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A Possible Flux Density Value of 10^{-12} W·m^{-2} for "Spontaneous" Photon Emissions in Fixed Human Brain Tissue: Was Spinoza Correct?

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Abstract The equivalence between universal values of 10^{-20} J and 10^{-12} W·m^{-2} involves the product of the inverse of diffusivity of wave impedance distributed over the hydrogen wavelength divided by the magnetic permeability of free space. These two values reflect the increment of energy associated with action potentials (a major correlate of cognition) and the power densities of photon emissions during imagination as measured experimentally. The human brain, alive or dead (if structurally maintained) has similar mass and occupies space. We tested the hypothesis that these two properties would be sufficient to produce enhanced "spontaneous" photon emission compared to empty space. The photon flux density from different volumes (masses) of fixed human brain ranging between 20 mg and 1100 g were measured. Compared to the 20 mg masses that did not differ from dark counts (background), the average flux density for 100 to 1000 g volumes was ~$2\cdot10^{-12}$ W·m^{-2}. These results are consistent with the possibility that mass occupying space reflects it fundamental properties that relate to an intrinsic relationship between energy (J) and flux density (kg·s^{-3}). Within the human cerebrum the energy density would be about 10^{-11} W·m^{-3} or 10^{-14} J·s^{-1}. This is equivalent to the discharge of ~10^7 cortical neurons which is within the range of experiencing a percept in the living human brain. These results also support the Hameroff and Penrose concept of "consciousness" as well as Spinoza's implicit argument that cerebral properties indicates it is a subset of all space. There is quantitative evidence by calculation that the mediating variable may be related to the neutral hydrogen line which exhibits ubiquitous presence in the universe.

Keywords Fixed human brain, Spontaneous photon emissions, 10^{-12} W·m^{-2}, Flux density, Hameroff-Penrose "Orch-OR Theory", Mach, Kant, Spinoza

1. Introduction

Hameroff and Penrose [9] have developed a cogent and convincing argument for consciousness in the universe that results from discrete physical events. They have argued that "such events have always existed in the universe as non-cognitive, proto-consciousness events, these acting as part of precise physical laws not yet fully understood". Eddington's [8] approach to astronomy and the nature of the universe was implicitly that its perception and conception were influenced by the physics, chemistry and physiology of the human brain. Some assumptions of quantum physics indicate that observation or more specifically measurement can affect the outcome of photon interactions [13]. The phenomenon of entanglement [1] would allow two complex systems to be excessively correlated such that a change in one component produces a complimentary change in the other regardless of distance. "Entanglement energies" or those associated with "excess correlations" [6] that are associated with non-local effects are within the same magnitude (~10^{-20} J) as those associated with action potentials [15] of the neurons whose patterns are strongly correlated with human consciousness [3, 7]. The most frequently considered unit by which the phenomena of excess correlation might be mediated is the photon [4].

Recently Dotta and his colleagues [5] have shown that normal people engaging in vivid imagination of light display reliable increases in photon emissions equivalent to about 10^{-12} W·m^{-2} from their right hemispheres. Additional calculations by Persinger [18] indicated that this quantity of power density could be coupled to the basic unit of energy (10^{-20} J per s) through the inverse of diffusivity of the wave impedance distributed over the neutral hydrogen wavelength when this value was divided by the magnetic permeability of space. If this is valid then the presence of mass, such as the human brain, should exhibit this order of magnitude of flux density. Here we present empirical evidence that different

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masses of fixed human brain tissue emit "spontaneous" photons that reflect the 10^{-12} W·m^{-2}.

Multiple philosophies have assumed the presence of a universal field or substance that reflects the structure of space. Different increments of mass occupy different volumes of space and reflect these characteristics. One inference of this assumption is that the human cerebrum which occupies about 10^{-3} m^3 will reflect a feature of this space. Because billions of human brains are similar in volume they will all display a commonality by which coherence and "condensate" like properties could emerge under specific situations [16]. Spinoza [10], without the benefit of quantification, had argued that the human brain's special abilities (including cognition and consciousness) was a reflection of the universal property being represented within cerebral space. There is quantified support for this supposition. If the averaged energy density of the universe is about 10^{-9} J·m^{-3} and a percept is associated with about 10^7 neurons [23] distributed through the cerebral cortices each discharging ~10 Hz, then the total energy from 10^{-20} J per action potential is 10^{-12} J per s. Because the human cerebrum is about 10^{-3} m^3 this is equivalent to 10^{-9} J·m^{-3} which is the same order of magnitude [19, 20].

2. Calculations

According to Persinger [18] the relationship between W·m^{-2} and J·s^{-1} can be equated by:

$$W \cdot m^{-2} = (s \cdot m^{-2}) \cdot (J \cdot s^{-1}) \cdot s^{-1} \quad (1)$$

or as stated semantically the flux power density is equal to the product of joules per second, the inverse of diffusivity and frequency. As predicted by Ernst Mach we would expect the values for these quantities to be universal. We assumed s^{-1} is the rotational Bohr frequency for an electron ($6.59 \cdot 10^{15}$ s^{-1}).

For inverse diffusivity we assumed that the wave impedance of 376.73 Ω applied across the hydrogen wavelength ($2.12 \cdot 10^{-1}$ m), or $7.99 \cdot 10^{1}$ Ω·m. When divided by magnetic permeability in a vacuum, which is $1.26 \cdot 10^{-6}$ N·A^{-2}, the diffusivity would be $6.34 \cdot 10^{7}$ m^2·s^{-1}. The inverse value is $0.16 \cdot 10^{-7}$ s·m^{-2}. The product of $1.5 \cdot 10^{-20}$ J, the basic quantity that emerges as a property of water [12] and the energy per Planck's voxel [17, 20], the inverse diffusivity term and the Bohr frequency is $1.6 \cdot 10^{-12}$ W·m^{-2}.

The hydrogen wavelength, perhaps the most ubiquitous signature that traverses space-time, is required for the balanced solution between two fundamentals: the quantity of energy per unit of interaction and what appears to be the optimal photon flux density to produce many of the magnetic pattern effects we have measured for cells, mice and humans. For example for every 1 nT decrease in the earth's magnetic field around the heads of people who are imagining, the photon emissions increased by about 10^{-12} W·m^{-2} [5]. A similar relationship has been found with direct measurements over aggregates of melanoma cells [21] as well as within background measurements [24].

The inclusion of the neutral hydrogen line in these calculations was not for convenience. W. Ross Adey [2] once described an interesting relationship between voltage and band width which was:

$$V^2 = 4kTBR \quad (2)$$

where k was the Boltzmann constant, T=temperature, B was band width and R was resistance. If instead B (band width) is solved and we assumed 40μV potential difference across ~11 cm (the cube root of the volume) of cerebral cortical space, the band width is within a few percent of 1.42 GHz. This is the intrinsic neutral hydrogen (21 cm) frequency.

3. Measurements

Specimens were obtained from the Laurentian University Behavioural Neuroscience Program's Brain Library. All brains had remained fixed in ethanol-formalin-acetic acid for 10 to 20 years. This fixative maintains the general detail of neuronal soma as verified by direct histological examination. Fixed brain photon data from four months of research were compiled into a single dataset and analyzed based on rank order from least to greatest average photon counts. Previous photon data were recorded from various cuts of fixed brain tissue from: 0.02 gram portions of white and grey matter of cerebral cortex, 3 coronal sections, 2 of left and right sagittal brain sections, and 3 whole human brains respectively by rank order. All photon recordings took place in a dark, enclosed chamber using a single photon recording device placed 1-9 cm away from the fixed brain tissue.

A single photomultiplier tube (PMT) from Sens-Tech Sensor Technologies was used in all experiments to measure temporal photon counts, with a spectral response range between 300-850 nm. Sens-Tech Counter Timer software recorded all data with the photomultiplier tube at a 50 Hz sampling rate for 5000 readings (20 msec data points for 100 seconds) on a Lenovo ThinkPad laptop. Dark counts which were defined as the photon measurements within the special hyperdark room when only air (no tissue) was present averaged 109 per 20 ms. Dark counts are presumed to originate from the intrinsic components of the photomutilplier circuits. Consequently the actual photon counts from any mass in adjacent to the sensor aperture would be that value minus the dark counts.

4. Results

The means and standard errors of the means (SEM) for the numbers of photon counts per 20 ms (the raw data) for the different types of human brain tissue are shown in Figure 1. The grey-white matter samples which involved 20 mg quantities were not significant statistically from the dark counts which involved measurements with no tissue present. As can be seen in Figure 2, when compared to the smallest mass 20 mg which did not differ from dark counts, the brain masses between 100 g and 1100 g (whole brain) displayed

systematic increases in numbers of photon counts. The average difference from dark counts was 26 photons per 20 ms or $1.3 \cdot 10^{3}$ photons per s. Assuming each photon has a median value of $5 \cdot 10^{-19}$ J, the power would have been $6.5 \cdot 10^{-16}$ W. Because the width of the PMT aperture was about 2 cm the area would have been $3.14 \cdot 10^{-4}$ m^2. Consequently the flux power density would be ~$2.1 \cdot 10^{-12}$ W·m^{-2}.

5. Discussion

The results of these measurements support the concept that fundamental properties within space may be manifested when the mass that occupies that space is present. Assuming the more or less consistent measurement of ~$2.1 \cdot 10^{-12}$ W·m^{-2} across the 100 to 1100 g of various fixed brain masses is not an artifact of the restricted limit, the presence of human cerebral tissue enhanced photon detection over dark (background) counts by the value that is related quantitatively to 10^{-20} J. This emerges when a term composed of the product of inverse diffusivity of wave impedance over the neutral hydrogen wavelength is divided by the magnetic permeability in a vacuum.

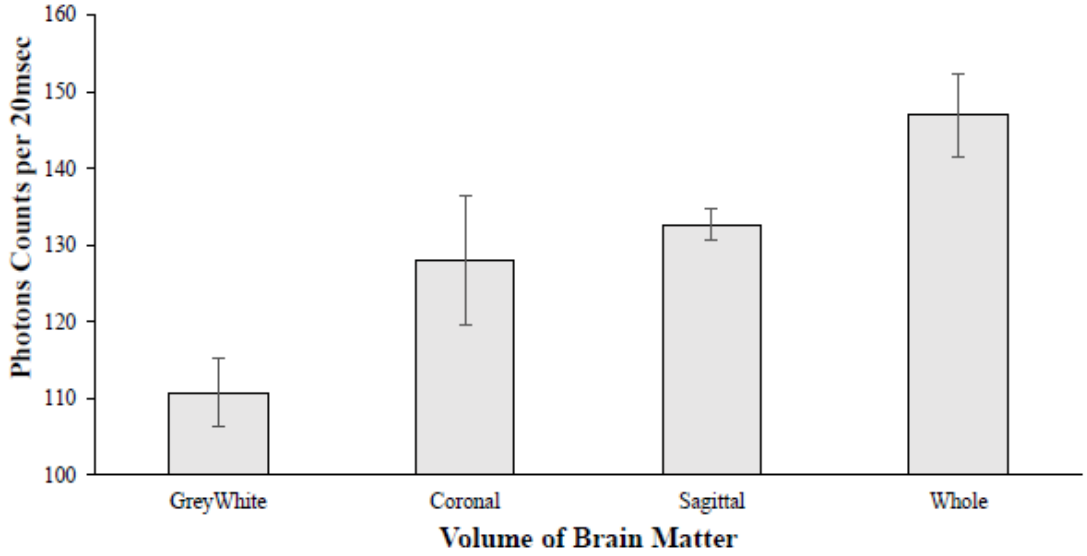

Figure 1. Raw photon counts per 20 ms for different sections (volumes) of fixed human brain tissue. The grey-white tissue (20 mg) values did not differ from background or dark counts

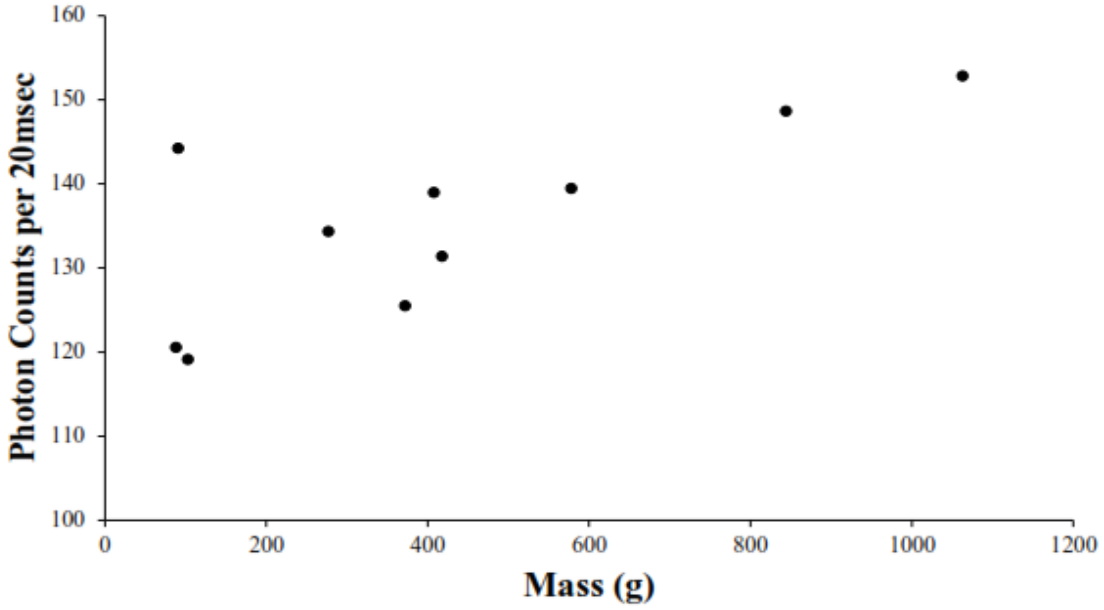

Figure 2. Raw photon counts for the actual mass of each component of human brain tissue measured. The values from the dark counts which were similar to the 20 mg tissue samples (not shown) ranged between 108 and 112 counts per 20 ms

When bold conjectures are considered quantitative solutions become even more important for verification or in the least support of the proposition. If the human brain, even when it is fixed, occupying space is associated with enhanced manifestations of ~$2.1 \cdot 10^{-12}$ W·m^{-2} then the energy within the volume can be estimated. Within the ~10^{-3} m^3 of the human cerebrum, the energy density would be $2.1 \cdot 10^{-12}$ W·m^{-2} divided by $1.1 \cdot 10^{-1}$ m or $2 \cdot 10^{-11}$ J per s per m^3. Within the specific dimensions of the 10^{-3} m^3 cerebrum, this is $2 \cdot 10^{-14}$ J per s. Assuming 10^{-20} J per action potential [15] and the energy required to sequester most ligands to receptors, the numbers of neurons would be between 10^6 (at 10 Hz) to 10^7 (at 1 Hz). As discussed by Rouleau and Dotta [23] and verified by estimates from fMRI (functional Magnetic Resonance Imaging) data, the typical numbers of neurons in an intracerebral "network" associated with a percept or a thought is about that magnitude.

This convergence elicits important philosophical questions. First, is there something specific if not unique about the average human brain volume that enhances its congruence with the universal properties? Eddington [8], who was in our opinion inappropriately demeaned for his views, integrated the brain mediated perception of the universe as its essential properties. Implicitly he argued that the properties of the universe as we measure them (even with the most sophisticated tools that are extensions of our basic senses) are reflections of intrinsic brain structure. This concept had been articulated earlier by Immanuel Kant [11] who emphasized that the perception of three-dimensional space and time are innate properties of the human brain.

Second, if there is an intrinsic feature of space and the mass that occupies this space amplifies its properties then Spinoza's concepts may have experimental support. His philosophy was similar to the physical assumptions of Ernst Mach [14] whose principle of the Immanence of the Universe indicated that any part of the universe is affected by all of the other parts and visa versa. These concepts create the conditions for both holographic models and the possibility of entanglement where by any two points within the universe can be mutually affected regardless of the distance. In other words, the occupation of a space by a specific mass could indicate that that the mass becomes a subset set of the total set in terms of both properties and microfunction.

Third, if fixed human brain tissue spontaneously displays photon emissions whose quantities simulate those associated with consciousness and the experience of percepts within the human brain, what differentiates the living from the non-living human cerebrum? In biology and chemistry, structure dictates function. We know histologically that the neuronal somas are remarkably intact within the cerebral cortices of these brain specimens. Whether or not there are residual properties still remaining within fixed human brains that could contribute to entanglement or to other fundamental properties has rarely been considered or investigated.

Two questions that might be examined are: 1) what is the role of this prominent frequency as a carrier of phase and frequency modulations between 1 Hz and 1.42 GHz (like communication carrier waves), and, 2) can we measure this frequency from the human brain? The Adey [2] solution for width of the wave band within the human brain according to our calculations is the neutral hydrogen frequency. This indicates that frequency or phase modulation from the lowest value up to the limit of 1.42 GHz could be a major source for the communication of information within brain space. It may not be spurious that velocity of light within an aqueous environment such as the brain divided by the averaged diameter of the cerebrum (assuming a sphere) is within the range of variability for human brain volumes for 1.42 GHz.

Whether or not the human brain volume generates a small compliment of the neutral hydrogen line would have significant implications for interpretations within physical neuroscience as well as for the integration of biological, chemical, physical and astronomical relationships. The energy associated with the hydrogen line is associated with a shift in electron spin which occurs within an individual hydrogen ion once every approximately 10 million years or 10^{14} s. There are 10^{27} proton mass equivalents within the human cerebrum that weighs about 1.5 kg.

Assuming a pH of about 6 within the cerebral volume, there would be $6 \cdot 10^{17}$ hydronium ion (with an extra proton) per mole or 18 cc and because the average cerebral volume is 1350 cc, the total numbers of protons would be $4.5 \cdot 10^{19}$. When divided by the time for a single electron spin shift, the numbers of proton-electrons involved would be $4.5 \cdot 10^5$ per s. The $2 \cdot 10^{-20}$ J increment associated with each proton results in $9 \cdot 10^{-15}$ W. When divided by the cross sectional area of the human cerebrum of 10^{-2} m^2 the power density would be ~10^{-12} W·m^{-2}. This does not prove that hydrogen line emissions are being generated by the human brain volume. However, if it is detected the energy levels by inference would be sufficient to be discerned.

6. Conclusions

The fixed human brain at different volumes displays "spontaneous" photon emissions whose flux densities are the same order of magnitude as the value of wave impedance and magnetic permeability produces the equivalence to 10^{-20} J. The quantitative equivalence involves an important role of the energies associated with the neutral hydrogen line that might be of sufficient quantity to be discerned by sensitive equipment from human brain. The persistence of spontaneous photon emission within mass equivalents of human brain that are associated with cognitive functions and ideation supports the concepts of Eddington, Mach, and Spinoza and suggests that structured matter, any where within the universe, may simply reflect the intrinsic properties of that total set.

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