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POSSIBLE EXISTENCE OF A METAMATERIAL INSIDE MICROTUBULES AND THE RESULTING EXPLANATION FOR ANESTHETIC ACTION OF SUPERLUMINAL PHOTONS UPON CONSCIOUSNESS

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ABSTRACT

D. Georgiev presented an idea that consciousness could be the result of quantum computation via short laser-like pulses controlling quantum gates within the brain cortex. However, he later rejected this theory because the wavelength of super radiant photon emission in the infrared spectrum is two orders of magnitude longer than the size of any microtubule cavity. To revive this idea of quantum computation within the brain, the author proposes that the substance within a microtubule cylinder has characteristics of a metamaterial composed of sub-wavelength structures. From this hypothesis, we can show that microtubule could be used for manipulation of qubits to achieve quantum computation by utilizing superluminal photons, which also permit the microtubule to manipulate the storage and retrieval of stored data in the brain. From which, we can also provide a mechanism for general anesthetic action which brings about a loss of consciousness.

KEYWORDS: Metamaterial, Microtubule, Superluminal photon, Quantum computation, Anesthetic.

1. INTRODUCTION

1.1 Severe error discovered on quantum computation in the neural microtubles

S.R. Hameroff suggested in his paper that a centriole cylinder composed of microtubules functions as a waveguide for evanescent photons, which can allow quantum signal processing.[1] Georgiev also proposed the idea that consciousness can be the result of quantum computation via applied laser-like pulses in quantum gates within the brain cortex.[2] Subsequently, Georgiev concluded that this mechanism cannot be used for manipulation of the qubits inside the microtubule cavities, or centrioles, because the photon wavelength is two orders of magnitude longer than the size of these centrioles[3]; super radiant photons in the microtubule cavities could have wavelength of λ = 100 nm or more suggested by Smith[4], incompatible with the length of a moderate-sized microtubule cavity, which is about 1 nm. Therefore, super-radiant emissions could not be used to signal qubits in a fashion similar to standing wave lasers in an ion trap computation. As this mechanism currently stands, the infrared photon cannot account for manipulation of the quantum qubits inside the microtubule cavity.

1.2 Hypothesis of the existence of metamaterial inside the microtubles

To resolve this problem, we can suggest the hypothesis that the substance in the microtubule cylinder has the characteristics of a metamaterial composed of sub-wavelength structures. Metamaterials are artificial material engineered to have peoperties that may not be found in nature. They are assemblies of multiple individual elements fashioned from conventional microscopic materials. They gain their properties not from thier composition but from their arranged structures with repeating patterns.[5,6] If microtubules have similar properties as a metamaterial, evanescent waves inside the microtubule cavity waveguide can propagate below the cutoff frequency. M. Jibu et al. claimed that human consciousness can be understand as arising from those creation-annihilation dynamics of a finite number of evanescent photons in microtubules.[7] The author also studied the possibility of quantum computation in microtubles of biological systems, which utilize superluminal evanescent photons[8] and we can model the brain mechanism based on a theory of superluminal photons from this hypothesis.

2. Wavelength of the super radiant photons in microtubules

Hereafter we consider the possibility of super radiant photons in the microtubule which can be used for signal processing in the brain.

Microtubules are a common component of the cytoskeleton, found throughout the cytoplasm. These tubular polymers of tubulin can grow as long as 50 μm, with an average length of 25 µm,[9] and are highly dynamic. The outer diameter of a microtubule is about 25 nm while the inner diameter is about 12 nm. Microtubules are found in all eukaryotic cells and are formed by the polymerization of a dimer of two globular proteins, alpha and beta tubulin.

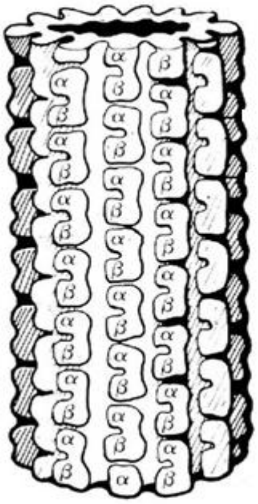


Figure.1 Periodic structure of the microtubule composed of α-tubulin and β-tubulin subunits

According to the paper by D.D. Georgiev[2], the wavelength of photons of the superradiant emission inside the microtubules within the model developed by Jibu et al. should have

$$\lambda = hc/E = 310\mu m, \qquad (1)$$

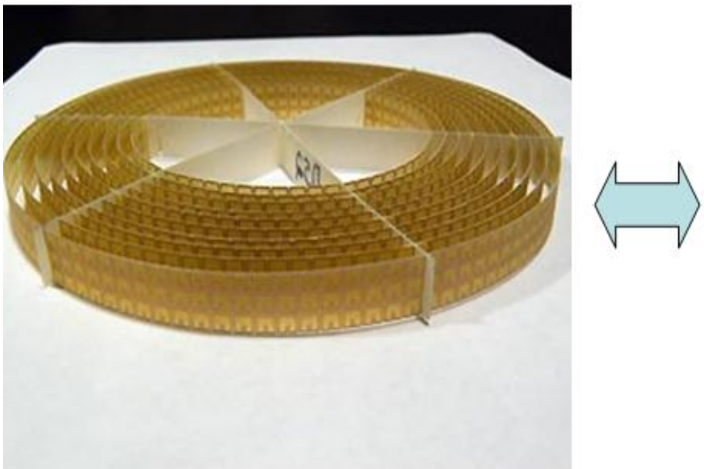
by introducing $h = 6.63\times10^{-34}(J\cdot s)$, $c = 3\times10^{8}(m/c)$ and $E = 4meV$, where h is Planck's constant, c is light speed and E is the energy difference between the two eigenstates in the superradiating water model.[10]

If the super radiant emission is considered in a fashion similar to the use of standing wave lasers in the ion trap computation, there cannot be any nodes and anti-nodes inside the microtubule because the wavelength of superradiant emission is much larger than the size of the microtubule. Contrary to this conclusion, the author proposes that the cylinder formed by the microtubule cavity may contain a medium which has a negative refractive index, similar to a metamaterial.[11]

3. Possible existence of matamaterial inside the microtubule

3.1 Structures of electromagnetic metamaterial and the microtubule

Typically, metamaterials have a negative refractive index, a property that is not normally found in nature.[5,6] They usually gain their properties from structure rather than composition, using microscopic inhomogeneities to create an effective macroscopic behavior. Their precise shape, geometry, size, orientation and arrangement can affect the waves of light in an unconventional manner, creating material properties which are unachievable with conventional materials. Electromagnetic metamaterials affect electromagnetic waves by having structural features smaller than the wavelength of the respective electromagnetic wave. They achieve the desired effects by incorporating structural elements of sub-wavelength sizes, i.e. features that are actually smaller than the wavelength of the waves. Figure.2 shows the striking similarity between the structures of an electromagnetic metamaterial, constructed of copper slit-ring resonators and wires mounted on interlocking sheets of fiberglass circuit board, and a cross-section of a natural, biological microtubule.[12]



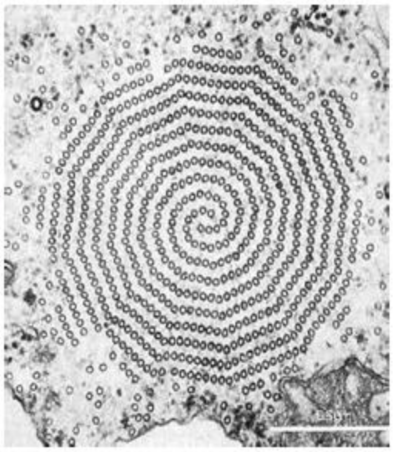


Figure 2: Similarity between the metamaterial (left figure) and the cross-section of an axoneme composed of microtubules (right figure).

As shown in this figure, the cross section of the biological microtubule is very similar to the periodic structure of the artificial electromagnetic metamaterial and we can readily suppose the inner medium of the microtubules cylinder possesses the same metamaterial characteristics.

3.2 Electromagnetic wave propagation inside the metamaterial

Specifically the characteristic of a negative refractive index, in which the generation of evanescent photons is enhanced, and they can propagate lossless inside the neurons, according to these properties of the metamaterial.

From analysis of the amplification of evanescent waves through a rectangular waveguide filled with a metamaterial, of cross section size "a", J.D. Baena et al.[13] has shown that the propagation of electromagnetic waves along this wave guide is only possible if $\omega < \omega_c$, where $\omega_c = (\pi / a)/\sqrt{\varepsilon\mu}$.

From this equation, the wavelength for the case where electromagnetic waves propagate through the waveguide becomes

$$\lambda > 2a. \qquad (2)$$

As the average size of microtubules is about $1\mu m$ we can see Eq.(2) is satisfied for photons of super radiant emission from the value obtained by Eq.(1).

If the microtubules are composed of a metamaterial, the supperradiant emission can be used similar to the use of standing wave lasers in ion trap computation and they can be applied for the manupilation of water qubits inside the microtubule. Therefore it seems highly plausible that macroscopic quantum ordered dynamic systems of evanescent photons in the brain could play an essential role for quantum computations to exist in the brain.

4. Possibility of superluminal tunneling photons performing quantum computation inside microtubules

It has been pointed out evanescent photons generated inside microtubules are superluminal in this paper by Musha.[14] Ziolkowski also pointed out in his paper, superluminal pulse propagation, permitting consequent superluminal exchange without a violation in causality, is possible in electromagnetic metamaterials.[15] Thus we can suppose microtubule structure permits superluminal propagation of evanescent photons like the metamaterials, which achieve these properties not from their composition, but from their exactingly, designed structures. Microtubules are hollow structures composed of many identical building blocks, proteins called tubulin, which also make up the internal structure of cilia and flagella. Microtubules provide platforms for intracellular transport and are involved in a variety of cellular processes, including the movement of secretory vesicles, organelles, and intracellular substances. If the inner medium of a microtubules cylinder possesses the characteristics of a metamaterial, with negative refractive index, tunneling photons will propagate losslessly inside the neuron's microtubules. This will occur in a way which is not restricted by wavelength, and therefore infrared photons could be used for the manipulation of qubits in the brain, allowing the brain to perform quantum computation.

The author has thus proposed the hypothesis quantum computation is conducted within the brain utilizing superluminal photons created inside microtubules.[8] In another paper, by the same author, it has been proposed memory within the brain is due to a holographic mechanism of storing and retrieving superluminal photons in microtubules as follows[16];

We suppose the cylinder of a microtubule consists of a storage material, whose thickness is much smaller when compared to the penetration depth of an evanescent photon. According to the integral equation for hologram reconstruction, reconstruction can be given by integrating over the volume of the hologram as

$$U(\vec{r}) \approx \iint U_0(\vec{r}) \exp(-i\beta\vec{n}\cdot\vec{r}/|\vec{r}|)\varepsilon(\vec{r})\cdot d\vec{r}, \quad (3)$$

Where U_0 is an illuminating wave, U is a wave including the information of object wave field, β is a parameter satisfying: $[\nabla^2 + \beta^2]G(r', r) = -\delta(|r' - r|)$ and ε is a dielectric constant which is a function of the local intensity given by $\varepsilon = f(I \cdot \tau)$, where τ is an exposure time..

This means that the guided readout wave propagates in the same direction as the reference wave during recording as shown in Fig.3. It is diffracted by the hologram structure and the object field can be reconstructed. This is the mechanism of holographic memory of the brain.

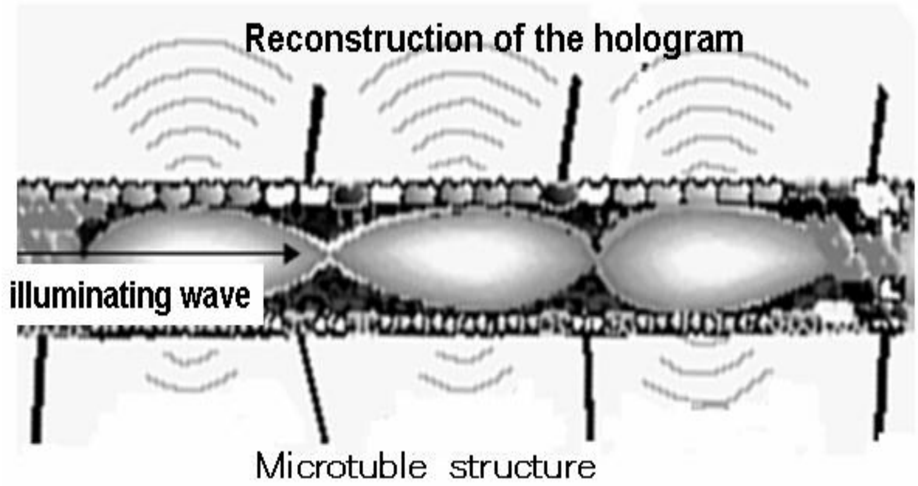


Figure.3: Mechanism of holographic memory by superluminal photons.

Utilizing features of both of these mechanisms within the microtubules, we can define how consciousness is created in the human brain. According to these suggestions, consciousness could be the result of superluminal photons, generated inside the microtubules, which can not only perform quantum computation but also manipulate the storage and retrieval of stored data in the brain, as shown in Fig.4.[17]

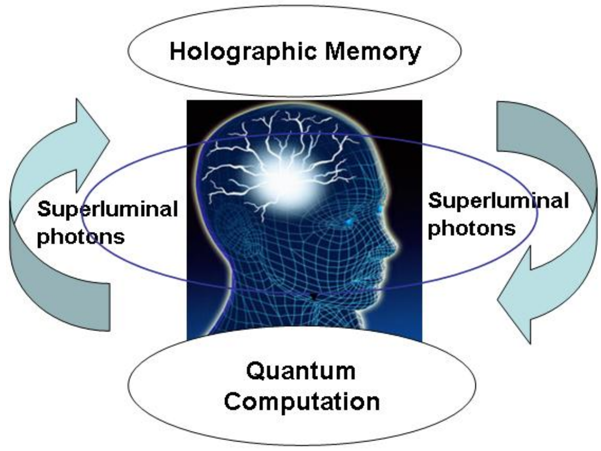


Figure.4 Generation of human consciousness via the flow of superluminal photons.

According to the hypothesis proposed by Prof. Dutheil, the brain is nothing more than a simple computer that transmits information.[18]

Human brain receive the program to recognize the world from the superluminal consciousness created by superluminal photons inside microtubles as the terminal computers receive their commands from the central processor as shown in Fig.5, and thus it can be considered that we can recognize the world as the three dimensional reality.

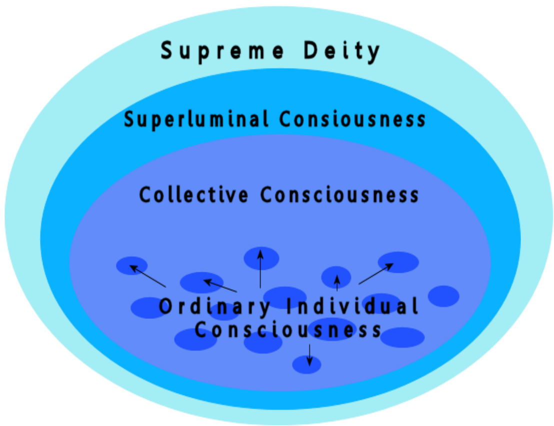


Figure 5: Probable structure of the human mind.[19]

From this assumption, we can explain the riddle of general anaesthetic action as follows.

5. Mechanism of Anesthetics from the standpoint of superluminal photons

It has been believed that general anaesthetics exert their effect by modulating the activity of membrane proteins in the neuronal membrane. However, the exact location and mechanism of this action are still unknown, although much research has been done in this area. Of importance to this paper, are the discoveries of Meyer and Overton, who discovered a striking correlation between the physical properties of general anaesthetic molecules and their potency: specifically the greater the lipid solubility of the compound, the greater its anesthetic potency.[20] Furthermore, it is known that a lipid soluble substance can enter a cell by dissolving in the lipid portion of the membrane and diffusing through it. The greater the lipid solubility, the more readily a molecule can pass through the membrane.

It is proposed we should consider a microtubule may lose the property of negative refractive index, when this lipid soluble substance is injected into the human body. Thus superluminal photons generated inside the microtubules can no longer propagate along the microtubule and the flow of superluminal photons in Fig.4 are interrupted. Then the mechanism of quantum computation and holographic memory conducted in the brain would be inhibited and thus it is considered that it brings loss of consciousness for a human brain, which is consistent with the mechanism of general anesthesia.

CONCLUSION

From the hypothesis that the substance inside microtubules has the properties of a metamaterial, we can conclude that superluminal photons generated inside the microtubule could be used to manipulate qubits and the storage and retrieval of stored data in the brain, requirements for a quantum computer system. Thus we can consider the human brain is a quantum computer system driven by superluminal photons generated inside these microtubules. Furthermore, this mechanism leads to an explanation for general anesthetic action, whose exact mechanism has been unknown for a long time. To confirm these results, it is required to conduct further experiments to verify whether the microtubles have a property of negative refractive index.

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