Motorized Molecules Destroy Diseased Cells

Motorized molecules driven by light have been used to drill holes in the membranes of individual cells and show promise for either bringing therapeutic agents into the cells or directly inducing the cells to die. [13]

Nanoengineers at the University of California San Diego have demonstrated for the first time using micromotors to treat a bacterial infection in the stomach. [12]

The ability to stimulate neural circuits with very high precision light to control cells—optogenetics—is key to exciting advances in the study and mapping of the living brain. [11]

A breakdown of memory processes in humans can lead to conditions such as Alzheimer's and dementia. By looking at the simpler brain of a honeybee, new research published in Frontiers in Molecular Neuroscience, moves us a step towards understanding the different processes behind long-term memory formation. [10]

New research from Emory University School of Medicine, in Atlanta, has shown that it is possible for some information to be inherited biologically through chemical changes that occur in DNA. During the tests they learned that that mice can pass on learned information about traumatic or stressful experiences – in this case a fear of the smell of cherry blossom – to subsequent generations. [9]

A new way of thinking about consciousness is sweeping through science like wildfire. Now physicists are using it to formulate the problem of consciousness in concrete mathematical terms for the first time.

Discovery of quantum vibrations in 'microtubules' inside brain neurons supports controversial theory of consciousness.

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.

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Preface

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.

Motorized molecules drill through cells, destroy diseased cells

Motorized molecules driven by light have been used to drill holes in the membranes of individual cells and show promise for either bringing therapeutic agents into the cells or directly inducing the cells to die.

Researchers at Rice, Durham (U.K.) and North Carolina State universities demonstrated in lab tests how rotors in single-molecule nanomachines can be activated by ultraviolet light to spin at 2 to 3 million rotations per second and open membranes in cells.

The researchers used motors based on work by Nobel laureate Bernard Feringa, who won the prize for chemistry in 2016. The motor itself is a paddle-like chain of atoms that can be prompted to move in a single direction when supplied with energy. Properly mounted as part of the cell-targeting molecule, the motor can be made to spin when activated by a light source.

The work detailed this week in Nature was led by chemists James Tour of Rice, Robert Pal of Durham and Gufeng Wang of North Carolina State. Their labs collaborated to create several motorized molecules that can home in on specific cells, and they viewed what happens when they activate the motors with light.

The Tour lab previously demonstrated molecular motors whose diffusion in a solution was enhanced, if not specifically directed, when activated by ultraviolet light. The rotors needed to spin between 2 and 3 megahertz—2 to 3 million times per second—to show they could overcome obstacles presented by adjacent molecules and outpace natural Brownian motion.

"We thought it might be possible to attach these nanomachines to the cell membrane and then turn them on to see what happened," Tour said. The motors, only about a nanometer wide, can be designed to target and then either tunnel through a cell's lipid bilayer membrane to deliver drugs or other payloads or disrupt the 8-10 nanometer-wide membrane, thereby killing the cell. They can also be functionalized for solubility and for fluorescent tracking, he said.

"These nanomachines are so small that we could park 50,000 of them across the diameter of a human hair, yet they have the targeting and actuating components combined in that diminutive package to make molecular machines a reality for treating disease," Tour said.

The Rice lab created 10 variants, including motor-bearing molecules in several sizes and peptide-carrying nanomachines designed to target specific cells for death, as well as control molecules identical to the other nanomachines but without motors.

The Wang lab first successfully tested the motorized molecule's ability to open a synthetic lipid bilayer vesicle, allowing dyed solution to get inside. Next, they trapped dye-carrying molecular motors inside a vesicle, activated them with ultraviolet light and watched as the fluorescent dye faded, which suggested the motor had punched through the vesicle wall.

The researchers found it takes at least a minute for a motor to tunnel through a membrane. "It is highly unlikely that a cell could develop a resistance to molecular mechanical action," Tour said.

Pal expects nanomachines will help target cancers like breast tumors and melanomas that resist existing chemotherapy. "Once developed, this approach could provide a potential step change in noninvasive cancer treatment and greatly improve survival rates and patient welfare globally," he said.

The Pal lab at Durham tested motors on live cells, including human prostate cancer cells. Experiments showed that without an ultraviolet trigger, motors could locate specific cells of interest

but stayed on the targeted cells' surface and were unable to drill into the cells. When triggered, however, the motors rapidly drilled through the membranes.

Test motors designed to target prostate cancer cells broke through their membranes from outside and killed them within one to three minutes of activation, Pal said. Videos of the cells showed increased blebbing - bubbling of the membrane—within minutes after activation.

Smaller molecular motors were harder to track but proved better at getting into cells quickly upon ultraviolet activation, disrupting their membranes and killing them. Motorless control molecules were unable to kill cells upon ultraviolet exposure, which eliminated thermal absorption of ultraviolet light as the cause of disruption, according to the researchers.

They expect the rotors may eventually be activated by two-photon absorption, near-infrared light or radio frequencies, which would make the technique more viable for in-vivo treatment; this would pave the way toward the establishment of novel, easy and cost-effective photodynamic therapy.

"The researchers are already proceeding with experiments in microorganisms and small fish to explore the efficacy in-vivo," Tour said. "The hope is to move this swiftly to rodents to test the efficacy of nanomachines for a wide range of medicinal therapies." [13]

Drug-delivering micromotors treat their first bacterial infection in the stomach

Nanoengineers at the University of California San Diego have demonstrated for the first time using micromotors to treat a bacterial infection in the stomach. These tiny vehicles, each about half the width of a human hair, swim rapidly throughout the stomach while neutralizing gastric acid and then release their cargo of antibiotics at the desired pH. Researchers published their findings on Aug. 16 in Nature Communications.

This micromotor-enabled delivery approach is a promising new method for treating stomach and gastrointestinal tract diseases with acid-sensitive drugs, researchers said. The effort is a collaboration between the research groups of nanoengineering professors Joseph Wang and Liangfang Zhang at the UC San Diego Jacobs School of Engineering. Wang and Zhang pioneered research on the in vivo operation of micromotors and this study represents the first example of drug-delivering micromotors for treating bacterial infection.

Gastric acid can be destructive to orally administered drugs such as antibiotics and protein-based pharmaceuticals. Drugs used to treat bacterial infections, ulcers and other diseases in the stomach are normally taken with additional substances, called proton pump inhibitors, to suppress gastric acid production. But when taken over longer periods or in high doses, proton pump inhibitors can cause adverse side effects including headaches, diarrhea and fatigue. In more serious cases, they can cause anxiety or depression.

The micromotors have a built-in mechanism to neutralize gastric acid and effectively deliver their drug payloads in the stomach—without the use of proton pump inhibitors.

"It's a one-step treatment with these micromotors, combining acid neutralization with therapeutic action," said Berta Esteban-Fernández de Ávila, a postdoctoral scholar in Wang's research group at UC San Diego and a co-first author of the paper.

Each micromotor consists of a spherical magnesium core coated with a protective layer of titanium dioxide, followed by a layer of the antibiotic clarithromycin, and an outer layer of a positively-charged polymer called chitosan that enables the motors to stick to the stomach wall.

This binding is also enhanced by the propulsion of the micromotors, which is fueled by the stomach's own acid. The magnesium cores react with gastric acid, generating a stream of hydrogen microbubbles that propel the motors around inside the stomach. This reaction also temporarily reduces the amount of acid in the stomach, increasing the pH level enough to allow the micromotors to release the drug and perform treatment. The normal stomach pH is restored within 24 hours.

Researchers tested the micromotors in mice with Helicobacter pylori infections. The micromotors—packed with a clinical dose of the antibiotic clarithromycin—were administered orally once a day for five consecutive days. Afterwards, researchers evaluated the bacterial count in each mouse stomach and found that treatment with the micromotors was slightly more effective than when the same dose of antibiotic was given in combination with proton pump inhibitors.

The micromotors are mostly made of biodegradable materials. The magnesium cores and polymer layers are dissolved by gastric acid without producing harmful residues.

Researchers say that while the present results are promising, this work is still at an early stage. The team is planning future studies to further evaluate the therapeutic performance of the micromotors in vivo and compare it with other standard therapies against stomach diseases. Researchers also plan to test different drug combinations with the micromotors to treat multiple diseases in the stomach or in different sections of the gastrointestinal tract. Overall, the researchers say that this work opens the door to the use of synthetic motors as active delivery platforms for in vivo treatment of diseases. [12]

Optical probes overcome light scattering in deep-brain imaging

The ability to stimulate neural circuits with very high precision light to control cells—optogenetics—is key to exciting advances in the study and mapping of the living brain. In the current state of the art, spatially patterned light projected via free-space optics stimulates small, transparent organisms and excites neurons within superficial layers of the cortex.

However, light scattering and absorption in neural tissue cause light penetration to be extremely short, making it impossible to employ free-space optical methods to probe brain regions deeper than about 2 mm.

In "Patterned photostimulation via visible-wavelength photonic probes for deep brain optogenetics," published today by SPIE, the international society for optics and photonics, in the journal Neurophotonics, principal author Eran Segev of professor Michael Roukes' group at Caltech, along with coauthors from Caltech, Baylor College of Medicine, and Stanford University, describe a solution. The article is available via open access.

Their approach combines nanophotonics and microelectromechanical systems (MEMS) in an implantable, ultra-narrow, silicon-based photonic probe to deliver light deep within brain tissues. This minimally invasive technique avoids major tissue displacement during implantation.

Using techniques of optogenetics, a protein in the brain serves as a sensory photoreceptor and can be controlled by specific wavelengths of light. These combined techniques provide a new approach to stimulation of brain circuits with remarkable resolution, enabling observation and control of individual neurons.

These breakthroughs present widespread and promising applications for the neuroscience and neuromedical research communities. From characterizing the role of specific neurons and identifying neural circuits responsible for behavior to enabling new methods of operant conditioning through reward-induced circuit activations, optogenetics has become a new path for neuroscientists seeking advances in research capabilities.

The article appears in a special section in Neurophotonics, Brain Mapping and Therapeutics, with Shouleh Nikzad, Jet Propulsion Laboratory, Caltech, serving as senior guest editor. The special section is part of an SPIE partnership with the Society for Brain Mapping and Therapeutics (SBMT), serving as a multidisciplinary approach for using advanced technology to solve neurological disorders and disease and to understand neuroscience. The effort was initiated during Nikzad's term as SBMT president in 2015. [11]

Honeybee memories: Another piece of the Alzheimer's puzzle?

A breakdown of memory processes in humans can lead to conditions such as Alzheimer's and dementia. By looking at the simpler brain of a honeybee, new research published in Frontiers in Molecular Neuroscience, moves us a step towards understanding the different processes behind long-term memory formation.

"We show that DNA methylation is one molecular mechanism that regulates memory specificity and re-learning, and through which experiences of the organism could be accumulated and integrated over their lifetime," says Dr Stephanie Biergans, first author of the study and researcher at the University of Queensland, Australia.

"Honeybees have an amazing capacity to learn and remember," says the researcher. "They can count up to four, and orientate themselves by learning patterns and landmarks. They are also social insects that interact, teach and learn, making them successful foragers. Bees remember how to find a food source, how good the source was, and how to return to the hive."

As such, the honeybee can form complex memories through processes much like those happening in human brains. But, the honeybee brain is simpler and they have a smaller genome. This makes them an ideal model for investigating how the different processes needed for long-term memories happen.

Scientists know that when a memory is formed, molecular changes can trigger physical changes to the brain, including new or altered neural connections and activity. These build up over a lifetime to create our long-term memory.

One series of molecular changes that can occur due to experience or environmental changes and that affect memory formation is the differential expression of certain genes, mediated, among others, through processes collectively called epigenetic mechanisms. They regulate gene expression through modifications of the DNA or its associated proteins, without changing the genes themselves.

"We knew that DNA methylation is an epigenetic process that occurs in the brain and is related to memory formation," Biergans explains. "When we block this process in honeybees it affects how they remember."

Biergans taught two groups of honeybees to expect sugar in the presence of a particular smell. One group learned over an extended period, being exposed to the sugar and smell together many times. The other was given the combination only once. Using an inhibitor compound, Biergans halted DNA methylation in some bees in each group. The bees' memory formation in the two groups were tested and compared, with and without, DNA methylation occurring. By changing the smell that accompanied the food, Biergans and colleagues also found that DNA methylation affects how a bee can re-learn.

"When the bees were presented with sugar and a smell many times together, the presence of DNA methylation increased memory specificity - they were less responsive to a novel odour. On the other hand, when only introduced to the combination once, DNA methylation decreased specificity," she summarises.

For a foraging honeybee, this makes total sense. When a bee gets food from a single flower, it's not worthwhile remembering how it smells. That bee will have a general memory of the site, but will shop around and try other flowers - there is no specificity to its foraging. But, when each flower with that smell proves over and over to be a good source of nourishment, the bee will stick to those flowers and seek them out.

DNA methylation also occurs in the human brain and the team's findings are key to understanding how we remember. And, how we forget.

"By understanding how changes to the epi-genome accumulate, manifest and influence brain function, we may, in the future, be able to develop treatments for brain diseases that also develop over a lifetime. There is thought to be a genetic predisposition for some conditions, such as Alzheimer's and dementia, but in many cases environmental factors determine whether the disease will manifest," Biergans concludes. [10]

Scientists have found that memories might be passed down through generations in our DNA

According to the Telegraph, Dr Brian Dias, from the department of psychiatry at Emory University, said: ”From a translational perspective, our results allow us to appreciate how the experiences of a parent, before even conceiving offspring, markedly influence both structure and function in the nervous system of subsequent generations.

“Such a phenomenon may contribute to the etiology and potential intergenerational transmission of risk for neuropsychiatric disorders such as phobias, anxiety and post-traumatic stress disorder.”

This suggests that experiences are somehow transferred from the brain into the genome, allowing them to be passed on to later generations.

The researchers now hope to carry out further work to understand how the information comes to be stored on the DNA in the first place.

They also want to explore whether similar effects can be seen in the genes of humans.

Professor Marcus Pembrey, a pediatric geneticist at University College London, said the work provided “compelling evidence” for the biological transmission of memory.

He added: “It addresses constitutional fearfulness that is highly relevant to phobias, anxiety and post-traumatic stress disorders, plus the controversial subject of transmission of the ‘memory’ of ancestral experience down the generations. “

It is high time public health researchers took human transgenerational responses seriously.

“I suspect we will not understand the rise in neuropsychiatric disorders or obesity, diabetes and metabolic disruptions generally without taking a multigenerational approach.”

Professor Wolf Reik, head of epigenetics at the Babraham Institute in Cambridge, said, however, further work was needed before such results could be applied to humans.

He said: “These types of results are encouraging as they suggest that transgenerational inheritance exists and is mediated by epigenetics, but more careful mechanistic study of animal models is needed before extrapolating such findings to humans.”

May our DNA Carrying also spiritual and cosmic memories passed down in genes from our ancestors? [9]

Why Physicists Are Saying Consciousness Is A State Of Matter, Like a Solid, A Liquid Or A Gas

A new way of thinking about consciousness is sweeping through science like wildfire. Now physicists are using it to formulate the problem of consciousness in concrete mathematical terms for the first time.

There's a quiet revolution underway in theoretical physics. For as long as the discipline has existed, physicists have been reluctant to discuss consciousness, considering it a topic for quacks and charlatans. Indeed, the mere mention of the 'c' word could ruin careers.

That's finally beginning to change thanks to a fundamentally new way of thinking about consciousness that is spreading like wildfire through the theoretical physics community. And while the problem of consciousness is far from being solved, it is finally being formulated mathematically as a set of problems that researchers can understand, explore and discuss.

Today, Max Tegmark, a theoretical physicist at the Massachusetts Institute of Technology in Cambridge, sets out the fundamental problems that this new way of thinking raises. He shows how these problems can be formulated in terms of quantum mechanics and information theory. And he explains how thinking about consciousness in this way leads to precise questions about the nature of reality that the scientific process of experiment might help to tease apart.

Tegmark's approach is to think of consciousness as a state of matter, like a solid, a liquid or a gas. "I conjecture that consciousness can be understood as yet another state of matter. Just as there are many types of liquids, there are many types of consciousness," he says.

He goes on to show how the particular properties of consciousness might arise from the physical laws that govern our universe. And he explains how these properties allow physicists to reason about the conditions under which consciousness arises and how we might exploit it to better understand why the world around us appears as it does.

Interestingly, the new approach to consciousness has come from outside the physics community, principally from neuroscientists such as Giulio Tononi at the University of Wisconsin in Madison.

In 2008, Tononi proposed that a system demonstrating consciousness must have two specific traits. First, the system must be able to store and process large amounts of information. In other words consciousness is essentially a phenomenon of information.

And second, this information must be integrated in a unified whole so that it is impossible to divide into independent parts. That reflects the experience that each instance of consciousness is a unified whole that cannot be decomposed into separate components.

Both of these traits can be specified mathematically allowing physicists like Tegmark to reason about them for the first time. He begins by outlining the basic properties that a conscious system must have.

Given that it is a phenomenon of information, a conscious system must be able to store in a memory and retrieve it efficiently.

It must also be able to process this data, like a computer but one that is much more flexible and powerful than the silicon-based devices we are familiar with.

Tegmark borrows the term computronium to describe matter that can do this and cites other work showing that today's computers underperform the theoretical limits of computing by some 38 orders of magnitude.

Clearly, there is so much room for improvement that allows for the performance of conscious systems.

Next, Tegmark discusses perceptronium, defined as the most general substance that feels subjectively self-aware. This substance should not only be able to store and process information but in a way that forms a unified, indivisible whole. That also requires a certain amount of independence in which the information dynamics is determined from within rather than externally.

Finally, Tegmark uses this new way of thinking about consciousness as a lens through which to study one of the fundamental problems of quantum mechanics known as the quantum factorisation problem.

This arises because quantum mechanics describes the entire universe using three mathematical entities: an object known as a Hamiltonian that describes the total energy of the system; a density matrix that describes the relationship between all the quantum states in the system; and Schrodinger's equation which describes how these things change with time.

The problem is that when the entire universe is described in these terms, there are an infinite number of mathematical solutions that include all possible quantum mechanical outcomes and many other even more exotic possibilities.

So the problem is why we perceive the universe as the semi-classical, three dimensional world that is so familiar. When we look at a glass of iced water, we perceive the liquid and the solid ice cubes as independent things even though they are intimately linked as part of the same system. How does this happen? Out of all possible outcomes, why do we perceive this solution?

Tegmark does not have an answer. But what's fascinating about his approach is that it is formulated using the language of quantum mechanics in a way that allows detailed scientific reasoning. And as a result it throws up all kinds of new problems that physicists will want to dissect in more detail.

Take for example, the idea that the information in a conscious system must be unified. That means the system must contain error-correcting codes that allow any subset of up to half the information to be reconstructed from the rest.

Tegmark points out that any information stored in a special network known as a Hopfield neural net automatically has this error-correcting facility. However, he calculates that a Hopfield net about the size of the human brain with 10^11 neurons, can only store 37 bits of integrated information.

“This leaves us with an integration paradox: why does the information content of our conscious experience appear to be vastly larger than 37 bits?” asks Tegmark.

That’s a question that many scientists might end up pondering in detail. For Tegmark, this paradox suggests that his mathematical formulation of consciousness is missing a vital ingredient. “This strongly implies that the integration principle must be supplemented by at least one additional principle,” he says. Suggestions please in the comments section!

And yet the power of this approach is in the assumption that consciousness does not lie beyond our ken; that there is no “secret sauce” without which it cannot be tamed.

At the beginning of the 20th century, a group of young physicists embarked on a quest to explain a few strange but seemingly small anomalies in our understanding of the universe. In deriving the new theories of relativity and quantum mechanics, they ended up changing the way we comprehend the cosmos. These physicists, at least some of them, are now household names.

Could it be that a similar revolution is currently underway at the beginning of the 21st century? [8]

Quantum Consciousness

A review and update of a controversial 20-year-old theory of consciousness published in Physics of Life Reviews claims that consciousness derives from deeper level, finer scale activities inside brain neurons. The recent discovery of quantum vibrations in "microtubules" inside brain neurons corroborates this theory, according to review authors Stuart Hameroff and Sir Roger Penrose. They suggest that EEG rhythms (brain waves) also derive from deeper level microtubule vibrations, and that from a practical standpoint, treating brain microtubule vibrations could benefit a host of mental, neurological, and cognitive conditions. [6]

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]

Consciousness as a State of Matter

We examine the hypothesis that consciousness can be understood as a state of matter, "perceptronium", with distinctive information processing abilities. We explore five basic principles that may distinguish conscious matter from other physical systems such as solids, liquids and gases: the information, integration, independence, dynamics and utility principles. If such principles can identify conscious entities, then they can help solve the quantum factorization problem: why do conscious observers like us perceive the particular Hilbert space factorization corresponding to classical space (rather than Fourier space, say), and more generally, why do we perceive the world around us as a dynamic hierarchy of objects that are strongly integrated and relatively independent? Tensor factorization of matrices is found to play a central role, and our technical results include a theorem about Hamiltonian separability (defined using Hilbert-Schmidt superoperators) being maximized in the energy eigenbasis. Our approach generalizes Giulio Tononi's integrated information framework for neural-network-based consciousness to arbitrary quantum systems, and we find interesting links to error-correcting codes, condensed matter criticality, and the Quantum Darwinism program, as well as an interesting connection between the emergence of consciousness and the emergence of time. [7]

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

It is high time public health researchers took human transgenerational responses seriously.
May our DNA Carrying also spiritual and cosmic memories passed down in genes from our ancestors? [9]
There's a quiet revolution underway in theoretical physics. For as long as the discipline has existed, physicists have been reluctant to discuss consciousness, considering it a topic for quacks and charlatans. Indeed, the mere mention of the 'c' word could ruin careers.
That's finally beginning to change thanks to a fundamentally new way of thinking about consciousness that is spreading like wildfire through the theoretical physics community. And while the problem of consciousness is far from being solved, it is finally being formulated mathematically as a set of problems that researchers can understand, explore and discuss. [8]
Discovery of quantum vibrations in 'microtubules' inside brain neurons supports controversial theory of consciousness. [6]
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]
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]
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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