Quantum World and Local Realism

Physicists have reported some of the strongest evidence yet that that the quantum world does not obey local realism by demonstrating new evidence for the existence of quantum entanglement. [12]

Mathematicians at the Universities of York, Munich and Cardiff have identified a unique property of quantum mechanical particles – they can move in the opposite way to the direction in which they are being pushed. [11]

For the first time, physicists have experimentally demonstrated the violation of "bilocal causality"—a concept that is related to the more standard local causality, except that it accounts for the precise way in which physical systems are initially generated. The results show that it's possible to violate local causality in an entirely new and more general way, which could lead to a potential new resource for quantum technologies. [10]

The microscopic world is governed by the rules of quantum mechanics, where the properties of a particle can be completely undetermined and yet strongly correlated with those of other particles. Physicists from the University of Basel have observed these so-called Bell correlations for the first time between hundreds of atoms. [9]

For the past 100 years, physicists have been studying the weird features of quantum physics, and now they're trying to put these features to good use. One prominent example is that quantum superposition (also known as quantum coherence)—which is the property that allows an object to be in two states at the same time—has been identified as a useful resource for quantum communication technologies. [8]

Quantum entanglement—which occurs when two or more particles are correlated in such a way that they can influence each other even across large distances—is not an all-or-nothing phenomenon, but occurs in various degrees. The more a quantum state is entangled with its partner, the better the states will perform in quantum information applications. Unfortunately, quantifying entanglement is a difficult process involving complex optimization problems that give even physicists headaches. [7]

A trio of physicists in Europe has come up with an idea that they believe would allow a person to actually witness entanglement. Valentina Caprara Vivoli, with the University of Geneva, Pavel Sekatski, with the University of Innsbruck and Nicolas Sangouard, with the University of Basel, have together written a paper describing a scenario where a human subject would be able to witness *an instance of entanglement—they have uploaded it to the arXiv server for review by others. [6]*

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.

Contents

Author: George Rajna

Preface

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. In a new proposed experiment in this area, two toaster-sized "nanosatellites" carrying entangled condensates orbit around the Earth, until one of them moves to a different orbit with different gravitational field strength. As a result of the change in gravity, the entanglement between the condensates is predicted to degrade by up to 20%. Experimentally testing the proposal may be possible in the near future. [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.

Probability that the quantum world obeys local realism is less than one in a billion, experiment shows

Physicists have reported some of the strongest evidence yet that that the quantum world does not obey local realism by demonstrating new evidence for the existence of quantum entanglement. By performing an essentially loophole-free Bell test, they have shown that two atoms separated by a distance of a quarter of a mile share correlations that should be impossible under the hypothesis of local realism, and are most likely explained by quantum entanglement.

The new Bell test was performed by a group of researchers led by Harald Weinfurter at the Ludwig Maximilian University of Munich and the Max Planck Institute for Quantum Optics, both in Germany.

The probability that the observed correlations can be explained by local realism due to some unknown "hidden variables" rather than entanglement is less than one in a billion, the physicists write in their paper published in Physical Review Letters. By accounting for all of their accumulated data, taken over the course of seven months, that probability drops even further, down to about one in ten quadrillion (the number 1 followed by 16 zeros). This means that the quantum world violates either locality (that distant objects cannot influence each other in less than a certain amount of time) or realism (that objects exist whether or not someone measures them), or possibly both.

Three Bell tests

The test reported here is the latest loophole-free Bell test: one that simultaneously closes the two biggest loopholes, the locality loophole and the detection loophole. Closing both loopholes is vital for excluding any alternative explanations, such as the possibility that two entangled objects are secretly sharing information (locality loophole) or that the particles being detected are not representative of the whole sample but rather form a special subset that skews the data (detection loophole).

The first loophole-free Bell test, reported in 2015 by a team led by Ronald Hanson at the University of Delft, demonstrated entanglement between the electron spins of nitrogen-vacancy (NV) centers in diamond. Shortly after, other loophole-free Bell tests reported entanglement between photons. The Bell test reported here demonstrates entanglement between a third type of system: the spin states of atoms.

"In my opinion, the greatest significance of this work is the definite ruling out of local realism," coauthor Wenjamin Rosenfeld, at the Ludwig Maximilian University of Munich and the Max Planck Institute for Quantum Optics, told Phys.org. "It is good that similar experiments were performed with different systems (photons, NV centers) essentially at the same time, so all results together can be taken as truly conclusive. Now it is no more a matter of belief whether nature can or cannot be described in a local-realistic way, but a matter of fact. (However, the freedom-of-choice problem still needs to be solved.)"

Experimental setup

The new experiment involved trapping one rubidium atom in the basement of the physics building at the Ludwig Maximilian University of Munich and trapping a second rubidium atom in the basement of the economics building, about 400 meters away. An optical fiber connected the two measurement sites.

In their tests, the scientists excited the atoms, causing them to emit photons at precisely defined times. The photons then travelled through the optical fiber and interfered with each other. This quantum interference, in theory, causes the atoms to become entangled. To detect this entanglement, the researchers performed measurements on the photons, repeating the measurements over and over for tens of thousands of photon pairs. The results showed overwhelmingly that the distant photon pairs were indeed entangled.

Last loophole

One of the last remaining possible loopholes for most Bell tests concerns the choice of measurement made on the atoms. Since these measurements can be performed in multiple ways, it's important to confirm that the experimenter is free to choose which particular measurement to make, and that hidden variables are not influencing the choice of measurement and somehow allowing the atoms to synchronize their properties. This possibility is called the free-will or freedom of choice loophole.

To attempt to close this loophole, the researchers used a high-speed quantum random number generator that chooses measurement settings that are truly random—almost. The problem is that there is a very slight possibility that the random number generators could have communicated with each other or the rest of the experiment before the experiment began. This could allow the atoms to know the random numbers, and consequently the measurements to be performed, in advance, allowing them to synchronize their properties.

The physicists explain that the only way to completely close this loophole is to use an extraterrestrial random number generator, such as the inherently random photon emission from stars located millions of light-years away. The vast distance between the stars and an Earth-based experiment would make it practically impossible for any covert communication to occur, since it would mean that such communication would have had to take place before the light left the stars, millions of years ago. Several physics labs are currently developing extraterrestrial random number generators for this purpose.

Secure communication

Since quantum entanglement is likely to be an important resource in future secure quantum technologies, closing these loopholes helps to increase the security of future applications at the most fundamental level. The researchers expect that the methods used in this study will also contribute to new developments in quantum information systems and quantum repeater networks, which are used for communicating quantum information over long distances. They plan to further investigate this application in the future.

"Apart from further fundamental questions considering the freedom-of-choice problematic, there is a lot one can work on here," Rosenfeld said. "On the one side one can try to push the system further (especially the fidelity of the entangled state) to be able to perform so-called 'device-independent' protocols. These would allow to obtain a secure cryptographic key even from devices which are potentially not trusted (provided by a third party). Here, Bell's inequality provides the possibility to test, whether the devices were somehow prepared in advance to produce a key which is known to an adversary. Moreover, the techniques for generating entanglement between distant objects are important for quantum networks enabling secure communication over long distances." [12]

New breakthrough discovery—every quantum particle travels backwards

Mathematicians at the Universities of York, Munich and Cardiff have identified a unique property of quantum mechanical particles – they can move in the opposite way to the direction in which they are being pushed.

In everyday life, objects travel in the same direction as their momentum – a car in forward motion is going forwards, and certainly not backwards.

However, this is no longer true on microscopic scales - quantum particles can partially go into reverse and travel in the direction opposite to their momentum. This unique property is known as 'backflow'.

New discovery

This is the first time this has been found in a particle where external forces are acting on it. Previously, scientists were only aware of this movement in "free" quantum particles, where no force is acting on them.

Using a combination of analytical and numerical methods, researchers also obtained precise estimates about the strength of this phenomenon. Such results demonstrate that backflow is always there but is a rather small effect, which may explain why it has not been measured yet.

This discovery paves the way for further research into quantum mechanics, and could be applied to future experiments in quantum technology fields such as computer encryption.

Unique to quantum particles

Dr Henning Bostelmann, Researcher in York's Department of Mathematics, said: "This new theoretical analysis into quantum mechanical particles shows that this 'backflow' effect is ubiquitous in quantum physics.

"We have shown that backflow can always occur, even if a force is acting on the quantum particle while it travels. The backflow effect is the result of wave-particle duality and the probabilistic nature of quantum mechanics, and it is already well understood in an idealised case of force-free motion."

Dr Gandalf Lechner, Researcher in Cardiff's University's School of Mathematics, said: "Forces can of course make a particle go backwards - that is, they can reflect it, and this naturally leads to increased backflow. But we could show that even in a completely reflection-free medium, backflow occurs. In the presence of reflection, on the other hand, we found that backflow remains a small effect, and estimated its magnitude."

External forces

Dr Daniela Cadamuro, Researcher at the Technical University of Munich, said: "The backflow effect in quantum mechanics has been known for quite a while, but it has always been discussed in regards to 'free' quantum particles, i.e., no external forces are acting on the particle.

"As 'free' quantum particles are an idealised, perhaps unrealistic situation, we have shown that backflow still occurs when external forces are present. This means that external forces don't destroy the backflow effect, which is an exciting new discovery."

"These new findings allow us to find out the optimal configuration of a quantum particle that exhibits the maximal amount of backflow, which is important for future experimental verification." [11]

Physicists demonstrate new way to violate local causality

For the first time, physicists have experimentally demonstrated the violation of "bilocal causality"—a concept that is related to the more standard local causality, except that it accounts for the precise way in which physical systems are initially generated. The results show that it's possible to violate local causality in an entirely new and more general way, which could lead to a potential new resource for quantum technologies.

The physicists, Gonzalo Carvacho et al., from institutions in Italy, Brazil, and Germany, have published a paper on the demonstration of the violation of bilocal causality in a recent issue of Nature Communications.

In general, the idea of local causality is usually taken for granted: objects can influence other objects only when they are physically close together, and any correlations between distant objects must have originated in the past when they were closer together. But in the quantum world, distant particles can be correlated in ways that are impossible for classical objects, unless these distant particles can somehow influence each other.

To determine whether local causality has been violated, physicists perform Bell tests, which attempt to violate Bell inequalities. If a Bell inequality is violated, then either locality or realism (or simply "local realism") has also been violated.

There are dozens of different versions of Bell inequalities, but currently they all make the same assumption: that the correlations between particles all originate from a single common source. In real experiments, however, particles and their correlations can come from many different sources.

To address this issue, the new paper considers a new type of Bell inequality that accounts for the fact that the two sources of states used in the experiment are independent, the so-called bilocality assumption. By violating this new type of Bell inequality, the researchers have for the first time violated bilocal causality, indicating the presence of non-bilocal correlations that are completely different than other types of quantum correlations.

The researchers also showed that, in certain situations, it's possible to violate bilocal causality but not any other type of local causality. This finding further suggests that this type of violation is truly different than any standard local causality violation.

"Our work is an experimental proof-of-principle for network generalizations of Bell's theorem," coauthor Fabio Sciarrino at the Sapienza University of Rome told Phys.org. "We experimentally demonstrated how bilocality can be considered a powerful resource enlarging our current capabilities to process information in a non-classical way."

Overall, the results contribute to the perspective that the standard Bell inequalities are just one particular type of more general phenomena. Further exploring this idea could guide the design of future experiments that may reveal greater insight into the violations of local causality and how they might be used in applications. The new non-bilocal correlations, for instance, could be used as a resource for establishing highly secure quantum communication channels in complex quantum networks.

In the future, the researchers plan to extend the experimental demonstration to larger quantum networks. They also noted that the current experiment is subject to loopholes, just like any other Bell test, other than the recent loophole-free Bell tests. The physicists hope that one day a loophole-free test may also be developed for bilocal causality violation.

"A natural next step is to experimentally realize larger quantum networks by adding more nodes and more entangled sources," Sciarrino said. "Our current research plans address the study of the bilocality in quantum networks under strict conditions of reference frames between the different parties in order to highlight another characteristic of this new resource." [10]

The atom without properties

The microscopic world is governed by the rules of quantum mechanics, where the properties of a particle can be completely undetermined and yet strongly correlated with those of other particles. Physicists from the University of Basel have observed these so-called Bell correlations for the first time between hundreds of atoms. Their findings are published in the scientific journal Science.

Everyday objects possess properties independently of each other and regardless of whether we observe them or not. Einstein famously asked whether the moon still exists if no one is there to look at it; we answer with a resounding yes. This apparent certainty does not exist in the realm of small particles. The location, speed or magnetic moment of an atom can be entirely indeterminate and yet still depend greatly on the measurements of other distant atoms.

Experimental test of Bell correlations

With the (false) assumption that atoms possess their properties independently of measurements and independently of each other, a so-called Bell inequality can be derived. If it is violated by the results of an experiment, it follows that the properties of the atoms must be interdependent. This is described as Bell correlations between atoms, which also imply that each atom takes on its properties only at the moment of the measurement. Before the measurement, these properties are not only unknown - they do not even exist.

A team of researchers led by professors Nicolas Sangouard and Philipp Treutlein from the University of Basel, along with colleagues from Singapore, have now observed these Bell correlations for the first time in a relatively large system, specifically among 480 atoms in a Bose-Einstein condensate. Earlier experiments showed Bell correlations with a maximum of four light particles or 14 atoms. The results mean that these peculiar quantum effects may also play a role in larger systems.

Large number of interacting particles

In order to observe Bell correlations in systems consisting of many particles, the researchers first had to develop a new method that does not require measuring each particle individually - which would require a level of control beyond what is currently possible. The team succeeded in this task with the help of a Bell inequality that was only recently discovered. The Basel researchers tested their method in the lab with small clouds of ultracold atoms cooled with laser light down to a few billionths of a degree above absolute zero. The atoms in the cloud constantly collide, causing their magnetic moments to become slowly entangled. When this entanglement reaches a certain magnitude, Bell correlations can be detected. Author Roman Schmied explains: "One would expect that random collisions simply cause disorder. Instead, the quantum-mechanical properties become entangled so strongly that they violate classical statistics."

More specifically, each atom is first brought into a quantum superposition of two states. After the atoms have become entangled through collisions, researchers count how many of the atoms are actually in each of the two states. This division varies randomly between trials. If these variations fall below a certain threshold, it appears as if the atoms have 'agreed' on their measurement results; this agreement describes precisely the Bell correlations.

New scientific territory

The work presented, which was funded by the National Centre of Competence in Research Quantum Science and Technology (NCCR QSIT), may open up new possibilities in quantum technology; for example, for generating random numbers or for quantum-secure data transmission. New prospects in basic research open up as well: "Bell correlations in many-particle systems are a largely unexplored field with many open questions - we are entering uncharted territory with our experiments," says Philipp Treutlein. [9]

Physicists quantify the usefulness of 'quantum weirdness'

Recently, physicists have been developing ways to measure the amount of quantum coherence in a system. Now in two new papers, a team of physicists and mathematicians (Carmine Napoli, et al., and Marco Piani, et al.) has introduced a way to quantify the usefulness of quantum coherence by looking at this property from a purely operational perspective. The new measurement method can answer questions such as "how useful will a system's quantum coherence be for a task like encoding and decoding secret messages?" In other words, the new method quantifies the advantage of using quantum mechanics.

"We introduce a new way to quantify quantum coherence, the quintessential signature of quantum mechanics, capturing the extent to which a system can live in a superposition of distinct states (like a coin being simultaneously heads and tails, or a famous cat dead and alive)," the researchers wrote.

As the scientists explain, the usefulness of quantum coherence can be described by a measure that they introduce as the "robustness of quantum coherence."

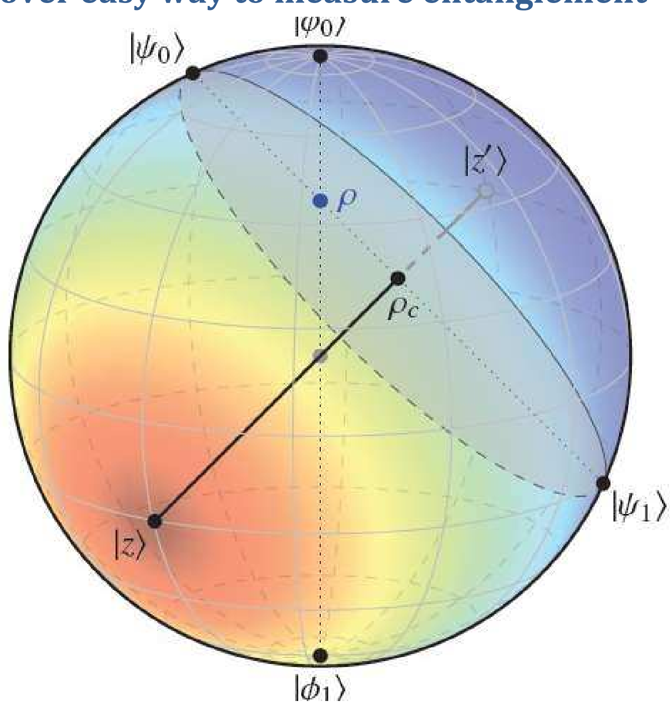
Basically, this measures how easy it is to destroy a state's quantum coherence.

The concept is a specific version of a more general measure the scientists introduce: the "robustness of asymmetry." When a quantum system is asymmetrical, it's possible to distinguish between different 'rotations' of the system. Physicists can then use the system as a physical reference frame, or for quantum metrology applications, it could be used to make extremely precise measurements that would not be possible in the absence of asymmetry.

Overall, the physicists view the results as a step forward in the quest to turn the weird fundamental features of quantum mechanics into something useful. Besides benefitting physics applications such as quantum metrology and secure communication, the new measure could also be used to quantify quantum coherence in biological systems, such as photosynthesis and bird navigation.

"The realization that quantum properties can be harnessed for practical applications is presently fueling a heated international race to develop and deploy quantum technologies," the physicists wrote. "This is no coincidence: the improved study and test of fundamental quantum properties and our increased ability to exploit them go hand in hand." [8]

Physicists discover easy way to measure entanglement—on a sphere



Entanglement on a sphere: This Bloch sphere shows entanglement for the one-root state ρ and its radial state ρc. The color on the sphere corresponds to the value of the entanglement, which is determined by the distance from the root state z, the point at which there is no entanglement. The closer to z, the less the entanglement (red); the further from z, the greater the entanglement (blue). Credit: Regula and Adesso. ©2016 American Physical Society

Now in a new paper to be published in Physical Review Letters, mathematical physicists Bartosz Regula and Gerardo Adesso at The University of Nottingham have greatly simplified the problem of measuring entanglement.

To do this, the scientists turned the difficult analytical problem into an easy geometrical one. They showed that, in many cases, the amount of entanglement between states corresponds to the distance between two points on a Bloch sphere, which is basically a normal 3D sphere that physicists use to model quantum states.

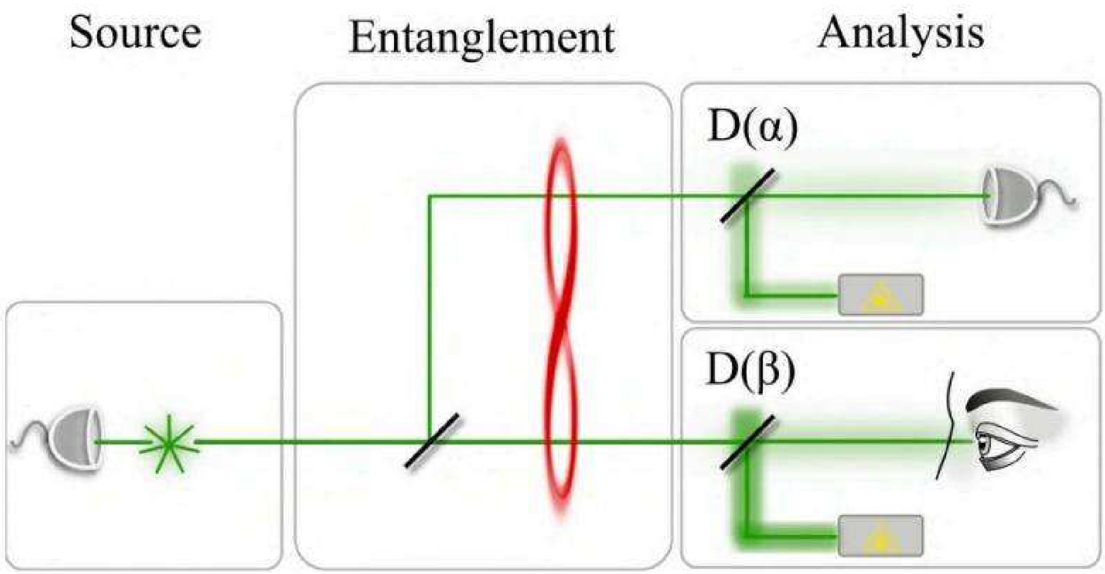
As the scientists explain, the traditionally difficult part of the math problem is that it requires finding the optimal decomposition of mixed states into pure states. The geometrical approach completely eliminates this requirement by reducing the many possible ways that states could decompose down to a single point on the sphere at which there is zero entanglement. The approach requires that there be only one such point, or "root," of zero entanglement, prompting the physicists to describe the method as "one root to rule them all."

The scientists explain that the "one root" property is common among quantum states and can be easily verified, transforming a formidable math problem into one that is trivially easy. They demonstrated that the new approach works for many types of two-, three- and four-qubit entangled states.

"This method reveals an intriguing and previously unexplored connection between the quantum features of a state and classical geometry, allowing all one-root states to enjoy a convenient visual representation which considerably simplifies the study and understanding of their properties," the researchers explained.

The simple way of measuring a state's entanglement could have applications in many technological areas, such as quantum cryptography, computation, and communication. It could also provide insight into understanding the foundations of thermodynamics, condensed matter physics, and biology. [7]

An idea for allowing the human eye to observe an instance of entanglement



Scheme of the proposal for detecting entanglement with the human eye. Credit: arXiv:1602.01907

Entanglement, is of course, where two quantum particles are intrinsically linked to the extent that they actually share the same existence, even though they can be separated and moved apart. The idea was first proposed nearly a century ago, and it has not only been proven, but researchers routinely cause it to occur, but, to date, not one single person has every actually seen it happen—they only know it happens by conducting a series of experiments. It is not clear if anyone has ever actually tried to see it happen, but in this new effort, the research trio claim to have found a way to make it happen—if only someone else will carry out the experiment on a willing volunteer.

The idea involves using a beam splitter and two beans of light—an initial beam of coherent photons fired at the beam splitter and a secondary beam of coherent photons that interferes with the photons in the first beam causing a change of phase, forcing the light to be reflected rather than transmitted. In such a scenario, the secondary beam would not need to be as intense as the first, and could in fact be just a single coherent photon—if it were entangled, it could be used to allow a person to see the more powerful beam while still preserving the entanglement of the original photon.

The researchers suggest the technology to carry out such an experiment exists today, but also acknowledge that it would take a special person to volunteer for such an assignment because to prove that they had seen entanglement taking place would involve shooting a large number of photons in series, into a person's eye, whereby the resolute volunteer would announce whether they had seen the light on the order of thousands of times. [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]

The Secret of Quantum Entanglement

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] When one of the entangled particles wave function is collapses by measurement, the intermediate photon also collapses and transforms its state to the second entangled particle giving it the continuity of this entanglement. Since the accelerated charges are self-maintaining their potential locally causing their acceleration, it seems that they entanglement is a spooky action at a distance.

Conclusions

The accelerated charges self-maintaining potential shows the locality of the relativity, working on the quantum level also.
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.
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 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. 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.

References

[1] The Magnetic field of the Electric current and the Magnetic induction

http://academia.edu/3833335/The_Magnetic_field_of_the_Electric_current

[2] 3 Dimensional String Theory

http://academia.edu/3834454/3_Dimensional_String_Theory

[3] Graviton Production By Two Photon and Electron-Photon Processes In Kaluza-Klein Theories With Large Extra Dimensions

http://arxiv.org/abs/hep-ph/9909392

[4] Quantum Entanglement

http://en.wikipedia.org/wiki/Quantum_entanglement

[5] Space-based experiment could test gravity's effects on quantum entanglement

http://phys.org/news/2014-05-space-based-gravity-effects-quantum-entanglement.html

[6] An idea for allowing the human eye to observe an instance of entanglement

http://phys.org/news/2016-02-idea-human-eye-instance-entanglement.html

[7] Physicists discover easy way to measure entanglement—on a sphere

http://phys.org/news/2016-02-physicists-easy-entanglementon-sphere.html

[8] Physicists quantify the usefulness of 'quantum weirdness'

http://phys.org/news/2016-04-physicists-quantify-quantum-weirdness.html

[9] The atom without properties

http://phys.org/news/2016-04-atom-properties.html

[10] Physicists demonstrate new way to violate local causality

https://phys.org/news/2017-04-physicists-violate-local-causality.html

[11] New breakthrough discovery—every quantum particle travels backwards

https://phys.org/news/2017-07-breakthrough-discoveryevery-quantum-particle.html

[12] Probability that the quantum world obeys local realism is less than one in a billion, experiment shows

https://phys.org/news/2017-07-probability-quantum-world-local-realism.html