What ÁCTUALLY is Super-Symmetry!?!

The symmetry "**SuSy**" is a proposed symmetry between <u>elementary</u> force-particles and <u>elementary</u> matter-particles. I.e., this symmetry assumes that each elementary **boson** has a corresponding elementary **fermion** as a so-called "**Super-Partner**" and vice-versa:

Elementary <u>fermion</u> ←(<u>SuSy</u>)→ Elementary <u>boson</u> (1)

Super-Symmetry was for the first time assumed by Japanese **Hironari Miyazawa** in **1966** when he was analyzing **QCD** used to describe elementary **quarks** and all their "assumed" interactions.

The **LSP** (**Lightest Supersymmetric Partner**) is the lightest of the **Super-Symmetrical particles** which have to be added to the theoretical model of our reality. This **LSP** is right-now assumed to be one of the most important candidates as the source of **dark matter**: Unlike other Super-Symmetrical (elementary) particles it is not able to decay into lighter particles (because in this case new, even less massive, **Super-Symmetrical particles** would be created), and besides its mass cannot have any interaction with our well-known matter.

The main reason why physicists assume validity of **SuSy** results from a still not-understood mathematical-mechanism with the name **re-normalization** used in the **Standard Model** of **Special Relativistic Quantum Field Theories**. If **SuSy** is valid many difficult to understand divergences (Divisions by Zero) can be offset by opposite **Super-Partner** divergences all of the **same** order.

All divisions by zero result because elementary particles can as "point-particles" reach one-another **up-to-zero** distance. This is a result of the used "simple" mathematical point-analysis used for all described interacting elementary particles. And the main question right-now is, is this relative simple-linear point-analysis actually correct!?!

The answer on this logical question can be answered completely from the theories of relativity of **Albert Einstein**, i.e. with the easy "linear" analyzed **SR** in which the **Theory of General Relativity** is also included to yield a mathematical analysis in compliance with the **Comprehensive Action Principle**. A mathematical analysis in compliance with the **CAP** must include gravitation, i.e. curvature of the only possible 4D-spacetime analysis. In 2003, more than 10 years ago now, **Grigori Perelman** together with **Prof. Dr. Richard Hamilton** (at the **Stonybrook university of New York**) showed during their common published solution of **Thurston's Geometrization conjecture**, the consequently proven **Poincaré conjecture** posed in 1904, which before its solution was viewed as one of the most important and difficult open problems in **topology**. **Perelman** his published articles can also be found **here**. In solving the **Poincaré conjecture Perelman** also showed that mathematical, i.e. "closed", knots are only possible in 4D-spacetime! To me it remains deeply sad that **Perelman** withdrew his mathematical research after repeated abuse of his published work. Because up to this very day it still appears that no-one seems to be able to understand the only possible **Theories Of Everything** even a very little-bit!

This is probably due to the fact that éven **Albert Einstein** himself could not grasp the mathematical consequences of curvature. If Einstein had understood that **mathematical-knots** could only be described in easy-imaginable 4D-spacetime he would have analyzed **Bernard Riemann** his work completely differently. Because **Riemann** analyzed curvature-of-space in linear mathematical space in which the amount of orthogonal coordinates was increased, mostly doubled. With the extra amount of coordinates curvature was being solved with easy "linear" mathematical methods.

And because **Einstein** didn't understand the used, more than 4-Dimensional Riemann-indices, he always contracted all results into 4D-spacetime expressions by multiplying all co- and contra-variant vectors with identical Riemann-indices. Also **Albert Einstein** could not sympathize with the **Quantum Mechanics** as proposed in 1927 via the **Copenhagen Interpretation** by **Niels Bohr** and **Werner Heisenberg**. Only remember **Einstein** his famous phrase: "**God does Not play dice!**".

Despite all these objections of **Albert Einstein** on the **QM,** he still remains the first person who discovered that the **EM-field** can be described as the effect of elementary massless **photons**.

Only why all wave-like phenomenon must be analyzed mathematically in "simple" mathematical 4D-spacetime was NOT known/understood by **Albert Einstein**!
All elementary "matter"-particles, i.e. **fermions**, experimentally have rest-masses > 0 and all elementary **fermions** are usually assumed to be spin½ elementary particles.

Even though this assumption isn't entirely correct, one experimentally completely proven characteristic of **fermions** appears to be:

> All elementary **fermions** posses half-integer spins > 0 and rest-masses > 0. (2)

This at once explains why our universe has more families of spin½ **neutrino's** with only different rest-masses.

All possible elementary particles, i.e. both **fermions** and all different "force-particles", called **bosons**, possess energy directly proportional to a frequency. This was for the first time described in 1924 by **Louis de Broglie** in his thesis and rewarded with a **Nobel Prize in Physics** in 1929.

This oscillating-energy implies that all **elementary particles** cannot be analyzed as "simple" point-particles, but that they should be described with a mathematical extensiveness allowing them to harmonically oscillate during their existence.

How do we add this property of all **elementary particles** with "simple linear", i.e. mathematical, analysis to make the description comply to the **CAP** !?!

First of all we need to remove a common misunderstanding about **spin** from the physics community. In **QM** analyses all **elementary particles** are assumed to be mathematical point-particles with "intrinsic" properties, like **energy**, **angular-momentum**, **Bohr-magneton > 0**, etc.. This is exactly why **QM** cannot be understood "logical" on "simple-linear" mathematical grounds! In the "not-understood" **QM** the following "**spin**"-symmetry is valid for the "wave-function" of a described **elementary particle**:

A wave-function with **spin s** possesses symmetry by rotation around the direction of motion of the described **elementary particle**. The symmetry rotation-angle is:

$$\varphi_{symmetry} = \frac{2\pi}{s} \qquad (3)$$

The wave-function of a spin½ **lepton** must be rotated over 4π radians around the axis-of-motion to obtain the same wave-function again. Rotation of the spin½ wave-function around one complete circle of 2π radians yields "minus" the wave-function. No physicist can deny this fact. This halving of degrees of freedom explains why only **neutrino's** with negative **helicity** exist and only **anti-neutrino's** with positive **helicity** are observed.

For the **EM**-"invisible" spin2 **gravitational-field** exactly the opposite is valid. Here the (not-visible) wave-function will rotate twice around the axis of motion by a rotation of the wave-function over just 2π radians! This characteristic completely explains why compliance to the **CAP** mathematically is a "**dual**" characteristic! In other words, a mathematical characteristic to comply to the **CAP** must be included in two completely orthogonal ways!

This property of **elementary particles** can only be added when they are described mathematically as ideal harmonic oscillators in the 2D-plane orthogonal to the direction of motion. Even a not-moving **elementary particle** shall always have a direction of motion, because time always progresses and time and motion should be imagined in the 2D-complex $(z, ic\tau)$-plane of "motion" in the here assumed positive z-axis direction. For convenience the best choice for the mathematically described **elementary particle** is from the "local" inertial-frame with origin moving with the average position of the harmonic oscillating particle in the positive z-direction. The origin of the so-chosen inertial-frame coincides with the assumed point-particle in the usual analyzed **QM** methods. The microscopic harmonic oscillation should now be described in the (x, y)-plane orthogonal to the chosen positive z-axis, i.e. the direction of motion described in the passed complex **proper-time** $(ic\tau)$, i.e. the mathematical "dual" orthogonal complex 2D-plane $(z, ic\tau)$.

The harmonic oscillation in the 2D-plane orthogonal to the direction of motion shows accelerations, so that the used **Differential Equations** contain either a second-order time derivative, or two consecutive first order time derivatives. The most easy to solve option has two consecutive first order time derivatives, so this option is chosen. If one chooses the time measured from the origin of the chosen inertial-frame, this time just is the **proper-time** as always used in the **SR QM**.

To solve these **DE** in the most logical way cylindrical coordinates are chosen:

$$(x, y, z, ic\tau) \quad \rightarrow \quad (\rho, \varphi, z, ic\tau) \tag{4}$$

Too high powers in the radius ρ makes it impossible to solve the **DE** of ρ. However, the **DE** can be re-written exactly for the variable $x = \rho^2$ and because $\rho > 0$ these squared solutions of $x = \rho^2$ at once also result in unique solutions of ρ.

First solutions are found for the inverse-function $\tau(x)$ and these solutions exactly describe all characteristics of the complex **Hilbert-space** also used in the **SR QFT** of the **Standard Model**. The **proper-time** $\tau(x)$ has complex solutions with incomplete elliptic integrals of the first and second kind. The solutions for the angle in the 2D-plane $\varphi(x)$ are complex solutions with incomplete elliptic integrals of the third kind with exactly identical arguments. All identical arguments allow exact solutions in all possible cases. In other words, for all possible **elementary particles** in any possible **Theory Of Everything**. Inverting $\tau(x)$ results into exact solutions of $\rho(\tau)$ > 0 in exactly the same complex **Hilbert-space** of the **QM**, however now with **elliptic functions** of the first and second kind for $\rho(\tau)$ and of the third kind for $\varphi(\tau)$.

The limits of ρ are easily extracted from the solutions of the **DE** and are given by:

$$\rho_{max} = 2\rho_{min} \wedge 2\langle\rho\rangle = \rho_{max} + \rho_{min} = 3\ \rho_{min} = 1\frac{1}{2}\ \rho_{max} = \underline{s} \cdot \underline{\varphi} \cdot \underline{l_h}, \qquad \text{with:} \tag{5}$$

- – **s** the positive integer spin of **bosons** or half-integer spin of **fermions**.
- – $\underline{\varphi} = \frac{1}{2}(\sqrt{5} + 1)$ the **Golden Ratio**.
- – $\underline{l_h} = \sqrt{(\hbar G/c^3)}$ the **Planck-length**.

After all, this is a "simple" mathematical described harmonic oscillator with a lot of occurring

beautiful symmetries. As a result of circular symmetry in the 2D-plane of rotation the solutions can only be solved exactly using **Boundary Conditions**.

The **Boundary Conditions** appear to show precisely two different solutions, i.e. are spin2 "dual":

- Open-**BC** describe **elementary particles** that are able to interact in all three different spacial directions and as a direct result of that also always interact with the symmetrical spin2 **graviton** and if the particles are electrically charged also with the anti-symmetrical spin1 **photon** of the **EM-field**.
  It is immediately clear that these solutions must describe all elementary **fermions**. With open-**BC** there are more allowed symmetry solutions for the harmonic oscillation. After $2\pi \cdot n$, with $n \in \mathbb{Z}^+$, rotations around the direction of motion the phase-angle of the oscillation will be the same as before this rotation. This positive integer number n will specify the so-called **fermion**-family. Our universe has 3 different **fermion**-families with only different rest-masses.
  The larger the integer number n, the more interaction with the spin2 **gravitational-field**, so the higher the rest-mass. By mathematically determining the possible positive integers $\{n_1, n_2, n_3\}$ of our "3-families" universe the ratios of the masses of elementary **fermions** related to their different families can be determined.
- Closed-**BC** now appear to describe all elementary **bosons**. The mathematical difference between open-**BC** and closed-**BC** now shows that there are no so-called "families" of elementary **bosons**, so for every degree of freedom of any possible irreducible described symmetry-group there is only one unique force-particle, i.e. one **boson**. This explains why the U(1) x SU(2) gauge-symmetry group mixed by the **Weinberg-angle**, precisely describes 4 gauge-bosons $\{\gamma, W^{\pm}, Z^0\}$ of which 3 are "intrinsic"-charged, so also massive.

Only if elementary **bosons** of a symmetry-group are all uncharged they can also be without rest-mass. This completely explains why only the spin1 **photon** described as an harmonic oscillator in compliance with the **CAP** to represent the anti-symmetrical **EM-field** precisely in a complete non-reducible way and the spin2 **graviton** of the "invisible" symmetrical **gravitational-field** both have rest-masses equal to zero. All other **elementary particles** must have rest-masses greater than zero!

The **CAP** implied mathematical dual character of the **Boundary Conditions** and its explanation on one hand with unique symmetry-group related elementary **bosons** and on the other hand multi-elementary particle families of elementary **fermions** explains exactly why **Super-Symmetry**, or symmetry given by (1), is on mathematical grounds completely incorrect..   .   **Q.E.D.**

At this time we have the opportunity to investigate all possible symmetries of the only possible always massive elementary **fermions** in the mathematical only possible 4D-spacetime.

All possible 4D-spacetime transformations can be represented non-reducible completely with the most general 4 x 4 transformation-tensor $T^{\mu\nu}$:

$$T^{\mu\nu} = A^{\mu\nu} + S^{\mu\nu} \tag{6}$$

With $A^{\mu\nu}$ the anti-symmetrical transformation-tensor with 6 degrees-of-freedom and $T^{\mu\nu}$ the symmetrical transformation-tensor with 10 degrees-of-freedom. According to the **CAP** all curvature of the only possible 4D-spacetime analysis must always be used as a logical mathematical starting-point of any acceptable analysis. This implies that all **elementary particles** must be described mathematical as harmonic oscillators in the 2D-plane orthogonal to the direction-of-motion.

The mathematical solutions for the **CAP** demanded extensiveness of **elementary particles** explains completely why the conserved spin **s** of all-possible harmonic oscillating particles must be described mathematically in complex **Hilbert-space** with **elliptic functions**!

The two orthogonal transformations given in (6) can, of-course, also be given with mathematical "extended" spin-representations:

$$A^{\mu\nu} = \text{spin1} \otimes \text{spin½} \quad \wedge \quad S^{\mu\nu} = \text{spin2} \otimes \text{spin½} \qquad (7)$$

This completely explains why the ONLY detected spin-values of "stable"-particles are given by:

$$\underline{s} \in \{2, 1, ½\} \qquad (8)$$

This at-once results into the following possible spin-values of **elementary particles**:

$$\underline{s} \in \{2, 1½, 1, ½\} \qquad (9)$$

In which ónly the spin1½ **elementary particles** cannot exist independently of so-called "partners". This is why **quarks** must be analyzed mathematical as non-stable spin1½ **elementary particles**. Consequently **quarks** cannot be described as not-understood spin½ elementary **fermions** with additional so-called "**isospin**" (also spin½ to end-up with the correct amount of degrees-of-freedom of the SU(3)-gauge-symmetry-group). However, as a correct mathematical analysis of this SU(3)-gauge symmetry-group shows directly, elementary **quarks** can only be spin1½ **fermions**, which can only exist together in a "quark-sea" as **hadrons** in combinations of more coupled **quarks** with spin values given by (8).

In the only possible 4D-spacetime analysis the complete non-reducible (anti-symmetrical) **gauge-symmetry** is exactly the complete **gauge-symmetry** used in the **Standard Model**:

$$U(1) \otimes SU(2) \otimes SU(3) \qquad (10)$$

All these actions are anti-symmetrical, i.e. related to the spin1 **EM-field** and as a result of that must be connected to electrical charge. And because all **elementary particles** must in accordance with the **CAP** oscillate harmonically pure electric neutral **elementary particles** do not exist. This at once explains why also "uncharged" **neutrinos** posses a **Bohr-magneton > 0**.

Only the symmetrical, and as a result of that spin2, gravitational-field cannot be analyzed by gauge-symmetry. However, in the **SM** the gravitational-field is still assumed to be a gauge-field. And this incorrect assumption of many theoretical physicists blocks a logical understandable "overview" of the only possible: **Theories Of Everything**

To me it's really sad that real theoretical progress of knowledge of our own reality can't proceed as a result of this! However, this article explains completely why the new experiments at the **LHC** will soon show that **SuSy** is a not valid symmetry of "nature".

For more information about *the only possible* **Theories Of Everything** please contact:

Ir. M.T. de Hoop
Bouwensputseweg 6
4471RC Wolphaartsdijk
Zeeland, The Netherlands
Telephone: 06 12 66 82 08
E-mail: tomdehoop@solcon.nl
Homepage: http://quantumuniverse.eu