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Article

Theoretical and Experimental Evidence of Macroscopic Entanglement Between Human Brain Activity and Photon Emissions: Implications for Quantum Consciousness and Future Applications

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ABSTRACT

Entanglement has been described as excess correlation between separated parts of a quantum system that may exceed the boundaries of light velocity across space and time. The concept of macroscopic entanglement is considered an emergent condition of microscopic or quantum entanglement such that functional relationships between electron spin, orbital time and photon movements allow an interface with biological systems, particularly brain activity and function. Quantitative evidence is provided for such macroentanglement and discussed with respect to consciousness and electromagnetic fields, photon emissions from the human brain and geomagnetically based contributions, where quantitative convergence suggests processes associated with thinking could be linked to intrinsic characteristics of the electron from which quantum entanglement would emerge.

Key Words: entanglement, consciousness, photons, electromagnetic fields, brain function, quantification, cosmology.

1. Introduction

That two particles, once proximal or identities, maintain a functional instantaneous connection within the maximum range of space and time challenges the implicit boundaries that define cause-effect models. Such a condition, which Schrödinger (1935) labelled as "entanglement", requires a process or processes linking the particles together. Entanglement has been considered an application of the superposition principle to a composite system consisting of two or more subsystems (Aczel, 2002). This principle effectively defines emergent properties because a new state (A+B) shares some of the properties from each of the two states (A, B). If the two states are locations, then the new state has something in common with each location.

According to Bohr (1958), the simultaneous emission of two particles with opposite spin from an atom produces a condition such that altering the spin of one instantaneously reverses the spin of the other no matter what the distance. Entanglement is associated with non-locality that has been described by Cramer (1997) as enforced correlation between separated parts of a quantum system that are outside of the boundaries of light velocity across space and time to ensure the parts of the system maintain equilibrium. It might even be considered as a trans-temporospatial application of Newton's third law "for action (or force) there is an equal and opposite reaction (or force)."

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In this paper the concept of macroentanglement is considered as an emergent condition of quantum entanglement. The definition is the same as for (micro)entanglement except that it is applied to larger aggregates of space sufficient to contain living systems. The human brain can be considered a large aggregate of particles that under certain conditions may behave as a "condensate" or a single global brain state (functionally a "particle") when the activity of a single cortical neuron can modify this state (Cheng-yu et al, 2009). Two brains with histories of space-time proximity, such that a system is created, might be entangled by processes as quantifiable and as experimentally reproducible as those displayed by pairs of particles.

2. Brain-Particle Entanglement

2.1 The Bohr Magneton Connection

The first step to establishing either a similarity of process or even some variant of an isomorphism between the cerebral functions associated with consciousness and those that appear to be correlative preconditions for quantum and entanglement phenomena for the particle is to discern the potential linking functions and congruence between these two levels of discourse. The Bohr magneton (μ_B) for the magnetic moment of an electron can be considered a central source for macroentanglement as well as its microscale manifestations.

The magneton is the circulatory current created by the angular momentum of an electron moving in its orbit. This fundamental constant is 9.28×10^{-24} Am^2 or J/T. According to some solutions for wave mechanics, the spin of an electron, the rotation around its own axis, is also exactly one Bohr magneton. The electron has two possible states that reflect the spin in a given direction (referenced as up or down). This also allows for two electrons in an atom with spins of ½ + ½ or -½ - ½ to have resultant spins of 1 or 0, respectively. These properties are conditions for entanglement as well as the potential digital (0,1) representations of information which is considered central to quantum computation, communication, and free-space quantum teleportation (Jin et al, 2010).

An electron in an atomic orbital displays both orbital angular momentum and intrinsic spin at the same order of magnitude but with the latter's coefficient being twice that of the former. In quantum theory the spin angular momentum or spin is parameterized to the spin quantum number which is the fourth of four numbers employed to describe the unique state of an electron. The fourth quantum number has been linked to determining the locations of matter within a frame of reference. According to Hu and Wu (2006) two interacting quantum entities such as two electrons, become entangled with each other through spin processes by exchanging one or more entangling photons.

The occurrence of a quantitative value for spin predicts a potential range of energies within brain space within which consciousness and thinking occurs. For a magnetic field of 70 pT or 7×10^{-11} T the energy would be the product of this value and the spin moment or 6.624×10^{-34} J. This is equivalent according to a frequency (once divided by Planck's constant of 6.624×10^{-34} J s), of about 1 Hz. For intensities within the 100 to 200 pT range, well within the expected operating intensity of some cerebral functions, the frequency range would span 10 to 40 Hz. This quantitative convergence suggests that the processes associated with thinking could be coupled to the intrinsic characteristics of the electron from which quantum and entanglement phenomena emerge.

Functional relationships between electron spin and orbital time and photon movements allow an interface with biological activity, specifically brain function. The intercalation between the photon and the neuronal membrane may be more quantitatively congruent than expected. The numbers of revolutions per second for an electron in a Bohr magneton is 6.8 x 10^{15} per sec; consequently one complete rotation or completion of a single cycle requires the inverse value or 1.5 x 10^{-16} s.

2.2 Photon Interaction

By comparison, the time required for a photon moving across a neuronal membrane of 10^{-8} m (10 nm) in brain space at 2 x 10^{8} m/s would be about 10^{-16} s. The neuronal membrane is the source of the action potential whose composites are likely sources of the states of consciousness and thought. The convergence of 10^{-16} s for both the photon passage and the single rotation of a Bohr electron would be sufficient for the energy and the information within the photon to be represented within the single cycle or one closed loop of the electron's revolution.

This quantitative convergence between a single rotation time and the width of a neuronal membrane also suggests that the phenomena associated with the photon and its interaction with electron orbits and shells could be more than the physical substrate for the creation of thought and consciousness. Because photons, which in large part are derived from the sun, have been argued to exhibit variable progression near the maximum velocity of c, the historical representation within the photon could involve the functional equivalent of millions to billions of years.

If the quantitative threshold is approached from the synchronization of information from a field of photons traversing a critical number of neuronal membranes, then consciousness and thought might respond to stimuli at times and distances quite disparate from the frame of reference of the brain that is being stimulated. That the activity of only one neuron within an aggregate of millions can change overt behavior has been shown experimentally (Houweling and Brecht, 2008). That the application of the equivalent current dipole moment of about 10^{-8} A m from a neuronal magnetic field applied over the width of an electron (10^{-15} m) is the same order of magnitude as the Bohr magneton suggests that singular values with critical quantities might produce global effects.

2.3 Mass-Energy Equivalents

Bohr had hypothesized that thinking and consciousness might even involve the extraordinarily weak quantum energies. There is quantitative support for Bohr's intuition. The magnetic moment of 9.28 x 10^{-24} J/T within a magnetic field of 1 pT, which is well within the range of very local magnetic fields generated around axons, would be associated with an energy of 9.28 x 10^{-36} J. The mass equivalence of this energy is in the order of 10^{-52} kg or 10^{-49} g. This is exactly the order of magnitude of the upper limit of the rest mass of the photon which has been estimated by several authors (Tu et al, 2005).

From the perspective of macroentanglement for brain function this upper limit of the rest mass of a photon is important. First, because the mass of the photon is non-zero, the dispersion will produce frequency dependence in the velocity. The group velocity of photons will differ from the phase velocity which means that information can be stored within quantum phase differences. Group velocity refers to the singular “steady” value for the entire wave envelope within which the different complex components can display phase (temporal) shifts. Ahn et al, (2000) have suggested that information can be stored and retrieved through quantum phase shifts.

The concept of variable velocity, particularly if very small and near c, could help explain the solution of 10^{-}

^{20} J as the net energy equivalence between the classical radius of an electron and its Compton wavelength which is about 1000 times larger. To meet the Lorentz transformation for the discrepancy in this length, the velocity must be 0.9999995 c. Comparable differences in net velocity below c could produce similar energies. This would suggest that the energy associated with the action potential, 10^{-20} J and implicitly thought itself, would be sufficient to modulate the differences between the particle and wave state (Persinger 2008).

Secondly, the nonzero mass would allow a third state of polarization in which, in addition to the classic perpendicular orientations for the magnetic and electric field components of the electromagnetic wave with respect to its direction of movement, there would be the emergence of a longitudinal photon (Tu et al, 2005). This can allow individual photons to carry angular momentum of multiples of $h/2\pi$ with superimposition of these eigen states (Vaziri, et al, 2002). Hence, there would be greater degrees of freedom and factorial combinations that enhance the potential for entanglement.

Third, the presence of a magnetic field could modulate and enhance the characteristics of the actual non-zero mass of the photon. When geomagnetic data from earthbound and satellite measurements were combined the upper limit of the rest mass of a photon was about 4×10^{-51} kg with a Compton wavelength of about 13 times the earth's circumference which is about 4×10^{7} m. Within a stronger magnetic field, such as Jupiter's, the estimated upper limit from direct measurement of the fields by satellite observations was less than 10^{-52} kg.

The geomagnetic field component for revealing or influencing the measurement of the mass of a photon is important because of its own intrinsic entanglement. Korotaev et al (2005, 2006) showed that non-locality could occur within the earth's magnetic field. Once periodicities were removed, coherence was observed between "random" or dissipative processes for measurements from sensors separated by tens of kilometres. Experimentally, entanglement between two spins in an antiferromagnetic solid can be affected by the external magnetic field. Increasing the field strength to certain values can create entanglement between otherwise disentangled spins (Arnesen, et al, 2001).

2.4 Connection to Consciousness and EM fields

One approach to arguing macroentanglement is that consciousness and thought are coupled to electron movements (orbital or spin) and hence aggregates of these movements should reflect the microcosm even if the numbers of electrons (assuming a brain mass of 1.5 kg) is in the order of 10^{27} to match the numbers of protons. Stated alternatively, macrocosm reflects microcosm when the numbers of units in the former reach some critical value to allow this pattern to emerge. That the cerebral cortices display the characteristics of a single global state was described by Wackermann (1999). Experimental support for the homogeneity of this system was recently reported by Cheng-yu et al (2009) who found that the burst spiking of a single cortical neuron could modify the entire global state.

If this argument has validity then the quantitative characteristics of the macroscopic manifestations of quantum-level properties should be congruent with the magnetic field strengths associated with neurocognitive activity. The operating intensity of the cerebrum as a matrix or volume has been argued to be in the pT range. From this context it is interesting that kg/As * 1/s or the mass of an electron divided by a unit charge multiplied by 7 Hz is 9.1×10^{-31} kg/1.6×10^{-19} As * 7 Hz (1/s) or 40×10^{-12} T. In general the pT range would include most of the most important frequencies of small (action potential) and large scale (steady potentials in the mHz range) brain function.

2.5 Application of Zeeman Phenomena

The Zeeman effect occurs when an atom is placed within a magnetic field. There is a separation of spectral lines, the indicators of photon emission as electrons shift singlet states. This process is related to the coupling between the intrinsic spin and orbital angular momentum of the electron as well as interactions between spin magnetic moments of the electron and the nucleus (Hill, 2007). These quantum mechanical phenomena provide unequivocal evidence for the existence of the intrinsic spin of the electron which is central to Hu and Wu's (2006) hypothesis. The quantum energy requirements define limits for the plane of an electron orbit that are specific angles to the applied field.

The occurrence of the Zeeman effect and the mechanism responsible for it has relevance for macroentanglement and consciousness. First it indicates that the application or presence of an external magnetic field within which systems are immersed results in shifts in functional location of states that were initially superimposed or occult. Their hyperfine differences only become evident with the application of or immersion within the magnetic field.

If macrocosm reflects microcosm, even in a non-specific manner, the hyperfine structure of the emergent appearance of two (and sometimes three) lines in atomic spectra should have an analogue within consciousness. The concept of transient inductions of a "second consciousness" or parasitic consciousness was proposed by Hughlings Jackson more than a century ago to explain the experiences of partial complex epileptic patients with foci in the temporal lobes (Bancaud et al, 1994). These individuals reported the presence of "another" Sentient Being during electrical seizures which biophysically are equivalent to brief periods of coherent, paroxysmal enhancements of electromagnetic fields within the brain space. We (Booth et al, 2005) have suggested that the appropriately patterned application of a magnetic field across large volumes of the cerebrum encourages a Zeeman-like duality of states such that the person experiences a "sensed presence" that is effectively the right hemispheric equivalent of the left hemispheric sense of self. Under typical conditions this duality, like the Zeeman split in atomic spectra, remains occluded.

The third important implication of Zeeman phenomena for consciousness involves the potential entanglement between the two states of consciousness, the sense of self and the sense of the other, and perhaps the third state within the microstructural arrays of approximately 10^{13} synapses within the cerebral cortices. Changes in the electromagnetic fields associated with the sensed presence could affect the state of the electromagnetic fields associated with the sense of self and visa versa during transient conditions when they are separated. Consequently either the sense of self or the sensed presence could exist transiently in different spatial locations and potentially respond to information within these distinctly different and separate locations.

Similarly changes in one of the two electromagnetic states associated with the sensed presence or the sense of self, which are potentially non-local, could affect the activity of the anomalous third state dependent upon brain structure. Thus stimuli that affect the microstructure of the brain at the synaptic level would produce a specific change in the sense of self or the sensed presence or any process that modifies the electromagnetic fields which constitute the sensed presence or sense of self could affect the electromagnetic field associated with the microstructure due to quantum processes.

There is quantitative support for Zeeman phenomena within brain space even for magnetic field strengths within the operational pT range of cerebrum. The change in angular frequency with an applied field of 40 x 10^{-12} T would be, according to classic Zeeman formula solutions, the product of 4 x 10^{-11} T * 1.6 x 10^{-19} As divided by 12.56 * 9.1 x 10^{-31} kg or about 0.6 Hz. However in non-angular systems it would be 7 Hz. The

potential intensity is within the pT range that can occur within the cerebrum and would accommodate the primary frequency range of 0.1 to 100 Hz.

2.6 Neuronal Quantum

Persinger (2010), in order to reduce the myriad of molecular pathways presently complicating the understanding of cell function to a fundamental unit, has suggested that the ubiquity of a quantum with a value of about 2 x 10^{-20} J could minimize the complexity. This quantum unit was the solution for the energy: 1) at the average distance of the release processes associated with diffusion time of classical neurotransmitters, 2) between charges on the surface of the membrane that creates the membrane potential, and, 3) when force over distance between atomic bonds, particularly covalent forms, are distributed over interatomic space. The increment of 10^{-20} J was found to be the unit associated with membrane-linked photon emission from the plasma membrane of the cell, the energy at binding sites for phosphorylation during posttranslational modifications of proteins, and the actual shift in wavelengths during bioluminescence. Such quantitative commonality would suggest an underlying physical process to which all chemical reactions that cause or are strongly correlated with brain function are related.

This relationship should be transformed into larger spaces that constitute the brain-consciousness connection, the cerebral cortices. The average number of neurons within a unit volume of human cerebral cortices is about 5 x 10^4 neurons/mm^3. Assuming an average cortical thickness of 4 mm and the width of a cortical column to be about .75 mm (or a thickness of 3 mm and width of 1 mm), then there would be about 15 x 10^4 neurons per column.

If the column is considered a functional unit of cerebral energy, then with each neuron generating an average 7 action potentials per sec (7 Hz) and each action potential generating 1.2 x 10^{-20} J, there would be 1.26 x 10^{-14} J per column per sec. The frequency equivalence of this amount, obtained by dividing by Planck's constant, is 1.26 x 10^{-14} J/6 x 10^{-34} J s or .21 x 10^{20} Hz.

The equivalent wavelength of this frequency, assuming an operational velocity of c, is 3 x 10^8 m/s divided by 0.2 x 10^{20} Hz or 15 x 10^{-12} m which is 37 pm, the classic radius of the hydrogen atom or the standing wave distance between a proton and its electron. The Bohr magneton, with a magnetic moment of 9.28 x 10^{-24} Am^2 or J/T, lays at the basis of quantum mechanics and the concept of entanglement (Aczel, 2002).

The importance of the average range in cerebral cortical thickness may be coupled to an as of yet unexplored association with the oxygen absorption spectra (48 to 72 GHz) and the 4 to 6 mm wavelength band. Absorption peaks for water occur around 1.5 and 0.9 mm. Because oxygen exhibits a strong affinity for electrons, there is large amount of energy released when it is reduced to form water. The potentially fatal consequences of the attraction to sequester three more electrons “immediately” once the first has been absorbed to form the superoxide radical was reduced by the emergence of cytochrome oxidase to slow the process. Consequently an electron is donated and received about once every 5 to 20 ms or on average every 12 ms (Alberts, et al, 2002). This interval is almost precisely the phase modulation associated with electromagnetic fields associated with consciousness (Llinas and Ribardy, 1993).

2.7 Connecting Cerebral-Consciousness Timing to the Electron

Over the average functional rostral-caudal length of about 11 cm of the cerebral surface one full phase (cycle) of a 40 Hz ripple would move at 1.1 x 10^{-1} m/2.5 x 10^{-2} s or about 4.5 m/s. When such bulk velocity is applied to the resonance formula derived from the velocity divided by the circumference, the typical standing wave or resonance frequency of the cerebral perimeter would be (4.5 m/s)/.6 m or between 7 to

8 Hz (Nunez, 1995). Once again this allows global congruence between the modal frequencies associated with memory and awareness and would facilitate the synaptic basis for memory storage form the hippocampus to within the cerebral cortices (Bear, 1996).

De Broglie's matter waves or pilot waves, an important concept during the early development of quantum theory, depended upon the quantity of momentum (p)= h/λ where h is Planck's constant and λ is wavelength resulting in units of kg m/s. For an electron or proton with a radius or wavelength of 2.82×10^{-15} m, the momentum is 2.35×10^{-19} kg m/s. If a packet of energy was moving at an average of about 4.5 m/s, such as the rostral-caudal bulk velocity of the electromagnetic field over the cerebral cortical manifold, the energy is about 10^{-20} J. Given the likely range of the bulk velocity around this central value, this is well within the range of the energy generated by a single action potential (Persinger, 2010a).

The variant of this equation, Heisenberg's Uncertainty Principle, is expressed conventionally as $\Delta p \Delta x > h$ where Δp is the change in momentum and Δx is the difference or uncertainty of location. If we assume complete certainty of the location of an electron with a classical radius of 2.82×10^{-15} m then the uncertainty (difference) of momentum is $dp=6.624 \times 10^{-34}$ J s/2.82×10^{-15} m or 2.35×10^{-19} kg m/s. At a bulk velocity of about 4.5 m/s for transcerebral magnetic fields, the energy would be 10^{-20} J.

This value becomes relevant for the spatial extent of potential entanglement if gravity is considered. The gravitational force between two charged particles being carried by sodium ions each separated by 10 nm on a cell membrane is about 3×10^{-45} N (Persinger et al, 2008a). This is an extremely small force but when spread over the spatial extent of the universe with a width of 10^{25} m to 10^{26} m the associated energy (force times distance) is in the order of 10^{-20} J.

For entanglement this marked congruence in magnitude between a quantum unit of neuronal function and the energy between two particles that compose this function through membrane polarization at the distance of the width of the universe could constitute an identity or the potential for a variant of a condensate. It also suggests that the completeness of the "entanglement" would require a "second" virtual or identical particle effectively on the other side of the universe such that both particles would be juxtaposed. With such juxtaposition a change in one particle could be associated with the alteration in the other instantaneously. Of course the critical question is "where" is the "other side"? If the other side is effectively the reference point after light has traversed the circumference of the universe, then the "other particle" would be infinitesimally proximal and separated from the reference (particle) by a single Planck's length (Persinger and Koren, 2007).

3.0 Experimental Production of "Macroentanglement"

3.1 Macroquantum Effects Predicted by the Einstein Relation

Recently we demonstrated that quantum phenomena, such as the Einstein relation, might be also manifested at the level of brain space. This relationship is formally expressed as $f=(E_a-E_b)/h$ where E_a is the energy state of A and E_b is the energy state of B and h is Planck's constant. Frequency can be in turn converted into wavelength or spatial distance.

Persinger et al (2008b) calculated the energetic difference between 37 and 38 deg C which was 1.4×10^{-23} J. The frequency equivalence when divided by Planck's constant was 0.2×10^{11} Hz the wavelength for which, assuming c, was about 1.5 cm. This is the effective distance in the brain that not only separates the

two cerebral hemispheres but is within the range of separation between foci activated by the expression of one of two languages within the prefrontal cortices of bilingual individuals. They often perceive themselves as "different" selves when they are engaging in the different languages. Their brains can be considered systems that can exist in either of two different energy states.

During approximately 2 ksec of transcerebral magnetic field application of burst-firing, frequency-modulated patterns with a slight enhancement of intensity over the right hemisphere, volunteers reported a sensed presence. The intensity gradient was equivalent to about 70 pT per neuronal width of 10 um and assuming attenuation during application would be at least within the single digit pT range. External thermometers inserted comfortably into both ears indicated that the increase in 1 deg over the right hemisphere compared to the left was the threshold required for the report of a sensed presence. In fact the slope for the 0,1 report of a sensed presence as a function of the interval-based change in right ear temperature was effectively unity.

3.2 Entanglement of Thoughts for Two People?

Our first demonstration of macroentanglement involved a relatively simple paradigm. It was based upon the results of an experiment (Persinger et al, 2003) involving siblings. In that study the brain of one sibling was exposed to magnetic fields that were pulsed for various durations as they rotated counterclockwise from each of 8 equally spaced solenoids placed around the person's head. We employed the counterclockwise direction because we presumed the direction of the field would be moving against the rostral-caudal creations of the natural macroscopic magnetic fields generated from the cerebrum. This would produce the interference patterns sufficient to influence the temporal recreation of consciousness.

This rotational direction had significantly affected subjective time distortion (Cook et al, 1999); the duration of the total time distortion was a function of the numbers of rotations. Special subjects who were involved with verifiable "remote viewing" showed measurable improvements of these capacities during the days following exposures to the rotational fields. Ingo Swann's (Persinger, et al, 2002) accuracy for information concerning stimuli at substantial distances from his brain was strongly correlated with the durations of unusual 7 Hz spike like waves over his right hemisphere during the "viewing" process. MRI and EEG measures revealed anomalies of no obvious "pathological" significance within the space occupied by the white matter in the temporoparietal lobes of the right hemisphere.

The acquisition of "information from a distance", a type of analogue to "action at a distance" was so conspicuous during the application of the circumcerebral magnetic fields that we re-evaluated our more conservative interpretation of the historical claims of information occurring in spaces and times quite distal to the experient and involving non-traditional sensory modalities. We asked the question: if consciousness was "recreated" within the transcerebral electromagnetic fields once every 10 ms to 20 ms then what occurs in that finite but very small duration of time between the end of one transcerebral electromagnetic field and the beginning of the next? What occurs during the "infinitesimal infinity" of that interval?

In other words is consciousness a type of filter that prevents access to or awareness of extracerebral information? If one assumes electromagnetic configurations create or are strongly correlated with consciousness, a profound hypothesis is derived. During these brief suspensions before the generation of the next transcerebral wave information from space-time, in a quantum sense, could be incorporated into the next cortical manifold and converge within the sequence of units that form the stream of consciousness.

Consequently the circumcerebral device was tuned to overlap with the temporal characteristics of the emergent processes, in the order of 20 msec, associated with consciousness. The rate of rotation of the 0.5 to 1 μT magnetic fields in this horizontal plane just above the ears (from an external perspective) could be programmed to accelerate or de-accelerate. Although a constant velocity in a circle is technically also always accelerating, we designed the experimental apparatus to produce consistently changing angular velocities.

Applied field strengths in the order of 1 μT (10 milligauss) are usually considered too small to compensate for many of the thermal-related processes within cerebral space. However the penetrability of the magnetic fields within this constrained volume allows for potential storage of energy which can be estimated by $J=[B^2/(2* 4\pi \mu)] * m^3$ where B is the field strength, μ is magnetic permeability and m^3 is the volume. The potential energy within a volume of about 10^{-3} m^3 (the human brain) would be about 10^{-9} J. If one assumes each of the approximately 10^{10} cerebral cortical neurons are firing on average at 10 Hz and each action potential involves an energy quantum of 10^{-20} J, then this applied strength would be sufficient to interact with the average energy display from electromagnetic activity of the entire cortices.

For example, a 20+2 configuration (the first number is the base duration and the second number is change in duration) indicated that at the first solenoid over the left frontal region the duration of the complex frequency-modulated magnetic field (derived from the computer inputs) was 20 ms. At the next solenoid around this counterclockwise direction over the left frontal-temporal interface the duration was 18 ms. This change continued until at the final, 8^{th} solenoid over the right prefrontal region where the duration was 6 ms. If the configuration was 20-2, this meant that the first duration was still 20 ms but with each successive solenoid the duration was 2 ms longer.

We reasoned that in addition to averaged velocity and acceleration around the entire brain, there were additional changes in rates between successive solenoids. Intuitively, at the beginning of these studies during the year 2000, we selected the base duration of 100 ms and 20 ms because of their obvious relationship to peaks power frequencies (10 Hz and 50 Hz, respectively) within the cerebral EEG and well as the then emerging research involving microstates that existed over the entire cortical surface (Koenig et al, 2002).

3.3 Sibling Study

In the experiment with siblings, one wore the eight-solenoid device while sitting in a closed acoustic chamber (which was also a Faraday Cage) while the other sibling's EEG was recorded from eight locations over the left and right frontal, temporal, parietal, and occipital lobes. The latter sibling or response person sat blindfolded in the dark in other rooms either 5 m or 10 m away. A 20 sec baseline of the quantitative EEG (QEEG) activity was recorded and stored. During each of the 6 different serially presented 5 min configurations of rotating (circumcerebral) magnetic field presentations to the "stimulus" person in the chamber 20 sec of QEEG measurements were recorded for the response person. During the recording period the stimulus person in the chamber was asked to imagine being in the other room with their sibling and touching him or her.

The results were clear. When the 20+2 ms presentations occurred the response person's EEG showed increased power within the theta range, particularly 5 Hz to 5.9 Hz but only if the stimulus person was imagining being near the response person. The greatest increase occurred over the (right) parietal lobe. Many of the response persons reported a sensed presence along their left sides at this time as well. The effect did not occur when there was no magnetic field being generated around the head of the stimulus person and much less so during other configurations.

We interpreted these results as the potential consequence of entanglement that was encouraged by the application of the circumcerebral magnetic field to the stimulus person. However the major confounding variable was the potentially shared genetic or anomalous environmental history (proximity) over which we had no control. In order to accommodate these limitations, another experiment was designed (Persinger et al, 2008c).

3.4 Randomly Assigned Strangers with Subsequent Spatial Proximity

During the second week of a first year university psychology class, 8 students (for four pairs) were randomly selected from the class roster of about 80 students and asked to participate in an experiment for a reinforcement of $50 per pair. Each pair was instructed to meet twice per week for one hour for four consecutive weeks. From our perspective the purpose was to establish a history of proximity without either genetic or familial factors confounding the "entanglement".

On the day of the experiment pairs were exposed to the same procedures as those subjects in the sibling study. When the stimulus person in the chamber was wearing the equipment that generated the circumcerebral magnetic fields with 20+2 configurations and imagining being in the room with the response person, his or her EEG displayed increased power within the theta range. However the effect was more related to the temporal lobes, with a slight right hemispheric enhancement. The subjective experiences of the response persons whose EEGs were recorded were even more intense than those reported by the response persons in the sibling study.

When the stimulus person during the 20+2 field presentations was simply thinking about the other (response) person, he or she showed a marked increase in the feeling of a sensed presence, anger, and sexual arousal. Such experiences did not occur for the stimulus persons. Pairs of random strangers, obtained by recruiting people walking by the laboratory and who were exposed to the same procedures did not display significant changes in either their EEG profile or their subjective experiences.

Although interesting the apparent support for macroentanglement did not meet the qualitative criteria or the essential procedural operations of what Bohr and Schrödinger had envisioned. Entanglement involves a process by which two particles (or by inference an aggregate of particles that behave as a single particle) respond simultaneously to a change in each others states despite the distance between them at anytime after their diminished close proximity. In other words the two distal particles are still responding as if they occupy the same space or may even be the same particle with the potential for two different states.

3.5 Geomagnetic Field-Based Entanglement?

Dotta et al (2009) tested the concept of macroscopic entanglement by simultaneously measuring the quantitative EEG of pairs of people separated by about 75 m. They found that about 50% of the variance of the simultaneous EEG power was shared between the pairs of brains. Considering the measurements by Mulligan et al (2010) that showed significant correlations between power within the theta and gamma bands over the right prefrontal regions and daily geomagnetic activity, such "excessive" correlations would be expected. Both members of the pairs would have been exposed to similar geomagnetic activity. This third factor would have produced the apparent coherence or "excess correlations".

The critical observation for this study was the direction of the correlations. Pairs of strangers showed positive correlations in power output within the alpha and gamma bands over the frontal and temporal lobes. This would be expected if a third recondite (to the observers) factor produced both. However, people who shared a reinforcement history (that previously shared locations) displayed *negative*

correlations in power within the alpha and theta band over these regions. This could be considered an analogue of quantum phenomena when the state of one particle is opposite to the one with which it is entangled. Direct measurements with a fluxgate magnetometer of the static geomagnetic field intensities within both locations where the EEG measurements were taken were unusually similar, as if they were "the same" space.

3.6 Experimental Production of the "Same Space" for Macroentanglement

To create spatial identities we employed two, eight circular solenoid systems separated by 15 m. One person sat within the acoustic chamber and wore one unit while a second person sat blind-folded in the dark in a separate room wearing the second unit. The two units were synchronized by being connected to the same computer that generated the complex, altering-velocity rotating magnetic fields to both brains simultaneously. We assumed this "simultaneous" production of identical fields in two separate locations would be topologically equivalent to a translation of spatial-temporal axes such that they become the same space. If this is valid, then what occurs in one space (and the brain occupying it) should occur in the other space (and the brain occupying it) even though the distances are significant and classical sensory modalities are not operative.

We employed a much simpler paradigm than the "transmission of thought". While both the stimulus person and the response person were exposed to the same complex configurational magnetic field the stimulus person was exposed to flashes of white light of about 1 lux for 30 s intervals. The flash frequency was between 4 and 15 Hz. At the same time the QEEG for the response person was measured for 20 s just before and 20 s during the light flashes were presented to the stimulus person. In several experiments involving three different sets of experimenters employing the same paradigm, the response subjects' power profiles from QEEG analyses showed increases within the right parietal-temporal region only when the stimulus person was watching the light flashes.

The power increase was maximum within the range of the frequency of the light flash but was most conspicuous and significant statistically for the 8 Hz to 10 Hz flashes. However unlike the "projection of thought" entanglement studies for the sibling and randomly-assigned stranger studies, the most effective configuration for producing this effect was an initial duration of 100 msec and a change duration of 10 msec. This meant that the duration at each of the 8 successive solenoids changed from 100 ms to 90 ms etc until it was 30 ms over the right prefrontal region. This duration is within the range of the microstates and the interval of a percept, about 80 to 120 msec that lies at the bases of visual perception (Koenig et al, 2000).

3.7 Photon Emissions from the Human Brain

At the quantum level the intricacies of entanglement are coupled with photons. To discern if photon emission could occur from the brain of the response person in a double-circumcerebral field paradigm, Dotta and his colleagues (Dotta et al, 2010) measured the energy of photon emissions from the response person while the stimulus person was exposed to the flashing lights. In this situation the stimulus person sat within the closed acoustic chamber while the response person sat blindfolded 10 m away in a closed, dark room. Instead of measuring EEG activity, a photomultiplier tube (PMT) was placed 15 cm away form the right hemisphere on the same plane as the temporal lobe.

The right hemisphere had been selected because Dotta and Persinger (2010) had found that when the average person sitting in the dark was asked to think about light rather than casual or random events, there was an increase of photon emission from the right relative to the left hemisphere. The energy of the

photon emission was 10^{-13} J and, assuming 10^{-20} J per action potential, would be equivalent to about 10^{7} neurons firing per second. This is within the range of the numbers of neurons involved with known areas of activation during specific thinking as inferred by the oxygen uptake or positron emission during bold fMRI or PET studies. The measurements were also consistent with the hypothesis by Bokkon (2005) and his colleagues that biophotons are not only routinely emitted from neuronal processes such as action potentials, but may be an energetic field that actually is the visual experience associated with visual perception and dreaming.

In this macroentanglement paradigm 7 to 8 Hz white light flashes of about 1 lux (diffusely projected against the wall) were presented in 30 sec on-off sequences to the stimulus person while the photon emissions form the right side of the head of the response person were recorded every second. The output from the PMT was sent directly to a laptop computer screen that allowed not only recording but real time observation of the energy output. During the entire experiment both subjects wore the circumcerebral devices containing the 8 solenoids and were exposed to various no field or field conditions. The field conditions involved either accelerating or de-accelerating rotations each presented for between 2 and 5 min. The primary base durations and changing durations were 20 +2, 20-2, 100+10, and 100-10.

Analyses of the data indicated that when the stimulus person was watching the diffuse light flashes there was a net increase of about 10^{-11} W/m^2 from the response person's right hemisphere. The integrated total increase would have been in the order of 10^{-12} W or J/s. Assuming 10 action potentials per sec and each action potential was 10^{-20} J, this would be equivalent to about 10 million neurons. Three pairs of stimulus-response persons were tested and all three response persons displayed this effect. One of them reported perceiving "white light" in the visual field, even though the subject was sitting in the dark and blind folded, during 5 of the 6 intervals the stimulus person was watching the light flash. Obviously, the person was not told when the light would be presented to the stimulus person.

The potential application to macroentanglement is apparent. First, the presentation (absorption) of photons to the stimulus person was associated with the emission of photons from the response person. Such "equilibrium" is similar in kind to the reversal or polarity of a photon when one of the pair is affected if arbitrary values of increase or decrease are made equivalent to + and – or top and down references. What is not clear is whether or not the photon emissions measured by our PMT from the response person's head were the same photons absorbed by the stimulus person's eyes (and skin) from the light flashes. Clearly 1 lux which is about 10^{-3} W/m^2 was not transmitted in bulk. However the energy through the aperture of the pupil (about 1 mm^2) would be about 10^{-9} J/s and with the approximately 100 fold attenuation through the lens and humours would be about 10^{-12} J/s by the time the rods and cones were encountered.

The third implication from the magnitude of energy measured during this entanglement experiment is the marked similarity of the estimated mass equivalent of a fundamental "exotic" transfinite particle as proposed by El Naschie (2004). This particle displays an intrinsic energy of 3×10^{-13} J (1.8 MeV) and has been hypothesized to determine the GUT (General Unified Theory) and total unification of all fundamental interactions. This value is also very similar to the particles of vacuum fluctuations within space-time. Such congruence would be important to connect micro- and macroentanglement.

The concept that gravity is not a fundamental interaction but rather an induced effect produced by changes in quantum fluctuation energies of the vacuum when matter is present shifts the operation of gravity closer to Casimir forces rather than to fundamental Coulomb forces (Puthoff, 1989). This allows for a quantum-fluctuation-induced gravity coupled to zero-point-potential (ZPF). The gravitational constant would be an inverse of the high frequency cut off of the ZPF which effectively is the inverse of Plancks'

time or in the order of 10^{44} Hz. This allows for possible solitonic "extended particles" into quantum gravity Hilbert space (El Naschie, 2004). Effectively the condition is set for the existence of gravitational "instantons", which, as the name implies, can cross space in zero time.

4.0 Implications of Macroentanglement and Future Directions

The generalization of experimentally-produced macroentanglement would have significant implications for understanding the manner in which human thought and the occurrence and the sequence of events are perceived. From a practical perspective, it might allow the development of the control of and interaction with intelligent machines on other planets that would overcome the limitations of response delays. From an evolutionary perspective, it could reveal the interconnection between human thinking as a "geopsyche" (Persinger and Lafreniere, 1977) or, from the perspective of integrative biology, the entanglement of all living systems on the earth that have and now share immersion with the space occupied by the earth's magnetic field. The interactions would be simultaneous.

In addition the issue of events occurring as the result of reversals in temporal direction from what we perceive now as future events would be re-evaluated. If entanglement is involved with photons from electron spins as proposed by Hu and Wu (2006) from before the "Big Bang", then the connectiveness of matter, including that which composes the human brain and the configurations experienced as consciousness, could be affected by a novel type of determinism that could alter cultural philosophies. The possibility that a single thought could affect the sequence of events in the universe (Persinger et al, 2008a) may have real although limited application.

4.1 Geomagnetic Immersion and Connections

All human brains are immersed within the earth's magnetic field within which life, as currently defined, developed. Assuming 10^{11} neurons in the human neocortices, an energy of 2×10^{-20} J per action potential, an average of 10 action potentials (10 Hz) per neuron and a life span of 2×10^{9} s, the total "thought energy" per person would be about 10 J. The total numbers of human beings over the last 3,500 years may have been about 55 billion, with a total "thought" energy of 5.5×10^{11} J.

Energy "storage capacity" within the earth's magnetic field is its average strength of 5×10^{-5} T multiplied by the dipole moment (8×10^{22} A m^2) or 4×10^{18} J. This means all of the energy equivalents of thoughts from every human being who has ever existed could be stored or representative within the earth's magnetic field. With an inductance (Webers/A) of 1.6×10^{2} Henrys, a capacitance of 2 Farads, and a frequency of 7 Hz (the fundamental Schumann value) the time required for representation is about 2 ksec or 30 min. This is within the range of the electrical lability period for human memory consolidation and would suggest there are two representations.

The first type would be spatial patterns created by the growths of dendritic spines which require about 15 to 30 min to emerge, assuming the appropriate long-term potentiation. These memories and thoughts would be bound to the complex configurational electromagnetic fields whose topology is the fractal space of the approximately 10^{13} synapses within the cerebral cortices. When this deteriorates at biological death, this information dissipates. The loss of structure dictates loss of function.

The second form would be represented as electromagnetic phenomena within the space occupied by the earth's magnetic field (Persinger et al, 2008a). This information would be maintained as transforms of the

energy from the digital sequences of action potentials. Candidates for this storage would require some physical equivalent of Hilbert space within the boundary of the geomagnetic field. Stored as phase relations, the information could also be retrieved. The existence of both systems of representation of information would be equivalent to the history of DNA within the context of the individual relative to the species. Although a single person's expression terminates with her or his demise, the approximately 3 billion year history is maintained through successive transmission to offspring who maintains the temporal continuity of the specific sequences of base pairs.

If all human brains are immersed within the geomagnetic field and as a result are simply punctuate nodes displaying very similar genetically-determined structures along this continuous line, the steady state induced magnetic field within the entire line or the entire species can be calculated. The shared magnetic field intensity for all human beings as a field would be $B=1/2 * \mu * i* d$, where B is the magnetic field strength, μ is magnetic permeability, i is the electric current density (Voland, 1977; Winch et al, 2005), and, d is the linear distance of all 6 billion brains. The average value for B would be $1/2 * 1.26 \times 10^{-6}$ [kg m]/[s^2A^2] * 10^{-13} A/m^2 * 6×10^8 m (from 6 billion brains * each length of 10 cm) or about 30 pT. This quantity is within operating range of the average brain.

Such congruence of magnitudes between the induced operating magnetic field strength from the topological connection of all human brains by geomagnetic space and the operating intensities of the individual brain would qualitatively produce the conditions for a condensate as well as a hologram. The characteristics of each unit would be reflected in the characteristics of the aggregate such that it behaves as a unit. This is sufficient for a quiet geomagnetic baseline connection with state-dependent properties of the brain superimposed on that baseline.

Events occurring within one unit, such as an intense physiological arousal, would have the capacity to affect every other unit (brain) with specific electromagnetic configurations within the aggregate that shared the same state. The time required for such influence is quantifiable if we assume a process similar to magnetic diffusivity. It is defined as $(1/\mu)*\sigma$ where σ is conductivity. With $\mu=4\pi \times 10^{-7}$ N/A^2 and σ=2.1 S/m (physiological saline) the solution is $1/2.64 \times 10^{-6}$ s/m^2 or $.378 \times 10^6$ m^2/s. The time required to diffuse through 9×10^7 m^2, the total surface area of all human brains, would be a 238 s or about 4 min. The time to access the EM configuration for all human cerebra from a single brain would be within the duration of normal ranges for global cerebral states.

Similar durations were measured empirically by satellite data for hydromagnetic waves within the 5 mHz (200 s) range that were generated about 5×10^7 m from the center of the earth. These waves required about 90 s to traverse to the earth's surface (Tu et al, 2005). Within these physical constraints of the magnetic field intensity and plasma density within this volume, the required photon mass would be $< 4 \times 10^{-50}$ kg. This is within the range of energy equivalence that could functionally connect the production of the Bohr magneton and the operational intensity of cerebral magnetic field strengths.

These latencies are within the time range of an average period of dream or rapid eye movement (REM) activity for human beings. These periods, which occur on average every 90 min to 120 min increase from about 10 min during the first few hours of sleep to 20 min or more during latter hours of sleep. The dream state shares many of the neurophysiological characteristics of the waking state, including the 10 to 20 msec intracortical integrations, phase shifts, and rostral-to-caudal wave propagations over the cerebrum.

The right hemisphere is both preferentially activated during REM periods and is more sensitive to geomagnetic activity. In the waking state we have found significant correlations between day-to-day geomagnetic variations and the power within specific frequency bands over the right hemisphere. The

latter are also strongly correlated with a more recent indicator, atmospheric power density (Mulligan et al, 2010). The calculations suggest that once a person enters REM sleep the "connection" or association with all of the other millions of brains that are within the same state at the same time would allow superposition of information between at least a subset of those brains. Marks et al (1995) have suggested that REM sleep even directs the course of brain maturation in early life through the control of neural activity.

Bokkon (2005) has suggested that the images associated with visual perception and dreaming are the experiences of fields of photons structurally organized within the cerebral cortices due to its intrinsic neuroanatomy. These photons would be generated by intracellular processes as well as from action potentials. It is relevant that the energy associated with 10^{-20} J, associated with an action potential, is equivalent to a frequency near the velocity of light which approximates the average neuronal soma's width, about 10 µm. If these photons were entangled from previous proximity, such as from within the sun, which according to Popp (1986) is the source of most biophotons, then mutual dreaming between millions of brains would have the potential for exchange of information.

The relationships between the geomagnetic environment within which human brains are immersed and the emission of photons could reveal mechanisms. We have found reliable negative correlations between normal ranges (5 to 500 nT) in minute-to-minute geomagnetic activity over 24 hr periods and the energies of photon emissions as measured by photomultiplier tubes. This would suggest that periods of minimum geomagnetic activity, whose wide band spectral periodicities are within the mHz range, would be associated with greater photon emission from brain space. In fact enhanced geomagnetic activity would be predicted to obscure or interfere with the intrinsic connection between all brains immersed within it.

Commensurate with this assumption, several correlational studies involving cases collected for over a century, have shown that "information" about sudden death or crisis to individuals related to the experient occurs much more frequently if there is minimal geomagnetic activity at the time of the experience (Persinger and Schaut, 1988). Stated alternatively, they occur when there are minimum disturbances in the baseline geomagnetic connection. As predicted the majority of these experiences occur during dreams or related states during the day. The effect was replicated within dream laboratories (Persinger and Krippner, 1989).

The relationships between the experient and the person to whom the adverse events occur reflect a gradient of shared history of locality. The most common experiences occur between members of the immediate family, followed by distant family and friends. Other researchers (Lipnicki, 2009) have reported that bizarre dreams, which are those that contain content that are difficult to rationalize by classical sensory operations, also occur during periods of minimal geomagnetic activity.

The occurrence of entanglement from shared geomagnetic immersion during shared cerebral electromagnetic states by billions of people has profound implications. First, the apparent temporal distortions, pejoratively described as "precognition" or "retrocognition" would be more congruent with the quantum concepts that the past and present are arbitrary serial perceptions. Instead they are connected. The quantitative duration of the apparent separation between the event and the experience might be lawfully distributed according to intrinsic processes such as the central limit theorem (the normal distribution curve) whose value might reflect the nature of the "band width" of the specious present.

One empirical study showed that the temporal disparity between the experience and the event displays a normal distribution with about 70% of the cases occurring within +/- 3 days of each other (Persinger, 1993). For events that occurred between 3 days to a year after the experience the geomagnetic activity at

the time of the experiences for the future events was moderately correlated with what the intensity of the geomagnetic activity would be one to two days before the actual events (Dotta and Persinger, 2009). The magnitude of correlation is remarkably similar to that reported by Korotaev et al (2005) for the non locality-like coherence in "random" variations in geomagnetic activity several weeks before a significant solar event.

4.2 The Casimir Energy

The Casimir effect has been considered a manifestation of zero point oscillations. The effect is defined as the interaction between a pair of neutral parallel conducting planes correlated with a disturbance of the vacuum of the electromagnetic field. The Casimir relation is considered to be an example of a pure macroquantum effect. The manifestation is based upon the assumptions that: 1) there is an infinite vacuum energy of free Minkowski space, 2) there is infinite energy when free space is set equal to zero, 3) there are zero point oscillations, 4) external magnetic fields affect vacuum polarization, and, 5) boundary conditions are concentrations of external fields.

There are three main consequences of these assumptions. First, material boundaries polarize the vacuum of a quantitized field such that the force acting on the boundary is a result of polarization. Second, the application of external fields create particles from the vacuum because energy is transferred by the external field to virtual particles (vacuum oscillations), thus transforming them into real particles. Third, and important for the experimental production of these effects, there is no effect with static boundaries. If the boundary conditions are changing as a function of time, there is particle creation as well as the production of a force.

The formula for the Casimir force is: $(\pi^2/240)^* (\hbar c/a^4)$ S, where ħ is the modified Planck's constant, c is the velocity of light, a is the distance of separation between the two plates and S is the area. The Casimir force across the synapse with distance between the two "plates" of about 10 nm would be $(.014 * 1.06 \times 10^{-34}$ Js $* 3 \times 10^8$ m/s$)/(10^{-8}$m$)^4$. Assuming the maximum width of a synapse is 2 um and is square-shaped the area would be 4×10^{-12} m^2, the force would be $.52 \times 10^{-6}$ N and when applied across 10^{-8} m the energy would be $.52 \times 10^{-14}$ J.

Although this is a small energy, the frequency equivalence according to J=hf would be $.52 \times 10^{-14}$ J/6.626×10^{-34} J s or $.078 \times 10^{20}$ Hz. The equivalent wavelength, assuming the velocity of light would be $(3 \times 10^8$ m/s$)/(.078 \times 10^{20}$ Hz) or 38×10^{-12} m or 38 pm which is within measurement error of the atomic radius for neutral hydrogen (Persinger and Koren, 2007). Such solutions would be expected for the critical increments of space, such as the interneuron interface (the synapse) and the plasma membrane that connect the intrinsic quantum effect with the macrocosmic expression of consciousness.

The relationships remain systematic within smaller functional spaces. If the distance between the boundary is about 1 nm, which is the closest integer to the 0.6 nm layer of charge that creates the membrane potential, the Casimir force between both sides of this thin layer of charge over the area of a pre- or post-synaptic area would be 5.2×10^{-11} J which has an equivalent frequency of $.785 \times 10^{23}$ Hz and resulting wavelength of about 4×10^{-15} m. This is proximal to the radius of the classical electron and the proton.

However for entanglement to have the potential to relate the particle to the universe there must be an integrating factor such that each unit is mapped upon the whole (Koren and Persinger, 2010). The Casimir solution for the surface of the known universe as two plates with the inner plate defined by the average intrinsic pressure is 54 um or 5.55×10^{12} Hz (THz). The energy equivalence from Planck's constant is 3.7 x

10^{-21} J which results, when divided by the unit charge of 1.6 x 10^{-19} As, is a value of about 22 mV. This is within the range of potential difference across many cell membranes, particularly those that are prone to burst-firing. Such patterns are important for both the encoding and retrieval of information within brain space.

Changes in the spatial dimensions that support the organization of particles, such as protons, and hence the properties of their aggregates (atoms) might also be considered. If the Casimir force manifests matter from virtual particles based upon applications to a changing boundary of the structure of space, then a change in the configurational frequency of space might allow elements to change spatial geometry. The altered spatial organization could result in different elements without fission or fusion that involves massive displays of energy.

For example what levels of energy would be required to represent the difference between lead (Pb) and gold (Au) if the radii of their nuclei are assumed to be 7.1 x 10^{-15} m and 7.3 x 10^{-15} m, respectively? The classic gold (Au) atom has a force/charge solution of: (9 x 10^{9} $Nm^2/Coul^2$ * 79 * 1.6 x 10^{-19} Coul)/ 7.3 x 10^{-15} m, or, 21.347 x 10^{20} N/Coul or V/m. This is an extraordinary value at the levels of macrospace.

However at the level of Planck's length which is 1.62 x 10^{-35} m, the product is 3.4497 x 10^{-14} V. The effect of this potential difference on a charge of 1.6 x 10^{-19} A s results in an energy of 5.55195 x 10^{-33} J. Using Planck's constant, the resulting frequency is about 8.3 Hz. The energy difference if Pb shifted to Au or 82 Daltons to 79 Daltons, assuming a radius of 7 x 10^{-15} m would be 6.24 x 10^{-33} J. This is equivalent to frequency of 9.4 Hz. Both frequencies are within the peak power of cerebrum function during alpha activity, associated with imagination and relaxation, and approach the intrinsic fundamental oscillation within the earth-ionospheric resonance system, the Schuman resonance.

4.4 Accessing Zero Potential Energy

The energy associated with ZPF or Zero Point Fluctuations is $[\pi c^5 \hbar)/(4G)]^{1/2}$ or about 2.8 x 10^{9} J or 1.7 GeV. The voltage associated with that energy is J/q or 2.8 x 10^{-10} V. The classic frequency of 40 Hz associated with consciousness is associated with 264 x 10^{-34} J. The magnetic field strength sufficient to affect the spin magnetic moment of 9.78 x 10^{-24} J/T would be 27 x 10^{-10} T (about 3 nT). The area associated with this magnetic field strength, electric field, and frequency according to m^2=V/fB is 5 cm which is average radius of the human cerebrum.

From this perspective spaces with radii in the range of the human cerebrum could have access to the energy associated with the zero point fluctuations (Puthoff, 1989). The frequency associated with the Zitterbewegung (ZPF or "jitter") can be calculated from $\pi c^5 / \hbar G$ or 3.30 x 10^{43} Hz. The square root of this value is 5.7 x 10^{21} √Hz. When multiplied by Plank's constant to the resulting value is 3.8 x 10^{-12} J √s. If we assume the frequency density of the cerebrum is within the 100 Hz range, then multiplying by the square root of this value √100 1/s) results an intrinsic energy of about 3.8 x 10^{-11} J. Consequently the energy for the entire brain resonance of 100 Hz (or 10 ms increments) would be within the range generated by a 100 million neurons firing around 10 Hz.

4.5 Comparable Energy Density of Universal Space and the Human Brain.

Given a pressure of 1.5 x 10^{-10} Pa (kg/ms^2) the force associated with a cross sectional area of 1.12 x 10^{53} m^2 (the area of the universe's boundary assuming a radius of 10^{26} m) is 1.68 x 10^{43} N. When this value is multiplied by the length of 9.47 x 10^{25} M the resulting energy is 1.59 x 10^{69} J. This value is comparable to the equivalent for the mass of the universe of 10^{52} kg (Persinger, 2009) and is remarkably similar to that

obtained with the relativistic equation.

The energy density for the universe would be 1.59×10^{69} J divided by the estimated volume 3.57×10^{78} m^3 (if one assumes a sphere) or 0.44×10^{-9} J/m^3. Within the volume of the human brain this would be 5.7×10^{-13} J. Because each action potential with a net change of 120 mV is associated with an energy on a unit charge of 10^{-20} J, which is also the energy required to stack a base on a sequence of RNA, the total number of action potentials that would be equivalent to the universal energy density is 5.7×10^{7}. If we assume the average power of the brain is around 10 Hz and this reflects the average numbers of action potentials per neuron, only a total of about 6 million neurons within the cerebral cortices would be required to match this universal density.

4.6 The Problem of Entanglement from the Future

Hu and Wu's (2006) primary assumption was that quantum entanglement arises from the primordial self-referential spin processes which are the integrating function for space-time dynamics, quantum mechanics, and consciousness. The entanglement that occurred in pre-space time between electrons involved exchanging one or more entangling photons. One possible consequence of this connection is that what will happen within the boundaries of the age of the universe has been implicitly structured.

This concept is congruent with the boundary condition of Nyquist limits applied to the relationship between Δs (an increment of space) and Δt (an increment of time). In the perception of physical phenomena as functional wholes, there is an intrinsic correlation (Persinger, 1999). To view picometer space one requires a minimum increment of picosecond time; to view millimetre space one requires millisecond time. However to perceive process there must be at least two successive Δts. The upper limit occurs with the maximum possible Δs, the universe, and the maximum Δt, the age of the universe. At this perspective, there is no process and no time, but only a static, non changing single unit.

One approach to understand how intrinsic pre-spacetime entanglement might affect future events is to assume G is associated with the duration of matter within the universe. A function could be derived that relates this constant to time from which a quantitative value could be calculated. Dimensional analysis allows G($N\ m^2/kg^2$) to be equivalent to the product of the inverse of density (m^3/kg) and squared frequency ($1/s^2$). Hence $Hz^2=G/(1/d)$ which is 3.33×10^{-19} Hz and the inverse is 3×10^{18} s. The duration is equivalent to about 95 billion years.

This constraint would suggest at the current estimate of 10 to 13.3 billion years only about 10% to 15% of the potential has been achieved. The most obvious question is could the "dark matter" be the matter yet to be displayed? If there are two forms of energy, potential and kinetic, might there also be two types of matter: kinetic and potential? The amount of one would be the inverse of the other.

The most likely (known) moderating process for such transtemporal connection would be the photon. It may not be coincidence that the energy associated with the age (or frequency) of the universe, about 4×10^{17} s would have a value of 6.6×10^{-34} J s * $.24 \times 10^{-17}$ Hz or about 2×10^{-51} J. This value is remarkably similar to the upper limits of the rest mass (about 10^{-51} kg) of a photon which is a quantity expected following the removal of c^2 from the relationship. One interpretation of this apparent identity is that the energy contained within a photon with a velocity near c contains the information of and a connection with the age of the universe and supports the assumptions of quantum philosophy (Horgan 1992) and Hu and Wu (2006).

4.7 The Involvement of Gravitational Energy with Consciousness

Calculations by Ahmed et al (1997) indicated the effects of gravity (as inferred by weightlessness) on the human EEG, assuming axon conduction of about 20 m/s, was about 2 parts per million. However with 4 m/s, the bulk velocity associated with the cerebral cohesive waves that results in about 7 Hz for its fundamental resonance $(f[n(n+1)/2]^{1/2} * v/2\pi r$ (where cerebral circumference is about 55 cm), the value would be about 2 parts per 10 million. This means that if we assume the transmission is by hydrogen (90% of the universe) with a peak emission of 1.42 GHz (21 cm) one complete phase shift from one peak to the next would require 2×10^7 divided by 1.42×10^9 1/s (Hz) or about 14 msec. This would suggest that processes associated with gravity could affect the phase modulation of cerebral activity.

Minakov et al (1992) explored the conditions by which gravitational waves might be converted into electromagnetic waves. An interface occurred when the gravitational wave interacted with a static electric field within the natural resonator formed by the earth's surface and ionosphere. The Schumann resonances, which display a fundamental frequency of about 8 Hz and higher-order modes separated by about 5 Hz to 6 Hz (Schlegel and Füllekrug, 1999) operates within this resonator. The most powerful amplification region for gravity-to-electromagnetic conversion occurred within the second global Schumann resonance of about f=14 Hz. In this frequency band detection of gravity waves was increased by an order of magnitude.

The physical intensities of the Schumann frequencies as well as their patterns are remarkably similar to those of the human brain. As shown by Konig and his colleagues (1981) the major temporal structures, such as delta, alpha, and beta patterns, that typify the electroencephalographic frequencies of the human brain are generated within the shell between the earth and the ionosphere. The magnetic component of the Schumann resonances between 7 and 40 Hz is within 10 to 100 pT (10^{-12} T) while the electric component is in the order of 10^{-2} V/m.

Phase modulation, which has been considered the most optimal means to propagate the most information over distance, is obtained by time divided by $\sqrt{[v^2/c^2]}$. Because most of the electromagnetic fields associated with lightning are between 10 kHz and 100 kHz (atmospherics), the $\Delta c/c$ is .05 according to Tu et al (2005). This means the phase shift for every second is 1/.9897 or 16 ms. This value is congruent with the phase comparisons of approximately 10 to 20 ms associated with the continuous 40 Hz oscillations over the entire cerebral mantle (Llinas and Ribary, 1993). Such convergence sets the conditions for resonance exchange of information between the cerebrum and the geophysical, electromagnetic-gravitational environment.

Quantitative shifts in this sensitivity could be modulated by minute but discrete shifts in the Schumann resonance parameters. Technically the Schumann frequencies are described by $f=\sqrt{[n(n-1)/2\pi]} * (c/r_e) * \sqrt{(h_1/h_2)}$ where c is the velocity of light, r_e is the earth's radius and h_1 (40 km to 50 km) and h_2 (75 km to 90 km) are two characteristic heights in the D region of the ionosphere. Schlegel and Füllekrug (1999) found that during strong solar proton events with durations between about 3 days to 3 weeks, the amplitude of the Schumann resonance increased by about 0.2 pT (range =-0.1 to +0.4 pT) while the frequency increased between 0.05 Hz to 0.14 Hz.

The increase in intensity, when multiplied by Planck's constant would be equivalent to energy with a frequency of about $.28 \times 10^{-2}$ Hz or 2.8 mHz. This is within the range of resonant oscillations (with amplitudes in the order of 0.5 nGal or 5×10^{-12} m/s^2) between the earth and the atmosphere as recorded by Nishida et al (2000). For a human weighing 70 kg this would be a force of 3.5×10^{-10} N and with cross section of .25 m^2 the resulting pressure would be 5.8×10^{-9} Pa. When applied to the person's volume the

energy would be 4 x 10^{-12} J which is equivalent to about 2 x 10^{-11} W/m^2. This is within the range of the photon output from the right hemisphere of volunteers while they were thinking of white light (Dotta and Persinger, 2010). If we know the energy then we can calculate the equivalent magnetic field (B^2=Jμ2/m^3). It would be about 12 nT which is within the range of the changes in the earth's magnetic field surrounding a person who displayed a history of potential entanglements between his experiences and those of others (Persinger, 2010b).

The amplitude of the power spectral density for the 3 mHz to 5 mHz band was in the order of 3 x 10^{-18} m^2/s^3 (Nishida et al, 2000). When acting upon a human mass of about 70 kg the power would be about 2 x 10^{-16} W or the equivalent of about 10^4 action potentials. However the effect would not be immediate but require the integration or sum of these potentials over 3 to 6 min, or, on average about 4 minutes. This is the time required for magnetic diffusivity if all brains were functionally connected within the earth's magnetic field.

That the value of G itself might be correlated with geomagnetic activity has been measured. Vladimirskii & Temuryants (1996) found that during periods of minimum geomagnetic activity the values for G were higher. This correlation occurred within the range of 10^{-13} to 10^{-14} values for G (whose primary value is 10^{-11}). Because a major peak in power during geomagnetic activity is within the mHz, the possibility of a quantitative connection between the geomagnetic field, within which human brains are immersed and likely connected, and information from gravitational phenomena would have significant implications for the experimental demonstration of entanglement.

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