Date: Wednesday, March 6, 2019 Time: 18:49:10

Quantum Mechanics explained C(omplete) N(on-Reducible):

I have always been curious about the why of our daily experienced reality. This is why I decided to study physics, while following education in Civil-Engineering at the secondary technical School at the small village by the sea called Vlissingen in the Netherlands.

While following these lessons based on very simplistic easy imaginable so-called applied mechanics CN based on easy linear so-called mathematics I gradually came to the conclusion that I had chosen the wrong subject to study seriously! At that time I mentally switched from applied so-called "experimental" physics to more logical understandable easy linear mathematical analyses of reality called Theoretical Physics.

In August 1986 I started with Applied Physics at the Technical university of Delft. Here I sadly enough had to discover that all teachers, now called professors, didn't have any logical explanation related to so-called Quantum Mechanics! For example, all teachers described QM with elementary Point-Particles with assumed so-called intrinsic-properties. The most prominent not-understood QM-feature was and still is so-called spin. As a direct consequence, I decided to finish my studies in physics in High Energy Physics at institute Lorentz at the State University of Leiden. This was the same location where Hendrik Anthoon Lorentz and Albert Einstein had their talks about Special Relativity around 1905. At that time, Albert Einstein stayed with Hendrik Lorentz in the "old" Dutch canal-city called Haarlem and they both traveled by steam-train between the theoretical institute at the university of Leiden and Hendrik's homestead in Haarlem.

I finished my studies in HEP under guidance of Prof. Dr. F.A. Berends on the description of the assumed spinless elementary Higgs-boson described as a compound particle build out of two fermions both with half-integer spin-values in the range $s \in \{½, 1½, 2½\}$ multiplied by the reduced Planck constant ħ (h-bar the Dirac constant) to include the correct dimensional proportionality-constant. To yield logical testable results, all expressions were calculated up to second order radiation corrections. However, these calculations in SR QFT did not give me a better insight into the still misunderstood so-called QM!

This is why I later decided to re-write QM CN from logical linear-mathematical First Principles.

In other words, I decided to mathematically describe all assumed "intrinsic" properties of elementary particles *(mathematically)* explicitly, i.e. overruling the assumed mathematical-property of elementary point-particles *(with incorrectly assumed so-called "intrinsic"-properties)*.

According to Albert Einstein his General Relativistic Comprehensive Action Principle, all valid math. models of our reality must always include the always dependent action of General Relativity. Compliant to the CAP the always dependent only invisible elementary symmetrical spin 2 gravitational-field (math. to be represented by so-called invisible "QM" Gravitons) must be a required basic ingredient of any valid mathematical model! So, without the "orthogonal" invisible gravitational-field any analyzed math. model of reality just can ***not*** describe it correctly!

Albert Einstein solved GR not-understood in a higher-dimensional so-called Riemannian-manifold to be able to math. describe induced "curvature" of SR 4D-Spacetime by the action of General Relativity. Here one should keep in mind that even Albert Einstein himself had no idea how to interpreted this $n > 4$ higher-dimensional linear mathematical Riemannian-spacetime! As a direct result he only used this higher-dimensional space to mathematical symbolically analyze gravitational-curvature of 4D-Spacetime resulting from the gravitational-field.

Albert Einstein sadly enough never had the time to also investigate conserved angular-momentum in the direction-of-motion of analyzable stable (elementary and compound) fundamental-particles, (not-understood) called spin. Actually massive particles have conserved spin in the direction-of-motion called chirality and the only **CAP-*dual*** 2 orthogonal *(required elementary)* bosons with zero rest-masses have conserved spin in the direction-of-motion called helicity.

So-called conserved spin in the direction-of-motion is mathematically CN related to **Rotational-Symmetry** when rotating an analyzed particle with conserved spin s around it's axis of motion, called it's SR worldline:

After a rotation over $(\frac{2\pi}{s})$ radians around the axis-of-motion (SR worldline) the QM

wave-function repeats itself again. Here s is the half-integer spin of stable fermions or positive integer spin of stable elementary bosons. Of-course, the dimensional proportionality-constant ħ is omitted here. N.B. An elementary particle without conserved angular-momentum cannot oscillate harmonically, so must have zero-energy proportional to a frequency, i.e. just can ***not*** describe a QM-particle.

This easy imaginable rotational-symmetry resulting into conserved so-called spin in the direction-of-motion results into decreased or increased degrees-of-freedom of the analyzed stable particles related to their conserved integer > 0 or half-integer spin-values "s":

All stable fermions with conserved chirality ½ (in the direction-of-motion) miss half of all possible degrees-of-freedom. This math. explains why all spin ½ particles only possess one kind of handedness, while their (electromagnetic) counterparts called anti-particles only possess the other kind of handedness. For example, neutrino's only possess left-handed chirality while anti-neutrino's only have right-handed chirality. Here it should be realized that all neutrino's as spin ½ fermions must have conserved rest-masses > zero and non-zero charge-densities resulting in conserved non-zero Bohr-magnetons. As a direct math. result compliant to the CAP so-called neutrino's must also be analyzed as ideal harmonic oscillating massive and charge densities in the 2D-plane orthogonal to the direction-of-motion. On the other hand, the only elementary spin 2 boson, i.e. the invisible graviton, repeats itself twice when rotated one complete circle around it's axis-of-motion.

This explain from symmetry analysis why the gravitational-field always requires 2 orthogonal math. effects in a correct description. Notice that these analyses of the gravitational-field related to rotational-symmetry just do not require the difficult to understand higher-dimensional Riemannian-spacetime analyses. So in the first-place, these "*incorrect*" higher-dimensional mathematical analyses should better be omitted all-together.

In 2003 Grigori Perelman helped Prof. Dr. Richard Hamilton at the Stony Brook university in New York solve the Poincaré-conjecture with his 3 papers. In these 3 papers it was also proven that mathematical (Closed-) Knots can only be described / analyzed in easy imaginable 4D-Spacetime.

According to the CAP all allowed stable particles must be analyzed **CAP-*dual*** Complete Non-Reducible as:

Ideal Harmonic Oscillating (math.) Point-Waves in the 2D-Plane Perpendicular to the Direction-of-Motion (SR-worldline) with *(required)* CAP-*dual* Open- or Closed- Boundary Conditions. (1)

So, the reanalyzed CAP of Albert Einstein in the only CN math. 4D-Spacetime that allows required always massive fermions with open boundary conditions as a direct math. result can be used to CN derive QM with all its still not-understood properties.

Open-BC describe all fermions which as a direct result must allow interactions in all allowed (3D-) space-like directions. This explains why all fermions must have both conserved rest-masses greater than zero and oscillating non-zero charge-densities explaining their conserved non-zero Bohr-magnetons. Open-BC CN describe stable particles which as a direct result comply to Fermi-Dirac statistics under interactions.

For example, two different fermions are not allowed to be at the same 4D-Spacetime position whatever their so-called QM eigenvalues. Open-BC also allow more so-called Fermi-Families with only different conserved rest-masses.

Closed-BC describe all bosons which as a direct result are only allowed to interact directly in the direction-of-motion (SR-worldline). N.B. When such particles are massive and charged (non-zero charge-densities) they of-course also allow interactions in the other space-like directions, however their resulting (inter-) actions by their math. properties themselves ónly allow interactions in the traveled SR-worldline! This mathematical property CN explains why all bosons must comply to Bose-Einstein statistics under exchange of pairs of bosons. Closed-BC, of course only allow one stable elementary particle for each degree-of-freedom of the analyzed 4D-Spacetime symmetry-group, so not more so-called particle-families.

This CN explains why there are only 4 different ***elementary*** (anti-symmetrical) spin 1 gauge-bosons: U(1)- Gauge-Symmetry Photon CN representing the anti-symmetrical spin 1 EM-field and the massive SU(2) gauge-bosons $\{W^+, W^-, Z\}$ CN representing the weak nuclear-force mixed by the Weinberg-angle. The last allowed gauge-symmetry in CN analyzed only-possible 4D-Spacetime is the SU(3)- Gauge-Symmetry. In the Standard Model of HEP this field describes the 3 Fermi-Families of Quarks not-understood as spin ½ fermions with additional in this case also required assumed also ***dual*** so-called Isospin ½ to end-up with 4 degrees-of-freedom. However, this model does not explain why Quarks must always be surrounded by a so-called sea-of-quarks or in other words why they cannot exist on their own. As a direct math. result, so-called "***Quarks***" can only be analyzed as elementary spin 1½ fermions which combine in bosonic duo's with spin 1 *(never stable spin 2 bosons!)* or fermionic trio's with (combined) stable spin ½.

In the only-possible 4D-Spacetime or 4D-Momentumenergy analyses the CN Gauge-Symmetry just is the experimentally determined Gauge-Symmetry of the Standard Model: U(1) x SU(2) x SU(3).

In CN 4D-Spacetime (and **CAP**-***dual*** 4D-Momentumenergy) analyses all possible transformations are CN described by a 4 x 4 = 16 degrees-of-freedom transformation-tensor $T^{\mu\nu}$ that can be expressed compliant to the **CAP** as the sum of 2 orthogonal contributions, of which one is symmetrical and the orthogonal part is anti-symmetrical: $T^{\mu\nu} = A^{\mu\nu} + S^{\mu\nu}$, (2)

with $A^{\mu\nu}$ anti-symmetrical with zero's on the diagonal and inverted 6 different non-zero elements in the upper and lower triangles. $S^{\mu\nu}$ is of-course symmetrical and has 10 degrees-of-freedom, i.e. possibly maximum 10 different non-zero transformation-variables.

Following CAP-compliant description (1) the two orthogonal transformation-tensors can be represented by math. explicitly described Spin-Representations:

$$T^{\mu\nu} = (\text{spin } ½ \otimes \text{spin } 1) \oplus (\text{spin } ½ \otimes \text{spin } 2), \quad (3)$$

with the first spin ½ sources the non-zero ideal harmonic-oscillating electromagnetic charge-densities (1) which are the sources of all possible gauge-fields and the second spin ½ representing the stable *(also)* ***oscillating*** rest-masses > zero which are the fundamental sources of the gravitational-field.

The explicitly described oscillating motion around the average axis-of-motion (SR-worldline) describes the experimentally always conserved spin CN.

CAP-***dual*** there are only two independent elementary bosons with zero rest-masses: The spin 1 anti-symmetrical U(1)- gauge-symmetry so-called photon CN representing the EM-field with it's (*spin*) 1 x (*anti-symmetrical*) 6 = 6 degrees-of-freedom and the orthogonal spin 2 symmetrical orthogonal, so invisible, graviton with it's (*spin*) 2 (***dual***) x (*symmetrical*) 10 = 20 degrees-of-freedom CN representing the graviton math. (CN) representing the invisible gravitational-field.

All aspects of all correct mathematical analyses must have 2 mathematical orthogonal contributions to make these analyses comply to Albert Einstein his still not-understood CAP! And these linear math. analyses can ***only*** be described in CN 4D-Spacetime and CAP-dual 4D-Momentumenergy which as only mathematical 4D-manifolds allow always massive fermions as required sources.

When solving the exact solvable Differential Equations, which are either one second-order time-derivative or easier to solve two consecutively first-order time-derivative DE both with 2 required Boundary Conditions to yield unique solutions, math. the following conclusions follow:

- One may also solve the DE for the squared polar-distance $x = \rho^2$ without any loss of information. This is a result of the DE of ideal harmonic oscillation in the 2D-plane orthogonal to the direction-of-motion and the fact that polar-distance $\rho \geq \rho_{min} > 0$.
- The average extensiveness described from the inertial-frame moving with the extended particle with origin at the average-position (at its SR-worldline) resulting from rotational-symmetry is in polar-coordinates given by:

$$2\langle\rho\rangle = \rho_{max} + \rho_{min} = 1½\rho_{max} = 3\ \rho_{min} = s \cdot l_h \cdot \Psi, \qquad (4)$$

with s the half-integer spin of fermions or the non-zero integer spin of elementary bosons, $l_h \approx 1.616\ 229(38) \times 10^{-35}$ [m] the well-known Planck-length and the Golden Ratio is $\Psi = ½(\sqrt{5}+1) \equiv 1 + \frac{1}{\Psi} \equiv 1 + \varphi = 1 + ½(\sqrt{5}-1) \approx 1.6180339887$.

Beautiful relationship (4) is a direct result of (CAP-) required ideal loss-less harmonic oscillation in the 2D-plane orthogonal to the direction-of-motion, also see (1).

Here it should be noted that so-called "***spinless***" ***elementary*** bosons just cannot carry energy proportional to a frequency because conserved angular-momentum is the result of **CAP** compliant ideal oscillating motion CN described by (1). This at-once already disproves the still assumed to be valid so-called Higgs-mechanism.

Quantum mechanics predicts that if it is possible for a particle to decay into a set of lighter particles, then it will eventually do so. This is also true for the still assumed to be valid elementary spinless so-called Higgs boson. The likelihood with which this happens depends on a variety of factors including: the difference in mass, the strength of the interactions, etc. Most of these factors are fixed by the Standard Model, except for the mass of the Higgs boson itself. For a Higgs boson with a mass of 125 GeV/c^2 the SM predicts a mean life time of about: 1.6×10^{-22} [s]. Even when a Higgs-boson is moving with the speed-of-light $c \approx 3\text{x}10^8$ [m/s] it will disintegrate within $4.8\text{x}10^{-14}$ [m] i.e.

a length of about 10.000^{th} of the average distance between an hydrogen-nucleus and its surrounding electron. Such an extreme unstable spinless-boson cannot ever impose a mass related conserved resistance to QM-particles with relativistic conserved rest-masses > zero!

For example, a massive particle must always have a non-zero speed related to the average-speed of the Higgs background-concentrate, so all different free moving massive particles just cannot have the same rest-masses due to possible different speeds related to the average speed of the assumed Higgs-background. The interaction between a Higgs-boson and any massive object must be independent of their relative speeds to be able to obtain an explanation of conserved rest-masses of analyzed objects called fundamental-particles. Actually, this shows completely that the still assumed to be valid Higgs mechanism must be CN incorrect.

The only way to resolve all difficult problems with still not-understood QM-theories is to stop analyzing stable QM-particles as Point-Particles with in this case required intrinsic-properties, but instead analyze QM (SR QFT) compliant to the CAP with extended particles described by (1).

As a direct result elementary bosons must have conserved spin in the direction-of-motion $s \geq 1$, of which all but one fundamental bosons have $s = 1$.

The only elementary bosons with different conserved spin values in the direction-of-motion, compared to the Standard Model are the both massive and charged quarks. Compliant to the CAP Quarks must be analyzed as the only elementary spin $s = 1½$ fermions, not as on their own stable spin ½ fermions with additional now also required dual so-called Isospin ½.

In the only massive fermions allowing 4D-Spacetime all possible transformations are CN represented by (2) and (3). As a direct result the only stable spin-values of (elementary or compound) particles are $s \in \{½, 1, 2\}$. However, the possible degrees-of-freedom run from $s = ½$ up to $s = 2$, so the only missing degree-of-freedom $s = 1½$ must also be used to describe quarks which are only detectable within an always surrounding Quark-Sea. This mathematically CN explains why Quarks must be analyzed as unstable elementary spin 1½ fermions. Quarks can only exist in the most stable spin 1 duo's called Mesons and Gluons (Quark Anti-Quark duo's with different color anti-color values) or the less-stable trio's with stable spin ½ so-called Baryons. Just like all other fermions, quarks must exist in 3 different rest-masses families in our 3 Fermi-Families universe {(up, down), (charm, strange), (top, bottom)}. By the way, other universes in the required valid so-called multiverse can also have different positive-integer Fermi-Families. In any case, all different universes in the multiverse must have their own unique Natural Constants, so must all be orthogonal so-called “invisible” & non-noticeable to one-another.