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Q(uantum)M(echanics) explained.

The up to this day still not understood QM , i.e. the **S**(pecial) **R**(elativistic) **Q**(uantum) **F**(ield) **T**(heories) resulting in the so-called Standard Model , appears mathematical ***unique*** derivable from a complete non-reducible **4D-Spacetime** symmetries analysis!

As will be explained later, the only possible space-like dimensionality of the mathematical analysis is 3D, i.e. uses the well-known 4D-spacetime analysis introduced by Albert Einstein. In this ***only*** possible mathematical space all possible space-time transformations of all possible SR tensors are given by a 4x4 = 16 degrees 2nd tensor. The dimension of a tensor gives the amount of times an independent 4-vector occurs in this tensor (a scalar is a 0th order tensor, a 1st order tensor just is a 4-vector, the fundamental tensor just is a 2nd order tensor, etc.. .). As said, all possible transformations of the only possible 4D-spacetime analysis are described with a 2nd degree tensor, which has ***only*** 4x4 = 16 degrees of freedom. This transformation tensor can be given completely by the consecutive operation with a 10D-symmetrical transformation tensor multiplied by a 6D-anti-symmetrical transformation tensor.

The 10D-freedom is mathematically also completely described with the direct product of spin2 x spin½, i.e. the spin2 graviton multiplied by all spin½ masses. The 6D-freedom can mathematically also be represented by the direct product of spin1 x spin½, i.e. the spin1 photon multiplied by all possible spin½ (electric) charges as the sources of the EM-field.

According to Einstein's C(omprehensive)A(ction)P(rinciple) , every mathematical analysis of our reality must ***always*** take into account curvature of 4D-spacetime! Up to this very day curvature is only taken into account on macroscopic scales. Like for example when describing our solar-system G(eneral) R(elativistic), to describe the orbits of our planets around the sun as processing harmonic elliptic oscillations around the sun. However, the CAP also demands curvature of 4D-spacetime to be included on *microscopic* scale, i.e. QM !

A SR-linear analysis implies that elementary particles are described mathematically as point-particles, which move along a linear 1D-worldline. The macroscopic curvature implies that this worldline, i.e. average position of this particle, on each described position possesses a finite point of curvature in the 2D-plane orthogonal to the worldline. For planets, described as massive point-particles around a static sun, this was for the first time described by Karl Schwarzschild. An identical method, that is doubling of degrees of freedom to comply to the CAP , implies on microscopic scales (QM), that elementary particles should be described extended in the 2D-plane orthogonal to the observed direction of motion (1D-worldline). And this non-compliance with the CAP is exactly why up to this day still nobody understands, the beautiful described Standard Model of SR QFT !

At the level of any QM description curvature of 4D-spacetime should also be taken into account, even when macroscopic gravitational curvature of 4D-spacetime can be neglected completely! So, even in a complete linear SR analysis of motion curvature of space-time ***must*** be included in the mathematical description of this described elementary particle! In other words, on local, i.e. mathematical linear level, which is easily described by standard mathematical means (SR QFT) our (and any possible other reality) can be derived completely from the following:

Experimentally all known elementary particles possess energy proportional to a detected frequency. This is why the CAP demanded doubling of degrees of freedom results in an harmonic oscillating motion described in the 2D-plane orthogonal to the described direction of motion. I.e. harmonic oscillation in the 2D-plane orthogonal to the observed direction of motion, i.e. the SR 1D-worldline.

The maximum extendedness (distance from the 1D-worldline) in this 2D-plane is ⅓ d_{max}(maximum diameter = $2\rho_{max}$), while the minimum distance from the average 1D-worldline is 1/6 d_{max}.

Mathematically the average extendedness <d> appears proportional with the constant angular momentum of the harmonic oscillating motion, i.e. the so-called spin , multiplied by the Planck-length and the proportionality constant just being the Golden Ratio ½(√5+1). From this mathematical symmetries analysis it's obvious that elementary spinless bosons do NOT comply to Einstein's CAP , i.e. must be human fiction. Furthermore, this mathematical analysis of QM also explains why the Golden Ratio appears so often. It's because it's a fundamental constant in the solution of the 2D-D(ifferential) E(quations) needed to solve the 2D-extendedness of all spinning elementary particles to describe them in compliance with Einstein's CAP !

The harmonic oscillation in the 2D-plane orthogonal to the observed direction of motion is most easily described with 2 consecutive 1st order DE. The easiest mathematical analysis uses cylindrical coordinates. To solve these integrals completely, two B(oundary) C(onditions) are required. These BC can be either open or closed.

Closed BC only allow one species for every independent symmetry group, while open BC have a positive integer number as free extra parameter of freedom. This positive integer number explains why our universe has more families of elementary particles, which only differ in the rest masses of the elementary particles. Our universe experimentally appears to have 3 different families, but the amount of possible different families depends on the natural constants, which come to life at the

start of the Big Bang (i.e. the collapse of a Black Hole in another universe) and the total energy which becomes available at this Big Bang.
As a direct result of this simple mathematical fact bosons (force-particles) must be described with closed BC, while fermions must be described with open BC! Particles with open BC are always able to interact with other particles in all space-like directions, i.e. ***must*** have non-zero masses. All electric charged elementary particles also possess charge, i.e. interact with the spin1 photon in all 3D-directions, and so also must be massive! This mathematical analysis explains why all fermions, including all charged elementary particles, are massive (m > 0) because they always interact with the invisible spin2 gravitational field.

Elementary particles with nonzero masses in a simple SR analysis allow knots in their harmonic oscillating path. This CAP consistent adaptation of the Standard Model implies that the ***only*** correct mathematical description of fermions (the sources of all bosons) must allow knots.
In 2004 Grisha Perelman proved that knots can only be described in 3D-space, i.e. **Einstein's well known 4D-spacetime**!

This fact shows that the only correct mathematical analysis of our reality must be a **4D-spacetime** analysis, which also complies to the CAP, i.e. ***describe elementary particles extended in the 2D-plane orthogonal to the direction of motion (SR-worldline)***!

The EM-field is not solved completely with the Maxwell relations. **SR** the Lorentz gauge-symmetry must also be imposed to solve the EM-field completely. The total gauge-symmetry in the only possible 4D-spacetime analysis just is the gauge-symmetry of the Standard Model, i.e. U(1)xSU(2)xSU(3) . The **U(1)xSU(2)** gauge symmetry describes the photon and weak nuclear forces {$W^{\pm}$, Z}, also see: http://en.wikipedia.org/wiki/W_and_Z_bosons . In this combined gauge-symmetry the **U(1)** photon and the **SU(2)** (also uncharged) Z-boson appear mixed by the so-called Weinberg angle. The **SU(2)** symmetry describes the charged $W^{\pm}$ bosons and the neutral Z boson. This is why the elementary charge-less Z-boson is massive, just like the charged $W^{\pm}$ bosons. As a result of this fact there are massive elementary bosons!

The SU(3) gauge-symmetry is a symmetry which mathematically describes spin3/2 quarks, without so-called " isospin ". This gauge-symmetry describes all hadrons , i.e. the uneven amount of combined quarks into spin½ baryons and the even amount of combined quarks, which represent the whole spin { …, -2, -1, 0, 1, 2, … } gluons and mesons. In general, that is at lower energies, only spins {-1, 0, 1} are observed as reasonable stable gluons and mesons.

As a result of this ***simple non-reducible complete 4D-spacetime symmetries analysis***, our universe, with 3 elementary fermions families, has only the following elementary particles:

All possible elementary particles in our 3-families universe:

Fermions: *3 different families*	**Bosons:**
leptons: electron, muon and tauon + anti-particles	graviton, the spin 2 elementary massless boson
leptons: massive chargeless neutrino's	photon, the spin 1 elementary massless boson
quarks 1st family: up-quark and down-quark	Weak nuclear forces: spin1 massive elementary gauge-bosons **W±, Z**
quarks 2nd family: charm-quark and strange -quark	Strong nuclear forces: spin1 colored quark+anti-quark gluons
quarks 3rd family: top-quark and bottom-quark	mesons: all non-gluon bose-quark combinations

All fermions have so-called **anti**-particles with sign-changed charged particles and helicity changed **anti**-particles in the case of neutral particles. All leptons are spin**½** particles and all non-separable quarks are spin**1½** particles without fictive so-called "isospin".

In **1931** Kurt Gödel proved his 2 incompleteness theorems. Proving that mathematical, i.e. ***linear***, analysis of any problem is incomplete. And the reason for these incompleteness problems is non-compliance with the CAP of all used easy linear mathematical analysis of our reality. Compliance with the CAP requires a doubling of the degrees of freedom to be able to describe curvature caused by always present **spin2** gravitational fields, which implies attraction between all massive elementary particles! Mathematical analysis just is an easy linear analysis of imaginable problems without curvature whatsoever! However, curvature can easily be imagined using mathematics when doubling the degrees of freedom to be able to describe curvature linearly! After compliance with the CAP , i.e. doubling of degrees of freedom in the mathematical analysis, Gödel's incompleteness theorems are solved completely by easy mathematical means. The only problem Kurt discovered in his mathematical logic analysis, was the problem of linearity of mathematics caused by curvature of **4D-spacetime** , i.e. non-compliance of math. used to analyze QM with the CAP !

Please also read http://quantumuniverse.eu/QMathematics.html to read how to rewrite QM such that this description includes curvature of space-time, i.e. complies with the CAP .

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