Single Electrons for Quantum Computing

Electrons represent an ideal quantum bit, with a "spin" that when pointing up can represent a 0 and down can represent a 1. Such bits are small (even smaller than an atom), and because they do not interact strongly they can remain quantum for long periods. However, exploiting electrons as qubits also poses a challenge in that they must be trapped and manipulated. Which is exactly what David Schuster, a University of Chicago assistant professor of physics and his collaborators at UChicago, Argonne National Laboratory, and Yale University have done. [10]

Physicists have unveiled a programmable five-qubit processing module that can be connected together to form a powerful quantum computer. The big challenge now is scale—combining these techniques in a way that can handle large numbers of qubits and perform powerful quantum calculations. [9]

By leveraging the good ideas of the natural world and the semiconductor community, researchers may be able to greatly simplify the operation of quantum devices built from superconductors. They call this a "semiconductor-inspired" approach and suggest that it can provide a useful guide to improving superconducting quantum circuits. [8]

The one thing everyone knows about quantum mechanics is its legendary weirdness, in which the basic tenets of the world it describes seem alien to the world we live in. Superposition, where things can be in two states simultaneously, a switch both on and off, a cat both dead and alive. Or entanglement, what Einstein called "spooky action-at-distance" in which objects are invisibly linked, even when separated by huge distances. [7]

While physicists are continually looking for ways to unify the theory of relativity, which describes large-scale phenomena, with quantum theory, which describes small-scale phenomena, computer scientists are searching for technologies to build the quantum computer.

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 build the Quantum Computer.

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Preface

While physicists are continually looking for ways to unify the theory of relativity, which describes large-scale phenomena, with quantum theory, which describes small-scale phenomena, computer scientists are searching for technologies to build the quantum computer.

Australian engineers detect in real-time the quantum spin properties of a pair of atoms inside a silicon chip, and disclose new method to perform quantum logic operations between two atoms. [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.

New device steps toward isolating single electrons for quantum computing

If biochemists had access to a quantum computer, they could perfectly simulate the properties of new molecules to develop novel drugs in ways that would take the fastest existing computers decades.

Electrons represent an ideal quantum bit, with a "spin" that when pointing up can represent a 0 and down can represent a 1. Such bits are small (even smaller than an atom), and because they do not interact strongly they can remain quantum for long periods. However, exploiting electrons as qubits also poses a challenge in that they must be trapped and manipulated. Which is exactly what David Schuster, a University of Chicago assistant professor of physics and his collaborators at UChicago, Argonne National Laboratory, and Yale University have done.

"A key aspect of this experiment is that we have integrated trapped electrons with more well-developed superconducting quantum circuits" said Ge Yang, lead author of a paper in Physical

Review X that reported the group's findings. The team captured the electrons by coaxing them to float above the surface of liquid helium at extremely low temperatures.

"It's a very important step along the way to being able to study single electrons and make those electrons work as quantum bits," Schuster said.

While electrons in vacuum store quantum information nearly perfectly, in real materials they are disturbed by the jiggling of atoms around them. However, electrons have a unique relationship with liquid helium. They levitate above the surface, insensitive to the frothy atomic fluctuations below. This occurs because electrons see their own mirror image across the surface of the helium.

Because their image has opposite charge, they are attracted to their own reflection, like Narcissus of the Greek myth. But quantum mechanical effects make them jiggle and move away. Attraction and repulsion balance out at about 10 nanometers above the surface of the helium—quite far, by atomic standards—and that's where the electrons stay.

"We can trap the electrons and hold them for basically as long as we want," said co-author Gerwin Koolstra, a graduate student in physics at UChicago. "We've left them there for 12 hours, and then we got bored."

"Electrons levitating, who would have guessed that? It's just a crazy thing," Schuster said. While this effect has been known, he said, "we're holding them in a superconducting structure that allows us to interact with them, on much faster timescales, and much more sensitively."

That structure is a "resonator" of a type Schuster's lab developed for other work with quantum circuits, but incorporating the helium and trapped electrons. Because they are so small electrons normally interact only very weakly with electrical signals. A resonator works like a hall of mirrors, allowing the signal to bounce back and forth more than 10,000 times, giving the electron more time to interact. It is this setup that makes it possible to build a qubit, while making the measurement extremely sensitive.

The scientists look at the microwave photons emerging from the resonator and monitor that signal as they slowly let electrons leak from the trap.

Building the device was a delicate business. "The most challenging part was the size and the placement of all of the features with respect to each other that really requires specialized equipment," said David Czaplewski, a scientist at Argonne's Center for Nanoscale Materials, who helped design and build it. The important features are around 100 nanometers, or 1,000 times smaller than the diameter of a human hair. And they had to be placed with an accuracy of about 10 or 20 nanometers, the span of about 30 atoms, inside a channel that's one micron deep and 500 nanometers wide.

Argonne's specialized equipment

"We couldn't have done it without Argonne's cleanroom facility and the fantastic staff scientists there," Schuster said. "The process involves a fair amount of chemistry and a number of specialized instruments, which requires deep technical know-how to get it to work. It wasn't just one piece of equipment or another. It was the whole facility."

The device is a circuit etched into a thick layer of niobium on a bed of sapphire, the same material used on the surface of Apple watches. Aluminum wires deposited on the bottom of the channel respond to applied electrical voltages and helps keep the floating electrons trapped in place.

At the beginning of the experiment, the team first floods the sample with superfluid helium. This is the only element that remains a liquid even at a hundredth of a degree above absolute zero—the temperature at which the experiments are conducted.

The electrons themselves come from the tungsten filament of a miniature toy light bulb often used as streetlights in model train layouts. As the bulb heats up, electrons "boil" off and fly onto the surface of the cold superfluid helium.

In the first wave of experiments the scientists have been working with around 100,000 electrons—too many to count, and too many to control quantum mechanically.

But they are whittling the number down. The goal is a trap that would hold just a single electron whose behavior can be analyzed and controlled for use as a quantum bit.

"We're not there yet, said Schuster. "But we're pretty close." [10]

The Long-Awaited Promise of a Programmable Quantum Computer

Physicists have unveiled a programmable five-qubit processing module that can be connected together to form a powerful quantum computer.

The quest to build a powerful quantum computer is one of the great challenges of 21st century physics. And although the hurdles are significant, physicists are chasing them down, one by one.

They've gradually learned how to control quantum particles with the precision necessary to run quantum algorithms on a small scale with just a few qubits.

The big challenge now is scale—combining these techniques in a way that can handle large numbers of qubits and perform powerful quantum calculations. Today, Shantanu Debnath and pals at the University of Maryland in College Park unveil a five-qubit quantum computer module that can be programmed to run any quantum algorithm.

But crucially, they say, this module can be linked to others to perform powerful quantum computations involving large numbers of qubits. "This small quantum computer can be scaled to larger numbers of qubits within a single module, and can be further expanded by connecting many modules," say Debnath and co.

Physicists have been able to run quantum algorithms on quantum computers for almost 20 years—the first two- and three-qubit machines began number crunching in the late 1990s. But since then, progress has stalled because of the extreme difficulty in linking together large numbers of quantum particles while maintaining their quantum states.

(This discounts the controversial work of the Canadian company D-Wave, which claims to have built a quantum computer capable of handling over 1,000 qubits. Most quantum physicists are deeply skeptical of these claims.)

The new device builds on the considerable work over the last two decades on trapped ion quantum computers. It consists of five ytterbium ions lined up and trapped in an electromagnetic field. The electronic state of each ion can be controlled by zapping it with a laser. This allows each ion to store a bit of quantum information.

Because they are charged, the ions exert a force on each other, and this causes them to vibrate at frequencies that can be precisely controlled and manipulated.

These vibrations are quantum in nature and allow the ions to become entangled. In this way, the quantum bits they hold can interact.

By controlling these interactions, physicists can carry out quantum logic operations. And quantum algorithms are simply a series of these logic operations one after the other.

The ability to perform an arbitrary series of operations is important—few quantum computers are capable of doing this. Indeed, most have been designed to perform a specific single quantum algorithm.

That's what Debnath and co have set out to change. These guys have built a self-contained module capable of addressing each of the ions with a laser and reading out the results of the interaction between qubits.

And it appears to work well. The team has put the device through its paces by implementing several different quantum algorithms: "As examples, we implement the Deutsch-Jozsa, Bernstein-Vazirani, and quantum Fourier transform algorithms," they say. "The algorithms presented here illustrate the computational flexibility provided by the ion trap quantum architecture."

That's certainly impressive but the team claims it can go much further. In particular, they say that their module is scalable—that several five-qubit modules can be connected together to form a much more powerful quantum computer.

But that's easier said than done, and the team has not yet demonstrated this. So the next step is obvious. What Debnath and co need to do next is show how to connect these modules and how this increases the utility of the computations that are possible.

That would be a big step and one that would be worth shouting from the rooftops about—if they achieve it. [9]

Semiconductor-inspired superconducting quantum computing devices

Builders of future superconducting quantum computers could learn a thing or two from semiconductors, according to a report in Nature Communications this week.

By leveraging the good ideas of the natural world and the semiconductor community, researchers may be able to greatly simplify the operation of quantum devices built from superconductors. They call this a "semiconductor-inspired" approach and suggest that it can provide a useful guide to improving superconducting quantum circuits.

Superconducting quantum bits, or qubits, are circuits made from superconducting components—such as wires, capacitors or non-linear inductors—that have zero resistance to electrical current. Designing these circuits from scratch offers tremendous flexibility, and has gone a long way toward realizing a full-scale quantum computer. On the other hand, qubits found in semiconductor materials like ultra-pure silicon offer good properties for quantum computing, like long quantum memory times and fast two-qubit gates. These benefits come with constraints, but those constraints have led to creative solutions from the semiconductor community.

Yun-Pil Shim and Charles Tahan at the Laboratory for Physical Sciences and the University of Maryland in College Park are exploring whether ideas gleaned from semiconductor qubits may be useful in designing better approaches to superconducting quantum computers. As a first step, they considered applying novel control approaches to state-of-the-art superconducting qubits. They found that they could eliminate one of the most costly overheads for control—microwave sources—by using a solution developed in the semiconductor qubit community. Notably, they found an even more efficient implementation in superconducting qubits, making the approach easier to realize than the semiconductor original.

"If the community could mimic the great properties of semiconductor qubits in man-made superconducting circuits, they might be able to have the best of both worlds," Tahan says. "In a large sea of parameters sometimes the best guide is nature."

Qubits can be realized in many different physical platforms, such as a superconducting circuit or an electron's spin. Spin is a quantum property of particles that physicists often think of as a small magnet that will point along the direction of an applied magnetic field. A spin can point up or down, corresponding the the 0 or 1 of conventional bits, but it can also point horizontally. This results in a quantum "superposition" of 0 and 1, a key feature of qubits. In some systems, these spin qubits can carry quantum information robustly because they are unaffected by electrical charge, a common source of noise.

Spins and superconducting qubits are controlled in similar ways. In both, microwave radiation can drive transitions between the two levels of the qubit allowing for quantum logic gates. But semiconductor spin qubits are also different. They often have weak coupling to the environment, leading to long memory times but slow quantum gates. Additionally, spin qubits are quite small, making them susceptible to inadvertent crosstalk from nearby spins.

The semiconductor community has dealt with both problems by developing "all-electrical" approaches to quantum computation that represent one qubit with multiple physical spins. Operations on this "encoded" qubit are performed by pairwise interactions between the physical spins. This requires at least three spins per encoded qubit and a large number of physical pulses to achieve a single encoded gate—a costly overhead for quantum computing, especially when pulses aren't perfect.

Shim and Tahan show that an encoded qubit approach can work even better with superconducting qubits. In fact, they show that modern superconducting qubits called transmons or fluxmons, which can be tuned individually, require only two physical qubits per encoded qubit. More importantly, the encoded gate time and gate error don't change much. For example, while a controlled-NOT gate may take roughly 20 qubit-qubit interactions to accomplish in semiconductor spins, Shim and Tahan show that a similar two-qubit gate can be accomplished using only one two-qubit pulse. This means that all quantum logic gates can be performed with fast DC pulses instead of relying on microwave-driven qubit rotations.

The authors claim that their scheme can be implemented with current superconducting qubits and control methods, but there are still open questions. In the encoded scheme, initializing qubits may be noisy. And ubiquitous "transmon" qubits maybe be outperformed by newer qubit types like the "fluxmon" or "fluxonium."

Quantum computers must preserve qubits from outside interference for as long as a calculation proceeds. Despite rapid progress in the quality of superconducting qubits (qubit lifetimes now surpass 100 microseconds, up from tens of nanoseconds a decade ago), qubit gate error rates are still limited by loss in the metals, insulators, substrates and interfaces that make up these devices. These limitations will also limit the performance of the encoded scheme as proposed, and more progress on these fundamental device issues is still needed.

A major goal on the path to a full-scale quantum computer is the demonstration of "fault-tolerant" quantum error correction, where the error of physical quantum gates is reduced by repeated error correction on a "logical" qubit consisting of many physical qubits. Removing the need for microwave control, along with the other benefits of the encoded qubit proposal, could make realizing a logical qubit with superconducting qubits easier. While the authors believe that this work represents an advance, they suggest that additional progress can be made by looking closer still at spin qubits. [8]

Quantum computing will bring immense processing possibilities

But weird or not, quantum theory is approaching a century old and has found many applications in daily life. As John von Neumann once said: "You don't understand quantum mechanics, you just get used to it." Much of electronics is based on quantum physics, and the application of quantum theory to computing could open up huge possibilities for the complex calculations and data processing we see today.

Imagine a computer processor able to harness super-position, to calculate the result of an arbitrarily large number of permutations of a complex problem simultaneously. Imagine how entanglement could be used to allow systems on different sides of the world to be linked and their efforts combined, despite their physical separation. Quantum computing has immense potential, making light work of some of the most difficult tasks, such as simulating the body's response to drugs, predicting weather patterns, or analysing big datasets.

Such processing possibilities are needed. The first transistors could only just be held in the hand, while today they measure just 14 nm – 500 times smaller than a red blood cell. This relentless shrinking, predicted by Intel founder Gordon Moore as Moore's law, has held true for 50 years, but cannot hold indefinitely. Silicon can only be shrunk so far, and if we are to continue benefiting from the performance gains we have become used to, we need a different approach.

Quantum fabrication

Advances in semiconductor fabrication have made it possible to mass-produce quantum-scale semiconductors – electronic circuits that exhibit quantum effects such as super-position and entanglement.

The image, captured at the atomic scale, shows a cross-section through one potential candidate for the building blocks of a quantum computer, a semiconductor nano-ring. Electrons trapped in these rings exhibit the strange properties of quantum mechanics, and semiconductor fabrication processes are poised to integrate these elements required to build a quantum computer. While we may be able to construct a quantum computer using structures like these, there are still major challenges involved.

In a classical computer processor a huge number of transistors interact conditionally and predictably with one another. But quantum behaviour is highly fragile; for example, under quantum physics even measuring the state of the system such as checking whether the switch is on or off, actually changes what is being observed.

Conducting an orchestra of quantum systems to produce useful output that couldn't easily by handled by a classical computer is extremely difficult.

But there have been huge investments: the UK government announced £270m funding for quantum technologies in 2014 for example, and the likes of Google, NASA and Lockheed Martin are also working in the field. It's difficult to predict the pace of progress, but a useful quantum computer could be ten years away.

The basic element of quantum computing is known as a qubit, the quantum equivalent to the bits used in traditional computers. To date, scientists have harnessed quantum systems to represent qubits in many different ways, ranging from defects in diamonds, to semiconductor nano-structures or tiny superconducting circuits.

Each of these has is own advantages and disadvantages, but none yet has met all the requirements for a quantum computer, known as the DiVincenzo Criteria.

The most impressive progress has come from D-Wave Systems, a firm that has managed to pack hundreds of qubits on to a small chip similar in appearance to a traditional processor.

Quantum secrets

The benefits of harnessing quantum technologies aren't limited to computing, however. Whether or not quantum computing will extend or augment digital computing, the same quantum effects can be harnessed for other means. The most mature example is quantum communications.

Quantum physics has been proposed as a means to prevent forgery of valuable objects, such as a banknote or diamond, as illustrated in the image below. Here, the unusual negative rules embedded within quantum physics prove useful; perfect copies of unknown states cannot be made and measurements change the systems they are measuring. These two limitations are combined in this quantum anti-counterfeiting scheme, making it impossible to copy the identity of the object they are stored in.

The concept of quantum money is, unfortunately, highly impractical, but the same idea has been successfully extended to communications. The idea is straightforward: the act of measuring quantum super-position states alters what you try to measure, so it's possible to detect the presence of an eavesdropper making such measurements. With the correct protocol, such as BB84, it is possible to communicate privately, with that privacy guaranteed by fundamental laws of physics.

Quantum communication systems are commercially available today from firms such as Toshiba and ID Quantique. While the implementation is clunky and expensive now it will become more streamlined and miniaturised, just as transistors have miniaturised over the last 60 years.

Improvements to nanoscale fabrication techniques will greatly accelerate the development of quantum-based technologies. And while useful quantum computing still appears to be some way off, it's future is very exciting indeed. [7]

Quantum Computing

A team of electrical engineers at UNSW Australia has observed the unique quantum behavior of a pair of spins in silicon and designed a new method to use them for "2-bit" quantum logic operations.

These milestones bring researchers a step closer to building a quantum computer, which promises dramatic data processing improvements.

Quantum bits, or qubits, are the building blocks of quantum computers. While many ways to create a qubits exist, the Australian team has focused on the use of single atoms of phosphorus, embedded inside a silicon chip similar to those used in normal computers.

The first author on the experimental work, PhD student Juan Pablo Dehollain, recalls the first time he realized what he was looking at.

"We clearly saw these two distinct quantum states, but they behaved very differently from what we were used to with a single atom. We had a real 'Eureka!' moment when we realized what was happening – we were seeing in real time the `entangled' quantum states of a pair of atoms." [5]

Researchers have developed the first silicon quantum computer building blocks that can process data with more than 99 percent accuracy, overcoming a major hurdle in the race to develop reliable quantum computers.

Researchers from the University of New South Wales (UNSW) in Australia have achieved a huge breakthrough in quantum computing - they've created two kinds of silicon quantum bit, or qubits, the building blocks that make up any quantum computer, that are more than 99 percent accurate.

The postdoctoral researcher who was lead author on Morello's paper explained in the press release: "The phosphorus atom contains in fact two qubits: the electron, and the nucleus. With the nucleus in particular, we have achieved accuracy close to 99.99 percent. That means only one error for every 10,000 quantum operations."

Both the breakthroughs were achieved by embedding the atoms in a thin layer of specially purified silicon, which contains only the silicon-28 isotope. Naturally occurring silicon is magnetic and therefore disturbs the quantum bit, messing with the accuracy of its data processing, but silicon-28 is perfectly non-magnetic. [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 $E = hv$ and $E = mc^2$, $m = hv /c^2$ that is the m depends only on the v 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

Quantum communication systems are commercially available today from firms such as Toshiba and ID Quantique. While the implementation is clunky and expensive now it will become more streamlined and miniaturised, just as transistors have miniaturised over the last 60 years. Improvements to nanoscale fabrication techniques will greatly accelerate the development of quantum-based technologies. And while useful quantum computing still appears to be some way off, it's future is very exciting indeed. [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]
The key breakthrough to arrive at this new idea to build qubits was to exploit the ability to control the nuclear spin of each atom. With that insight, the team has now conceived a unique way to use the nuclei as facilitators for the quantum logic operation between the electrons. [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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