

# Twin Paradox on Microchip

*Per Delsing and his team want to combine theoretical calculations with experiments on superconducting circuits to gain an understanding of how things fit together at the nano level. Among other things, they plan to simulate objects that move very rapidly, almost at the speed of light, and demonstrate the "twin paradox" on a microchip. [4]*

*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 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.*

## Contents

Preface.....	2
Popular questions about the Higgs Field and General Relativity:.....	2
How can we answer these questions? .....	2
Twin paradox on a chip .....	3
The trick – a superconducting circuit .....	3
It works in theory.....	4
Cold and silent with a cryostat.....	4
The Classical Relativistic effect .....	5
The Relativistic Quantum Mechanics .....	5
The Heisenberg Uncertainty Relation.....	5
The General Relativity - Electromagnetic inertia and mass.....	5
Electromagnetic Induction .....	5
Relativistic change of mass.....	5
The frequency dependence of mass .....	5
Electron – Proton mass rate .....	6

The weak interaction .....	6
The General Weak Interaction .....	7
The Higgs boson .....	7
Higgs mechanism .....	8
Gravity from the point of view of quantum physics .....	8
What is the Spin? .....	8
The Graviton .....	9
Conclusions .....	9
References .....	9

Author: George Rajna

## Preface

### **Popular questions about the Higgs Field and General Relativity:**

- 1.) If the Higgs field is responsible for imbuing particles with mass, and mass is responsible for gravity, is it possible that the Higgs field will provide the missing link between general relativity and quantum mechanics i.e. could the Higgs field be the basis of a quantum theory of gravity?
- 2.) Can the theoretical Higgs Field be used as the “cause” of relativistic momentum or relativistic kinetic energy of a moving body?
- 3.) Does Einstein's General Relativity need to be adjusted for the Higgs field?
- 4.) Since the Higgs field gives most particles mass, and permeates all space, then GR needs the Higgs field to be a theory of space?
- 5.) So where GR is highly curved, the Higgs field is also curved? And does a highly curved Higgs field affect the way particles acquire mass? For that matter, a curved space-time would also curve electromagnetic field?

### **How can we answer these questions?**

Discovering 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. [1]

Another bridge between the classical and quantum mechanics in the realm of relativity is that the charge distribution is lowering in the reference frame of the accelerating charges linearly:  $ds/dt = at$  (time coordinate), but in the reference frame of the current it is parabolic:  $s = a/2 t^2$  (geometric coordinate).

One origin of the Quantum Physics is the Planck Distribution Law of the electromagnetic oscillators, giving equal intensity for 2 different wavelengths on any temperature. Any of these two wavelengths will give equal intensity diffraction patterns, building different asymmetric constructions, for example proton - electron structures (atoms), molecules, etc. Since the particles are centers of diffraction patterns they also have particle – wave duality as the electromagnetic waves have. [2]

The Electroweak Interaction shows that the Weak Interaction is basically electromagnetic in nature. The arrow of time shows the entropy grows by changing the temperature dependent diffraction patterns of the electromagnetic oscillators.

## **Twin paradox on a chip**

Stuck on the wall of Per's office is a piece of paper on which is written: "It is easier to control a photon than it is to bring up four daughters."

"That's right," says Per, who is Professor of Experimental Physics at Chalmers University of Technology, without a second's hesitation.

But then again, he is a wiz at controlling photons – small particles of light. Among other things, his research team has succeeded in generating photons directly out of a vacuum. In their project, which has received funding from the Knut and Alice Wallenberg Foundation, they are using photons to demonstrate the twin paradox in a new way. The paradox is a thought experiment stemming from Einstein's special theory of relativity, and has occupied the minds of physicists for more than a hundred years.

Per, who happens to be a twin himself, explains:

"The twin paradox says that if I take a space journey in a high-speed rocket and then return, as an effect of acceleration I will be much younger than my twin brother."

This effect has been measured in various ways. What we want to do now is to demonstrate this on a microchip."

In other words, instead of traveling into space, his research team will move photons a very short distance at nano level.

"But the photons travel so quickly, close to the speed of light, which is difficult for us to reach in reality. And this is why we can achieve an effect even though this space journey only takes place on the actual chip."

## **The trick – a superconducting circuit**

The team is using a special type of superconducting electric circuit called SQUID, which stands for Superconducting Quantum Interference Device, which has been made in Chalmers' advanced clean room. When Per's team showed in 2011 how to create photons out of a vacuum, they used the specially designed SQUIDs as ultra-high-speed mirrors to generate light particles.

In addition to the twin paradox, the project aims to study two other new physical phenomena on microchips: "photon condensation" and "frequency combs".

"We always work on the boundaries of what is possible and what is new. The grant will enable us to realize these ideas and see how far we can go. The Foundation has also given us great freedom to use the resources as we ourselves see fit."

## It works in theory

A research team led by Göran Johansson (one of the co-investigators), Professor of Theoretical Physics at Chalmers, has published a scientific article showing that it is theoretically possible to demonstrate the twin paradox on a microchip. Per emphasizes how important it is to give a theoretical description of what is being done in practice.

"Sometimes it is easier to test in theory first; sometimes it is better to start by experimenting. So when we have recorded our data, the theoreticians make a model based on the results, and, hopefully, are able to reproduce our data so that they match. That is what we want to achieve. This is teamwork, and we know each other well. The theoreticians know what equipment we have, and we know what theoretical models and methods they have."

The third research team in the project is being led by David Haviland, Professor of Nanostructure Physics at KTH Royal Institute of Technology. He is developing methods of generating and analyzing signals with many tones at low frequencies (10 – 100 MHz) in "frequency combs".

"The good thing is that we can combine our equipment with David's and create frequency combs in the microwave region," Per says.

These frequency combs could in turn be used to drive the resonators used by the researchers to create photons. A resonator is a component that oscillates at a given frequency; in this case, it is a transmission line with a SQUID at each end.

"There are some theories that it might be possible to use frequency combs for quantum information."

## Cold and silent with a cryostat

The Foundation's grant will primarily be used to recruit more researchers, and to buy a new cryostat. This apparatus costs about SEK 3 million and is used to cool the SQUID down close to absolute zero. This is necessary for two reasons, as Per explains during a guided tour of the lab.

"First of all, we need to eliminate all the noise generated at higher temperatures. And a cryostat also ensures that our circuits will be superconducting."

Per, who is also a Wallenberg Scholar, is often asked what his research can be used for. The answer is he does not know. He is conducting pure basic research, understanding how everything fits together.

"When we focus on really small things, we are dealing with quantum physics; when we look at the really big picture, we have the general theory of relativity, which describes gravity. These two theories contradict each other to some extent, and have not yet been reconciled. Our research is approaching the limits where we can test things described by these two theories, and there is an opportunity to learn exciting new things." [4]

## The Classical Relativistic effect

The moving charges are self maintain the electromagnetic field locally, causing their movement and this is the result of their acceleration under the force of this field.

In the classical physics the charges will distributed along the electric current so that the electric potential lowering along the current, by linearly increasing the way they take every next time period because this accelerated motion.

## The Relativistic Quantum Mechanics

The same thing happens on the atomic scale giving a  $dp$  impulse difference and a  $dx$  way difference between the different part of the not point like particles.

Commonly accepted idea that the relativistic effect on the particle physics it is the fermions' spin - another unresolved problem in the classical concepts. If the electric charges can move only with accelerated motions in the self maintaining electromagnetic field, once upon a time they would reach the velocity of the electromagnetic field. The resolution of this problem is the spinning particle, constantly accelerating and not reaching the velocity of light because the acceleration is radial.

## The Heisenberg Uncertainty Relation

I think that we have a simple bridge between the classical and quantum mechanics by understanding the Heisenberg Uncertainty Relations. It makes clear that the particles are not point like but have a  $dx$  and  $dp$  uncertainty.

## The General Relativity - Electromagnetic inertia and mass

### Electromagnetic Induction

Since the magnetic induction creates a negative electric field as a result of the changing acceleration, it works as an electromagnetic inertia, causing an electromagnetic mass. [1]

### Relativistic change of mass

The increasing mass of the electric charges the result of the increasing inductive electric force acting against the accelerating force. The decreasing mass of the decreasing acceleration is the result of the inductive electric force acting against the decreasing force. This is the relativistic mass change explanation, especially importantly explaining the mass reduction in case of velocity decrease.

### The frequency dependence of mass

Since  $E = hv$  and  $E = mc^2$ ,  $m = hv/c^2$  that is the  $m$  depends only on the  $v$  frequency. It means that the mass of the proton and electron are electromagnetic and the result of the electromagnetic induction, caused by the changing acceleration of the spinning and moving charge! It could be that the  $m_0$  inertial mass is the result of the spin, since this is the only accelerating motion of the electric charge. Since the accelerating motion has different frequency for the electron in the atom and the proton, they masses are different, also as the wavelengths on both sides of the diffraction pattern, giving equal intensity of radiation.

## Electron – Proton mass rate

The Planck distribution law explains the different frequencies of the proton and electron, giving equal intensity to different lambda wavelengths! Also since the particles are diffraction patterns they have some closeness to each other – can be seen as a gravitational force. [2]

There is an asymmetry between the mass of the electric charges, for example proton and electron, can be 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 weak interaction

The weak interaction transforms an electric charge in the diffraction pattern from one side to the other side, causing an electric dipole momentum change, which violates the CP and time reversal symmetry. The Electroweak Interaction shows that the Weak Interaction is basically electromagnetic in nature. The arrow of time shows the entropy grows by changing the temperature dependent diffraction patterns of the electromagnetic oscillators.

Another important issue of the quark model is when one quark changes its flavor such that a linear oscillation transforms into plane oscillation or vice versa, changing the charge value with 1 or -1. This kind of change in the oscillation mode requires not only parity change, but also charge and time changes (CPT symmetry) resulting a right handed anti-neutrino or a left handed neutrino.

The right handed anti-neutrino and the left handed neutrino exist only because changing back the quark flavor could happen only in reverse, because they are different geometrical constructions, the u is 2 dimensional and positively charged and the d is 1 dimensional and negatively charged. It needs also a time reversal, because anti particle (anti neutrino) is involved.

The neutrino is a 1/2 spin creator particle to make equal the spins of the weak interaction, for example neutron decay to 2 fermions, every particle is fermions with  $\frac{1}{2}$  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  $\frac{1}{2}$  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.

## The Higgs boson

By March 2013, the particle had been proven to behave, interact and decay in many of the expected ways predicted by the Standard Model, and was also tentatively confirmed to have + parity and zero spin, two fundamental criteria of a Higgs boson, making it also the first known scalar particle to be discovered in nature, although a number of other properties were not fully proven and some partial results do not yet precisely match those expected; in some cases data is also still awaited or being analyzed.

In my opinion, the best explanation of the Higgs mechanism for a lay audience is the one invented by David Miller. You can find it here: <http://www.strings.ph.qmul.ac.uk/~jmc/epp/higgs3.html>.

The field must come first. The boson is an excitation of the field. So no field, no excitation. On the other hand in quantum field theory it is difficult to separate the field and the excitations.

The Higgs field is what gives particles their mass.

There is a video that gives an idea as to the Higgs field and the boson. It is here:

<http://www.youtube.com/watch?v=Rlg1Vh7uPyw>. Note that this analogy isn't as good as the Miller one, but as is usually the case, if you look at all the analogies you'll get the best understanding of the situation.

Since the Higgs boson is necessary to the W and Z bosons, the dipole change of the Weak interaction and the change in the magnetic effect caused gravitation must be conducted. The Wien law is also important to explain the Weak interaction, since it describes the  $T_{\max}$  change and the diffraction patterns change. [2]

### Higgs mechanism

The magnetic induction creates a negative electric field, causing an electromagnetic inertia. Probably it is the mysterious Higgs field giving mass to the charged particles? We can think about the photon as an electron-positron pair, they have mass. The neutral particles are built from negative and positive charges, for example the neutron, decaying to proton and electron. The wave – particle duality makes sure that the particles are oscillating and creating magnetic induction as an inertial mass, explaining also the relativistic mass change. Higher frequency creates stronger magnetic induction, smaller frequency results lesser magnetic induction. It seems to me that the magnetic induction is the secret of the Higgs field.

In particle physics, the Higgs mechanism is a kind of mass generation mechanism, a process that gives mass to elementary particles. According to this theory, particles gain mass by interacting with the Higgs field that permeates all space. More precisely, the Higgs mechanism endows gauge bosons in a gauge theory with mass through absorption of Nambu–Goldstone bosons arising in spontaneous symmetry breaking.

The simplest implementation of the mechanism adds an extra Higgs field to the gauge theory. The spontaneous symmetry breaking of the underlying local symmetry triggers conversion of components of this Higgs field to Goldstone bosons which interact with (at least some of) the other fields in the theory, so as to produce mass terms for (at least some of) the gauge bosons. This mechanism may also leave behind elementary scalar (spin-0) particles, known as Higgs bosons.

In the Standard Model, the phrase "Higgs mechanism" refers specifically to the generation of masses for the  $W^\pm$ , and Z weak gauge bosons through electroweak symmetry breaking. The Large Hadron Collider at CERN announced results consistent with the Higgs particle on July 4, 2012 but stressed that further testing is needed to confirm the Standard Model.

## Gravity from the point of view of quantum physics

### What is the Spin?

So we know already that the new particle has spin zero or spin two and we could tell which one if we could detect the polarizations of the photons produced. Unfortunately this is difficult and neither

ATLAS nor CMS are able to measure polarizations. The only direct and sure way to confirm that the particle is indeed a scalar is to plot the angular distribution of the photons in the rest frame of the centre of mass. A spin zero particles like the Higgs carries no directional information away from the original collision so the distribution will be even in all directions. This test will be possible when a much larger number of events have been observed. In the mean time we can settle for less certain indirect indicators.

## The Graviton

In physics, the graviton is a hypothetical elementary particle that mediates the force of gravitation in the framework of quantum field theory. If it exists, the graviton is expected to be massless (because the gravitational force appears to have unlimited range) and must be a spin-2 boson. The spin follows from the fact that the source of gravitation is the stress-energy tensor, a second-rank tensor (compared to electromagnetism's spin-1 photon, the source of which is the four-current, a first-rank tensor). Additionally, it can be shown that any massless spin-2 field would give rise to a force indistinguishable from gravitation, because a massless spin-2 field must couple to (interact with) the stress-energy tensor in the same way that the gravitational field does. This result suggests that, if a massless spin-2 particle is discovered, it must be the graviton, so that the only experimental verification needed for the graviton may simply be the discovery of a massless spin-2 particle. [3]

## Conclusions

The electric currents causing self maintaining electric potential is the source of the special and general relativistic effects. 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. Basing the gravitational force on the accelerating Universe caused magnetic force and the Planck Distribution Law of the electromagnetic waves caused diffraction gives us the basis to build a Unified Theory of the physical interactions.

Since graviton is a tensor field, it has spin = 2, could be 2 photons with spin = 1 together.

## References

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

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

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

[4] Twin paradox on a chip

<http://phys.org/news/2015-08-twin-paradox-chip.html>