Electron Model in Complex Molecules

Researchers from the Institute of Molecular Science and Technologies (ISTM-CNR, Italy), Moscow Institute of Physics and Technology (MIPT), and the University of Milan have experimentally confirmed a model to detect electron delocalization in molecules and crystals. [12]

A unique rapid-fire electron source—originally built as a prototype for driving next-generation X-ray lasers—is helping scientists at the Department of Energy's Lawrence Berkeley National Laboratory (Berkeley Lab) study ultrafast chemical processes and changes in materials at the atomic scale. This could provide new insight in how to make materials with custom, controllable properties and improve the efficiency and output of chemical reactions. [11]

A new scientific instrument at the Department of Energy's SLAC National Accelerator Laboratory promises to capture some of nature's speediest processes. It uses a method known as ultrafast electron diffraction (UED) and can reveal motions of electrons and atomic nuclei within molecules that take place in less than a tenth of a trillionth of a second – information that will benefit groundbreaking research in materials science, chemistry and biology. [10]

As an elementary particle, the electron cannot be broken down into smaller particles, at least as far as is currently known. However, in a phenomenon called electron fractionalization, in certain materials an electron can be broken down into smaller "charge pulses," each of which carries a fraction of the electron's charge. Although electron fractionalization has many interesting implications, its origins are not well understood. [9]

New ideas for interactions and particles: This paper examines the possibility to origin the Spontaneously Broken Symmetries from the Planck Distribution Law. This way we get a Unification of the Strong, Electromagnetic, and Weak Interactions from the interference occurrences of oscillators. Understanding that the relativistic mass change is the result of the magnetic induction we arrive to the conclusion that the Gravitational Force is also based on the electromagnetic forces, getting a Unified Relativistic Quantum Theory of all 4 Interactions.

Author: George Rajna

Scientists experimentally confirm electron model in complex molecules

Researchers from the Institute of Molecular Science and Technologies (ISTM-CNR, Italy), Moscow Institute of Physics and Technology (MIPT), and the University of Milan have experimentally confirmed a model to detect electron delocalization in molecules and crystals. The chemists, whose paper was published in Acta Crystallographica on April 1, 2016, have also illustrated examples of the same approach applied toward obtaining insights into the chemical bonding of a wide variety of systems, from metallorganic compounds to systems of biological relevance.

As electrons are quantum objects, they cannot be clearly localized in a particular place. This means that the behaviour of electrons cannot be described using equations that work with regular, non-quantum objects. Scientists must instead consider electrons as a blurred cloud. Developing a mathematical model to determine the distribution of electrons relatively quickly and accurately is one of the most significant challenges of modern science.

"The main novelty introduced by our study is the possibility of detecting electron delocalization directly from experimental data. Electron delocalization, which is a cornerstone paradigm of chemistry—fundamental, for example, for understanding aromaticity—could so far be estimated only through approaches relying on quantities not obtainable from experimental measurements, e.g. the so-called 'delocalization index.' Our results may therefore pave the way for looking at this important phenomenon in a new fashion," writes Gabriele Saleh, one of the co-authors of the study.

The mathematical model proposed in 1998 by the Canadian expert in quantum chemistry Richard Bader and the Italian researcher Carlo Gatti sees electron distribution in a crystal as the sum of contributions of so-called source functions. From this point of view, a molecule (or crystal) is seen as a set of individual elements, each of which contributes to the final distribution. This approach, as shown by subsequent studies, provides an insightful view of hydrogen bonds, metal-ligand bonds, and other types of chemical interactions.

From theory to practice

In 2016, Carlo Gatti, Gabriele Saleh and Leonardo Lo Presti demonstrated yet another use of the Bader-Gatti approach for studying chemical bonding directly from experimental results. For the analysis, they used data obtained previously by European and Australian scientists in X-ray and neutron diffraction experiments on samples of benzene, naphthalene and other compounds. In these experiments, an X-ray beam is directed onto a sample and once it passes through, it is diffracted.

By looking at how this diffraction occurs and in which direction particles are deflected, scientists can draw conclusions about the distribution of electrons within a crystal under study—this distribution is described using the concept of electron density.

In their paper, the researchers note that the results, presented in the form of X-ray diffraction derived electron density of molecules, allow the Bader-Gatti model to be used to describe the subtle effects associated with electron delocalization in organic molecular crystals. The experimental data is fully consistent with the results of ab initio numerical modelling based on the fundamental laws of quantum mechanics.

In some cases, electrons within molecules or crystals cannot be related to a particular bond or atom. They belong to the structure as a whole and are called "delocalized electrons." These particles play a key role in the formation of certain molecules and their behaviour can only be described using the principles of quantum chemistry—e.g., electrons forming a ring in a molecule of benzene or its derivatives.

The modeling of molecules and crystals is important both from a theoretical and practical point of view. Detailed knowledge of how electrons are distributed within a subject under study will enable scientists to understand the properties of the substance as a whole; this information is also needed to calculate interactions between the molecules themselves. Data on electron density is of paramount importance in developing new drugs, to identify exactly which molecules can reach a target protein and react with it. Electron density measurements are also used to calculate the characteristics of materials formed by various molecules.

Among the prospects for further research, are studies about the density of electrons and their spins—characteristics that determine the magnetic properties of a material.

The use of methods of quantum mechanics is increasingly blurring the boundary between scientific disciplines, and issues related to the chemistry of compounds are gradually moving into the field of physics and computational mathematics. [12]

Seeing atoms and molecules in action with an electron 'eye'

A unique rapid-fire electron source—originally built as a prototype for driving next-generation X-ray lasers—is helping scientists at the Department of Energy's Lawrence Berkeley National Laboratory (Berkeley Lab) study ultrafast chemical processes and changes in materials at the atomic scale. This could provide new insight in how to make materials with custom, controllable properties and improve the efficiency and output of chemical reactions.

This newly launched setup, dubbed HiRES (for High Repetition-rate Electron Scattering apparatus), will function like an ultrafast electron camera, potentially producing images that can pinpoint defects and their effects, track electronic and superconducting properties in exotic materials, and detail chemical reactions in gases, liquids and biological samples that are difficult to study using more conventional, X-ray-based experiments.

The new research tool produces highly focused electron bunches, each containing up to 1 million electrons. The electrons stream at a rate of up to 1 million bunches per second, or 1 trillion electrons per second.

Electrons will be used as a fast camera shutter to capture snapshots of samples as they change over femtoseconds, or quadrillionths of a second. An initial laser pulse will trigger a reaction in the sample that is followed an instant later by an electron pulse to produce an image of that reaction.

HiRES delivered its first electron beam March 28 and experiments are set to begin in May.

Daniele Filippetto, a Berkeley Lab scientist who is leading HiRES, has for much of his scientific career focused on building electron sources, also called "electron guns," that can drive advanced X-ray lasers known as "free-electron lasers." These electron guns are designed to produce a chain of high-

energy electron pulses that are accelerated and then forced by powerful magnetic fields to give up some of their energy in the form of X-ray light.

Free-electron lasers have opened new frontiers in studying materials and chemistry at the nanoscale and beyond, and Filippetto said he hopes to pave new ground with HiRES, too, using a technique known as "ultrafast electron diffraction," or UED, that is similar to X-ray diffraction.

In these techniques, a beam of X-rays or electrons hits a sample, and the scattering of X-rays or electrons is collected on a detector. This pattern, known as a diffraction pattern, provides structural information about the sample. X-rays and electrons interact differently: electrons scatter from a sample's electrons and the atoms' nuclei, for example, while X-rays scatter only from the electrons. [11]

Ultrafast electron diffraction reveals rapid motions of atoms and molecules

"We've built one of the world's best UED systems to create new research opportunities in ultrafast science," says SLAC's Xijie Wang, who is in charge of developing the new instrument described in a paper published July 24 in Review of Scientific Instruments. "Our apparatus delivers electron beams with a better quality than any other UED machine. For example, it allows us to study chemical processes in the gas phase that are up to four times faster than those we can examine with current UED technologies."

The technique complements ultrafast studies with SLAC's X-ray free-electron laser. Similar to X-ray light, highly energetic electrons can take snapshots of the interior of materials as they pass through them. Yet, electrons interact differently with materials and "see" different things. Both methods combined draw a more complete picture that will help researchers better understand and possibly control important ultrafast processes in complex systems ranging from magnetic data storage devices to chemical reactions.

'Seeing' Ultrafast Processes with Electrons

The superior performance of the new UED system is due to a very stable "electron gun" originally developed for SLAC's X-ray laser Linac Coherent Light Source (LCLS), a DOE Office of Science User Facility. This electron source produces highly energetic electrons, packed into extremely short bunches. It spits out 120 of these bunches every second, generating a powerful electron beam that the researchers use to probe objects on the inside.

But how can scientists actually catch a glimpse of the interior of materials with particles like electrons?

The method works because particles have a second nature: They also behave like waves. When electron waves pass through a sample, they scatter off the sample's atomic nuclei and electrons. The scattered waves then combine to form a so-called diffraction pattern picked up by a detector. The whole apparatus works like a high-speed camera, capturing differences in diffraction patterns over time that scientists use to reconstruct the sample's inner structure and how it changes.

Since electron bunches in SLAC's UED instrument are extremely short, they reveal changes that occur in less than 100 quadrillionths of a second, or 100 femtoseconds, for instance in response to ultrashort laser pulses.

This animation explains how researchers use high-energy electrons at SLAC to study faster-than-ever motions of atoms and molecules relevant to important material properties and chemical processes.

"UED has been under development for the past 10 to 15 years, but the repulsive forces between electrons in the electron beam limited the time resolution of previous experiments," says the paper's first author Stephen Weathersby, the facility manager of SLAC's Accelerator Structure Test Area (ASTA), where the UED machine is installed. "LCLS expertise in electron gun technology and ultrafast laser systems gives our system the performance and stability needed to study much faster processes."

## *Electrons Plus X-rays for Ultrafast Science*

Electrons behave similarly to X-rays in the way they explore speedy phenomena in nature. Electrons scatter off both electrons and atomic nuclei in materials. X-rays, on the other hand, interact only with electrons. Therefore, electron and X-ray studies of very fast structural changes complement each other.

The SLAC-led team has already begun to combine both approaches to better understand the link between the magnetic behavior of certain materials and their structural properties in studies that could help develop next-generation data storage devices.

Electrons also provide a path to studies that are very challenging to perform with X-rays.

"Electrons interact with materials much more strongly than X-rays do," says SLAC's Renkai Li, the paper's lead author. "We were able to analyze samples such as very thin films whose X-ray signals would be very weak."

For instance, the researchers studied a single atomic layer of a material that is interesting for future electronic devices.
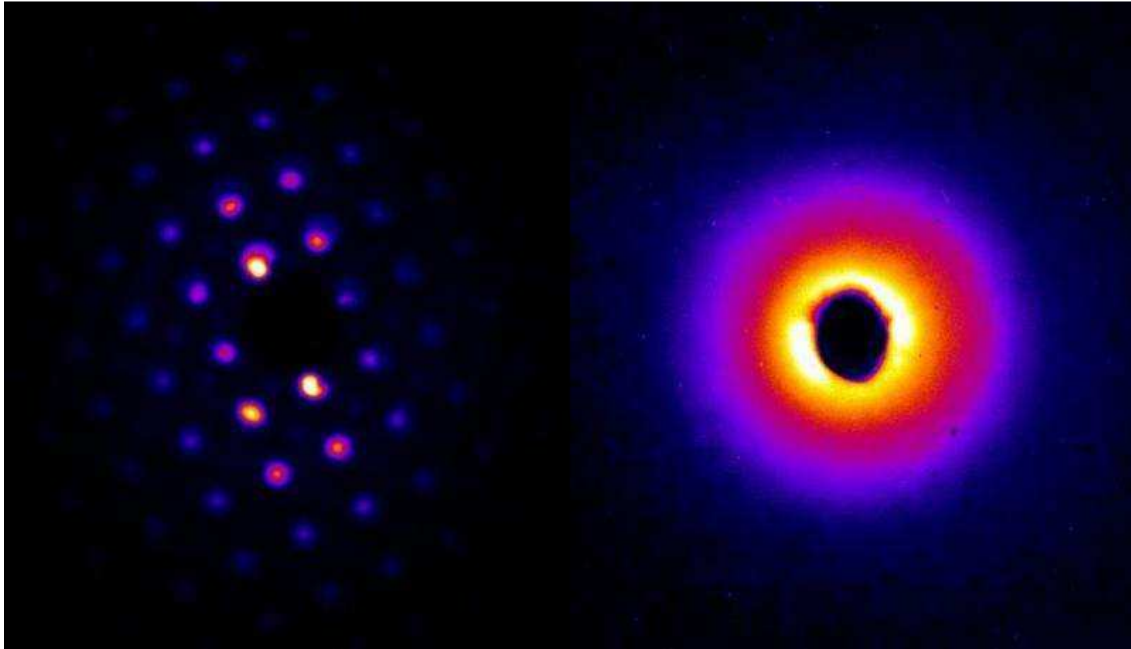
Ultrafast electron diffraction patterns of single-crystal gold (left) and nitrogen gas (right) obtained with SLAC's new experimental setup. By analyzing changes in patterns like these, scientists learn about motions in materials that take …more

"Another interesting case is gas phase samples," Li says. "Due to the almost 1,000-fold shorter wavelength of electrons compared to X-rays, UED can see much finer structural details. We're able to see how atoms in molecules move with UED, which is an important step toward making molecular movies of ultrafast chemical reactions."

Adding 'Ultrasmall' to the Mix

The researchers have already mapped out the next steps to further improve the UED instrument.

They plan on making it even faster – corresponding to a camera with a shutter speed close to 10 femtoseconds – and will eventually reduce the size of the electron beam from its current 100 microns – the diameter of an average human hair – to below one micron. These advances could be used to investigate how ultrafast motions in tiny regions of materials are linked to magnetism and other material properties.

The scientists' ultimate goal is to turn UED into an ultrafast electron microscope – an instrument that would show details too small to be seen with an optical microscope. Existing electron microscopes can already capture events in 10 billionths of a second, but with SLAC's instrument, the researchers hope to push the speed limit to processes that are 1,000 times faster.

"Ultrafast electron microscopy will bring two established, independent communities together: researchers working in electron microscopy and in ultrafast X-ray science," says co-author Hermann Dürr of SLAC, who is one of the project's science coordinators. "This will generate unforeseen possibilities for ultrafast science with electrons, similar to the great things we saw happening a few years ago at LCLS, when laser science and X-ray science merged into the new field of ultrafast X-ray science." [10]

When an electron splits in two

Now in a new paper published in Nature Communications, a team of physicists led by Gwendal Fève at the Ecole Normale Supérieure in Paris and the Laboratory for Photonics and Nanostructures in Marcoussis have applied an experiment typically used to study photons to investigate the underlying mechanisms of electron fractionalization. The method allows the researchers to observe single-electron fractionalization on the picosecond scale.

"We have been able to visualize the splitting of an electronic wavepacket into two fractionalized packets carrying half of the original electron charge," Fève told Phys.org. "Electron fractionalization has been studied in previous works, mainly during roughly the last five years. Our work is the first to combine single-electron resolution—which allows us to address the fractionalization process at the elementary scale—with time resolution to directly visualize the fractionalization process."

The technique that the researchers used is called the Hong-Ou-Mandel experiment, which can be used to measure the degree of resemblance between two photons, or in this case electron charge pulses, in an interferometer. This experiment also requires a single-electron emitter, which some of the same researchers, along with many others, have recently been developing.

The researchers first analyzed the propagation of a single electron in the interferometer's outer one-dimensional wire, and then when that electron fractionalized, they could observe the interaction between its two charge pulses in the inner one-dimensional wire. As the researchers explain, when the original electron travels along the outer wire, Coulomb interactions (interactions between charged particles) between excitations in the outer and inner wires produce two types of excitation pairs: two pulses of the same sign (carrying a net charge) and two pulses of opposite signs (which together are neutral). The two different excitation pairs travel at different velocities, again due to Coulomb interactions, which causes the original electron to split into two distinct charge pulses.
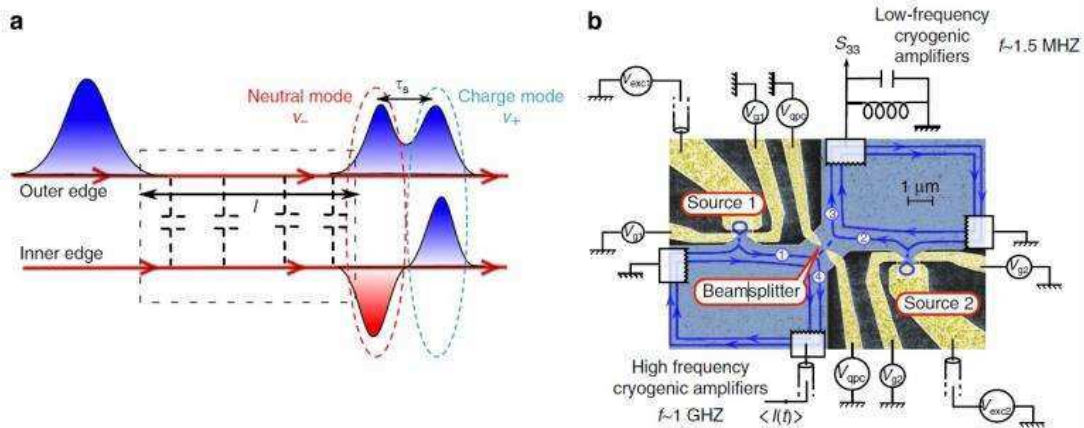
(a) An electron on the outer channel fractionalizes into two pulses. (b) A modified scanning electron microscope picture of the sample. Credit: Freulon, et al. ©2015 Nature

The experiment reveals that, when a single electron fractionalizes into two pulses, the final state cannot be described as a single-particle state, but rather as a collective state composed of several excitations. For this reason, the fractionalization process destroys the original electron particle. Electron destruction can be measured by the decoherence of the electron's wave packet.

Gaining a better understanding of electron fractionalization could have a variety of implications for research in condensed matter physics, such as controlling single-electron currents in one-dimensional wires.

"There has been, during the past years, strong efforts to control and manipulate the propagation of electrons in electronic conductors," Fève said. "It bears many analogies with the manipulations of the quantum states of photons performed in optics. For such control, one-dimensional conductors are useful, as they offer the possibility to guide the electrons along a one-dimensional trajectory. However, Coulomb interactions between electrons are also very strong in one-dimensional wires, so strong that electrons are destroyed: they fractionalize. Understanding fractionalization is understanding the destruction mechanism of an elementary electron in a one-dimensional wire. Such understanding is very important if one wants to control electronic currents at the elementary scale of a single electron."

In the future, the researchers plan to perform further experiments with the Hong-Ou-Mandel interferometer in order to better understand why fractionalization leads to electron destruction, and possibly how to suppress fractionalization.

"The Hong-Ou-Mandel interferometer can be used to picture the temporal extension (or shape) of the electronic wavepackets, which is what we used to visualize the fractionalization process," Fève said. "It can also be used to capture the phase relationship (or phase coherence) between two components of the electronic wavepacket.

"This combined information fully defines the single-electron state, offering the possibility to visualize the wavefunction of single electrons propagating in a one-dimensional conductor. This would first provide a complete understanding of the fractionalization mechanism and in particular how it leads to the decoherence of single-electron states. It would also offer the possibility to test if single electrons can be protected from this decoherence induced by Coulomb interaction. Can we suppress (or reduce) the fractionalization process by reducing the strength of the Coulomb interaction? We would then be able to engineer and visualize pure single-electron states, preserved from Coulomb interaction.

"The next natural step is then to address few-particle states and electron entanglement in quantum conductors. Again, the question of the destruction of such states by Coulomb interaction effects will be a crucial one." [9]

The Electromagnetic Interaction

This paper explains the magnetic effect of the electric current from the observed effects of the accelerating electrons, causing naturally the experienced changes of the electric field potential along the electric wire. 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. [2]

Asymmetry in the interference occurrences of oscillators

The asymmetrical configurations are stable objects of the real physical world, because they cannot annihilate. One of the most obvious asymmetry is the proton – electron mass rate M_p = 1840 M_e while they have equal charge. We explain this fact by the strong interaction of the proton, but how remember it his strong interaction ability for example in the H – atom where are only electromagnetic interactions among proton and electron.

This gives us the idea to origin the mass of proton from the electromagnetic interactions by the way interference occurrences of oscillators. The uncertainty relation of Heisenberg makes sure that the particles are oscillating.

The resultant intensity due to n equally spaced oscillators, all of equal amplitude but different from one another in phase, either because they are driven differently in phase or because we are looking at them an angle such that there is a difference in time delay:

(1) $I = I_0 \sin^2 n\ \phi/2 \mathbin{/} \sin^2 \phi/2$

If ϕ is infinitesimal so that $\sin\phi = \phi$, than

(2) $I = n^2\ I_0$

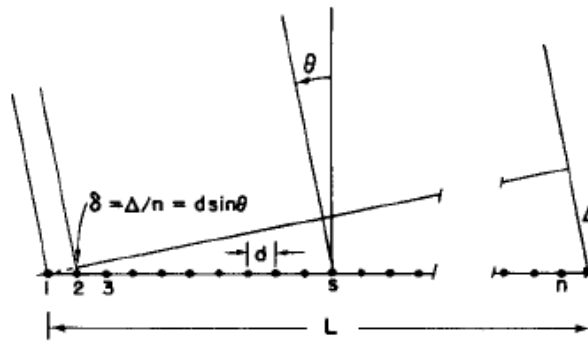This gives us the idea of

(3) $M_p = n^2\ M_e$

Fig. 30–3. A linear array of n equal oscillators, driven with phases $\alpha_s = s\alpha$.

Figure 1.) A linear array of n equal oscillators

There is an important feature about formula (1) which is that if the angle φ is increased by the multiple of 2π, it makes no difference to the formula.

So

(4) d sin θ = m λ

and we get m-order beam if λ less than d. [6]

If d less than λ we get only zero-order one centered at θ = 0. Of course, there is also a beam in the opposite direction. The right chooses of d and λ we can ensure the conservation of charge.

For example

(5) 2 (m+1) = n

Where 2(m+1) = N_p number of protons and n = N_e number of electrons.

In this way we can see the H_2 molecules so that 2n electrons of n radiate to 4(m+1) protons, because $d_e > \lambda_e$ for electrons, while the two protons of one H_2 molecule radiate to two electrons of them, because of $d_e < \lambda_e$ for this two protons.

To support this idea we can turn to the Planck distribution law, that is equal with the Bose – Einstein statistics.

Spontaneously broken symmetry in the Planck distribution law

The Planck distribution law is temperature dependent and it should be true locally and globally. I think that Einstein's energy-matter equivalence means some kind of existence of electromagnetic oscillations enabled by the temperature, creating the different matter formulas, atoms molecules, crystals, dark matter and energy.

Max Planck found for the black body radiation

As a function of wavelength (λ), Planck's law is written as:

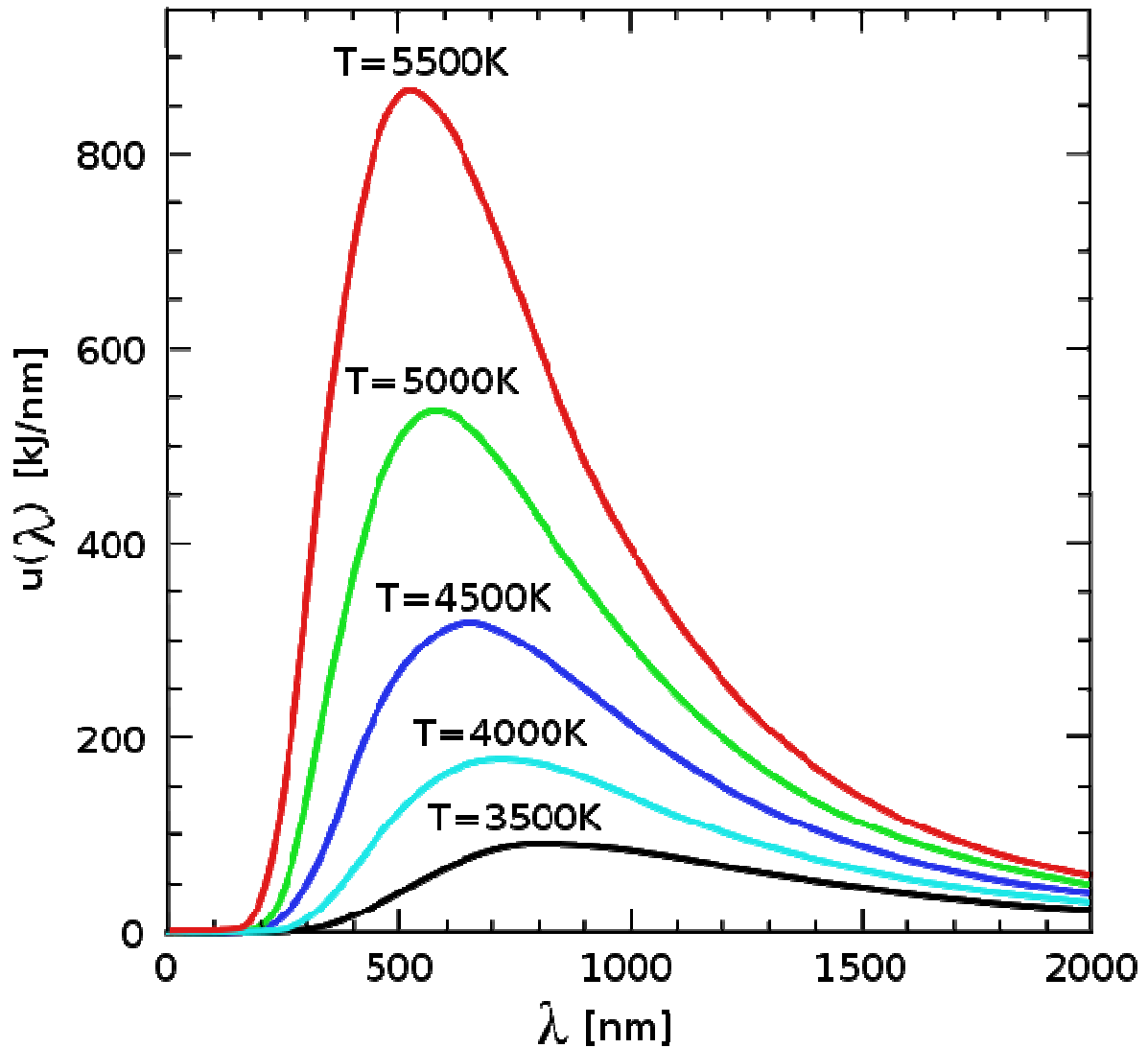$$B_\lambda(T) - \frac{2hc^2}{\lambda^5} \frac{1}{e^{\frac{hc}{\lambda k_B T}} - 1}.$$

Figure 2. The distribution law for different T temperatures

We see there are two different λ_1 and λ_2 for each T and intensity, so we can find between them a d so that $\lambda_1 < d < \lambda_2$.

We have many possibilities for such asymmetrical reflections, so we have many stable oscillator configurations for any T temperature with equal exchange of intensity by radiation. All of these configurations can exist together. At the λ_{max} is the annihilation point where the configurations are symmetrical. The λ_{max} is changing by the Wien's displacement law in many textbooks.

(7)
$$\lambda_{max} = \frac{b}{T}$$

where λ_{max} is the peak wavelength, T is the absolute temperature of the black body, and b is a constant of proportionality called *Wien's displacement constant*, equal to $2.8977685(51) \times 10^{-3}$ m·K (2002 CODATA recommended value).

By the changing of T the asymmetrical configurations are changing too.

The structure of the proton

We must move to the higher T temperature if we want look into the nucleus or nucleon arrive to d<10^{-13} cm. If an electron with λ_e < d move across the proton then by (5) 2 (m+1) = n with m = 0 we get n = 2 so we need two particles with negative and two particles with positive charges. If the proton can fraction to three parts, two with positive and one with negative charges, then the reflection of oscillators are right. Because this very strange reflection where one part of the proton with the electron together on the same side of the reflection, the all parts of the proton must be quasi lepton so d > λ_q. One way dividing the proton to three parts is, dividing his oscillation by the three direction of the space. We can order 1/3 e charge to each coordinates and 2/3 e charge to one plane oscillation, because the charge is scalar. In this way the proton has two +2/3 e plane oscillation and one linear oscillation with -1/3 e charge. The colors of quarks are coming from the three directions of coordinates and the proton is colorless. The flavors of quarks are the possible oscillations differently by energy and if they are plane or linear oscillations. We know there is no possible reflecting two oscillations to each other which are completely orthogonal, so the quarks never can be free, however there is an asymptotic freedom while their energy are increasing to turn them to the orthogonally. If they will be completely orthogonal then they lose this reflection and take new partners from the vacuum. Keeping the symmetry of the vacuum the new oscillations are keeping all the conservation laws, like charge, number of baryons and leptons. The all features of gluons are coming from this model. The mathematics of reflecting oscillators show Fermi statistics.

Important to mention that in the Deuteron there are 3 quarks of +2/3 and -1/3 charge, that is three u and d quarks making the complete symmetry and because this its high stability.

The Pauli Exclusion Principle says that the diffraction points are exclusive!

The Strong Interaction

Confinement and Asymptotic Freedom

For any theory to provide a successful description of strong interactions it should simultaneously exhibit the phenomena of confinement at large distances and asymptotic freedom at short distances. Lattice calculations support the hypothesis that for non-abelian gauge theories the two domains are analytically connected, and confinement and asymptotic freedom coexist.
Similarly, one way to show that QCD is the correct theory of strong interactions is that the coupling extracted at various scales (using experimental data or lattice simulations) is unique in the sense that its variation with scale is given by the renormalization group. [4]
Lattice QCD gives the same results as the diffraction theory of the electromagnetic oscillators, which is the explanation of the strong force and the quark confinement. [1]

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.

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. [5]

Fermions and Bosons

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

The Higgs boson or Higgs particle is a proposed elementary particle in the Standard Model of particle physics. The Higgs boson's existence would have profound importance in particle physics because it would prove the existence of the hypothetical Higgs field - the simplest of several proposed explanations for the origin of the symmetry-breaking mechanism by which elementary particles gain mass. [3]

The fermions' spin

The moving charges are accelerating, since only this way can self maintain the electric field causing their acceleration. The electric charge is not point like! This constant acceleration possible if there is

a rotating movement changing the direction of the velocity. This way it can accelerate forever without increasing the absolute value of the velocity in the dimension of the time and not reaching the velocity of the light.

The Heisenberg uncertainty relation says that the minimum uncertainty is the value of the spin: 1/2 h = d x d p or 1/2 h = d t d E, that is the value of the basic energy status.

What are the consequences of this in the weak interaction and how possible that the neutrinos' velocity greater than the speed of light?

The neutrino is the one and only particle doesn't participate in the electromagnetic interactions so we cannot expect that the velocity of the electromagnetic wave will give it any kind of limit.

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 source of the Maxwell equations

The electrons are accelerating also in a static electric current because of the electric force, caused by the potential difference. The magnetic field is the result of this acceleration, as you can see in [2].

The mysterious property of the matter that the electric potential difference is self maintained by the accelerating electrons in the electric current gives a clear explanation to the basic sentence of the relativity that is the velocity of the light is the maximum velocity of the matter. If the charge could move faster than the electromagnetic field than this self maintaining electromagnetic property of the electric current would be failed.

Also an interesting question, how the changing magnetic field creates a negative electric field?
The answer also the accelerating electrons will give. When the magnetic field is increasing in time by increasing the electric current, then the acceleration of the electrons will increase, decreasing the charge density and creating a negative electric force. Decreasing the magnetic field by decreasing the electric current will decrease the acceleration of the electrons in the electric current and increases the charge density, creating an electric force also working against the change.
In this way we have explanation to all interactions between the electric and magnetic forces described in the Maxwell equations.
The second mystery of the matter is the mass. We have seen that the acceleration change of the electrons in the flowing current causing a negative electrostatic force. This is the cause of the relativistic effect - built-in in the Maxwell equations - that is the mass of the electron growing with its acceleration and its velocity never can reach the velocity of light, because of this growing negative electrostatic force. The velocity of light is depending only on 2 parameters: the magnetic permeability and the electric permittivity.
There is a possibility of the polarization effect created by electromagnetic forces creates the negative and positive charges. In case of equal mass as in the electron-positron pair it is simply, but

on higher energies can be asymmetric as the electron-proton pair of neutron decay by week interaction and can be understood by the Feynman graphs.

Anyway the mass can be electromagnetic energy exceptionally and since the inertial and gravitational mass are equals, the gravitational force is electromagnetic force and since only the magnetic force is attractive between the same charges, is very important for understanding the gravitational force.

The Uncertainty Relations of Heisenberg gives the answer, since only this way can be sure that the particles are oscillating in some way by the electromagnetic field with constant energies in the atom indefinitely. Also not by chance that the uncertainty measure is equal to the fermions spin, which is one of the most important feature of the particles. There are no singularities, because 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 greatest proton mass.

The Special Relativity

The mysterious property of the matter that the electric potential difference is self maintained by the accelerating electrons in the electric current gives a clear explanation to the basic sentence of the relativity that is the velocity of the light is the maximum velocity of the matter. If the charge could move faster than the electromagnetic field than this self maintaining electromagnetic property of the electric current would be failed. [8]

The Heisenberg Uncertainty Principle

Moving faster needs stronger acceleration reducing the dx and raising the dp. It means also mass increasing since the negative effect of the magnetic induction, also a relativistic effect!

The Uncertainty Principle also explains the proton – electron mass rate since the dx is much less requiring bigger dp in the case of the proton, which is partly the result of a bigger mass m_p because of the higher electromagnetic induction of the bigger frequency (impulse).

The Gravitational force

The changing magnetic field of the changing current causes electromagnetic mass change by the negative electric field caused by the changing acceleration of the electric charge.

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 M_p = 1840 M_e. 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. [1]

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 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]

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 Casimir effect

The Casimir effect is related to the Zero-point energy, which is fundamentally related to the Heisenberg uncertainty relation. The Heisenberg uncertainty relation says that the minimum uncertainty is the value of the spin: 1/2 h = dx dp or 1/2 h = dt dE, that is the value of the basic energy status.

The moving charges are accelerating, since only this way can self maintain the electric field causing their acceleration. The electric charge is not point like! This constant acceleration possible if there is a rotating movement changing the direction of the velocity. This way it can accelerate forever without increasing the absolute value of the velocity in the dimension of the time and not reaching the velocity of the light. 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 is not a point like particle, but has a real charge distribution.

Electric charge and electromagnetic waves are two sides of the same thing; the electric charge is the diffraction center of the electromagnetic waves, quantified by the Planck constant h.

The Fine structure constant

The Planck constant was first described as the proportionality constant between the energy (E) of a photon and the frequency (v) of its associated electromagnetic wave. This relation between the energy and frequency is called the **Planck relation** or the **Planck–Einstein equation**:

$$E = h\nu.$$

Since the frequency ν, wavelength λ, and speed of light c are related by $\lambda v = c$, the Planck relation can also be expressed as

$$E = \frac{hc}{\lambda}.$$

Since this is the source of Planck constant, the e electric charge countable from the Fine structure constant. This also related to the Heisenberg uncertainty relation, saying that the mass of the proton should be bigger than the electron mass because of the difference between their wavelengths.

The expression of the fine-structure constant becomes the abbreviated

$$\alpha = \frac{e^2}{\hbar c}$$

This is a dimensionless constant expression, 1/137 commonly appearing in physics literature.

This means that the electric charge is a result of the electromagnetic waves diffractions, consequently the proton – electron mass rate is the result of the equal intensity of the corresponding electromagnetic frequencies in the Planck distribution law, described in my diffraction theory.

Path integral formulation of Quantum Mechanics

The path integral formulation of quantum mechanics is a description of quantum theory which generalizes the action principle of classical mechanics. It replaces the classical notion of a single, unique trajectory for a system with a sum, or functional integral, over an infinity of possible trajectories to compute a quantum amplitude. [7]

It shows that the particles are diffraction patterns of the electromagnetic waves.

Conclusions

"The next natural step is then to address few-particle states and electron entanglement in quantum conductors. Again, the question of the destruction of such states by Coulomb interaction effects will be a crucial one." [9]

The magnetic induction creates a negative electric field, causing an electromagnetic inertia responsible for the relativistic mass change; it is the mysterious Higgs Field giving mass to the particles. The Planck Distribution Law of the electromagnetic oscillators explains the electron/proton mass rate by the diffraction patterns. The accelerating charges 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 Relativistic Quantum Theories. The self maintained electric potential of the accelerating charges equivalent with the General Relativity space-time curvature, and since it is true on the quantum level also, gives the base of the Quantum Gravity. The electric currents causing self maintaining electric potential is the source of the special and general relativistic effects. The Higgs Field is the result of the electromagnetic induction. The Graviton is two photons together.

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