

Abstract:

Degeneracy classes of “quanta” are providing 2 levels:

- 1) **Quantum Gravity together with Hermitean conjugation, and**
- 2) **the Grand Unification (GUT) of all forces of nature.**

By 1), space-time and Einstein’s General Relativity are fully quantized, revealing Dark Energy to be some quantum effect on cosmic scale determining the non-vanishing big bang radius of a non-singular universe.

By 2), gravitation is identified to be the singlet component related to a triplet of “internal” forces whose triple Kronecker terms are adding 4 additional fundamental forces. By using gravitation as a blueprint for “internal” interactions, this triplet structure explains the experimentally observed quark confinement.

Assuming a primeval universe to saturate all “internal” bonds, we deduce the experimental properties of (Cold) Dark Matter together with a mechanism how ordinary particles are condensing out of it. Particles are summing up the tiny masses of their “internally” saturated non-valence constituents plus (negligibly) their valence parts. Higgs particles are not needed.

Last year in Göttingen [2], I presented the No-Go-Theorems stating why the mathematics used by strings and branes never will succeed.

In another lecture in Jena [3], I showed that a realistic model of nature should be an atomistic one. Then, the simple combination of combinatorics with probability is giving rise [3] to a classification scheme of nature according to (small) powers of the number 8 of degeneracy “classes” of quanta: $q \rightarrow q_r \rightarrow q_{r,s} \rightarrow \dots (r,s, \dots \in \{1, \dots, 8\})$.

The 1st octuplication $q \rightarrow q_r$ yields

Quantum Gravity,

i.e., the **fully quantized version of** background-independent **General Relativity,**

**treating a particle observed from outside
by the same equation as
our universe observed as a particle from inside.**

The 2nd octuplication $q_r \rightarrow q_{r,s}$ extends QG to the

Grand Unification (GUT) of all forces of nature.

For a 3rd octuplication, actually, there is not yet any experimental necessity. Equations are not derived from the variation principle but from Casimir operators.

Due to $8 = 2^3$, every such 8-dimensional label may be replaced by some triple bit structure

$$\mathbf{r} \equiv (\mathbf{him}), \quad \mathbf{s} \equiv (\mathbf{jkl})$$

whose labels h,i,j,k,l,m are running from 1 to 2, each, giving

$$\mathbf{q}_{r,s} \equiv \mathbf{q}_{hijklm}.$$

By the 3-component h_3 of h-spin, and by defining

$$\mathbf{q}_{2im} \equiv \Psi_{im}, \quad \mathbf{q}_{1im} \equiv \Psi_{im}^+,$$

we obtain Dirac's theory with the non-diagonal components

h_1 and h_2 defining Hermitean conjugation.

They *formally* are giving rise to extending real probability amplitudes to complex ones [3].

The labels i,m are defining a classification according to a group $U(2,2)$, whose $(2+2)^2 = 16$ generators may be identified [5] [2] with

$$\begin{aligned} L_\mu &\equiv (\text{charge}, \quad \text{spin}), \\ M_\mu &\equiv (\text{heavy mass}, \text{Lorentz booster}), \\ P'_\mu &\equiv (\text{energy}, \quad \text{momentum}), \\ Q'_\mu &\equiv \text{CMS-(time, \quad space)}. \end{aligned}$$

After introducing the measuring units $\mathbf{c} = 1 = \hbar$, and

$$\begin{aligned} \mathbf{P}_\mu &\equiv \frac{1}{\ell} \mathbf{P}'_\mu, \\ \mathbf{Q}_\mu &\equiv \ell \mathbf{Q}'_\mu, \\ \mathbf{D} &\equiv \ell \mathbf{M}_0, \end{aligned}$$

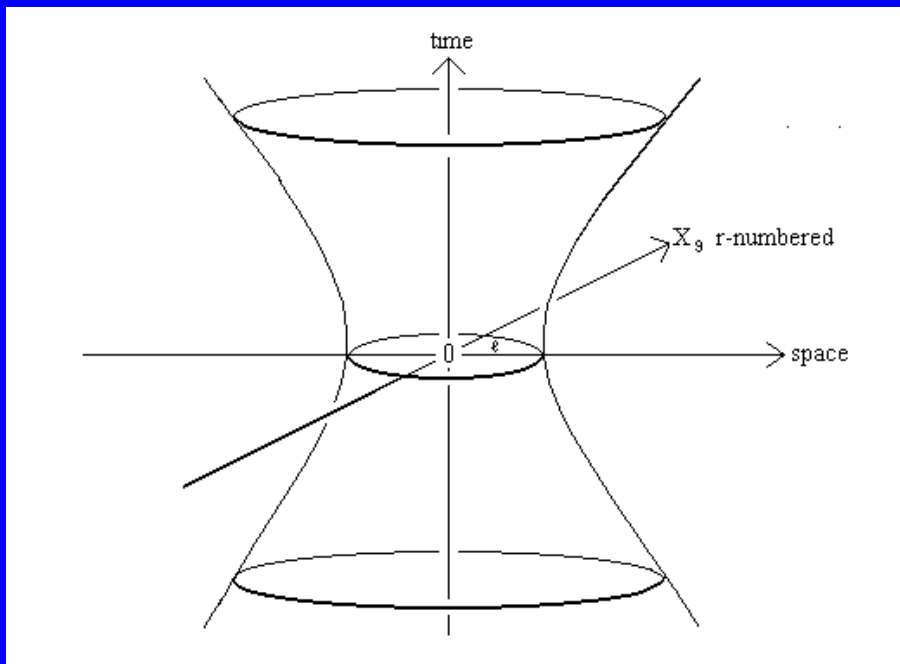
(ℓ is not Planck's length!)

Einstein's *bent* space-time is identified [5] [2] as the non-linear form

$$\mathbf{X}_\mu \equiv \mathbf{Q}_\mu / \mathbf{D}_\mu,$$

or, more precisely, $2 \mathbf{D} \mathbf{X}_\mu \mathbf{D} = [\mathbf{D}, \mathbf{Q}_\mu]_+$.

- **Quantization**, then, is defined by the **SU(2,2) commutation relations** (collapsing to canonical quantization in the approximation of commuting space-time components X_{μ}).
- Einstein's **curvature of space-time** is reproduced by $C_{\text{SU}(2,2)}^{(2)} = \text{const.}$, where the non-linear eigenvalue condition of the 2nd-order Casimir operator is describing some **bent** hyperplane.
- And Einstein's **background independence** of GR is nothing else than the **irreducibility** condition of our SU(2,2) representation forcing all physics onto Einstein's **bent** hypersurface of space-time X_{μ} given by $C^{(2)} = \text{const.}$ (" X_9 " is collecting the remaining parameters):



Observe the waist radius l : It is the same parameter we met already with the identification of Dark Energy [5] [2], namely:

By the quantized version of GR, Heisenberg's uncertainty commutator $[X_{\mu}, P'_{\mu}] \propto \delta_{\mu\mu}$ is supplemented by a term (*in rsd*)

$$[P'_{\mu}, X_{\mu}] = -i \left((-1)^{\delta_{\mu'0}} \delta_{\mu'\mu''} - \frac{1}{2\ell^2} (\widehat{X}_{\mu''} \widehat{X}_{\mu'} + \widehat{X}_{\mu'} \widehat{X}_{\mu''}) \right) \xrightarrow{\ell \rightarrow \infty} -i (-1)^{\delta_{\mu'0}} \delta_{\mu'\mu''}$$

to be identified to represent Dark Energy [5] [2]. What Bojowald already had shown by his LQG approximation – namely that the Big Bang is not singular and that one can proceed to negative absolute times by circumventing it – here is proved directly. Thus, we may state:

Dark energy is some quantum effect on cosmic scale.

Dark energy is the agent of *physics* to execute the *mathematical irreducibility* of our universe.

And

Irreducibility is *slicing* parameter space into **bent universes** orthogonal to each other.

These properties of the “internal” singlet representation called “gravitation” are providing the blueprint for the behaviour of the “internal” vector representations. I regret not to have got the time, here, to proceed into the details of **cosmic inflation** [5] [2] and into the physics “**before the Big Bang**” [5].

Anyway, for Dirac's creation operators a^+_{i} , the 2nd octuplication $q_{him} \rightarrow q_{hijklm}$ yields an a^+_{ijkl} . Their labels $_{ijkl}$ are defining 3 “internal” forces in addition to gravitation given by $_{im}$:

- j** for **electromagnetism**,
- k** for **strong interactions**,
- l** for **weak interactions**.

Their $2^3 = 8$ diagonal eigenstates, altogether, are providing a preliminary set of 8 eigenvalues for each of the eight a_{ijk}^+ – remember that the “standard model” needs 24 quarks + leptons plus more than a dozen fundamental bosons:

#	spin component	“up ₁ ” / “down ₁ ”		“up ₂ ” / “down ₂ ”		“leptonics”		“exotics”	
		a_{i211}^+	a_{i111}^+	a_{i222}^+	a_{i122}^+	a_{i212}^+	a_{i112}^+	a_{i221}^+	a_{i121}^+
0.	$2h_3$	+	+	+	+	+	+	+	+
1.	$2j_3$	–	+	–	+	–	+	–	+
2.	$2k_3$	+	+	–	–	+	+	–	–
3.	$2l_3$	+	+	–	–	–	–	+	+
4.	$4j_3k_3$	–	+	+	–	–	+	+	–
5.	$4j_3l_3$	–	+	+	–	+	–	–	+
6.	$4k_3l_3$	+	+	+	+	–	–	–	–
7.	$8j_3k_3l_3$	–	+	–	+	+	–	+	–

Our dimension $8 = 2^3$ admits a triple Kronecker representation in terms of Pauli’s matrices

$$\sigma_j \times \sigma_k \times \sigma_l .$$

This form, now, allows the application of permutation operators on its 3 labels. When using these permutations as generators of some 3-dimensional continuous group – say a $U(3)$ – we observe that its split

$$U(3) \rightarrow U(1) \times SU(3).$$

yields the

“internal” **singlet U(1)** describing **GR**
and the “internal” **vector** describing the 3 “internal” forces.

As a subgroup of the 8-dimensional group of our 2^{nd} octuplication, it is manifesting the (formal) equivalence of all 4 forces, i.e., the Grand Unification: All 4 forces can be transformed into each other!

In addition, by splitting off the gravitational singlet, all “internal” $SU(3)$ generators are forced to become traceless:

$$A_\alpha^\beta \rightarrow A_\alpha^\beta - 1/3 \delta_\alpha^\beta \text{tr } A .$$

By equivalence, this property is spreading over the entire 8-dimensional group, except to its singlet “gravity” representation (*to which, however, I am adding the same factor due to convention*). In differences, these additives will cancel each other, of course. After constructing useful linear combinations and inverting some signs, the above table will adopt the following form:

#	spin / charge	“up ₁ ” / “down ₁ ”		“up ₂ ” / “down ₂ ”		“leptonics”		“exotics”		
		\mathbf{a}_{i211}^+	\mathbf{a}_{i111}^+	\mathbf{a}_{i222}^+	\mathbf{a}_{i122}^+	\mathbf{a}_{i212}^+	\mathbf{a}_{i112}^+	\mathbf{a}_{i221}^+	\mathbf{a}_{i121}^+	
0.	$\mathbf{N} \equiv -\frac{2}{3} \mathbf{h}_3$	$+\frac{1}{3}$	$+\frac{1}{3}$	$+\frac{1}{3}$	$+\frac{1}{3}$	$+\frac{1}{3}$	$+\frac{1}{3}$	$+\frac{1}{3}$	$+\frac{1}{3}$	← particle number N
1.	$\mathbf{Q} \equiv +\frac{1}{3} \mathbf{h}_3 - \mathbf{j}_3$	$+\frac{2}{3}$	$-\frac{1}{3}$	$+\frac{2}{3}$	$-\frac{1}{3}$	$+\frac{2}{3}$	$-\frac{1}{3}$	$+\frac{2}{3}$	$-\frac{1}{3}$	← electric charge Q
2.	$\mathbf{T} \equiv +\frac{1}{3} \mathbf{h}_3 - \mathbf{k}_3$	$-\frac{1}{3}$	$-\frac{1}{3}$	$+\frac{2}{3}$	$+\frac{2}{3}$	$-\frac{1}{3}$	$-\frac{1}{3}$	$+\frac{2}{3}$	$+\frac{2}{3}$	← strong charge T
3.	$\mathbf{L} \equiv \frac{1}{2} (\mathbf{l}_3 - \mathbf{k}_3)$	0	0	0	0	$-\frac{1}{2}$	$-\frac{1}{2}$	$+\frac{1}{2}$	$+\frac{1}{2}$	← lepton number L

#	Kronecker spins									<i>In addition we find:</i>
4.	$\mathbf{\Lambda} \equiv (\mathbf{j}_3 \times \mathbf{k}_3 - \mathbf{j}_3 \times \mathbf{l}_3 + 2\mathbf{j}_3 - \mathbf{j}_3 \times \mathbf{k}_3 \times \mathbf{l}_3)$	0	0	0	0	$-\frac{1}{2}$	$+\frac{1}{2}$	0	0	← leptonic charge Λ
5.	$\mathbf{E} \equiv \frac{1}{2} (\mathbf{j}_3 \times \mathbf{k}_3 - \mathbf{j}_3 \times \mathbf{l}_3 - 2\mathbf{j}_3 + \mathbf{j}_3 \times \mathbf{k}_3 \times \mathbf{l}_3)$	0	0	0	0	0	0	$+\frac{1}{2}$	$-\frac{1}{2}$	← exotic charge E
6.	$\mathbf{A} \equiv \frac{1}{2} (\mathbf{k}_3 \times \mathbf{l}_3 - \mathbf{l}_3)$	0	0	$+\frac{1}{2}$	$+\frac{1}{2}$	0	0	$-\frac{1}{2}$	$-\frac{1}{2}$	← strong charge A
7.	$\mathbf{M} \equiv \frac{1}{2} (\mathbf{j}_3 \times \mathbf{k}_3 + \mathbf{j}_3 \times \mathbf{l}_3 - 2\mathbf{j}_3 - \mathbf{j}_3 \times \mathbf{k}_3 \times \mathbf{l}_3)$	0	0	$+\frac{1}{2}$	$-\frac{1}{2}$	0	0	0	0	← strong charge M

The **additional strong charges** A and M are modifications of their main representative T, to be calculated from the various isomultiplet masses. (*A, e.g., keeps the nucleons at distance within a nucleus.*) Λ will reveal to be even stronger than the “strong” triality force; it **binds a lepton** together. The **exotic charge** E, *due to its special combinations with triality T and leptonic charge Λ , will give rise to some sophisticated kind of “organic” particle physics when compared with the relatively simple conventional “anorganic” particle physics [5]. Matter containing such “exotic” quanta (in addition to ordinary quanta) are expected to concentrate in the cores of black holes, e.g.* I regret not to have got time enough, here, for explaining all this in detail. Those “internal” forces will be adding additional parameters (*which string models are calling “dimensions”*) to our hyperboloid.

Locally, the irreducibility condition $C^{(2)} = \text{const.}$ can be expanded into a series of oscillator potentials. A part of these oscillator forces will have a “**horizon**” (*classically corresponding to the reversal point*) which is of macroscopic or even of cosmic magnitude – for electromagnetism, e.g. For other forces, however, these oscillator forces will show up some microscopic horizon.

In order to overcome such an oscillator force, our quanta necessarily must couple to aggregates whose compound charges the oscillator potentials are acting on are summing up to zero. *Otherwise they could not pass such a horizon* from in- to outside. For “trianity” charge T – i.e., for the main component of the “strong” nuclear forces – this is the well-known effect of

“quark confinement”.

Well, strings and branes have had more than 40 years time to to develop their model by 10,000s of theoreticians. I am working alone. My 15 minutes, here, do not suffice to provide you a full survey over QG and its GUT-extension, especially not over weak interactions, flavours, parity, and cosmology. Let me, hence, conclude with just one of the “hot spots” of physics:

Due to their horizon property, our quanta will predominantly have paired to the 4 complexes $a_i^+ b_i^+$, etc., with all their “internal” quantum numbers summed up to a singlet:

Our **virgin universe** will behave like a **gas** whose “molecules”
predominantly are pairs of the **4 types $a_i^+ b_i^+$, $a_i^+ a_i^-$, $b_i^- b_i^+$, $b_i^- a_i^-$.**

Those 16 pairs are generating QG. They **carry units of energy +1, 0, 0, -1**, respectively ($\ll m^{(\text{electron})}$).

Provided some of those quanta are left unpaired – *and if only because they did “not yet” find their partners* – then, those unpaired “**valence quanta**” among the “vapour molecules” of saturated “virgin matter”, obviously, are representing some kind of **condensation germs**, about which those building bricks of virgin matter are lumping together due to their Van-der-Waals-like forces – like water molecules in a cloud around a particle of soot. In our case,

The droplets condensing out of that quantum steam “humidity”
are (complete) **elementary particles**.

Now, those $a_i^+ b_i^+$, etc., are carrying their own units of energy as I just told you. Hence,

As particle **masses are accumulating** with their **non-valence parts**,
Higgs particles are not needed!

If “they” are found in spite, as ordinary particles – so what: It’s a different model! On the other hand,

The building bricks of virgin matter, as a matter of principle, are **not localizable**

because the space-time operators of QG are non-compact. For being measurable at least approximately, *according to the law of great numbers*, the “cooperation” of plenty of them would be necessary. However,

By their exactly measurable energies, at least the
 $a_i^+ b_i^+$ and $b_i^- a_i^-$ are executing **gravitation**.

Hence,

That diffuse “gas” made of the $a_i^+b_i^+$, $a_i^+a_i^-$, $b_i^-b_i^+$, $b_i^-a_i^-$
is identifiable as (“Cold”)

Dark Matter.

- [1] C. Birkholz, Verhandl. DPG (VI) **48,2/T** 25.3 (Dresden, 2013).
 - [2] C. Birkholz, Verhandl. DPG (VI) **47,1/GR** 10.1 (Göttingen, 2012).
 - [3] C. Birkholz, Verhandl. DPG (VI) **48,1/AGPhil** 10.3 (Jena, 2013).
 - [4] C. Birkholz, Verhandl. DPG (VI) **48,1/GR** 20.1 (Jena, 2013).
 - [5] C. Birkholz, “Weltbild nach Vereinheitlichung aller Kräfte der Natur im 3. Jahrtausend“, ISBN 978-3-00-030847-5 (2010).
- Since 2010, new, additional relations have been uncovered allowing the old discoveries to be founded more stringently.

Free copies on request. (My postcard address is in the conference catalogue.)