Quantum Dot Neurons

A transistor that simulates some of the functions of neurons has been invented based on experiments and models developed by researchers at the Federal University of São Carlos (UFSCar) in São Paulo State, Brazil, Würzburg University in Germany, and the University of South Carolina in the United States. [15]

For certain frequencies of short-wave infrared light, most biological tissues are nearly as transparent as glass. Now, researchers have made tiny particles that can be injected into the body, where they emit those penetrating frequencies. The advance may provide a new way of making detailed images of internal body structures such as fine networks of blood vessels. [14]

The proposed nano-MRI setup consists of an atomic qubit positioned 2-4 nm below a surface holding a molecule. The qubit acts as both the sensor and source of the magnetic field for encoding the nuclear spins of the molecule. The nuclear density data is then used to generate a 3D image of the molecular structure with angstrom-level resolution. [13]

Researchers at the University of Melbourne have developed a way to radically miniaturise a Magnetic Resonance Imaging (MRI) machine using atomic-scale quantum computer technology. [12]

With one in two Australian children reported to have tooth decay in their permanent teeth by age 12, researchers from the University of Sydney believe they have identified some nanoscale elements that govern the behaviour of our teeth. [11]

When cryoEM images are obtained from protein nanocrystals the images themselves can appear to be devoid of any contrast. A group of scientists from the Netherlands have now demonstrated that lattice information can be revealed and enhanced by a specialized filter. [10]

There is also connection between statistical physics and evolutionary biology, since the arrow of time is working in the biological evolution also.

From the standpoint of physics, there is one essential difference between living things and inanimate clumps of carbon atoms: The former tend to be much better at capturing energy from their environment and dissipating that energy as heat. [8]

This paper contains the review of quantum entanglement investigations in living systems, and in the quantum mechanically modeled photoactive prebiotic kernel systems. [7]

The human body is a constant flux of thousands of chemical/biological interactions and processes connecting molecules, cells, organs, and fluids, throughout the brain, body, and nervous system. Up until recently it was thought that all these interactions operated in a linear sequence, passing on information much like a runner passing the baton to the next runner. However, the latest findings in quantum biology and biophysics have discovered that there is in fact a tremendous degree of coherence within all living systems.

The accelerating electrons explain not only the Maxwell Equations and the Special Relativity, but the Heisenberg Uncertainty Relation, the Wave-Particle Duality and the electron's spin also, building the Bridge between the Classical and Quantum Theories.

The Planck Distribution Law of the electromagnetic oscillators explains the electron/proton mass rate and the Weak and Strong Interactions by the diffraction patterns. The Weak Interaction changes the diffraction patterns by moving the electric charge from one side to the other side of the diffraction pattern, which violates the CP and Time reversal symmetry.

The diffraction patterns and the locality of the self-maintaining electromagnetic potential explains also the Quantum Entanglement, giving it as a natural part of the Relativistic Quantum Theory and making possible to understand the Quantum Biology.

Contents

Author: George Rajna

Preface

Jeremy England, a 31-year-old assistant professor at the Massachusetts Institute of Technology, has derived a mathematical formula that he believes explains this capacity. The formula, based on established physics, indicates that when a group of atoms is driven by an external source of energy (like the sun or chemical fuel) and surrounded by a heat bath (like the ocean or atmosphere), it will often gradually restructure itself in order to dissipate increasingly more energy. This could mean that

under certain conditions, matter inexorably acquires the key physical attribute associated with life. [8]

We define our modeled self-assembled supramolecular photoactive centers, composed of one or more sensitizer molecules, precursors of fatty acids and a number of water molecules, as a photoactive prebiotic kernel system. [7]

The human body is a constant flux of thousands of chemical/biological interactions and processes connecting molecules, cells, organs, and fluids, throughout the brain, body, and nervous system. Up until recently it was thought that all these interactions operated in a linear sequence, passing on information much like a runner passing the baton to the next runner. However, the latest findings in quantum biology and biophysics have discovered that there is in fact a tremendous degree of coherence within all living systems. [5]

Quantum entanglement is a physical phenomenon that occurs when pairs or groups of particles are generated or interact in ways such that the quantum state of each particle cannot be described independently – instead, a quantum state may be given for the system as a whole. [4]

I think that we have a simple bridge between the classical and quantum mechanics by understanding the Heisenberg Uncertainty Relations. It makes clear that the particles are not point like but have a dx and dp uncertainty.

Quantum dot transistor simulates functions of neurons

A transistor that simulates some of the functions of neurons has been invented based on experiments and models developed by researchers at the Federal University of São Carlos (UFSCar) in São Paulo State, Brazil, Würzburg University in Germany, and the University of South Carolina in the United States.

The device, which has micrometric as well as nanometric parts, can see light, count, and store information in its own structure, dispensing with the need for a complementary memory unit.

It is described in the article "Nanoscale tipping bucket effect in a quantum dot transistor-based counter", published in the journal Nano Letters.

"In this article, we show that transistors based on quantum dots can perform complex operations directly in memory. This can lead to the development of new kinds of device and computer circuit in which memory units are combined with logical processing units, economizing space, time, and power consumption," said Victor Lopez Richard, a professor in UFSCar's Physics Department and one of the coordinators of the study.

The transistor was produced by a technique called epitaxial growth, which consists of coating a crystal substrate with thin film. On this microscopic substrate, nanoscopic droplets of indium arsenide act as quantum dots, confining electrons in quantized states. Memory functionality is derived from the dynamics of electrical charging and discharging of the quantum dots, creating current patterns with periodicities that are modulated by the voltage applied to the transistor's gates or the light absorbed by the quantum dots.

"The key feature of our device is its intrinsic memory stored as an electric charge inside the quantum dots," Richard said. "The challenge is to control the dynamics of these charges so that the transistor can manifest different states. Its functionality consists of the ability to count, memorize, and perform the simple arithmetic operations normally done by calculators, but using incomparably less space, time, and power."

According to Richard, the transistor is not likely to be used in quantum computing because this requires other quantum effects. However, it could lead to the development of a platform for use in equipment such as counters or calculators, with memory intrinsically linked to the transistor itself and all functions available in the same system at the nanometric scale, with no need for a separate space for storage.

"Moreover, you could say the transistor can see light because quantum dots are sensitive to photons," Richard said, "and just like electric voltage, the dynamics of the charging and discharging of quantum dots can be controlled via the absorption of photons, simulating synaptic responses and some functions of neurons."

Further research will be necessary before the transistor can be used as a technological resource. For now, it works only at extremely low temperatures - approximately 4 Kelvin, the temperature of liquid helium.

"Our goal is to make it functional at higher temperatures and even at room temperature. To do that, we'll have to find a way to separate the electronic spaces of the system sufficiently to prevent them from being affected by temperature. We need more refined control of synthesis and material growth techniques in order to fine-tune the charging and discharging channels. And the states stored in the quantum dots have to be quantized," Richard said. [15]

Quantum dots that emit infrared light open new window for biological imaging

For certain frequencies of short-wave infrared light, most biological tissues are nearly as transparent as glass. Now, researchers have made tiny particles that can be injected into the body, where they emit those penetrating frequencies. The advance may provide a new way of making detailed images of internal body structures such as fine networks of blood vessels.

The new findings, based on the use of light-emitting particles called quantum dots, is described in a paper in the journal Nature Biomedical Engineering, by MIT research scientist Oliver Bruns, recent graduate Thomas Bischof PhD '15, professor of chemistry Moungi Bawendi, and 21 others.

Near-infrared imaging for research on biological tissues, with wavelengths between 700 and 900 nanometers (billionths of a meter), is widely used, but wavelengths of around 1,000 to 2,000 nanometers have the potential to provide even better results, because body tissues are more transparent to that light. "We knew that this imaging mode would be better" than existing methods, Bruns explains, "but we were lacking high-quality emitters"—that is, light-emitting materials that could produce these precise wavelengths.

Light-emitting particles have been a specialty of Bawendi, the Lester Wolf Professor of Chemistry, whose lab has over the years developed new ways of making quantum dots. These nanocrystals, made of semiconductor materials, emit light whose frequency can be precisely tuned by controlling the exact size and composition of the particles.

The key was to develop versions of these quantum dots whose emissions matched the desired short-wave infrared frequencies and were bright enough to then be easily detected through the surrounding skin and muscle tissues. The team succeeded in making particles that are "orders of magnitude better than previous materials, and that allow unprecedented detail in biological imaging," Bruns says. The synthesis of these new particles was initially described in a paper by graduate student Daniel Franke and others from the Bawendi group in Nature Communications last year.

The quantum dots the team produced are so bright that their emissions can be captured with very short exposure times, he says. This makes it possible to produce not just single images but video that captures details of motion, such as the flow of blood, making it possible to distinguish between veins and arteries.

The new light-emitting particles are also the first that are bright enough to allow imaging of internal organs in mice that are awake and moving, as opposed to previous methods that required them to be anesthetized, Bruns says. Initial applications would be for preclinical research in animals, as the compounds contain some materials that are unlikely to be approved for use in humans. The researchers are also working on developing versions that would be safer for humans.

The method also relies on the use of a newly developed camera that is highly sensitive to this particular range of short-wave infrared light. The camera is a commercially developed product, Bruns says, but his team was the first customer for the camera's specialized detector, made of indium-gallium-arsenide. Though this camera was developed for research purposes, these frequencies of infrared light are also used as a way of seeing through fog or smoke.

Not only can the new method determine the direction of blood flow, Bruns says, it is detailed enough to track individual blood cells within that flow. "We can track the flow in each and every capillary, at super high speed," he says. "We can get a quantitative measure of flow, and we can do such flow measurements at very high resolution, over large areas."

Such imaging could potentially be used, for example, to study how the blood flow pattern in a tumor changes as the tumor develops, which might lead to new ways of monitoring disease progression or responsiveness to a drug treatment. "This could give a good indication of how treatments are working that was not possible before," he says. [14]

Proposed quantum nano-MRI could generate images with angstrom-level resolution

The proposed nano-MRI setup consists of an atomic qubit positioned 2-4 nm below a surface holding a molecule. The qubit acts as both the sensor and source of the magnetic field for encoding the nuclear spins of the molecule. The nuclear density data is then used to generate a 3D image of the molecular structure with angstrom-level resolution.

Similar to the way that a conventional magnetic resonance imaging (MRI) machine uses large magnets to generate 3D images, physicists have developed a proposal for a quantum nano-MRI machine that would use the magnetic properties of a single atomic qubit to generate 3D images with angstrom-level (0.1-nanometer) resolution. The new technique could lead to the development of single-molecule microscopes for imaging biomolecules, with applications in drug discovery and better understanding diseases.

The researchers, led by Lloyd Hollenberg, a physics professor at the University of Melbourne, have published a paper on the new technique in a recent issue of Nature Communications.

"Continuous scientific advances over the last decades have enabled us to understand and therefore cure many medical issues at the macroscopic scale, for example bone fractures or blood clots," lead author Viktor Perunicic at the University of Melbourne told Phys.org. "However, the diseases that humanity is facing today are microscopic, as they originate from malfunctions on the molecular level, for example a protein of a deformed shape somewhere in a cell. Cancer, diabetes, viral infections and many others have this in common, yet at present there is almost no means to see what is happening inside our bodies at this level.

"In our work, we aim to address this problem by developing a blueprint for technology that may enable direct 3D visual insight into the atomic structure of individual molecules in their cellular environment. We achieve this by leveraging quantum computing technology in a concept that brings magnetic resonance imaging to the atomic scale."

The proposed imaging system consists of an atomic qubit that is placed about 2 nanometers below a surface holding the molecule to be imaged. The qubit acts as both the source and the sensor of magnetic fields, with its quantum magnetic properties (its spin) interacting with the magnetic properties of the atoms in the target molecule. By collecting data on these interactions at various orientations, the system could determine the positions of individual atoms and construct a 3D image of the target molecule's structure.

The scientists simulated the new technique using a rapamycin molecule ($C_{51}H_{79}NO_{13}$), an immunosuppressant drug that is commonly used to prevent organ transplant rejection. In conventional imaging techniques, such as X-ray crystallography, it is difficult to detect the hydrogen atoms. But by measuring the hydrogen nuclear spin density, the nano-MRI method can generate 3D images of the hydrogen atoms, as well as the carbon atoms, with an average image resolution at the angstrom level.

"The ability to image the atomic structure of molecules in their native cellular environments is vital to both understanding disease's origin and finding its cure," Hollenberg said. "For example, in the search and testing of new drugs one would first identify a target, often a membrane protein. Imaging the true structure of the protein in the cellular environment is key to understanding how drug molecules will interact with it. On the basis of this information, a drug molecule could be selected or designed. Importantly, the same imaging device would provide means to understand and test how well the drug is working, by observing its interactions with the target molecule on the atomic level. Our goal is to develop a versatile technology for observing the presently inaccessible bio-chemical atomic structure of important molecules in situ, in manner analogue to how hospital MRI machines observe the anatomy of our bodies."

Due to the large amount of data involved, simulations show that the total time to generate an image of the rapamycin molecule is currently about 175 hours. However, the researchers expect that future improvements will greatly reduce this time, as well as further increase the resolution. In the future, they also plan to scale up the system design for imaging larger biomolecules.

"So far our work has focused on the fundamental theoretical groundwork, understanding how to physically construct the device with presently accessible technology," Perunicic said. "We are developing the intricate quantum mechanical control that would provide the capacity to image individual molecules, and are also performing simulations to test the performance under realistic conditions. As the outcomes of these investigations were encouraging, the natural direction for the next couple of years is to venture into experimental proof-of-concept demonstrations." [13]

Atomic-scale MRI holds promise for new drug discovery

Researchers at the University of Melbourne have developed a way to radically miniaturise a Magnetic Resonance Imaging (MRI) machine using atomic-scale quantum computer technology.

Capable of imaging the structure of a single bio-molecule, the new system would overcome significant technological challenges and provide an important new tool for biotechnology and drug discovery.

The work was published today in Nature Communications, and was led by Prof Lloyd Hollenberg at the University of Melbourne, working closely with researchers at the ARC Centre of Excellence for Quantum Computation and Communication Technology (CQC2T) to design the quantum molecular microscope.

The team propose the use of atomic-sized quantum bits (qubits) normally associated with the development of quantum computers, but here would be employed as highly sensitive quantum sensors to image the individual atoms in a bio-molecule.

"Determining the structure of bio-molecules such as proteins can often be a barrier to the development of novel drugs," said Prof. Lloyd Hollenberg, Thomas Baker Chair in Physical Biosciences at the University of Melbourne.

"By using quantum sensing to image individual atoms in a bio-molecule, we hope to overcome several issues in conventional biomolecule imaging, " Prof Hollenberg said.

State-of-the-art techniques create a crystal of the molecule to be studied and use X-ray diffraction to determine the molecules' average structure. However, the crystalisation and averaging processes may lead to important information being lost. Also, not all bio-molecules can be crystalised - particularly proteins associated with cell membranes, which are critical in the development of new drugs.

"Our system is specifically designed to use a quantum bit as a nano-MRI machine to image the structure of a single protein molecule in their native hydrated environments," added Prof Hollenberg.

"As part of our research in quantum computing we have also been working on the nearer-term applications of atomic-based quantum technology investigating the use of a single quantum bit as a highly sensitive magnetic field sensor," says Prof. Hollenberg.

Atomic qubits can be made to exist in two states at the same time, a disturbingly strange property that not only underpins the power of a quantum computer, but also the sensitivity of qubits as nano-sensors.

"In a conventional MRI machine large magnets set up a field gradient in all three directions to create 3D images; in our system we use the natural magnetic properties of a single atomic qubit," says University of Melbourne PhD researcher Mr. Viktor Perunicic, who was the lead author on the paper.

"The system would be fabricated on-chip, and by carefully controlling the quantum state of the qubit probe as it interacts with the atoms in the target molecule, we can extract information about the positions of atoms by periodically measuring the qubit probe and thus create an image of the molecule's structure." says Mr. Peruncic.

"The system could be constructed and tested relatively quickly using diamond-based qubits. However, to capture really high resolution molecular images in the longer term, CQC2T's silicon-based qubits might have the advantage because they have very long quantum coherence," said Prof. Hollenberg.

"The construction of such a quantum MRI machine for single molecule microscopy could revolutionise how we view biological processes at the molecular level, and could lead to the development of new biotechnology and a range of clinical applications." [12]

Researchers identified some nanoscale elements that govern the behavior of our teeth

With one in two Australian children reported to have tooth decay in their permanent teeth by age 12, researchers from the University of Sydney believe they have identified some nanoscale elements that govern the behaviour of our teeth.

Material and structures engineers worked with dentists and bioengineers to map the exact composition and structure of tooth enamel at the atomic scale.

Using a relatively new microscopy technique called atom probe tomography, their work produced the first-ever three-dimensional maps showing the positions of atoms critical in the decay process.

The new knowledge on atom composition at the nanolevel has the potential to aid oral health hygiene and caries prevention, and has been published today in the journal Science Advances.

Professor Julie Cairney, Material and Structures Engineer in the Faculty of Engineering and Information Technologies, said:

"The dental professionals have known that certain trace ions are important in the tough structure of tooth enamel but until now it had been impossible to map the ions in detail.

"The structure of human tooth enamel is extremely intricate and while we have known that magnesium, carbonate and fluoride ions influence enamel properties scientists have never been able to capture its structure at a high enough resolution or definition."

"What we have found are the magnesium-rich regions between the hydroxyapatite nanorods that make up the enamel.

"This means we have the first direct evidence of the existence of a proposed amorphous magnesium-rich calcium phosphate phase that plays an essential role in governing the behaviour of teeth. "

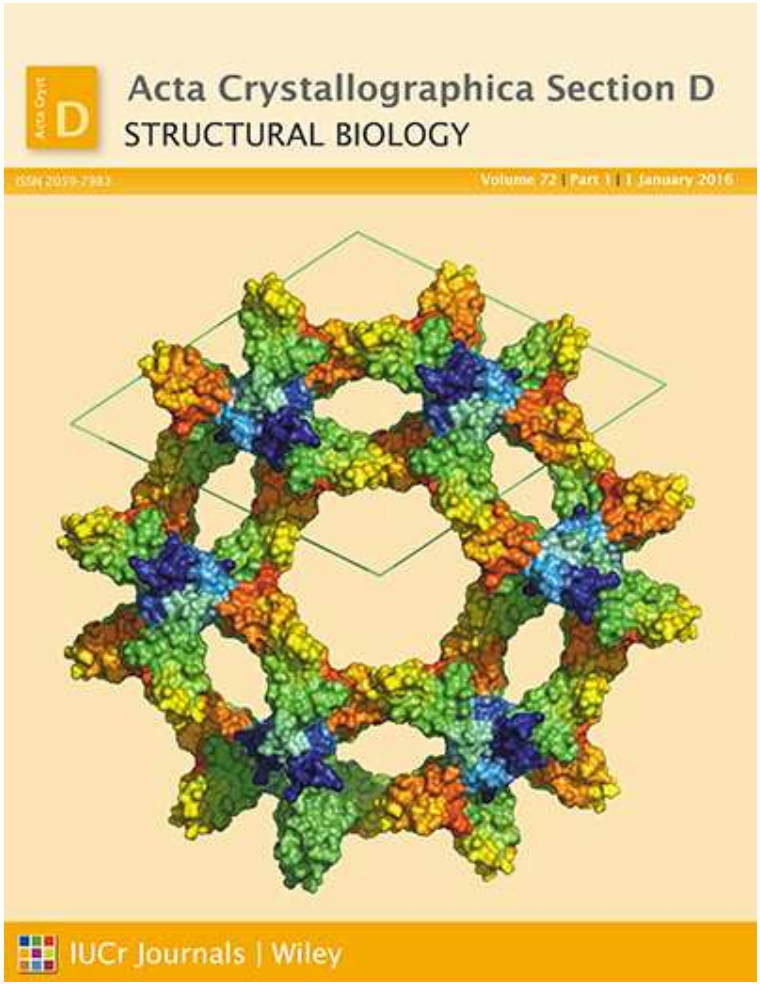
Co-lead researcher on the study, Dr Alexandre La Fontaine from the University's Australian Centre for Microscopy and Microanalysis, said:

We were also able to see nanoscale 'clumps' of organic material, which indicates that proteins and peptides are heterogeneously distributed within the enamel rather than present along all the nanorod interfaces, which was what was previously suggested.

The mapping has the potential for new treatments designed around protecting against the dissolution of this specific amorphous phase.

The new understanding of how enamel forms will also help in tooth remineralisation research." [11]

Digital enhancement of cryoEM photographs of protein Nanocrystals



The procedure described by van Genderen et al. [(2016). Acta Cryst. D71, 34-39] paves the way towards full three-dimensional structure determination at high resolution for protein crystals. The authors report on how lattice information can be enhanced by means of a wave finder in combination with Wiener-type maximum-likelihood filtering. The lattice filter is a very powerful tool for selecting and analysing extremely low contrast cryo-images of three dimensional protein/peptide nanocrystals. It confirms that the three-dimensional crystals are made up from multiple domains that are slightly differently oriented. Indeed, the algorithm can comfortably deal with multiple crystals with very different orientations, unit cells and/or space groups.

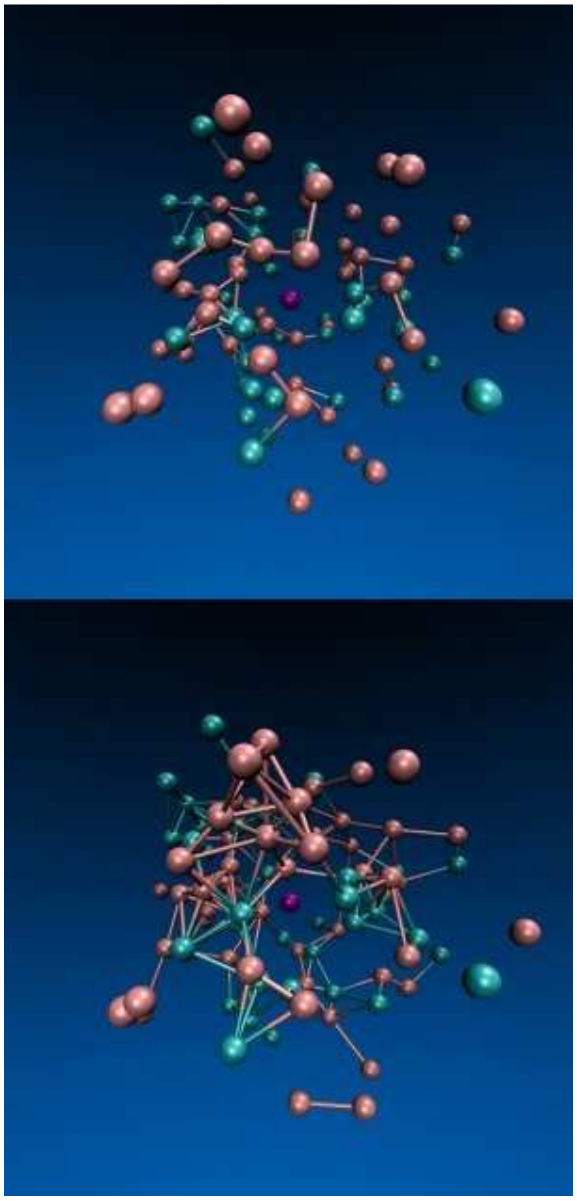
The authors of the paper propose the new lattice filter as a powerful tool for processing very noisy images with crystal factors (and thus the phase information) hidden within them. The filter is able to discriminate between noise images and the very noisy images with very low contrast which contain crystal-like structures. The lattice filter retains the shape of the spots in Fourier space and also retains any phase gradients within the Bragg spots (which determine the domain structure within the crystal). Thus, it retains all of the significant information from the Bragg spots. This will open the way to combining the phases acquired from stationary, two-dimensional images with intensities of rotation diffraction data taken from the same type of crystals. In this way, the authors expect to be able to phase the diffraction information of protein and peptide crystals. [10]

This Physicist Has a Groundbreaking Idea about Why Life Exists

“You start with a random clump of atoms, and if you shine light on it for long enough, it should not be so surprising that you get a plant,” England said.

England’s theory is meant to underlie, rather than replace, Darwin’s theory of evolution by natural selection, which provides a powerful description of life at the level of genes and populations. “I am certainly not saying that Darwinian ideas are wrong,” he explained. “On the contrary, I am just saying that from the perspective of the physics, you might call Darwinian evolution a special case of a more general phenomenon.”

At the heart of England’s idea is the second law of thermodynamics, also known as the law of increasing entropy or the “arrow of time.” Hot things cool down, gas diffuses through air, eggs scramble but never spontaneously unscramble; in short, energy tends to disperse or spread out as time progresses. Entropy is a measure of this tendency, quantifying how dispersed the energy is among the particles in a system, and how diffuse those particles are throughout space. It increases as a simple matter of probability: There are more ways for energy to be spread out than for it to be concentrated.



A computer simulation by Jeremy England and colleagues shows a system of particles confined inside a viscous fluid in which the turquoise particles are driven by an oscillating force. Over time (from top to bottom), the force triggers the formation of more bonds among the particles.

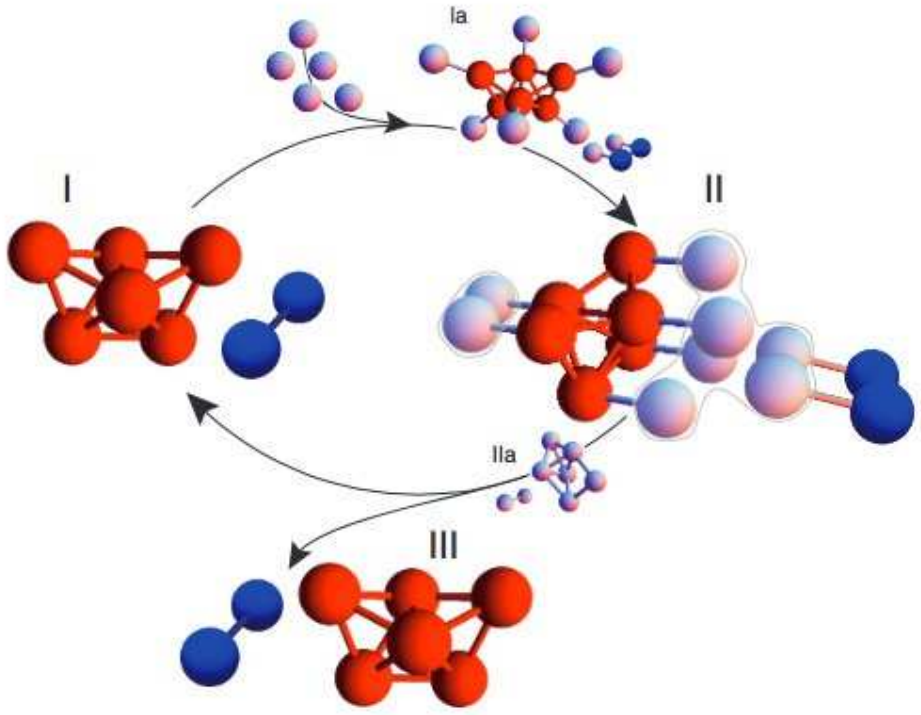
Thus, as particles in a system move around and interact, they will, through sheer chance, tend to adopt configurations in which the energy is spread out. Eventually, the system arrives at a state of maximum entropy called “thermodynamic equilibrium,” in which energy is uniformly distributed. A cup of coffee and the room it sits in become the same temperature, for example.

Although entropy must increase over time in an isolated or “closed” system, an “open” system can keep its entropy low — that is, divide energy unevenly among its atoms — by greatly increasing the entropy of its surroundings. In his influential 1944 monograph “What Is Life?” the eminent quantum physicist Erwin Schrödinger argued that this is what living things must do. A plant, for example, absorbs extremely energetic sunlight, uses it to build sugars, and ejects infrared light, a much less

concentrated form of energy. The overall entropy of the universe increases during photosynthesis as the sunlight dissipates, even as the plant prevents itself from decaying by maintaining an orderly internal structure.

Self-replication (or reproduction, in biological terms), the process that drives the evolution of life on Earth, is one such mechanism by which a system might dissipate an increasing amount of energy over time.

As England put it, “A great way of dissipating more is to make more copies of yourself.”



Self-Replicating Sphere Clusters: According to new research at Harvard, coating the surfaces of microspheres can cause them to spontaneously assemble into a chosen structure, such as a polytetrahedron (red), which then triggers nearby spheres into forming an identical structure.

Scientists have already observed self-replication in nonliving systems. According to new research led by Philip Marcus of the University of California, Berkeley, and reported in Physical Review Letters in August, vortices in turbulent fluids spontaneously replicate themselves by drawing energy from shear in the surrounding fluid. And in a paper in Proceedings of the National Academy of Sciences, Michael Brenner, a professor of applied mathematics and physics at Harvard, and his collaborators present theoretical models and simulations of microstructures that self-replicate. These clusters of specially coated microspheres dissipate energy by roping nearby spheres into forming identical clusters. “This connects very much to what Jeremy is saying,” Brenner said. [8]

Photoactive Prebiotic Systems

We propose that life first emerged in the form of such minimal photoactive prebiotic kernel systems and later in the process of evolution these photoactive prebiotic kernel systems would have produced fatty acids and covered themselves with fatty acid envelopes to become the minimal cells of the Fatty Acid World. Specifically, we model self-assembling of photoactive prebiotic systems with observed quantum entanglement phenomena. We address the idea that quantum entanglement was important in the first stages of origins of life and evolution of the biospheres because simultaneously excite two prebiotic kernels in the system by appearance of two additional quantum entangled excited states, leading to faster growth and self-replication of minimal living cells.
The quantum mechanically modeled possibility of synthesizing artificial self-reproducing quantum entangled prebiotic kernel systems and minimal cells also impacts the possibility of the most probable path of emergence of photocells on the Earth or elsewhere. We also examine the quantum entangled logic gates discovered in the modeled systems composed of two prebiotic kernels. Such logic gates may have application in the destruction of cancer cells or becoming building blocks of new forms of artificial cells including magnetically active ones.

Significance Statement

Our investigated self-assembly of molecules towards supramolecular bioorganic and minimal cellular systems depends on the quantum mechanics laws which induce hydrogen and Van der Waals bindings (Tamulis A, Grigalavicius, M, Orig Life Evol Biosph 41:51-71, 2011).

In the work presented here, quantum entanglement takes the form of a quantum superposition of the active components in synthesized self-assembling and self-replicating living systems. When a quantum calculation of an entangled system is made that causes one photoactive biomolecule of such a pair to take on a definite value (e.g., electron density transfer or electron spin density transfer), the other member of this entangled pair will be found to have taken the appropriately correlated value (e.g., electron density transfer or electron spin density transfer). In our simulations, the separation distance of supramolecular bio systems changes took place during geometry optimization procedures, which mimic real-world intermolecular interaction processes.

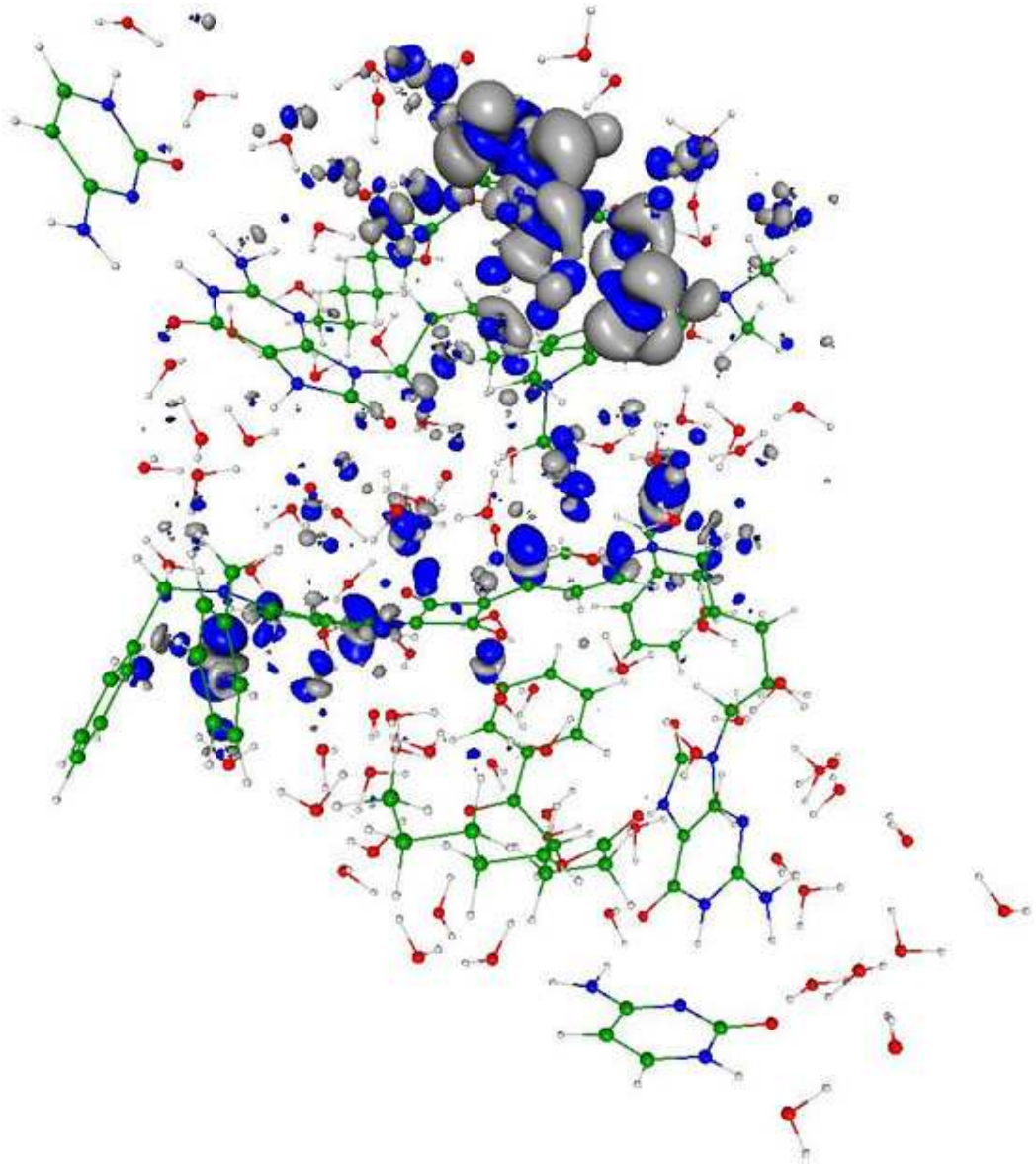
Our discovered phenomenon of the quantum entanglement in the prebiotic systems enhance the photosynthesis in the proposed systems because simultaneously excite two prebiotic kernels in the system by appearance of two additional quantum entangled excited states (Tamulis A, Grigalavicius M, Baltrusaitis J, Orig Life Evol Biosph 43:49-66, 2013; Tamulis A, Grigalavicius M, Krisciukaitis S (2014) , J Comput Theor Nanos, 11, 1597-1608, 2014; Tamulis A, Grigalavicius M, 8:117-140, 2014.). We can propose that quantum entanglement enhanced the emergence of photosynthetic prebiotic kernels and accelerated the evolution of photosynthetic life because of additional absorbed light energy, leading to faster growth and self-replication of minimal living cells.

We can state that: Livings are self-assembled and self-replicating wet and warm stochastically moving supramolecular systems where quantum entanglement can be continuously generated and destroyed by non-equilibrium effects in an environment where no static entanglement exists; quantum entanglement involve the biomolecule inside one living or between other neighboring livings.

This warm quantum coherence is basic for the explanation of DNA stability and for the understanding of brain magnetic orientation during migration in more than 50 species of birds, fishes and insects. Exists experimental evidence for quantum-coherent is used for more efficient light-harvesting in plant photosynthesis. Quantum entanglement exists in supramolecules determining the sense of smell and in the brain neurons microtubules due to quantum vibrations.

In the work presented here, we started to design and quantum mechanical investigations of the molecular logical devices which are useful for construction of nano medicine biorobots against the molecular diseases such a cancer tumors, and against the new kinds of synthesized microorganisms and nano guns.

Figure legend



You can see in the enclosed figure the quantum entanglement phenomenon in the closely self-assembled two synthesized protocell system due to the photo excited electron charge transfer from one protocell to another that leads to closer self-assembly and exchange of energy and information.

Visualization of the electron charge tunneling associated with the 6th (467.3 nm) excited state. The transition is mainly from squarine molecule of the first protocell situated in the bottom of this bi cellular system to precursor of fatty acid (pFA) molecule of the second subsystem (in the top) and little from the 1,4-bis(N,N-dimethylamino)naphthalene molecule (in the top-right) to the same pFA molecule of the second subsystem (in the top). The electron cloud hole is indicated by the dark blue color while the transferred electron cloud location is designated by the gray color.

As a result, these nonlinear quantum interactions compressed the overall molecular system resulting in a smaller gap between the HOMO and LUMO electron energy levels which allows enhanced tunneling of photo excited electrons from the sensitizer squarine and (1,4-bis(N,N-dimethylamino)naphthalene) to the pFA molecule resulting in its cleavage. The new fatty acid joins the existing minimal cell thus increasing it in size. After reaching some critical size, the minimal cell should divide (i.e. self-replicate) into two separate smaller minimal cells. [7]

Quantum Biology

Researchers have long suspected that something unusual is afoot in photosynthesis. Particles of light called photons, streaming down from the Sun; arrive randomly at the chlorophyll molecules and other light-absorbing 'antenna' pigments that cluster inside the cells of every leaf, and within every photosynthetic bacterium. But once the photons' energy is deposited, it doesn't stay random. Somehow, it gets channeled into a steady flow towards the cell's photosynthetic reaction centre, which can then use it at maximum efficiency to convert carbon dioxide into sugars. Quantum coherence in photosynthesis seems to be beneficial to the organisms using it. But did their ability to exploit quantum effects evolve through natural selection? Or is quantum coherence just an accidental side effect of the way certain molecules are structured? [6]

Quantum Consciousness

Extensive scientific investigation has found that a form of quantum coherence operates within living biological systems through what is known as biological excitations and biophoton emission. What this means is that metabolic energy is stored as a form of electromechanical and electromagnetic excitations. These coherent excitations are considered responsible for generating and maintaining long-range order via the transformation of energy and very weak electromagnetic signals. After nearly twenty years of experimental research, Fritz-Albert Popp put forward the hypothesis that biophotons are emitted from a coherent electrodynamics field within the living system.

What this means is that each living cell is giving off, or resonating, a biophoton field of coherent energy. If each cell is emitting this field, then the whole living system is, in effect, a resonating field-a ubiquitous nonlocal field. And since biophotons are the entities through which the living system communicates, there is near-instantaneous intercommunication throughout. And this, claims Popp, is the basis for coherent biological organization -- referred to as quantum coherence. This discovery

led Popp to state that the capacity for evolution rests not on aggressive struggle and rivalry but on the capacity for communication and cooperation. In this sense the built-in capacity for species evolution is not based on the individual but rather living systems that are interlinked within a coherent whole: Living systems are thus neither the subjects alone, nor objects isolated, but both subjects and objects in a mutually communicating universe of meaning. . . . Just as the cells in an organism take on different tasks for the whole, different populations enfold information not only for themselves, but for all other organisms, expanding the consciousness of the whole, while at the same time becoming more and more aware of this collective consciousness.

Biophysicist Mae-Wan Ho describes how the living organism, including the human body, is coordinated throughout and is "coherent beyond our wildest dreams." It appears that every part of our body is "in communication with every other part through a dynamic, tunable, responsive, liquid crystalline medium that pervades the whole body, from organs and tissues to the interior of every cell."

What this tells us is that the medium of our bodies is a form of liquid crystal, an ideal transmitter of communication, resonance, and coherence. These relatively new developments in biophysics have discovered that all biological organisms are constituted of a liquid crystalline medium. Further, DNA is a liquid-crystal, lattice-type structure (which some refer to as a liquid crystal gel), whereby body cells are involved in a holographic instantaneous communication via the emitting of biophotons (a source based on light). This implies that all living biological organisms continuously emit radiations of light that form a field of coherence and communication. Moreover, biophysics has discovered that living organisms are permeated by quantum wave forms. [5]

Information – Entropy Theory of Physics

Viewing the confined gas where the statistical entropy not needs the information addition is not the only physical system. There are for example quantum mechanical systems where the information is a very important qualification. The perturbation theory needs higher order calculations in QED or QCD giving more information on the system as in the chess games happens, where the entropy is not enough to describe the state of the matter. The variation calculation of chess is the same as the perturbation calculation of physics to gain information, where the numbers of particles are small for statistical entropy to describe the system. The role of the Feynman graphs are the same as the chess variations of a given position that is the depth of the variations tree, the Information is the same as the order of the Feynman graphs giving the Information of the micro system. [9]

Information – Entropy Theory of Life

There is also connection between statistical physics and evolutionary biology, since the arrow of time is working in the biological evolution also.
The Fluctuation Theorem says that there is a probability that entropy will flow in a direction opposite to that dictated by the Second Law of Thermodynamics. In this case the Information is growing that

is the matter formulas are emerging from the chaos. So the Weak Interaction has two directions, samples for one direction is the Neutron decay, and Hydrogen fusion is the opposite direction. The living biological systems have also entropy lowering and information growing direction by building more complicated or entangled molecules, governed by the quantum mechanics and the general weak interaction. On the other hand there is the arrow of time; the entropy growing is lowering the information by dissipating these entangled or otherwise connected biomolecules, aging the living systems.

Creating quantum technology

Another area of potential application is in quantum computing. The long-standing goal of the physicists and engineers working in this area is to manipulate data encoded in quantum bits (qubits) of information, such as the spin-up and spin-down states of an electron or of an atomic nucleus. Qubits can exist in both states at once, thus permitting the simultaneous exploration of all possible answers to the computation that they encode. In principle, this would give quantum computers the power to find the best solution far more quickly than today's computers can — but only if the qubits can maintain their coherence, without the noise of the surrounding environment, such as the jostling of neighboring atoms, destroying the synchrony of the waves. [6]

Quantum Entanglement

Measurements of physical properties such as position, momentum, spin, polarization, etc. performed on entangled particles are found to be appropriately correlated. For example, if a pair of particles is generated in such a way that their total spin is known to be zero, and one particle is found to have clockwise spin on a certain axis, then the spin of the other particle, measured on the same axis, will be found to be counterclockwise. Because of the nature of quantum measurement, however, this behavior gives rise to effects that can appear paradoxical: any measurement of a property of a particle can be seen as acting on that particle (e.g. by collapsing a number of superimposed states); and in the case of entangled particles, such action must be on the entangled system as a whole. It thus appears that one particle of an entangled pair "knows" what measurement has been performed on the other, and with what outcome, even though there is no known means for such information to be communicated between the particles, which at the time of measurement may be separated by arbitrarily large distances. [4]

The Bridge

The accelerating electrons explain not only the Maxwell Equations and the Special Relativity, but the Heisenberg Uncertainty Relation, the wave particle duality and the electron's spin also, building the bridge between the Classical and Quantum Theories. [1]

Accelerating charges

The moving charges are self maintain the electromagnetic field locally, causing their movement and this is the result of their acceleration under the force of this field. In the classical physics the charges will distributed along the electric current so that the electric potential lowering along the current, by

linearly increasing the way they take every next time period because this accelerated motion. The same thing happens on the atomic scale giving a dp impulse difference and a dx way difference between the different part of the not point like particles.

Relativistic effect

Another bridge between the classical and quantum mechanics in the realm of relativity is that the charge distribution is lowering in the reference frame of the accelerating charges linearly: ds/dt = at (time coordinate), but in the reference frame of the current it is parabolic: $s = a/2\ t^2$ (geometric coordinate).

Heisenberg Uncertainty Relation

In the atomic scale the Heisenberg uncertainty relation gives the same result, since the moving electron in the atom accelerating in the electric field of the proton, causing a charge distribution on delta x position difference and with a delta p momentum difference such a way that they product is about the half Planck reduced constant. For the proton this delta x much less in the nucleon, than in the orbit of the electron in the atom, the delta p is much higher because of the greater proton mass.

This means that the electron and proton are not point like particles, but has a real charge distribution.

Wave – Particle Duality

The accelerating electrons explains the wave – particle duality of the electrons and photons, since the elementary charges are distributed on delta x position with delta p impulse and creating a wave packet of the electron. The photon gives the electromagnetic particle of the mediating force of the electrons electromagnetic field with the same distribution of wavelengths.

Atomic model

The constantly accelerating electron in the Hydrogen atom is moving on the equipotential line of the proton and it's kinetic and potential energy will be constant. Its energy will change only when it is changing its way to another equipotential line with another value of potential energy or getting free with enough kinetic energy. This means that the Rutherford-Bohr atomic model is right and only that changing acceleration of the electric charge causes radiation, not the steady acceleration. The steady acceleration of the charges only creates a centric parabolic steady electric field around the charge, the magnetic field. This gives the magnetic moment of the atoms, summing up the proton and electron magnetic moments caused by their circular motions and spins.

The Relativistic Bridge

Commonly accepted idea that the relativistic effect on the particle physics it is the fermions' spin - another unresolved problem in the classical concepts. If the electric charges can move only with accelerated motions in the self maintaining electromagnetic field, once upon a time they would

reach the velocity of the electromagnetic field. The resolution of this problem is the spinning particle, constantly accelerating and not reaching the velocity of light because the acceleration is radial. One origin of the Quantum Physics is the Planck Distribution Law of the electromagnetic oscillators, giving equal intensity for 2 different wavelengths on any temperature. Any of these two wavelengths will give equal intensity diffraction patterns, building different asymmetric constructions, for example proton - electron structures (atoms), molecules, etc. Since the particles are centers of diffraction patterns they also have particle – wave duality as the electromagnetic waves have. [2]

The weak interaction

The weak interaction transforms an electric charge in the diffraction pattern from one side to the other side, causing an electric dipole momentum change, which violates the CP and time reversal symmetry. The Electroweak Interaction shows that the Weak Interaction is basically electromagnetic in nature. The arrow of time shows the entropy grows by changing the temperature dependent diffraction patterns of the electromagnetic oscillators.

Another important issue of the quark model is when one quark changes its flavor such that a linear oscillation transforms into plane oscillation or vice versa, changing the charge value with 1 or -1. This kind of change in the oscillation mode requires not only parity change, but also charge and time changes (CPT symmetry) resulting a right handed anti-neutrino or a left handed neutrino.

The right handed anti-neutrino and the left handed neutrino exist only because changing back the quark flavor could happen only in reverse, because they are different geometrical constructions, the u is 2 dimensional and positively charged and the d is 1 dimensional and negatively charged. It needs also a time reversal, because anti particle (anti neutrino) is involved.

The neutrino is a 1/2spin creator particle to make equal the spins of the weak interaction, for example neutron decay to 2 fermions, every particle is fermions with ½ spin. The weak interaction changes the entropy since more or less particles will give more or less freedom of movement. The entropy change is a result of temperature change and breaks the equality of oscillator diffraction intensity of the Maxwell–Boltzmann statistics. This way it changes the time coordinate measure and makes possible a different time dilation as of the special relativity.

The limit of the velocity of particles as the speed of light appropriate only for electrical charged particles, since the accelerated charges are self maintaining locally the accelerating electric force. The neutrinos are CP symmetry breaking particles compensated by time in the CPT symmetry, that is the time coordinate not works as in the electromagnetic interactions, consequently the speed of neutrinos is not limited by the speed of light.

The weak interaction T-asymmetry is in conjunction with the T-asymmetry of the second law of thermodynamics, meaning that locally lowering entropy (on extremely high temperature) causes the weak interaction, for example the Hydrogen fusion.

Probably because it is a spin creating movement changing linear oscillation to 2 dimensional oscillation by changing d to u quark and creating anti neutrino going back in time relative to the

proton and electron created from the neutron, it seems that the anti neutrino fastest then the velocity of the photons created also in this weak interaction?

A quark flavor changing shows that it is a reflection changes movement and the CP- and T- symmetry breaking!!! This flavor changing oscillation could prove that it could be also on higher level such as atoms, molecules, probably big biological significant molecules and responsible on the aging of the life.

Important to mention that the weak interaction is always contains particles and antiparticles, where the neutrinos (antineutrinos) present the opposite side. It means by Feynman's interpretation that these particles present the backward time and probably because this they seem to move faster than the speed of light in the reference frame of the other side.

Finally since the weak interaction is an electric dipole change with ½ spin creating; it is limited by the velocity of the electromagnetic wave, so the neutrino's velocity cannot exceed the velocity of light.

The General Weak Interaction

The Weak Interactions T-asymmetry is in conjunction with the T-asymmetry of the Second Law of Thermodynamics, meaning that locally lowering entropy (on extremely high temperature) causes for example the Hydrogen fusion. The arrow of time by the Second Law of Thermodynamics shows the increasing entropy and decreasing information by the Weak Interaction, changing the temperature dependent diffraction patterns. A good example of this is the neutron decay, creating more particles with less known information about them.
The neutrino oscillation of the Weak Interaction shows that it is a general electric dipole change and it is possible to any other temperature dependent entropy and information changing diffraction pattern of atoms, molecules and even complicated biological living structures.
We can generalize the weak interaction on all of the decaying matter constructions, even on the biological too. This gives the limited lifetime for the biological constructions also by the arrow of time. There should be a new research space of the Quantum Information Science the 'general neutrino oscillation' for the greater then subatomic matter structures as an electric dipole change. There is also connection between statistical physics and evolutionary biology, since the arrow of time is working in the biological evolution also.
The Fluctuation Theorem says that there is a probability that entropy will flow in a direction opposite to that dictated by the Second Law of Thermodynamics. In this case the Information is growing that is the matter formulas are emerging from the chaos. So the Weak Interaction has two directions, samples for one direction is the Neutron decay, and Hydrogen fusion is the opposite direction.

Fermions and Bosons

The fermions are the diffraction patterns of the bosons such a way that they are both sides of the same thing.

Van Der Waals force

Named after the Dutch scientist Johannes Diderik van der Waals – who first proposed it in 1873 to explain the behaviour of gases – it is a very weak force that only becomes relevant when atoms and molecules are very close together. Fluctuations in the electronic cloud of an atom mean that it will

have an instantaneous dipole moment. This can induce a dipole moment in a nearby atom, the result being an attractive dipole–dipole interaction.

Electromagnetic inertia and mass

Electromagnetic Induction

Since the magnetic induction creates a negative electric field as a result of the changing acceleration, it works as an electromagnetic inertia, causing an electromagnetic mass. [1]

Relativistic change of mass

The increasing mass of the electric charges the result of the increasing inductive electric force acting against the accelerating force. The decreasing mass of the decreasing acceleration is the result of the inductive electric force acting against the decreasing force. This is the relativistic mass change explanation, especially importantly explaining the mass reduction in case of velocity decrease.

The frequency dependence of mass

Since $E = h\nu$ and $E = mc^2$, $m = h\nu / c^2$ that is the m depends only on the ν frequency. It means that the mass of the proton and electron are electromagnetic and the result of the electromagnetic induction, caused by the changing acceleration of the spinning and moving charge! It could be that the m_o inertial mass is the result of the spin, since this is the only accelerating motion of the electric charge. Since the accelerating motion has different frequency for the electron in the atom and the proton, they masses are different, also as the wavelengths on both sides of the diffraction pattern, giving equal intensity of radiation.

Electron – Proton mass rate

The Planck distribution law explains the different frequencies of the proton and electron, giving equal intensity to different lambda wavelengths! Also since the particles are diffraction patterns they have some closeness to each other – can be seen as a gravitational force. [2]

There is an asymmetry between the mass of the electric charges, for example proton and electron, can understood by the asymmetrical Planck Distribution Law. This temperature dependent energy distribution is asymmetric around the maximum intensity, where the annihilation of matter and antimatter is a high probability event. The asymmetric sides are creating different frequencies of electromagnetic radiations being in the same intensity level and compensating each other. One of these compensating ratios is the electron – proton mass ratio. The lower energy side has no compensating intensity level, it is the dark energy and the corresponding matter is the dark matter.

Gravity from the point of view of quantum physics

The Gravitational force

The gravitational attractive force is basically a magnetic force.

The same electric charges can attract one another by the magnetic force if they are moving parallel in the same direction. Since the electrically neutral matter is composed of negative and positive

charges they need 2 photons to mediate this attractive force, one per charges. The Bing Bang caused parallel moving of the matter gives this magnetic force, experienced as gravitational force.

Since graviton is a tensor field, it has spin = 2, could be 2 photons with spin = 1 together.

You can think about photons as virtual electron – positron pairs, obtaining the necessary virtual mass for gravity.

The mass as seen before a result of the diffraction, for example the proton – electron mass rate Mp=1840 Me. In order to move one of these diffraction maximum (electron or proton) we need to intervene into the diffraction pattern with a force appropriate to the intensity of this diffraction maximum, means its intensity or mass.

The Big Bang caused acceleration created radial currents of the matter, and since the matter is composed of negative and positive charges, these currents are creating magnetic field and attracting forces between the parallel moving electric currents. This is the gravitational force experienced by the matter, and also the mass is result of the electromagnetic forces between the charged particles. The positive and negative charged currents attracts each other or by the magnetic forces or by the much stronger electrostatic forces!?

The gravitational force attracting the matter, causing concentration of the matter in a small space and leaving much space with low matter concentration: dark matter and energy.
There is an asymmetry between the mass of the electric charges, for example proton and electron, can understood by the asymmetrical Planck Distribution Law. This temperature dependent energy distribution is asymmetric around the maximum intensity, where the annihilation of matter and antimatter is a high probability event. The asymmetric sides are creating different frequencies of electromagnetic radiations being in the same intensity level and compensating each other. One of these compensating ratios is the electron – proton mass ratio. The lower energy side has no compensating intensity level, it is the dark energy and the corresponding matter is the dark matter.

The Higgs boson

By March 2013, the particle had been proven to behave, interact and decay in many of the expected ways predicted by the Standard Model, and was also tentatively confirmed to have + parity and zero spin, two fundamental criteria of a Higgs boson, making it also the first known scalar particle to be discovered in nature, although a number of other properties were not fully proven and some partial results do not yet precisely match those expected; in some cases data is also still awaited or being analyzed.

Since the Higgs boson is necessary to the W and Z bosons, the dipole change of the Weak interaction and the change in the magnetic effect caused gravitation must be conducted. The Wien law is also important to explain the Weak interaction, since it describes the T_{max} change and the diffraction patterns change. [2]

Higgs mechanism and Quantum Gravity

The magnetic induction creates a negative electric field, causing an electromagnetic inertia. Probably it is the mysterious Higgs field giving mass to the charged particles? We can think about the photon as an electron-positron pair, they have mass. The neutral particles are built from negative and positive charges, for example the neutron, decaying to proton and electron. The wave – particle duality makes sure that the particles are oscillating and creating magnetic induction as an inertial mass, explaining also the relativistic mass change. Higher frequency creates stronger magnetic induction, smaller frequency results lesser magnetic induction. It seems to me that the magnetic induction is the secret of the Higgs field.

In particle physics, the Higgs mechanism is a kind of mass generation mechanism, a process that gives mass to elementary particles. According to this theory, particles gain mass by interacting with the Higgs field that permeates all space. More precisely, the Higgs mechanism endows gauge bosons in a gauge theory with mass through absorption of Nambu–Goldstone bosons arising in spontaneous symmetry breaking.

The simplest implementation of the mechanism adds an extra Higgs field to the gauge theory. The spontaneous symmetry breaking of the underlying local symmetry triggers conversion of components of this Higgs field to Goldstone bosons which interact with (at least some of) the other fields in the theory, so as to produce mass terms for (at least some of) the gauge bosons. This mechanism may also leave behind elementary scalar (spin-0) particles, known as Higgs bosons.

In the Standard Model, the phrase "Higgs mechanism" refers specifically to the generation of masses for the $W^{\pm}$, and Z weak gauge bosons through electroweak symmetry breaking. The Large Hadron Collider at CERN announced results consistent with the Higgs particle on July 4, 2012 but stressed that further testing is needed to confirm the Standard Model.

What is the Spin?

So we know already that the new particle has spin zero or spin two and we could tell which one if we could detect the polarizations of the photons produced. Unfortunately this is difficult and neither ATLAS nor CMS are able to measure polarizations. The only direct and sure way to confirm that the particle is indeed a scalar is to plot the angular distribution of the photons in the rest frame of the centre of mass. A spin zero particles like the Higgs carries no directional information away from the original collision so the distribution will be even in all directions. This test will be possible when a much larger number of events have been observed. In the mean time we can settle for less certain indirect indicators.

The Graviton

In physics, the graviton is a hypothetical elementary particle that mediates the force of gravitation in the framework of quantum field theory. If it exists, the graviton is expected to be massless (because the gravitational force appears to have unlimited range) and must be a spin-2 boson. The spin follows from the fact that the source of gravitation is the stress-energy tensor, a second-rank tensor (compared to electromagnetism's spin-1 photon, the source of which is the four-current, a first-rank tensor). Additionally, it can be shown that any massless spin-2 field would give rise to a force indistinguishable from gravitation, because a massless spin-2 field must couple to (interact with) the stress-energy tensor in the same way that the gravitational field does. This result suggests that, if a massless spin-2 particle is discovered, it must be the graviton, so that the only experimental verification needed for the graviton may simply be the discovery of a massless spin-2 particle. [3]

Conclusions

There is also connection between statistical physics and evolutionary biology, since the arrow of time is working in the biological evolution also.
Prentiss, who runs an experimental biophysics lab at Harvard, says England's theory could be tested by comparing cells with different mutations and looking for a correlation between the amount of energy the cells dissipate and their replication rates. [8]
Exists experimental evidence for quantum-coherent is used for more efficient light-harvesting in plant photosynthesis. Quantum entanglement exists in supramolecules determining the sense of smell and in the brain neurons microtubules due to quantum vibrations.
In the work presented here, we started to design and quantum mechanical investigations of the molecular logical devices which are useful for construction of nano medicine biorobots against the molecular diseases such a cancer tumors, and against the new kinds of synthesized microorganisms and nano guns. [7]
One of the most important conclusions is that the electric charges are moving in an accelerated way and even if their velocity is constant, they have an intrinsic acceleration anyway, the so called spin, since they need at least an intrinsic acceleration to make possible they movement .
The accelerated charges self-maintaining potential shows the locality of the relativity, working on the quantum level also. [1]
The bridge between the classical and quantum theory is based on this intrinsic acceleration of the spin, explaining also the Heisenberg Uncertainty Principle. The particle – wave duality of the electric charges and the photon makes certain that they are both sides of the same thing.
The Secret of Quantum Entanglement that the particles are diffraction patterns of the electromagnetic waves and this way their quantum states every time is the result of the quantum state of the intermediate electromagnetic waves. [2]
These relatively new developments in biophysics have discovered that all biological organisms are constituted of a liquid crystalline medium. Further, DNA is a liquid-crystal, lattice-type structure (which some refer to as a liquid crystal gel), whereby body cells are involved in a holographic instantaneous communication via the emitting of biophotons (a source based on light). This implies that all living biological organisms continuously emit radiations of light that form a field of coherence and communication. Moreover, biophysics has discovered that living organisms are permeated by quantum wave forms. [5]
Basing the gravitational force on the accelerating Universe caused magnetic force and the Planck Distribution Law of the electromagnetic waves caused diffraction gives us the basis to build a Unified Theory of the physical interactions also.

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