Theories Of Everything.

To be able to explain causality, easy linear mathematical analysis will be used. Just like everybody did learn on Secondary School and university.

To start with the TOE a few pre-requisites must be discussed.

First of all the theory must comply to Albert Einstein's Comprehensive Action Principle, i.e. include curvature of spacetime in the mathematical analysis. This curvature of spacetime has to be taken into account in two ways. Macroscopic and microscopic. Macroscopic is about the orbits of planets around a much heavier sun or Black-Hole. This motion results in the well-known precessing elliptic orbits around the heavy source of attraction and for the first time described by Schwarzschild. The microscopic compliance to the CAP comes to life by describing elementary particles as extended particles in the 2D-plane orthogonal to the described direction of motion. This CAP compliance explains why all elementary particles possess energy proportional to a detectable frequency and why the harmonic oscillating particles possess non-zero constant angular-momentum in the direction of motion, i.e. helicity. From mathematical analysis it can be shown that the average extendedness from the inertial-frame with origin on the average position (SR-worldline) is equal to:

$$2<\rho> = \rho_{max} + \rho_{min} = s \cdot \varphi \cdot l_h \tag{1}$$

With s the conserved spin (without the $\hbar$ because this constant is used in l_h) in the direction of motion, φ the Golden Ratio and l_h the Planck-length.

Among other things this explains why we have never ever observed a spinless elementary-particle. The Differential Equations needed to solve (1) and to describe the harmonic oscillation of all possible elementary-particles consists of two successive first order time-derivative DE. These two DE can only be solved with two Boundary Conditions. There are only two different choices for these BC: The BC are either open or closed. Open-BC differ from closed-BC because they have an extra degree of freedom. It is a positive integer which specifies after how many rotations the har-

monic oscillation in the 2D-plane orthogonal to the direction of motion repeats itself again. This simple mathematical fact implies that all fermions must be described with open-BC and all bosons, i.e. "force-particles", must be described with closed-BC. As a direct result of this mathematical fact all elementary bosons only allow one species for all allowed symmetry-groups.

At this moment we only need to check how many spacelike dimensions are possible to yield a self-consistent mathematical analysis of the TOE! Massless particles move with the speed of light c. This simple fact implies that time can be analyzed as a space-like-coordinate after multiplication with c. This was analyzed by Albert Einstein in the past century. Special Relativity analyzes 4D-space-time vectors because time and space should both be taken into account in a correct mathematical analysis. Still, time and space are not independent (Lorentz-contraction, time-dilatation). The only question now is, are there just 3 spacelike dimensions, or is it possible that there are more spacelike dimensions like it is assumed in String theories!?!

Around 2004 this problem was completely solved by Grigori Perelman together with Prof. Dr. Richard Hamilton working at the Stony Brook university in New York. In this work Grigori Perelman showed that mathematical knots are only possible in 3D-space, i.e. 4D-spacetime.

The CAP rewritten Standard Model of Quantum Field Theories should describe elementary particles as harmonic oscillating waves in the 2D-plane orthogonal to the direction of motion.

In this analysis fermions are described with open-BC and as a direct result of that always possess possibly more families and non-zero mass. Our universe has 3 different fermion-families. Massive wavelike harmonic oscillating fermions can be analyzed as moving forward-backward-forward in such a way that the oscillating path allows knots. This allows one simple conclusion:

> Fermions can only be described in 4D-spacetime. (2)

Fermions are the primary sources of all possible force-fields, so without fermions also no bosons, i.e. nothing at all.

According to (2) the only quantities that can be analyzed mathematically are 4-vectors of a certain degree, i.e. amount of Greek indices, with scalars having zero indices.

Rule (2) is not only valid in SR but also in General Relativity. And this results in mathematically easy, because imaginable, analyzable problems.

According to (2) all possible continuous transformations are given by a 2 indices transformation-tensor. And this 4 x 4 transformation-tensor $T_{\mu\nu}$ can uniquely be written as the sum of a symmetrical and an anti-symmetrical transformation tensor:

$$T_{\mu\nu} = S_{\mu\nu} + A_{\mu\nu} \qquad (3)$$

The symmetrical transformation-tensor $S_{\mu\nu}$ has 10 degrees of freedom and the anti-symmetrical transformation-tensor $A_{\mu\nu}$ has 6 degrees of freedom. All elementary particles have non-zero spin and this spin is explained when describing these particles in compliance with the CAP. In this analysis spin isn't "intrinsic" anymore but indeed possesses spacelike extensiveness in the 2D-plane orthogonal to the direction of motion. So the spin has a mathematical representation which can be used to describe other properties like the two transformation-tensors of (3).

The anti-symmetrical transformation tensor $A_{\mu\nu}$ can be represented by spin½ x spin1. The spin1 is a representation of the anti-symmetrical EM-field and the spin½ represents the charges as sources of this EM-field. So, the photon does not "carry" the EM-field, but is itself the irreducible representation of this field.

The symmetrical transformation-tensor $S_{\mu\nu}$ can be represented by spin½ x spin2. The spin2 is a representation of the symmetrical gravitational-field and the spin½ represents the always massive particles again as sources of this gravitational-field.

Note that the spin½ masses and charges are called particles and not elementary particles here!

From (3) it is easily seen that the only observable particles must have spins with the values:

$$s \in \{½, 1, 2\} \qquad (4)$$

The EM-field is anti-symmetrical so allows both positive and negative charges, while the gravitational-field is symmetrical so only allows attraction between masses.

The gauge-symmetry of the SM is: U(1) x SU(2) x SU(3)   (5)

Any mathematical analyzable reality just has three spacelike orthogonal directions. As a result of this fact the gauge-symmetry of the SM (5) is the maximum allowed gauge-symmetry for any possible analysis.

The U(1) x SU(2) gauge-symmetry describes mixed by the Weinberg-angle the U(1) EM-field, i.e. the massless uncharged spin1 photon, and the SU(2) weak-nuclear force bosons of which two are charged with ± electron-charge e, described as $W^{\pm}$, and the SU(2) symmetry induced even heavier uncharged Z-boson.

Charged particles interact with the EM-field in all spacelike directions and as a result of that also interact with the spin2 gravitational-field, so must have non-zero rest-masses!

On mathematical grounds the SU(3) gauge-symmetry group describes all quarks as elementary spin1½ particles without so-called isospin of QCD. All possible "stable" spins are given with (4) and because quarks are spin1½ particles they cannot exist as stable particles on their own, but always stay together in at least couples of two quarks in a very dense quark-background. The spin1½ of quarks directly implies that their only possible charges are:

quark-charge $(q_q) \in \{\pm\frac{1}{3}, \pm\frac{2}{3}\}$ (6)

As a result of this analysis the only possible values of the spin s of elementary particles are:

$s \in \{\frac{1}{2}, 1, 1\frac{1}{2}, 2\}$ (7)

Any gauge-symmetry is an anti-symmetrical symmetry and this is why the gravitational-field cannot be described with a gauge-symmetry. Even though this is very often assumed!

All somehow stable quark combinations are called hadrons. The combined bosons are called gluons

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and mesons. The combined fermions are called baryons, i.e. the proton and neutron. In QCD gluons are assumed to be elementary particles representing the strong nuclear-force, however such elementary bosons can not be derived from a complete non-reducible 4D-spacetime symmetries analysis. Only the assumed spin1 of gluons is correct. In QCD the quarks possess a so-called color because the value appears to have 3 different values (Red, Blue and Green). However this is mathematically just a characteristic of the SU(3) gauge-symmetry group. A baryon as a stable particle is colorless. For example a proton uud is described as uRed-uBlue-dGreen. This implies for the strong nuclear-force that it both annihilates one color and creates another color and this is only possible in the form of a combined particle of two quarks, i.e. a quark anti-quark couple. For example ūRed-uBlue, with ūRed a Red anti-quark of the up-type. Here the anti-quark annihilates the color Red quark and the Blue up-quark comes to life after this interaction. This is also presented in the strong nuclear-force, however the explanation assumes spin1 elementary gluons are also needed in this interaction. And this cannot be derived from the complete non-reducible 4D-symmetries analysis.

Our universe has 3 different fermion-families and this implies 6 different quarks (up-down, charm-strange, top-bottom) and their anti-quarks, i.e. 12 different quarks.

The elementary leptons have for each family an electron and its anti-particle the positron and its uncharged third particle the neutrino. This amounts into a total of 3 x 3 = 9 different elementary leptons.

Together with the quarks this results into (4 + 3) x n different elementary fermions in a universe with n fermion-families. Our universe has 7 x 3 = 21 different elementary fermions.

From the most general transformation-tensor (3) and its equivalent mathematical spins-representation:

$$\text{spin2 x spin½ + spin1 x spin½} \tag{8}$$

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We now know that we only have two elementary (required uncharged) massless particles:

The spin1 [photon](#) and the spin2 [graviton](#)   (9)

These particles both move with the same maximum [light-speed](#) and this is always valid for any observer. Due to [Lorentz-contraction](#) such *massless* [elementary particles](#) seem to be real 1D-point-particles to all observers. However, at the moment of emission or absorption both the boson and the fermion have the same average position so the emission/absorption must be described with extended harmonic oscillating waves in the 2D-plane orthogonal to the direction of motion of the fermion, also see (1).

The only other 3 elementary Bose-particles in any possible universe are of course the spin1 SU(2)-gauge-symmetry weak-nuclear-force particles $W^{\pm}$ and the uncharged Z-boson.

So, a universe with n fermion-families has 5 + 7 x n different elementary particles, which follow completely with all their characteristics from a complete non-reducible 4D-spacetime symmetries analysis, just like [David Hilbert](#) already envisioned at the International Congress of Mathematicians in Paris in 1900. He sincerely hoped this in [problem 6](#) of his 23 presented problems in Paris.

This results in 26 different elementary particles in our 3-fermion families reality with spins given by (7). Also see the list on page 6 of [elementary particles](#).

The réal mathematical physicists can start their stress-releasing "linear" analysis straight away, because I've given ENOUGH hints how to perform this "simple" analysis to derive the ONLY POSSIBLE Theories Of Everything!!!

Please also visit my website for more information: http://quantumuniverse.eu

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