Romanes, 1964). Thus each erythrocyte, replete with iron ions embedded in hemoglobin, creates in effect, an ionized iron toroid (Wick, Pinggera, & Lehmann, 2000, p. 6).

Recent studies have also discovered neuronal generation of electromagnetic energy in the near infrared region of the spectrum centered around 10 microns. Radiation emission was repeatedly measured

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emanating from live crab neurons in extremely narrow, discrete spectral bands within the frequency range corresponding to a spectral region from 10.5 to 6.5 microns (A. Fraser & Frey, 1968).

The implications of this model are considerable: there may exist in nature a unique resonant frequency for each individual human being. It is useful here to step through a topological analysis of the possible functions of a human red blood cell, given its geometry, as a locus of consciousness, and the possible use of the erythrocyte as a locus of memory storage at human biological scales. If, as previously conjectured, the red blood cell has an ideal diameter to resonate electromagnetic radiation in its ferrite–embedded ring at the human infrared wavelength of 10 microns, then it is reasonable to ask if this configuration could accommodate a single unique isospheric frequency (wavelength) for each of the currently 7 billion living humans on the planet. In other words, does this geometry allow for the possibility of each unique human being to also have a single unique frequency within the infrared electromagnetic radiation that resonates within the human cardiovascular waveguide system? Figure 5 outlines the topological feasibility of this approach.

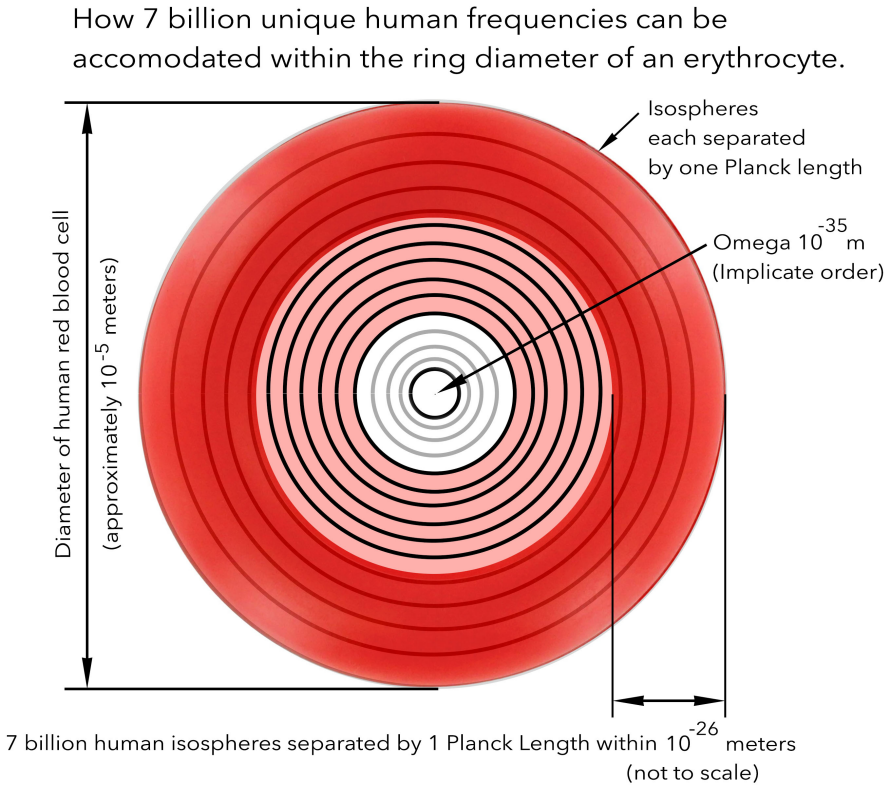

Figure 5. Isospheric capacity of a single erythrocyte (Joye, 2016, p. 224). Author's figure.

Assuming each unique frequency would match its radially unique isosphere, separated by only one Planck length, Figure 5 suggests how 7 billion unique isospheres, each of quantum discrete frequency, might be nested within the geometry of a typical human red blood cell (in the image, a multiple of 7 billion times the Planck length of

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approximately 10^{-35} m results in an estimated shell thickness of 10^{-26} m). This supports the feasibility that each living human being might have a unique holospheric frequency, detectable by other human blood cells via the implicate order about which each is centered, and thus provides a possible mechanism for communication, via the mechanisms of resonance, nonlocality, and superposition in the frequency domain of the implicate order.

Two Primary Modes of Consciousness: Explicate Consciousness and Implicate Consciousness

According to the two highly trained, professional, methodologically introspective explorers of consciousness, Teilhard de Chardin (1937/1969) and Rudolf Steiner (1923/1951), there are *two primary modes* of consciousness. In the last page of his essay, "The Activation of Human Energy," Teilhard de Chardin (1953a) states, "there are two different energies one axial, increasing, and irreversible, and the other peripheral or tangential, constant, and reversible: and these two energies are linked together in 'arrangement'" (p. 393). Likewise, during his discussion of a human physiology of consciousness, Rudolf Steiner (1951) provides a description, replete with diagrams, of how "nerve-activity" (p. 42) must be seen to be at right angles to the alignment of the "blood-activity" (p. 42) in consciousness. In the Pribram–Bohm hypothesis these two primary modes of consciousness are characterized rather generally as *implicate* consciousness and *explicate* consciousness.

Teilhard de Chardin (1953a) goes further and links the axial component of consciousness to the process of crossing "a certain *critical point of centration*" (p. 106), thus thermodynamically heating up consciousness while moving radially inward to resonate with ever smaller radial wavelengths. Teilhard also occasionally refers to radial consciousness as "soul" and "spirit" in his essays (perhaps to satisfy superiors in his religious order), and he also describes this radial component of energy as "a new dimensional zone" (Teilhard de Chardin, 1953b, p. 29) that brings with it "new properties" (p. 29). Teilhard (1953a) describes how increasing centration along the radial component leads to increasing states of complexity–consciousness which result in "being mentally ultra–humanized by self–compression" (p. 344). Congruently, Steiner (1951) and Teilhard (1953a) both agree that these modes of awareness can be seen to operate orthogonally to one another, each in their own domain, and thus they both refer to consciousness as operating in two modes: a *tangential* consciousness and an *axial* consciousness. It is of interest to note that Steiner (1951) says that one of these primary modes, the *radial mode* of consciousness, operates *within the blood system* (p. 43).

The Pribram–Bohm hypothesis posits that human consciousness, what is normally experienced as awareness by humans who are not sleeping, nor in a coma, is tangential consciousness, as it manifests, in accordance with Pribram's (1971, 1990) research, in the resonance of electromagnetic plasma fields swirling in space–time within the felt–like dendritic neuronal regions of the cerebral cortex. This is the "consciousness" examined in experiments conducted by Benjamin Libet (2004) whose research revealed that human awareness of an "intention to act" (p. 86) *lagged behind* the actual EEG measured "readiness potential" (p. 87) by an average of 200 milliseconds. This evidence supported the currently widely held view among neurophysiologists that consciousness is an epiphenomenon of neuronal activity. This epiphenomenal view is correct only if one mode of consciousness is being considered, what Teilhard and Steiner would call the

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tangential mode of human cognitive mental consciousness, which interfaces most generally with the neuronal synaptic activity of the nervous system throughout the human body.

The actual situation is more complex in the Pribram–Bohm holoflux model, in which two modes of consciousness function in a cybernetic process depicted by the diagrams in Figures 1 and 6, where the Teilhard/Steiner axial consciousness is seen to "peer out from" the transcendent implicate order on the left *into* the explicate space–time order on the right while simultaneously projecting the explicate configuration itself. The tangential mode of consciousness in the space–time explicate domain lags, temporally, behind the axial, due to its operational requirement of comparing slices of mnemonic information storage in the time stream. Given the various operating cycles of physiological systems with the human body, this lag is measured to be an average of 200 milliseconds *after* cognition by the more immediate, axial, implicate consciousness.

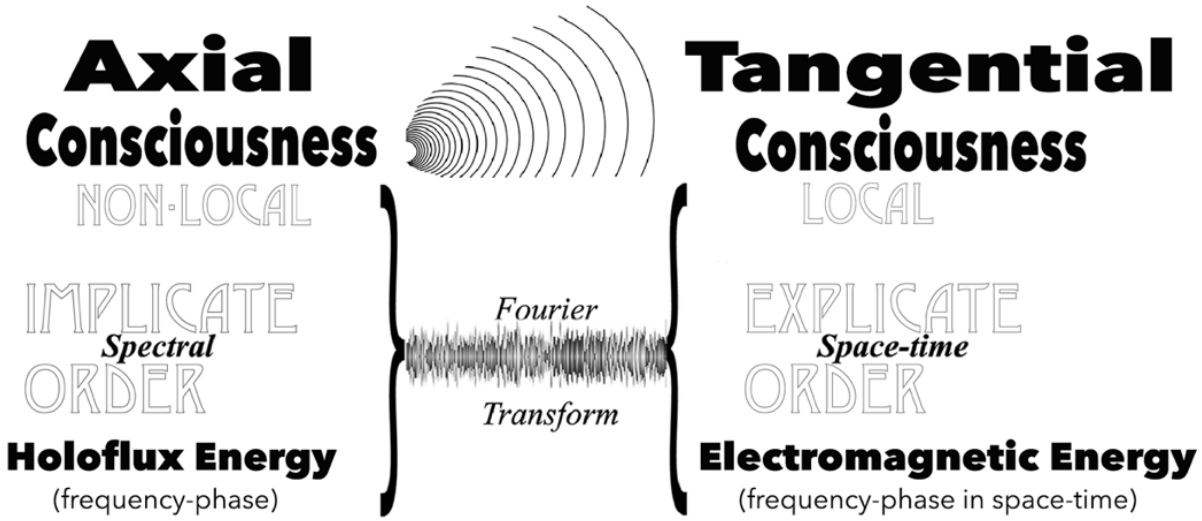

Figure 6. Axial consciousness and tangential consciousness. Author's figure.

This timing is in accordance with Libet's (2004) experimental data, and Bohm uses the phenomenon to draw a distinction between thought and a more primary mode of consciousness that is "before thought," the mode of consciousness that dwells in the present moment:

> *To dwell in the present moment requires not dwelling in thought, because thought takes duration and is a slow process. We start to find a need, not to deny thought, but to find the part of the experience with is before thought. (Bohm, 1985, p. 128)*

Solutions and Recommendations

The topological model set forth in this essay provides a feasible solution to the Chalmers (1995) "hard problem of consciousness" (p. 5). If consciousness is considered to be manifesting as energy flow in electromagnetic-frequency fields, then one should be able to determine experimentally the location of high information bandwidth

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channels within human physiology. Such channels must provide the data network infrastructure through which electromagnetic information interchange guides the growth process, effects repair, and catalyzes evolutionary mutation. The widespread assumption of contemporary neuroscience has been that consciousness emerges from neuronal activity in the human brain only as an epiphenomenon (Dennett, 1992, p. 406). Accordingly, there are regions within which a search would be recommended, outside of the domain of neuronal linkages and synaptic potential dynamics.

Future Research Directions

Dimensional analysis indicates that good candidate ranges for testing the electromagnetic field component of consciousness can be found in the near infrared spectrum. This region lies just below the threshold of the visible spectrum that is picked up by eye cone structures (Oyster, 1999). Human core body temperatures, ranging from 36.3 C to 37.5 C on a diurnal cycle, indicate that, applying Wien's Law, a search should be conducted within the infrared spectrum in a bandwidth between 9.36425 microns and 9.32808 microns, near the center of the infrared portion of the radiant spectrum (Becker, 1990).

Converting from wavelength, this range is equivalent to a frequency range of 30.3 gigahertz to 32.0 gigahertz, an enormously wide band compared to, for example, the FM radio frequency band, ranging from 87.0 to 88.1 MHz (Blakeslee, 1972). Assuming a bandwidth of 200 KHz (typically used for a single FM station), over 8000 equivalent FM radio stations could be broadcast within the human infrared radiation band, with no overlapping interference.

One approach in the search for an infrared component of consciousness would be to monitor the dynamics of an infrared spectrum emanating from within the human body in an attempt to detect information–carrying photons escaping the body as modulated infrared radiation. It is possible to detect wavelengths down to 5 microns (the far infrared region) using Fourier transform infrared spectroscopy and to record non–invasively site–specific emissions of infrared radiation issuing from within human organs (Griffiths & de Haseth, 2007).

> *Interestingly, because biologic materials are transparent to light in the near-infrared region of the light spectrum, transmission of photons through organs is possible. (Cohn, 2007, p. 323)*

The next step would be to demodulate (decode) these photon packet streams, the difficulty being that even in human communication technology there currently exist dozens of modulation techniques (American Radio Relay League, 2015, p. 42).

An alternate approach would be to search for infrared energy signals flowing as patterns *within* potential physiological waveguide channels located within the human body. The ubiquitous blood capillary system, for example, with typical inner diameters of 10 microns, is a likely candidate to act as an infrared waveguide. Capillaries provide a ready–made network infrastructure within which the flow and resonance of a modulated infrared energy plasma might be discovered. Figure 7 indicates the location of feasible electromagnetic bands of consciousness correlated with existing structural systems of the human body.

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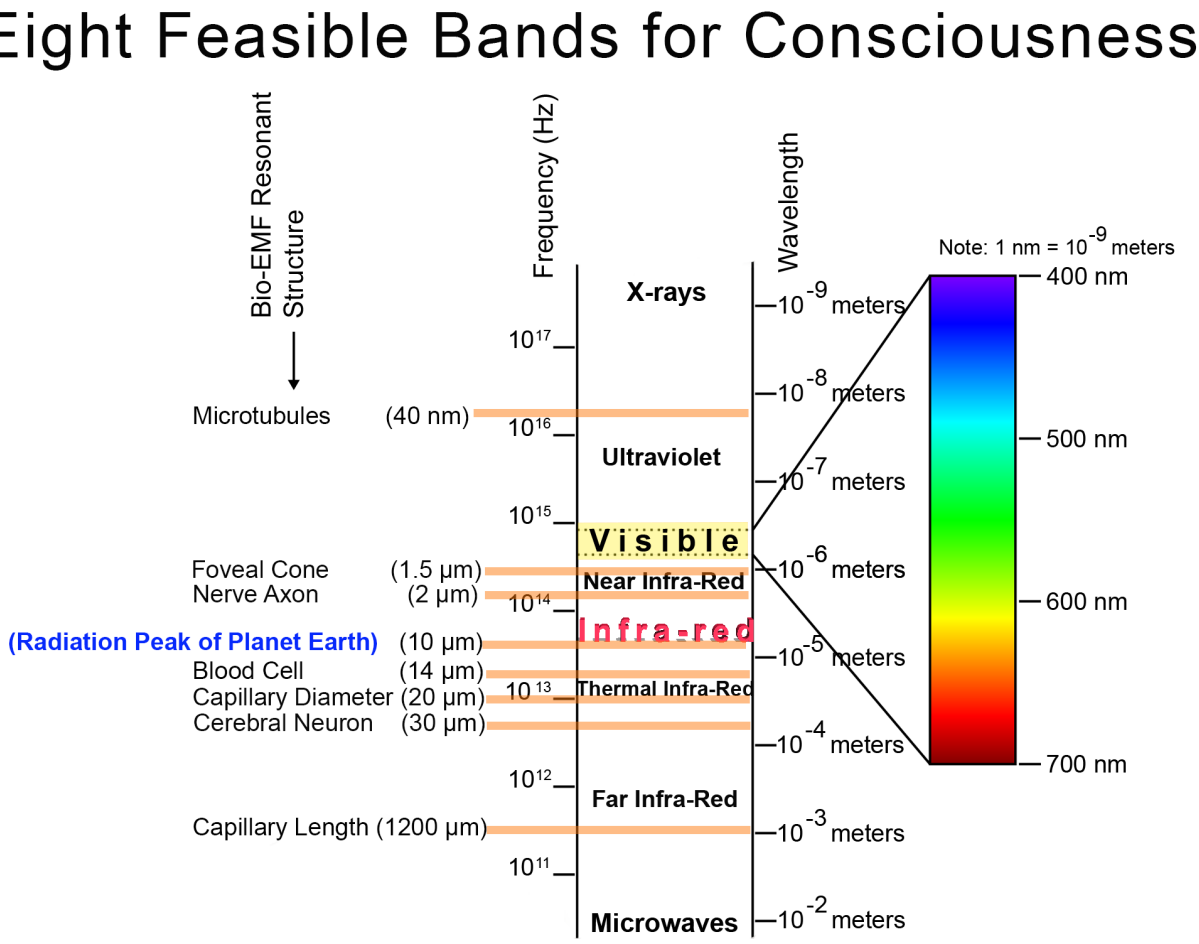

Figure 7. Eight feasible electromagnetic radiation bands of consciousness (Joye, 2016, p. 353). Author's figure.

As indicated in Figure 7, potential waveguide structures can be found to exist within the human body ranging in diameter (recall that diameter correlates to a dipole wavelength resonant frequency) from ultraviolet radiation in microtubules at a wavelength of approximately 10^{-8} m to erythrocyte radiation in capillaries located in the 10^{-3} m wavelength region.

Conclusion

Finally, it is reasonable to speculate on practical implications for this topology on future technology. In considering future technologies, the identification of an energy field manifesting information characteristics in multiple bandwidths of radiant energy associated with biological systems would support the feasibility that, in principle, major components of consciousness might eventually be stored, maintained, and manipulated using non-biological systems (e.g., fiber optics and silicon, perhaps) instead of wetware (biological tissue). An intriguing implication would be that consciousness might be uploaded from wetware into such a hardware environment. Current mainstream research, however, is almost exclusively directed at neuronal activity and brain wiring, under the tacit assumption that consciousness is somehow

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an accident of, or at best, an epiphenomenon of neuronal activity in the brain.

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Key Terms and Definitions

Explicate Order: One of the two primary dimensional orders in the universe, as posited by David Bohm (1980). The explicate order encompasses space-time and all manifestations within space-time. The other dimensional order Bohm termed the "Implicate Order."

Holosphere: A spherical boundary that has the diameter of one Planck length (3×10^{-35} m).

Holoplenum: A continuous plenum of Planck length holospheres at the bottom of space.

Holoflux: Energy-phase-information flux within Bohm's implicate order; it corresponds to electromagnetic flux in space-time.

Implicate Order: One of two primary dimensional orders in the universe, as posited by David Bohm. The implicate order is a nonlocal, nontemporal domain that can be found below the Planck length. In holoflux theory.

Planck length: The smallest possible length in space, determined by Max Planck from the gravitational constant and the speed of light. The value of the Planck length is 3×10^{-35} m.

Planck time: The smallest possible unit of time, determined by Max Planck from the gravitational constant and the speed of light. The value of Planck time is 5×10^{-44} s.

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