Making a Crystal Lattice

The treatment, described this week in Applied Physics Letters, creates the effect known as piezoelectricity, where electricity results from mechanical stress, in the material which did not originally see piezoelectric effects. [14]

Many people picture electrical conductivity as the flow of charged particles (mainly electrons) without really thinking about the atomic structure of the material through which those charges are moving. But scientists who study "strongly correlated electron" materials such as high-temperature superconductors and those with strong responses to magnetism know that picture is far too simplistic. [13]

In an electron microscope, electrons are emitted by pointy metal tips, so they can be steered and controlled with high precision. Recently, such metal tips have also been used as high precision electron sources for generating X-rays. [12]

In some chemical reactions both electrons and protons move together. When they transfer, they can move concertedly or in separate steps. Light-induced reactions of this sort are particularly relevant to biological systems, such as Photosystem II where plants use photons from the sun to convert water into oxygen. [11]

EPFL researchers have found that water molecules are 10,000 times more sensitive to ions than previously thought. [10]

Working with colleagues at the Harvard-MIT Center for Ultracold Atoms, a group led by Harvard Professor of Physics Mikhail Lukin and MIT Professor of Physics Vladan Vuletic have managed to coax photons into binding together to form molecules – a state of matter that, until recently, had been purely theoretical. The work is described in a September 25 paper in Nature.

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

Creating new physical properties in materials

A collaborative effort between research groups at the Technical University of Freiberg and the University of Siegen in Germany demonstrates that the physical properties of SrTiO3, or strontium titanate, in its single crystal form can be changed by a relatively simple electrical treatment. SrTi03 is a mineral often studied for its superconducting properties.

The treatment, described this week in Applied Physics Letters, creates the effect known as piezoelectricity, where electricity results from mechanical stress, in the material which did not originally see piezoelectric effects. This could be extremely important as our technologically-oriented society makes ever-growing demands for new materials and unusual properties.

Crystalline materials are made of atoms and electrons, which arrange themselves in periodic patterns. The atomic structure of a crystal is similar to a piece of a cross-stitching pattern, but the scale is about ten million times smaller. While a cross-stitching technique might be tricky at first, once you learn the pattern, you just repeat the same stitches to fill the available space. Nature works much the same way in building crystals: it "learns" how to connect atoms with each other in a so-called unit cell and then repeats this building block to fill the space making a crystal lattice.

Looking at a crystal structure is somewhat like looking at fabric through a magnifying glass. Using a technique called X-ray diffraction, researchers apply external stimuli (e.g. stretch or an electric voltage) to a crystal and see how different connections (atomic "stitches") respond.

"The idea for this work was born when I was giving a colloquium talk in TU Freiberg, presenting our new technique for time-resolved X-ray diffraction and investigating piezoelectric material. Our colleagues in Freiberg had been investigating artificially created near-surface volumes of SrTiO3 crystals, with properties different from the normal bulk SrTiO3," said Semën Gorfman, a University of Siegen physicist.

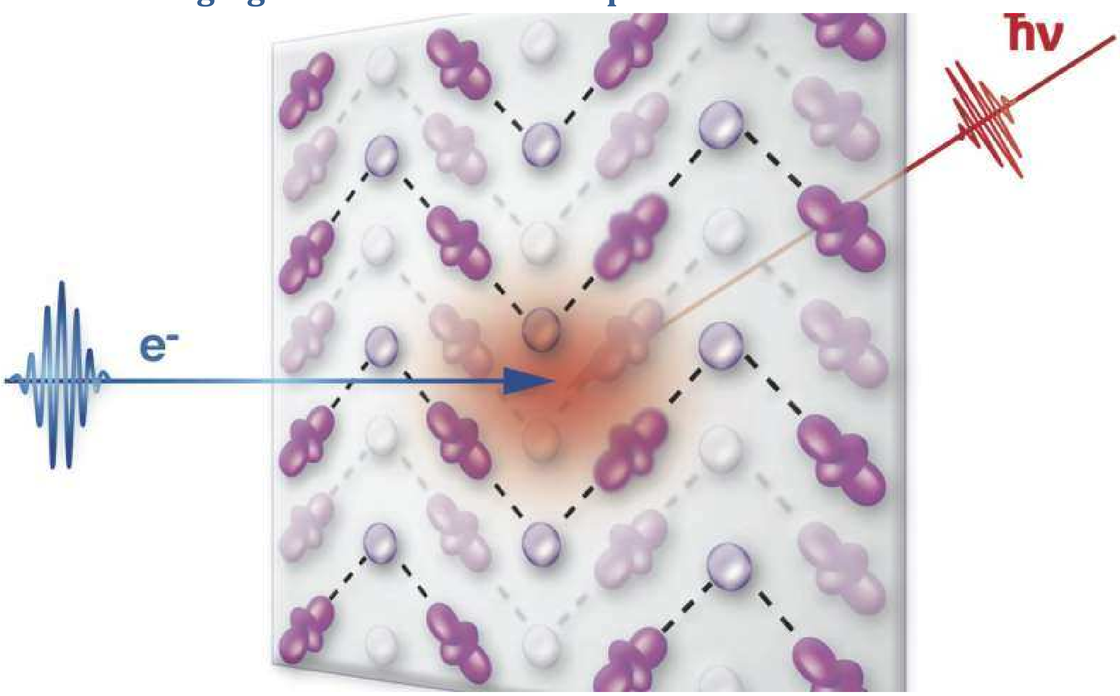
The Siegen research team had developed unique experimental equipment to investigate crystal structures under a periodically varying field using X-ray diffraction that is mobile and can connect to any available instrument, such as a home-lab X-ray diffractometer or a synchrotron beamline.

"Since the measurements are non-routine, this experimental equipment makes our research truly unique and original," Gorfman said. "It turned out that the technique developed at Siegen, was ideally matched to the research direction that the Freiberg team was working on, so we came up with the hypothesis to be tested (piezoelectricity in field-modified near surface phase of SrTiO3 crystal), and a suggested experimental method (stroboscopic time-resolved X-ray diffraction), performed the experiment and got results."

This work shows that new physical properties can be created artificially, reporting the piezoelectric effect in the artificially designed new phase of SrTiO3, a material that is not piezoelectric under normal conditions.

"We believe that physical properties of migration field induced polar phase in SrTiO3 opens a new and interesting chapter for research, Gorfman said. "The challenge now is to make the effect practical so that it can be used for devices." [14]

Ultrafast imaging reveals existence of 'polarons'



Imaging atomic-scale electron-lattice interactions: A laser pulse (red beam coming from right) gives electrons in a manganese oxide a 'kick' of energy while a high-energy electron beam (blue) probes the atomic structure. Circle- and rod-shaped blobs represent spherical and elongated electron clouds on the manganese atoms. The oxygen atoms (not shown) form regular and elongated octahedra around the manganese atoms. Varying the time delay between the pulse and the probe reveals time-resolved subtle shifts in atomic arrangements as the lattice responds to the kicked-up electrons. Credit: Brookhaven National Laboratory

Many people picture electrical conductivity as the flow of charged particles (mainly electrons) without really thinking about the atomic structure of the material through which those charges are moving. But scientists who study "strongly correlated electron" materials such as high-temperature superconductors and those with strong responses to magnetism know that picture is far too simplistic. They know that the atoms play a crucial role in determining a material's properties.

For example, electrical resistance is a manifestation of electrons scattering off the atoms. Less evident is the concept that electrons and atoms can move cooperatively to stop the flow of charge-or, in the other extreme, make electrons flow freely without resistance.

Now, a team led by physicist Yimei Zhu at the U.S. Department of Energy's Brookhaven National Laboratory has produced definitive evidence that the movement of electrons has a direct effect on atomic arrangements, driving deformations in a material's 3D crystalline lattice in ways that can drastically alter the flow of current. Finding evidence for these strong electron-lattice interactions, known as polarons, emphasizes the need to quantify their impact on complex phenomena such as superconductivity (the ability of some materials to carry current with no energy loss) and other promising properties.

As described in a paper just published in the Nature partner journal npj Quantum Materials, the team developed an "ultrafast electron diffraction" system-a new laser-driven imaging technique and the first of its kind in the world-to capture the subtle atomic-scale lattice distortions. The method has widespread potential application for studying other dynamic processes.

"The technique is similar to using stroboscopic photography to reveal the trajectory of a ball," said Zhu. "Using different time delays between throwing the ball and snapping the photo, you can capture the dynamic action," he said.

But to image dynamics at the atomic scale, you need a much faster flash and a way to set subatomic scale objects in motion.

The machine developed by the Brookhaven team uses a laser pulse to give electrons in a sample material a "kick" of energy. At the same time, a second laser split from the first generates very quick bursts of high-energy (2.8 mega-electron-volt) electrons to probe the sample. The electrons that make up these 130-femtosecond "flashes"-each lasting just 0. 00000000000013 seconds-scatter off the sample and create diffraction patterns that reveal the positions of the atoms. By varying the time delay between the pulse and the probe, the scientists can capture the subtle shifts in atomic arrangements as the lattice responds to the "kicked-up" electrons.

"This is similar to x-ray diffraction, but by using electrons we get a much larger signal, and the high energy of the probe electrons gives us better access to measuring the precise motion of atoms," Zhu said. Plus, his microscope can be built for a fraction of what it would cost to build an ultrafast x-ray light source. "This is a 'home-built' machine."

Key findings

The scientists used this technique to study the electron-lattice interactions in a manganese oxide, a material of long-standing interest because of how dramatically its conductivity can be affected by the presence of a magnetic field. They detected a telltale signature of electrons interacting with and altering the shape of the atomic lattice-namely, a two-step "relaxation" exhibited by the kicked-up electrons and their surrounding atoms.

In a normal one-step relaxation, electrons kicked up by a burst of energy from one atomic location to another quickly adapt their "shape" to the new environment.

"But in strongly correlated materials, the electrons are slowed down by interactions with other electrons and interactions with the lattice," said Weiguo Yin, another Brookhaven physicist working on the study. "It's like a traffic jam with lots of cars moving more slowly."

In effect the negatively charged electrons and positively charged atomic nuclei respond to one another in a way that causes each to try to accommodate the "shape" of the other. So an elongated electron cloud, when entering a symmetrical atomic space, begins to assume a more spherical shape, while at the same time, the atoms that make up the lattice, shift positions to try to accommodate the elongated electron cloud. In the second step, this in-between, push-me, pull-you arrangement gradually relaxes to what would be expected in a one-step relaxation.

"This two-step behavior, which we can see with our ultrafast electron diffraction, is the proof that the lattice vibrations are interacting with the electrons in a timely fashion. They are the proof that polarons exist," Yin said.

The finding yields insight into how the lattice response helps generate the huge decrease in electrical resistance the manganites experience in a magnetic field-an effect known as colossal magnetoresistance.

"The electron cloud shapes are linked to the magnetic attributes of the electrons," Yin explained. "When the magnetic moments of the electrons are aligned in a magnetic field, the electron cloud shape and the atomic arrangement become more symmetric and homogenous. Without the need to play the push-me, pull-you game, electric charges can flow more easily."

This work shows that an ultrafast laser can quickly modify electronic, magnetic, and lattice dynamics in strongly correlated electron materials-an approach that could result in promising new technical applications, such as ultrafast memory or other high-speed electronic devices.

"Our method can be used to better understand these dynamic interactions, and suggests that it will also be useful for studying other dynamic processes to discover hidden states and other exotic material behavior," said Zhu. [13]

Controlling electrons in time and space

In an electron microscope, electrons are emitted by pointy metal tips, so they can be steered and controlled with high precision. Recently, such metal tips have also been used as high precision electron sources for generating X-rays. A team of researchers at TU Wien (Vienna), together with colleagues from the FAU Erlangen-Nürnberg (Germany), have developed a method of controlling electron emissions with higher precision than ever before. With the help of two laser pulses, it is now possible to switch the flow of electrons on and off on extremely short time scales.

It's Just the Tip of the Needle

"The basic idea resembles a lightning rod," says Christoph Lemell (TU Wien). "The electrical field around a needle is always strongest right at the tip. That's why the lightning always strikes the tip of a rod, and for the same reason, electrons leave a needle right at the tip."

Extremely pointy needles can be fabricated with the methods of modern nanotechnology. Their tip is just a few nanometres wide, so the point at which the electrons are emitted is known with very high accuracy. In addition to that, it is also important to control at which point in time the electrons are emitted.

This kind of temporal control has now become possible using a new approach: "Two different laser pulses are fired at the metal tip," explains Florian Libisch (TU Wien). The colours of these two lasers are chosen such that the photons of one laser have exactly twice the energy of the other laser's photons. Also, it is important to ensure that both light waves oscillate in perfect synchronicity.

With the help of computer simulations, the team from TU Wien was able to predict that a small time delay between the two laser pulses can serve as a "switch" for electron emission. This prediction has now been confirmed by experiments performed by Professor Peter Hommelhoff's research group at FAU Erlangen-Nürnberg. Based on these experiments, it is now possible to understand the process in detail.

Absorbing Photons

When a laser pulse is fired at the metal tip, its electrical field can rip electrons out of the metal – that is a well-known phenomenon. The new idea is that a combination of two different lasers can be used to control the emission of the electrons on a femtosecond time scale.

There are different ways an electron can gain enough energy to leave the metal tip: It can absorb two photons from the high-energy laser or four electrons from the low-energy laser. Both mechanisms lead to the same result. "Much like a particle in a double-slit experiment, which travels on two different paths at the same time, the electron can take part in two different processes at the same time," says Professor Joachim Burgdörfer (TU Wien). "Nature does not have to pick one of the two possibilities – both are equally real and interfere which each other."

By carefully tuning the two lasers, it is possible to control whether the two quantum physical processes amplify each other, which leads to an increased emission of electrons, or whether they cancel each other, which means that hardly any electrons are emitted at all. This is a simple and effective way of controlling electron emission.

It is not just a new method of performing experiments with high energy electrons, the new technology should open the door to controlled X-ray generation. "Innovative X-ray sources are already being built using arrays of narrow metal tips as electron sources," says Lemell. "With our new method, these nano tips could be triggered in exactly the right way so that coherent X-ray radiation is produced." [12]

Using light to move electrons and protons

In some chemical reactions both electrons and protons move together. When they transfer, they can move concertedly or in separate steps. Light-induced reactions of this sort are particularly relevant to biological systems, such as Photosystem II where plants use photons from the sun to convert water into oxygen.

To better understand how light can lead to the transfer of protons in a chemical reaction, a group of researchers from the University of North Carolina, Shanxi University in China, and Memorial University in Newfoundland have conducted adsorption studies on a new family of experiments to observe the transition that occurs when protons transfer between hydrogen-bonded complexes in solution . They provide evidence for new optical transitions characteristic of the direct transfer of a proton. This report recently appeared in the Proceedings of the National Academy of Sciences.

N-methyl-4,4'-bipyridinium cation (MQ+) serves as proton acceptor, where a proton will add to the non-methylated pyridinium amine. If proton transfer occurs, then MQ+ will form a radical cation (MQH+•) whose absorbance spectra in the UV/visible range can be compared to N, N'-dimethyl-4, 4'-bypyridinium (MV2+).

By using ultrafast laser flash photolysis measurements, they found direct evidence for a low energy absorption band between p-methoxyphenyl and the mehylviologen acceptor, MQ+. It appears at 360 nm and as early as 250 fs after the laser pulse. Based on these properties, it is clearly the product of proton transfer from the phenol to give MeOPhO•—H-MQ+.

The appearance of this reaction involving the transfer of both an electron and proton after absorbing a single photon is supported by the vibrational coherence of the radical cation and by it characteristic spectral properties. By inference, related transitions, which are often at low intensities, could play an important role in the degradation of certain biological molecules, such as DNA.

The appearance of these absorption bands could have theoretical significance. They demonstrate a way to use simple spectroscopic measurements to explore the intimate details of how these reactions occur in nature. This provides new physical insight into processes that could be of broad biological and chemical relevance. [11]

A single ion impacts a million water molecules

EPFL researchers have found that water molecules are 10,000 times more sensitive to ions than previously thought.

Water is simple and complex at the same time. A single water molecule (H2O) is made up of only 3 atoms. Yet the collective behavior of water molecules is unique and continues to amaze us. Water molecules are linked together by hydrogen bonds that break and form several thousands of billions of times per second. These bonds provide water with unique and unusual properties. Living organisms contain around 60% water and salt. Deciphering the interactions among water, salt and ions is thus fundamentally important for understanding life.

Not 100 but 1,000,000 molecules react

Researchers at EPFL's Laboratory for fundamental BioPhotonics, led by Sylvie Roke, have probed the influence of ions on the structure of water with unprecedentedly sensitive measurements. According to their multi-scale analyses, a single ion has an influence on millions of water molecules, i.e. 10,000 times more than previously thought. In an article appearing in Science Advances, they explain how a single ion can "twist" the bonds of several million water molecules over a distance exceeding 20 nanometers causing the liquid to become "stiffer". "Until now it was not possible to see beyond a hundred molecules. Our measurements show that water is much more sensitive to ions than we thought," said Roke, who was also surprised by this result.

The molecules line up around the ions

Water molecules are made up of one negatively charged oxygen atom and two positively charged hydrogen atoms. The Mickey Mouse-shaped molecule therefore does not have the same charge at its center as at its extremities. When an ion, which is an electrically charged atom, comes into contact with water, the network of hydrogen bonds is perturbed. The perturbation spreads over millions of surrounding molecules, causing water molecules to align preferentially in a specific direction. This can be thought of as water molecules "stiffening their network" between the various ions.

From atomistic to macroscopic length scales

Water's behavior was tested with three different approaches: ultrafast optical measurements, which revealed the arrangement of molecules on the nanometric scale; a computer simulation on the atomic scale; and measurement of the water's surface structure and tension, which was done at the macroscopic level. "For the last method, we simply dipped a thin metal plate into the water and pulled gently using a tensiometer to determine the water's resistance," said Roke. "We observed that the presence of a few ions makes it easier to pull the plate out, that is, ions reduce the surface resistance of water. This strange effect had already been observed in 1941, but it remained unexplained until now. Through our multiscale analysis we were able to link it to ion-induced stiffening of the bulk hydrogen bond network: a stiffer bulk results in a comparatively more flexible surface."

Testing different salts and different "waters"

The researchers carried out the same experiment with 21 different salts: they all affected water in the same way. Then they studied the effect of ions on heavy water, whose hydrogen atoms are heavy isotopes (with an additional neutron in the nucleus). This liquid is almost indistinguishable from normal water. But here the properties are very different. To perturb the heavy water in the same way, it required a concentration of ions six times higher. Further evidence of the uniqueness of water.

No link with water memory

Roke and her team are aware that it might be tempting to link these stunning results to all sorts of controversial beliefs about water. They are however careful to distance themselves from any far-fetched interpretation. "Our research has nothing to do with water memory or homeopathy," she said. "We collect scientific data, which are all verifiable. "To prove the role of water in homeopathy, another million-billion-billion water molecules would have to be affected to even come close, and even then we are not certain."

The new discovery about the behavior of water will be useful in fundamental research, and in other areas too. The interaction between water and ions is omnipresent in biological processes related to enzymes, ion channels and protein folding. Every new piece of knowledge gives greater insight into how life works. [10]

Photonic molecules

Working with colleagues at the Harvard-MIT Center for Ultracold Atoms, a group led by Harvard Professor of Physics Mikhail Lukin and MIT Professor of Physics Vladan Vuletic have managed to coax photons into binding together to form molecules – a state of matter that, until recently, had been purely theoretical. The work is described in a September 25 paper in Nature.

The discovery, Lukin said, runs contrary to decades of accepted wisdom about the nature of light. Photons have long been described as massless particles which don't interact with each other – shine two laser beams at each other, he said, and they simply pass through one another.

"Photonic molecules," however, behave less like traditional lasers and more like something you might find in science fiction – the light saber.

"Most of the properties of light we know about originate from the fact that photons are massless, and that they do not interact with each other," Lukin said. "What we have done is create a special type of medium in which photons interact with each other so strongly that they begin to act as though they have mass, and they bind together to form molecules. This type of photonic bound state has been discussed theoretically for quite a while, but until now it hadn't been observed. [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) $I = I_0 \sin^2 n\,\phi/2\ \mathbf{/} \sin^2 \phi/2$

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

(2) $I = n^2 I_0$

This gives us the idea of

(3) $M_p = n^2 M_e$

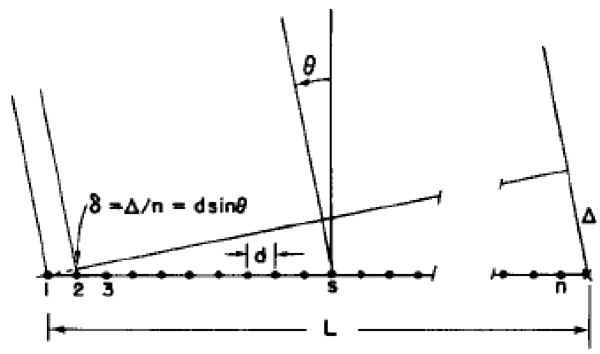


Fig. 30–3. A linear array of *n* equal oscillators, driven with phases $\alpha_s = s\alpha$.

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) $d \sin\theta = m\,\lambda$

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 $\theta = 0$. 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:

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

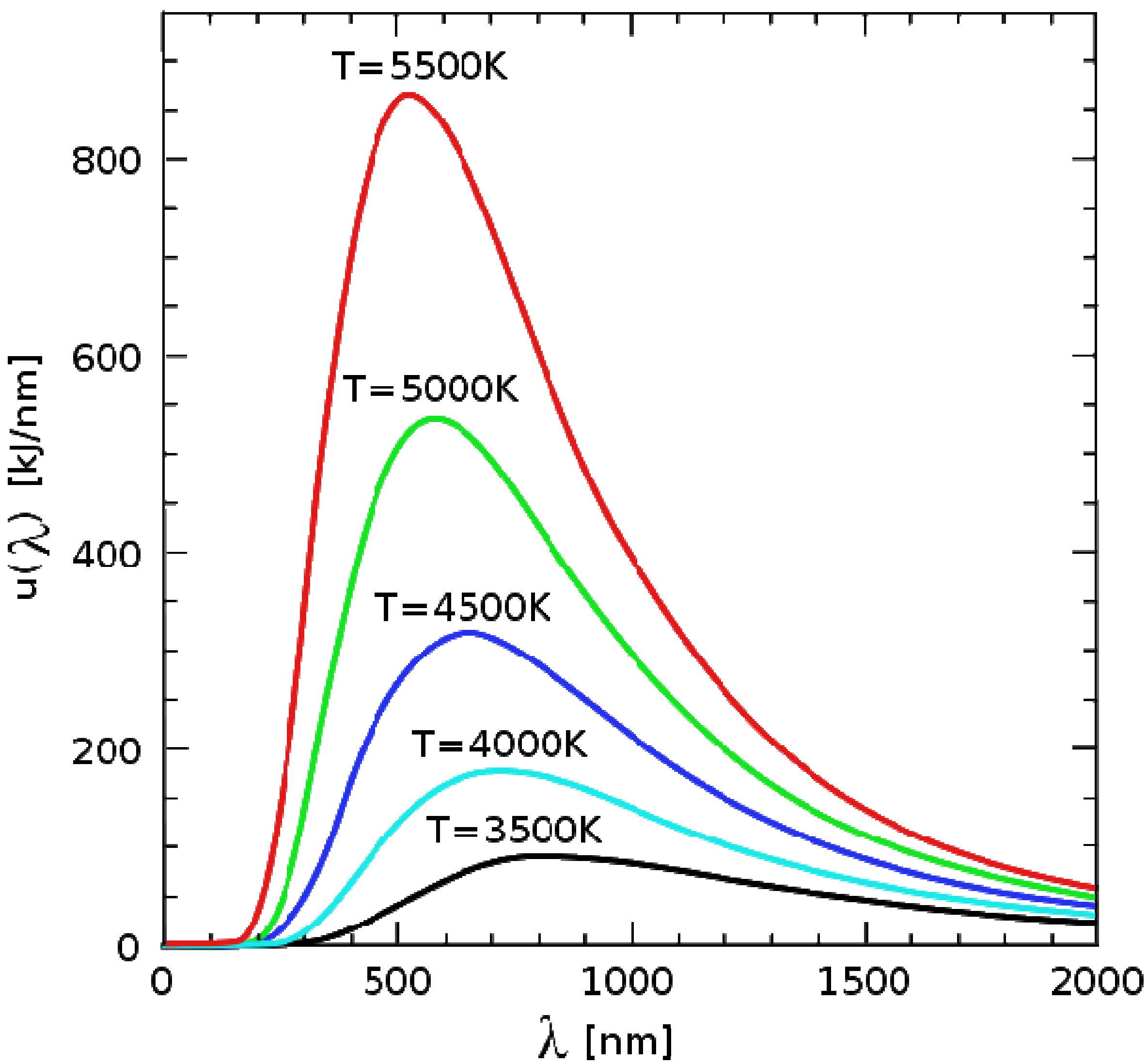


Figure 2. The distribution law for different T temperatures

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.

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

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 $2.8977685(51)\times10^{-3}$ 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 $\lambda_e < d$ 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 $d > \lambda_q$. 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 (*ν*) 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 *λν* = *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

"It's a photonic interaction that's mediated by the atomic interaction," Lukin said. "That makes these two photons behave like a molecule, and when they exit the medium they're much more likely to do so together than as single photons." To build a quantum computer, he explained, researchers need to build a system that can preserve quantum information, and process it using quantum logic operations. The challenge, however, is that quantum logic requires interactions between individual quanta so that quantum systems can be switched to perform information processing. [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.

References

[1] http://www.academia.edu/3834454/3_Dimensional_String_Theory

[2] http://www.academia.edu/3833335/The_Magnetic_field_of_the_Electric_current

[3] http://www.academia.edu/4158863/Higgs_Field_and_Quantum_Gravity

[4] http://www.academia.edu/4196521/The_Electro-Strong_Interaction

[5] http://www.academia.edu/4221717/General_Weak_Interaction

[6] The Feynman Lectures on Physics p. 274 (30.6)
Author: Richard Phillips Feynman
Publisher: Addison Wesley Longman (January 1970)
ISBN-10: **0201021153** | ISBN-13: **978-0201021158**

[7] Path Integral Formulation of Quantum Mechanics

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

[8] https://www.academia.edu/4215078/Accelerated_Relativity

[9] http://phys.org/news/2013-09-scientists-never-before-seen.html

[10] A single ion impacts a million water molecules

http://phys.org/news/2016-04-ion-impacts-million-molecules.html

[11] Using light to move electrons and protons

http://phys.org/news/2016-10-electrons-protons.html

[12] Controlling electrons in time and space

http://phys.org/news/2016-11-electrons-space.html

[13] Ultrafast imaging reveals existence of 'polarons'

http://phys.org/news/2016-11-ultrafast-imaging-reveals-polarons.html

[14] Creating new physical properties in materials

http://phys.org/news/2016-11-physical-properties-materials.html