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A conjecture on quantum horizontal gene transference, entanglement, and transport

Abstract

Genetic information transference may hypothetically occur through quantum entanglement of microscopic photon-pairs that use larger groupings of particles (>10^{12} atom groups) and/or simply travel through the use of photons as a data carrier. Furthermore, it is possible that entanglement and transport of particles of organic material may very well provide the energy and template necessary for horizontal gene transference to occur non-locally on a quantum level resulting in spontaneous nucleotide replication. This represents the transmission of a vast amount of data with regard to the potential transmission of genotype (information) or even phenotype (chemical) media. This data might be utilized as raw data stored and transmitted for bio-quantum-computing at light speed. Another potential use is to seed dangerous bacteria and viruses with inherent weaknesses. This possible future means may create transport or replication over large distances and near light speed or faster for complex organisms as a spatial transport mechanism. Another potential application in space travel would be the ability to pass tight photon beams through a sample of medication that would affect the same response as taking an actual dose. This would result in requiring less weight to be transported of medical supplies on long missions.

Keywords

Macroscopic quantum entanglement; Plasmid transference; Horizontal gene transfer; Teleportation; Quantum computing; Bio-computing; DNA; RNA; Pharmaceutical delivery methods; Adaptive mutation; Directed nucleotide templating.

INTRODUCTION

The main purpose of this article is to examine what possibilities might exist with regard to transferring or transporting biological material over distance via quantum level effects. The method used to pursue this objective is to compile in one document notes regarding existing research and experimental data from other scientists on the subject of quantum relationships to biological material, and; to investigate the plausibility of horizontal gene transfer on a quantum level. Most of the paper is a re-digestion of original research of the cited scientists. The hope is that this paper will inspire the reader to read the cited works, to incite further lines of investigation and make a call to replication of some of the key experiments cited.

Horizontal gene transfer (HGT) is where genetic information is transmitted between organisms in a manner other than traditional propagation. HGT has been documented in a variety of unicellular and multicellular[1] organisms. Typically the communication of genetic material occurs from ancestor to descendent, this process is called vertical gene transfer. The concept of lateral or horizontal gene transfer was first discussed in 1951[2]. The paper demonstrated the transfer of genetic information from one viral strain to another - creating a virulent strain from a non-virulent strain. In 1959 two scientists[3,4] demonstrated the transfer of genes between *different species* of bacteria. This is a powerful observation because it began to explain how micro-organisms could develop traits and characteristics present in other organisms - especially anti-biotic resistance in bacteria. This opened up a whole new world of possibility - just how much of our world

was effected by HGT?

Peter Gogarten[5] in an analogy referencing how we viewed the transfer of genetic material as vertical, the tree of life: "'…the original metaphor of a tree no longer fits the data from recent genome research' therefore biologists should use the metaphor of a mosaic to describe the different histories combined in individual genomes and use the metaphor of a net to visualize the rich exchange and cooperative effects of HGT among microbes."

The human body is comprised of 90% microbes, we are quite the mosaic of symbiotic life forms. This represents a tremendous possible impact[6]. Further development and investigation has only begun to scratch the surface; however for the purpose of this paper it is important to note that artificially engineered genetic material has been successfully transferred horizontally[7,8].

There are four known basic forms of HGT between micro-organisms:

(1) *Transformation*- the genetic alteration of a cell resulting from the introduction, uptake and expression of foreign genetic material (DNA or RNA),
(2) *Transduction*- the process in which bacterial DNA is moved from one bacterium to another by a virus,
(3) *Bacterial conjugation*- a process in which a bacterial cell transfers genetic material to another cell by cell-to-cell contact, and
(4) *Gene transfer agents*- virus-like elements encoded by the host.

Advances in understanding these quantum relationships and effects upon biological media suggest a possible fifth methodology - transmission of genetic data, even material on a quantum level. This methodology is one which does not require locality to grant access to create a change in the organism from the original organism used to supply the source data.

Certain conditions would have to be met for these things to occur. First, a relationship between the quantum level and the cellular level must first be demonstrated. Second, the method must be scalar and account for the transduction of energy on both a thermal and isothermal chemiosmotic level. Is there a demonstration of macro-scale groupings of biological material transporting on a quantum level? Third, distance and duration of effect is another major issue to be considered, if there is a quantum level effect is it exclusively local, or can it also be a non-local effect? If it can be a non-local effect, are distances an issue? With respect to duration, decoherence is a major issue, are there conditions wherein coherence is maintained for a longer period of time? Answering these questions is another goal of this article.

A significant amount of investigation has been conducted in researching adaptive mutation. The standard or conventional model of mutation in organic models has been Neo-Darwinian. In other words let us assume that all mutations are random or by chance. If so, the mutations provide an advantage for the organism over its competitors to survive, that will be further transferred or propagated. This selection process would evolve further under natural selection. The thought of adaptations being random was greatly challenged by a number of recent publications[9-11]. In fact, many adaptations have been observed which would appear to be adaptive to the environment as a reaction as opposed to random chance.

Not only is data storage and transport an interest, but there is a potential follow-on use in being able to seed dangerous antimicrobial resistant (AMR) bacteria and viruses with self-destructive genetic coding. This would require genetic engineering to produce such a package. The subject of fundamental protein or genome change in bacteria is much too broad of an article topic to include here; however, it should be noted that this article focuses on the feasibility of a transport method based upon existing work, not upon the actual content of that transport. These notions are supported by similar current investigations which will be covered in the discussion section.

If transference of genetic data is proposed[12] to reach light speed, or possibly even FTL speed on a subatomic D-Dimensional axis[13], from one coordinate to another, it might be possible in introducing genetic material. It then may allow transference of much more complex organisms over distance via quantum level pathways. This hypothetical concept may possibly make deep space colonization more readily available if replications of colonists and the necessary flora and fauna from the micro to the macro scale necessary to support colonization could transport as information along superluminal pathways. In this notion - one would send an unmanned vehicle into space that is equipped as an adequate receiver. The vehicle would land, and if conditions exist for colonization, transport of entire living beings could occur on a quantum level through the transmission of a template, while the original donor would still be alive and well remaining here on Earth. This would provide a form of quantum level, high-tech directed Panspermia.

The discovery of space-borne organic building blocks[14,15] has seen much discussion regarding whether extremophile or sporelike organisms may or may not have arrived prehistorically embedded in space debris,

such as a Martian meteorite that is of particular interest in recent discussions on the subject. There is documentation that particularly resilient terrestrial creatures can exist in the harsh conditions of space for long periods of time[16]. There is a great deal of controversy surrounding the existence of living organisms in other parts of the universe. Other views exist that organisms may transport through space as part of debris. The idea of directing Panspermia via unmanned spacecraft utilizing an advanced technology that transports genetic information ending in spontaneous nucleotide replication may seem incredible, though even flight was deemed impossible by many scientists even as the Wright brothers were making their first flight.

Another consideration would be the potential weaponization, or tragically accidental misuse of this technology. Any advancements which would evince changes on the molecular and cellular level using any technology developed to use quantum transport methods of this type could potentially be the source of class 1 severe black swan threat's. One would hope that a sane approach would prevail in the research and implementation of any development along the lines of this paper. Furthermore, that any development of transference of genetic material would be used as a panacea in medicine and the further empowerment of humanity.

DISCUSSION

Erwin Schrödinger speculated that there would be specifically different behavior on a quantum level that differentiated the living from of the non-living world. He began to examine the physical laws governing biology looking to further thoughts regarding an 'aperiodic crystal structure' upon which genetic information can be stored. This was a perceptive, if not a self-fulfilling prophetic attempt to understand the workings of living structures on a quantum level. Through this process he predicted molecular modeling of biological media; this work eventually was the inspiration for the study of microbiology. Niels Bohr's theory of complimentarity[17] offers a similar argument, that the differences between living and non-living models are fundamental, yet complimentary. This concept - one which also intimates the quantum mind concept is greatly controversial. One might intuit that if there is so much foundational structure from quantum mechanics in life science, that there would be more complimentary relationships to follow suit.

Despite this controversy, there is no doubt about the role that quantum mechanics has played in developing life science. Though most living structures exhibit classical mechanical conditions, there is a substantial crossover between the study of quantum mechanics and biology. One area of crossover would be in defining the templating functions of nucleic acids - where the qualities of one nucleic acid are used as a template to propagate another, and the specificity of proteins. Pauli, another contributor through his exclusion principle, formed the criteria that atoms and molecules have specific sizes; this impacts not only the templating of nucleic acids, but the properties of physical membranes, differential diffusion rates, and a host of other relationships. These areas where quantum mechanics has found application in biology are a basis for the start of a dialogue, one which supports the further investigation of quantum level relationships in protein templating and transport in organic materials.

Most biologists research chemical and energetic actions. Though certainly life is built upon a quantum state and the energy necessary to fuel biological processes that emerges from a bottom up sort of relationship. This relationship begins on the quantum level and derives order and function from chaos, affecting mutation on an apparent random level. Not much effort is made to understand how quantum level actions effect biological function. Of course the basic biological structures of molecular units can be understood regarding arrangement, shapes, sizes, stickiness, and rearrangement.

BACKGROUND

Quantum entanglement

"In some sense there is a web of entanglement that connects distant corners of the universe, including us." – Michio Kaku (Physics of the Impossible)

There are still fundamental concepts of quantum mechanics that deserve exploration in a complimentary fashion. Superposition, resonances and other quantum phases are investigated in neuroscience with much controversy. In 1935, a paper by Albert Einstein, Boris Podolsky, and Nathan Rosen described the EPR paradox[18]. Basically the quantum dynamic model of the universe was flawed because of hidden variables due to the relationships between particles. Einstein called this "spooky action at a distance". This brought about a response from Erwin Schrödinger[19,20]. Although these first studies focused on the counterintuitive properties of entanglement, the aim was to criticize quantum mechanics. John Bell showed with his theorem[21] that experimentation to determine whether this "spooky action at a distance" is real or not, could be attained. Eventually experiments were conducted validating the existence of quantum entanglement.

Quantum entanglement is controversial not only because of its contravention to Newtonian mechanics, but also because the concept typically deals with microscopic objects; photons and atoms. Of these two, the greater body of research has surrounded quantum entanglement of light, or photons where the basic concept is that one knows the location of one photon where they can infer the location of the entangled paired photon. An entangled state of a system consisting of two subsystems cannot be described as a product of the quantum states of the two subsystems[22,23]. Quantum Entanglement is typically of interest to philosophers of physics and computer scientists, because it deals largely with statistical correlations between two very small bodies.

The conventional wisdom would assume that the concept of quantum entanglement is relegated largely to the non-organic world. Most recently quantum entanglement, superpositioning and transport have primarily been of interest to computer scientists, though the concept has found significant traction in the last fifteen years with experiments conducted on macrobiological groupings. Tunneling would be quite exciting to explore in the search for the best method of transporting engineered plasmids horizontally. Further investigation should be conducted in every possible relationship between organic materials and Quantum Mechanics.

Non-locality and quantum entanglement are two quantum concepts that potentially would allow for such a transference. Another thought is the possibility of photonic transfer. In art, one may use an overhead projector to project an image upon a surface. If the projection is left on for a long time, the image will imprint upon the receiving surface, so that when the projector is turned off the image still remains. This is an analogy that is useful in picturing what occurs during transference of RNA or DNA data between chromophores of photosynthetic organisms, or media. This may also describe the effect of spin in photon pairs in nucleic acids during templating. A direct relationship between adaptive mutation and imaging through photon pairs may exist, this concept certainly warrants further investigation.

A very recent publication by Michele Sclafani et. al.[24] have demonstrated the propagation of complex molecules through the frustule of the alga *Amphipleura pellucida*. What this demonstrates is the quantum level transport of macromolecular biological structures.

Concepts surrounding applications of entanglement certainly provide quite a bit of furor, starting with the EPR paradox. More recently worth citing is the CIA's controversial Stargate program, and before that Operation Bluebird, wherein the concepts of non-local entanglement creating symmetry between non-local human consciousnesses were first considered. The critics of defining quantum 'non-trivial' actions have a wealth of strange assertions to fire upon; however, over recent years, experimentation in quantum computing and similar endeavors has supplied a great deal of experimental evidence proving the concept of entanglement on a physical scale.

The specific concepts used in quantum mechanics are the concepts of quantum entanglement, tunneling locality, superpositioning, and supersymmetry of ensembles. Quantum entanglement is a quantum mechanical phenomenon in which the quantum states of two or more objects are described with reference to each other (entanglement), even though the individual objects may be spatially separated (locality). When particles such as photons, electrons, and even molecules as large as buckyballs interact physically and then become separated, they continue to interact in such a manner that each resulting member of a pair, or even in a group (ensemble), can be properly described by the same quantum mechanical state such as position, momentum, spin (magnetism), etc.

If a data set of genetic material is transferred from one locality to another in the same manner, transference via an image of the data through light, the implication is that not only can data be transferred and stored through biological media, but also that it would be possible to completely imprint an organism through light transmission between two separate coordinates with a non-local foreign nucleotide. Possibly transferring nucleotide templating information from entirely different species or even one kingdom to another.

We will see how recent research supports a quantum relationship between directed adaptive mutation and quantum non-trivial action. This could be exceptionally helpful in treating anti-microbial resistant (AMR) organisms; which represent a staggering 40,000+ deaths annually in North America alone. Should AMR strains of bacteria make it out of their current containment in hospitals, the world wide pandemic would greatly exceed that of the Spanish Influenza in WW I.

Given the recent rise in antibiotic resistant bacteria, exploring methodologies for horizontal gene transfer (HGT) of plasmids and mitochondria may offer solutions. If we are able to engineer bacteria with inherent weaknesses in the plasmids, and these plasmids can be transferred horizontally to other bacteria via either macroscopic quantum entanglement or photonic imaging data transfer. Thus we may be able to stem a potential bio-hazard black-swan event. An engineered virus could be introduced into an anti-biotic resistant

strain of bacteria, thereby rendering it vulnerable to the anti-biotic.

Figure 1 : Methicillin-resistant staphylococcus aureus (MRSA)

Transference of genetic data

If transference of genetic data via light from one coordinate to another results in the spontaneous organization of materials in the local environment to recreate a non-local nucleotide; or, if it is possible to transfer actual enzymes or other biological material over distance during states of coherence and Eigen-state super-positioning, it then becomes possible to consider the transference of much more complex organisms over distance via light as long as there is a grouping of organic media and its necessary field (magnetic) boundaries at the receiving end. This may make deep space colonization more readily possible if colonists could transport as information along superluminal pathways into biological media sent ahead via unmanned craft. The concept of genetic material transference over distance between two bacteria may be possible under at least two different sets of conditions. The first being quantum entanglement, the second being photonic image transmission of the biological data. There is also significant data indicating the importance of magnetic fields in the organization of biological models. Each bio-structure is accompanied by a topologically quantized magnetic field defining corresponding magnetic bodies and these magnetic bodies form a hierarchy. Magnetic bodies could serve as templates for the formation of various biological control circuits crucial for homeostasis and biological information processing.

This gives rise to a question: does entanglement occur in organic material?

Under conditions where a low ambient electromagnetic frequency is present, transference of genetic material can occur in aqueous solutions[25]. Even a standard low frequency has an effect[26]. The image of the genetic data stimulates the attraction of enzymes which begins the building of base pairs, replicating the sender genetic material. In fact some evidence supports the concept that DNA itself produces a small EM wave.

HGT and Non-trivial quantum action

Energy transfer in material solids happens because of differences in pressure or temperature as related through intensive thermodynamic quantities. Living organisms are isothermal; therefore there is little temperature change, though it should be noted that there is some thermodynamic qualities to microbiology and chemical energy transduction - a good example would be in the production of adenosine diphosphate and adenosine triphosphate (ADP and ATP).

However, a summation noted by Paul Davies, states that the energetic function can be seen as an appropriate relationship to the thermodynamic function[27] in non-organic material. A number of scientists, including Davies[28] have related this to organic material. The comparison to thermodynamics can be seen in the metabolic cycle. The micro-engines that perform the act of energy transduction in plants and animals, chloroplasts and mitochondria, exchange energy using metabolic turnover and signal to various entry points on the surface of the membrane. In bacteria, energy is transduced through the plasma wall; in chloroplasts the transfer occurs at the thylakoid membrane, and; with complex living organisms at the mitochondrial membrane.

TABLE 1 : Similar terms can be defined on this basis as a relationship between thermodynamic and bioenergetic qualities. (From Davies et al., citation #5)

Thermodynamic Variable	Bioenergetic Quantity
Temperature (K)	Metabolic cycle time (s)
Specific heat (J kg^{-1} K^{-1})	Metabolic rate (J kg^{-1} s^{-1})
Gibbs-Boltzmann entropy (J K^{-1})	Entropy production rate (J K^{-1} s^{-1})

Davies goes on to make the relationship stronger using the *Quantization principle for material oscillation*[29]. Similarly, Einstein and Debye considered the heat capacity as associated with the harmonic vibrations of atoms in a crystalline solid. The vibrations were treated according to quantum theory and satisfied that the energy is stored by an oscillator with frequency ω as an integral multiple of a fundamental energy quantum $h\omega$:

$$E_n = nh\omega,\ n = 1, 2, 3 \quad (1)$$

Davies proposes the idea of enzymatic oscillators. He discusses the concept that an enzymatic oscillator is simply a series of carriers which transport electrons in a cytoplasm, powered by an energy source: ADP and ADT, both vehicles of molecular intercellular energy transfer; are a means of continuing the symmetry of this complimentary relationship between microbiology and quantum mechanics. This concept is referenced in a chemiosmotic function of bioenergetics[30]. This key develops a supposition that supports the concept of quantum HGT. Where does the energy and information come from that would allow such a transfer? Scaling from the quantum level to a cellular level is an issue.

Quantum scaling of organisms

Lloyd Demetrius in: Quantum statistics and allometric scaling of organisms[31], attempts to explain the relationship between quantum mechanics and biological media with reference scaling. He states a dual form of energy transduction in biological organisms, the first being the limits placed upon metabolic activity through the coupling of electron transport and proton translocation; the second uses limits set by evolutionary dynamics dependent upon ecological and demographic forces.

Using a bacterial model for the sake of simplicity, the transduction of energy within the plasma membrane can occur through two stages:

1. An energy source is used to power the movement of electrons through a series of carriers in the cytoplasmic membrane. These movements are coupled to the pumping of protons across the membrane generating a transmembrane electrochemical proton gradient.
2. The energy accumulated is used to move protons across the membrane, down their concentration gradient. This movement is coupled to the synthesis of ATP from ADP and P_i.

The set of redox reactions is the transfer of electrons from a reduced substrate to a terminal acceptor and the chemiosmotic reactions that translocate protons across the energy-transducing membranes. This is achieved by fundamental processes that drive energy transformation at the cellular level. It is difficult to account for even with conventional catalytic mechanisms; however, quantum tunneling may play an essential role[32].

A measure of the temporal organization of these processes is the mean transit time for the circuit of protons linking the primary proton pump with ATP synthesis. The significance of the different time scales of metabolic activity at cellular, organismic and population levels was recognized in several empirical studies[33].

Another relationship can be made between informational systems and boundaries. Recent discoveries regarding a capacity to store large amounts of data in a single DNA molecule chain[34] have demonstrated new potentials for the use of organic material. In this most recent, and a much publicized discovery, scientists effectively stored the entire works of Shakespeare in a DNA molecule. The works stored comprised 736 kilobytes of information, which was encoded into a DNA molecule, the molecule was then recreated with 100% data accuracy demonstrating the efficacy of storing data in synthesized DNA. If data could be stored and transferred via biological media on a quantum level - the processing and transference of data could become nearly instantaneous.

This is intriguing though it shows a top-down style of informational storage. This anthropogenic form of data storage occurs in a manner that allows us to store information and replicate that material, retrieving the encoded data. For the purpose of the argument supporting a platform of conditions under which quantum HGT may occur, we will consider instead a bottom up approach to informational storage and transfer.

In one sense all of existence can be quantized and represented as some basic level of information. This analogy is relative with regards to living organisms. All living things are seen as information processors of genetic material transporting through propagation. Davies describes this thought process by using phenotype and genotype as an analogy to hardware (chemistry) and software (informational molecules) respectively.

In this bottom-up approach one can see that the information flows from a sea of apparent randomness on a quantum level that arises as the form of the organism and its selective process. In this manner there appears that there might be a relationship between data transporting on a quantum level, and being utilized both as the building block and the template for the construction of biological material. Whether or not this data is accurate or not will require further investigation.

Even though quantum mechanics can describe the structure of living molecules, it is typically disregarded in the realm of information processing. Davies also discusses the informational difference between the use of classical bits (organic) and qubits (non-organic) in processing. This is because biological molecules operate on classical bits rather than qubits. This may not always be true.

It is possible that proton coding may be affected on a quantum level. Proton tunneling[35] can induce alteration to nucleotide bases, and possibly therefore effect templating. Mcfadden et al. Suggest that in some circumstances a genetic code might be considered to be a type of quantum code, so that spontaneous errors in base pairing might occur[36].

Photonic transference of genetic material and EM waves

French virologist Luc Montagnier, who is known for his Nobel prize in Physiology or Medicine for discovering the Human Immunodeficiency Virus (HIV) has published a controversial paper cited earlier in this document (Citation 12). From this paper the following is adapted:

In the filtration of bacterium of about 300nm in size from viral particles to approximately 120nm in size, two sterile filtrates of 100nm and 20nm respectively were cultured from a rich sterile medium SP4 (a human protein). A previously cloned and sequenced, adhesin, of *M. Pirum* (human mycoplasma), used as polymerase chain reaction (PCR) primers, were negative in the filtrate. Which means that when the filtrate was incubated with human lymphocytes, which were tested as negative for the mycoplasma, the mycoplasma was recovered numerous times with all of its previous characteristics. What this means is that genetic information was filtered out of a source material and then transmitted itself into a sterile group while in the aqueous filtrate. This was repeated numerous times. Further investigations of the DNA showed that in conditions where certain water dilutions of a filtrate, low frequency EM waves carry genetic information to other bacterial and viral DNA. Covering different intervals that correspond to scales present in the organisms, electromagnetic waves can be induced which transmit DNA data from an original organism to a host organism. In essence - the EM frequency, when corresponding to different components of the organism, facilitates the transfer of genetic material and data in a non-local environment, especially one that has been designed to mitigate (the filtrate) transfer through typical means of HGT.

Montagnier detected in certain dilutions of filtrates (100 nm, 20 nm) from cultures of micro-organisms (virus, bacteria) or from the plasma of humans infected with the same agents where ultra low frequency electromagnetic waves (ULF 500-3000 Hz) were present. In the case of m. Pirum - the human mycoplasma Montagnier was working with at the time, "…an isolated single gene (adhesin, previously cloned and sequenced) could induce the ems. As the gene is cloned in two fragments, each of the isolated fragments to generate ems, suggesting that a short DNA sequence was sufficient to induce the signals. Similarly, a short HIV DNA sequence (104 base pair) is sufficient to produce the ems."

How was this electromagnetic field detected? Montagnier writes: "The apparatus used to detect the electromagnetic signals comprises a solenoid (a copper coil with impedance of 300Ω, inside of a container) capturing the magnetic component of the waves produced by the DNA solution in a plastic tube converting the signals into electric current. This current is amplified and analyzed in a laptop computer using specific software."

What this work by Montagnier indicates is that the quantum level relationship between organic materials can be demonstrated. Not only this, but also that the importance of magnetic field frequency can be found in maintaining this relationship.

Coherence duration and decoherence avoidance

The major issue with any quantum level data transfer is the duration of coherence. Coherence is the quality of relationship between waves and or wave packets - this certainly relates to photons and electrons, but it can also relate to magnetic and gravity waves. With relationship to this model the coherence of main concern is electromagnetic.

Current models of quantum field theory require coherence for many of the phenomenon discussed earlier in this paper; therefore, the key to understanding, much less exploiting quantum level effects on biological media is likely to be electromagnetism and paired spin states, Quantum computing, for example requires coherence to work, once decohered a quantum system operates like a classical system - it loses the defining characteristics of supersymmetry, entanglement or even transport. For the transfer of quantum biological information to be effective, the typical decoherence rates cannot exceed the biochemically significant reaction rates. A nucleotide in the environment of a cell at room temperature has a decoherence time of less than 10^{-13} s. This is ridiculously short. How can any type of germane informational or energetic process be transferred in so short a time period?

There are at least two ways in which decoherence in a biological model could be evaded. One is screening; if the system of interest is isolated, even partially from the decohereing environment, then decoherence may be mitigated if not avoided. Matsuno[37] states: "An example is an enzyme molecule partially enveloping a

reaction region; similarly a histone wrapping of DNA might shield coding protons from decoherence. Organisms may exploit thermodynamic gradients to drastically reduce the effective temperature of certain molecular complexes. For example ATP molecules at actomyosin complexes slowly release their energy at an effective temperature of 1.6×10^{-3} K." This certainly demonstrates possibilities for avoiding decoherence.

A second method for avoiding decoherence would rely upon a decoherence-free subspace. Even though Bell's concept of a double-well one-dimensional potential[38] was developed in the context of neutrino oscillations, it has a potential for general application. If the particle (proton) is allowed to interact strongly with an external heat bath - or chemiosmotic repulsive ensemble - the oscillations of the particle will be forced into synchrony to maintain quantum coherence; and, if the system is forced into an entangled state of left and right well conditions, it will be reinforced by the repulsive environmental conditions. Both of these concepts are proven directly through experimental application, yet they do offer a possible road map to how quantum HGT might be obtained by maintaining a coherent state. If non-trivial quantum action does indeed play a role in screening or selection, then coherence models must exist for longer periods in the chemical energetic state than is currently observed using thermodynamic models.

With regard to length of entanglement - we are talking about extremely short periods of time. One study[39] demonstrated that entanglement between relatively large groups of cesium atoms could be generated by using a beam of light. The grouping was as large as 10^{12} atoms, and was maintained for 0.5 milliseconds.

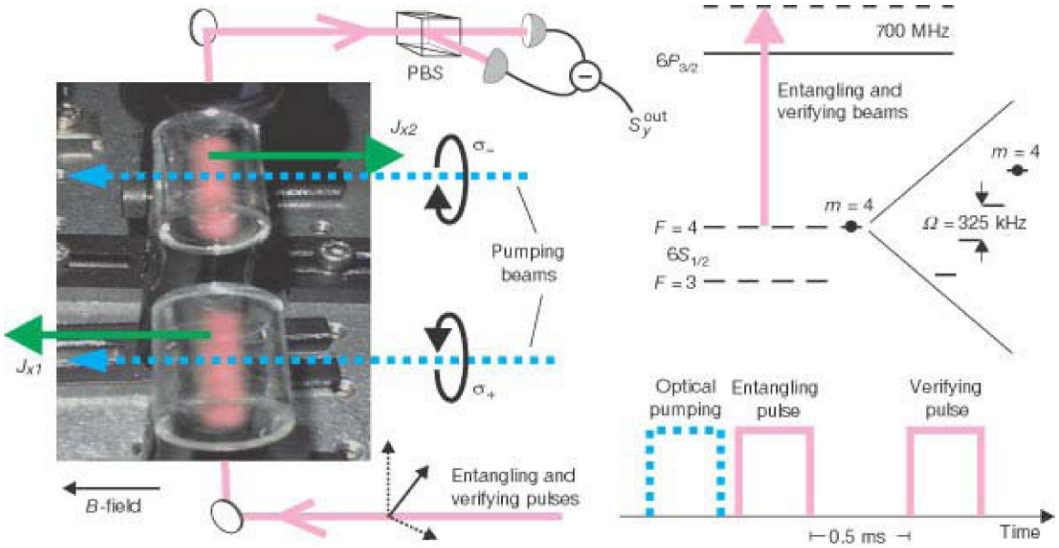

Figure 2 : Gas in the tubes is cesium, photon beams with alternate spin states are pumped through the chambers, creating a 'half-spin' state of entanglement. The image is of test-stand diagram for the experiment conducted by Juulsgard et al. In citation number 37 (Image from nature; Vol 413 ; 27 September 2001)

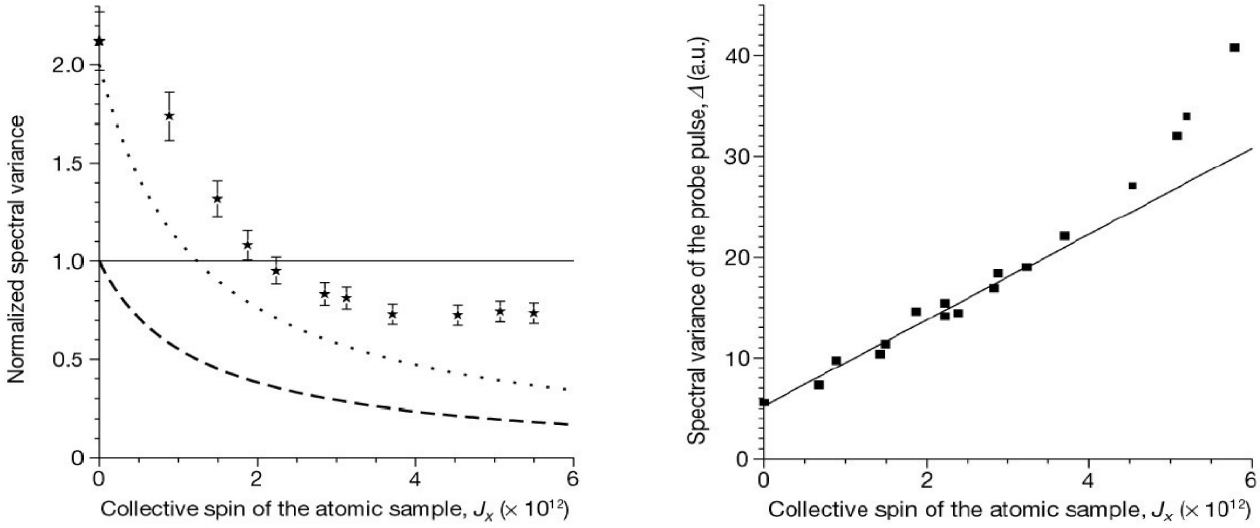

Figure 3 : Graphs demonstrating the results and entanglement of the experiment conducted by Juulsgard et al., also from citation number 37 (Image from Nature; Vol 413 ; 27 September 2001)

Half a millisecond is a very short duration; however as discussed in section E, above, frequency plays a role. Therefore it is possible that entanglement and transport may occur in organic material, when the material is perturbed not only by photonic beams, but also by specific EM wave frequencies. This may imply that repetition of entanglement - coherence and decoherence is a cycle and part of the process.

Photosynthetic light harvesting complexes

Photosynthesis is a perfect example of where to begin looking for quantum level energetic exchanges in organic material. Simply photosynthesis is the transduction of photonic energy into metabolic energy. A significant amount of research has gone into exactly how plants turn sunlight into energy. Recent investigations of quantum entanglement in photosynthetic light harvesting complexes[40] have demonstrated that non-Markovian entanglement can occur.

This means that observations have proven that information is transferred on a quantum macro-scale and persists with duration. In this instance, the transference is between two chromophores in separate organisms. During the initial stage of photosynthesis, light is captured by pigment-protein antennas known as light harvesting complexes (LHC). The excitation energy is transferred through these antennas to reaction centers where photosynthetic chemical reactions are initiated. In the Berkeley study, the bacteria exist in low-light environments. The densely packed units of pigmentation molecules are exceptional at transporting excitation energy in disordered environments[41]. "Site" coherence (coherence between spatially separated pigment molecules) occurs with an average inter-chromophore separation on the scale of ~15A. The dipole coupling of these molecules leads to coherent interactions[42,43] in observable time scales.

Entanglement of macroscopic groupings

Experimental data indicate that larger groupings of particles on a macroscopic scale can become entangled. One experiment[44] conducted with a magnetic salt compound of liho$_{0.045}$ $Y_{0.955}F_4$. The atoms in this salt act as small magnets, modeled after an Ising chain of small spins, which not only attracts each other, but also orients the magnetic field.

The basic experiment examines the susceptibility of particles in low temperatures. Susceptibility is how well a particle aligns with each other in the presence of an external magnetic field. One might intuit that the more correlated the magnets, the higher the susceptibility. One would also assume that the higher the temperature, the lower the susceptibility, because when the magnets heat up and reactions become more random to correlate less[45,46].

The experiment conducted by Ghosh et. Al. Shows the royal route of the salts that do not adhere to laws of classical mechanics (see *figure4&5*).

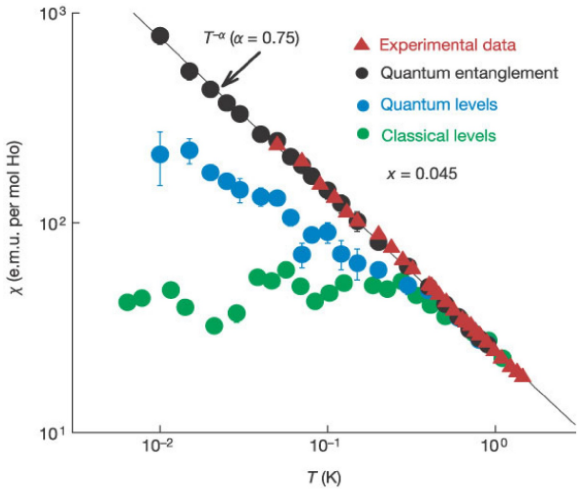

Figure 4 : Magnetic properties persist beyond curie temperatures in particles that are in an entangled state (Source: Ghosh et. Al. *Nature* 425, 48–51, 2003)

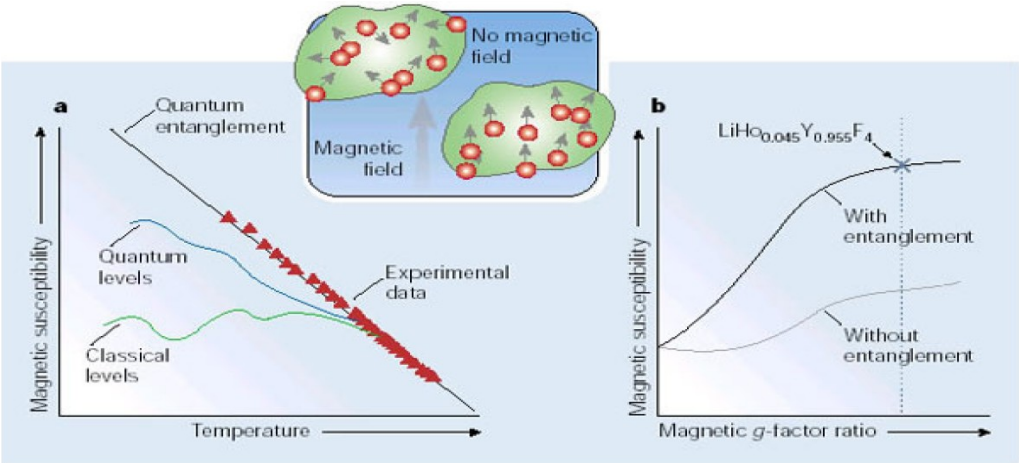

Figure 5 : Particles maintain magnetic susceptibility while in an entangled state, even at higher temperatures. (Source: Ghosh et. Al. *Nature* 425, 48–51, 2003)

ANALYSIS

This is a very small sampling of the available peer-reviewed and refereed publications on the subjects discussed. The presence of so much information is a positive indicator that there may be some 'there' there. Regarding the initial considerations the following analysis is made from this research:

Quantum HGT

There is significant evidence to support further investigation into quantum level effects upon adaptive mutation and the possibility of quantum horizontal gene transfer. Some of the research conducted may indicate a capacity for not only transmission of a template, but also the transference of energy for transduction to begin the building of the base pairs necessary to replicate RNA or DNA at a distance. This may be achieved through the use of tight photon beams, EM waves, ion beams, or other either standing waves/optical effects, in a variety of mediums – proteins, oxygen and other base elements, and even enzymatic sugars.

Potential use for quantum computing using biological media

The recent discoveries in the ability to transport anthropogenic data via photons, and the recent discoveries with reference to our ability to store man-made data upon synthesized DNA indicate that there is a potential synthesis between the two. The futurist's vision would be one where photonic pathways through organic media may create new super-computing capabilities, and possible new opportunities to develop Aug-Cog (cognitive augmentation hard and software) interfaces. The requirements for further investigation require new efficiencies in spectroscopy, further development of more efficient transitions between photonic and electron buffer interfaces and investigation in to what types of organic media may make the best interfaces.

Dr. Takaaki Musha, of Japan's Ministry of Defense, points out the possibility in the book titled "Computer Science Research and Technology, Vol.2"[47] "that superluminal photons can be generated inside microtubles of life forms. From quantum theory, we cannot localize them in space from the superpotition of solutions given by Feinberg[48]. Thus such a quantum superpotition cannot be made to vanish outside the sphere of finite radius, but rather influence outside the biological systems. Hence superluminal photons generated inside the biological system has the possibility to be entangled with each other via a tachyon field created from the quantum vacuum around them. From which, it can be considered that superluminal photons in the biological material behaves as an inseparable whole and correlate with each other throughout the Universe. One might consider that the information of the DNA and gene's structure is available throughout the Universe via access to the omnipresent tachyon field."

If issues of decoherence occurring in a warm wet-mind environment can be observed to be overcome through evanescing photon's accessing and storing information outside of the physical dimensions of a single mind - either through thermodynaimc homeostasis or some previously undiscovered chemiosmotic conditions, then this proposed method becomes definitive. The authors suggestion that "... the biological brain has the possibility to achieve large quantum bit computation at room temperature..." is certainly possible and warrants further investigation into how qubits relate to neurons and how the brain employs memory registers and processing units. Answers to these questions can certainly speed this line of investigation to more substatiative conclusions.

Potential use in medicine

The potential for further investigations into quantum level effects may be useful in genetic engineering, delivery of anesthetics[49], developing defense from viruses and bacteria – the list is long of possible uses in medicine. The next series of investigations could be as simple as placing two unique and independent engineered samples in their own clean broths, several feet apart, in a vacuum chamber and then distributing various optical or other waves through the samples in an attempt to affect a transfer. Ultimately a great deal of work still needs to continue. Davies, in his work cites many useful future lines of investigation.

Potential use in transport

Research into the transport of particles or ensembles on a quantum level is not conclusive at this point; however, there is a significant amount of work being conducted in researching these areas. If it is possible for ensembles of non-organic material to transport on a quantum level, which current research suggests, then it may very well be possible to transport living matter in a cohesive manner as well. This is a long track technology development, and currently we are quite a ways from such a synthesis of scientific disciplines.

FUTURE INVESTIGATIONS

A series of further investigations is proposed. The main investigation would look at whether or not large group-

ings, ensembles or even cells could be transported over distance. This experiment would require a large vacuum chamber, two samples of bacteria derived from separate stock with no contamination cross-over, a tight photon beam and an electromagnetic source.

Through this experiment each sample would be sealed in a clean environment and placed into the large vacuum chamber. The photon beam would be passed through one group of bacteria into the other. Different EM frequencies would be used during iterations of the testing procedure as well as temperature changes to determine if any combination of frequency or temperature has a more functional or destructive effect than another.

Results from this body of testing may allow for further testing on even larger groupings of organic material,

A variation on this experiment would be to incite an entangled state in a local group of particles and then to separate the group into several smaller batches. These batches would then be removed and placed in separate containers in the vacuum chamber. The source batch would then be changed and an effort to observe the separate batches would be made to see if the same effect occurs in the test samples.

An experiment to investigate the possibility of quantum organic computing could be developed using non-organic hardware, a photonic emitter transistor (PETRA - developed in another Morningstar program) and data stored upon one group of organic material and an artificial bio film as the transit conduit to the PETRA and then onward to imprint another grouping of biological storage media.

Lastly, further investigations should be conducted into the area of using photon beam transmission to deliver medications to patients.

CONCLUSIONS

It becomes clear that a great deal more research is required; both in new investigations and the replication of existing experiments, to discover whether or not this conjecture has real merit. In the interim it is clear that much has been done to pave the way for new insights into the emerging technology of quantum biology. There is a notion with every possibility of being true, that this type of pursuit may yield a panacea in medicine is clear. What is not clear is the validity of the science itself, this will require substantial investment in time and energy, though the effort will be well worth the expense even if further results disprove the current theories and their gaining traction.

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