The Structure of **Hadronic Flavours** and **Weak Interactions** as Deduced from **Quantum Gravity** and Its **GUT** Extension

C. Birkholz

presented at the DPG Spring Conf. on particle physics, Wuppertal/Germany, T 97.5 (2015) [1].
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Abstract:

In QG and its GUT extension, the valence parts of quarks are called “quanta”. It is argued why flavoured quanta should be multiple-quanta structures entirely made of ordinary up- and down-quanta. In fact, corresponding 3-quanta structures are presented to satisfy all we need. The existence and structure of additional quark generations is predicted.

It is shown that, after resolving all flavours into these 3-quanta structures based on QG, weak interactions of all kind are conserving all their quantum numbers absolutely. “Broken” quantum numbers do not exist.

This is exemplified by analysing various weak decay modes of baryons, mesons, and the weak bosons. Thus, not only the ordinary β-decay of baryons, mesons, and the weak bosons is scrutinized, but also purely non-leptonic and mixed modes.

All this is based on the fundamental indivisibility of a particle into a valence and a separate non-valence part in QG, denied by quantum field theories.

For more information on QG and GUT see www.q-grav.com .

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The "Standard Model" is a story of fundamentalism. A few years only after Gell-Mann had detected the quark structure of hadrons, narrow-minded fundamentalists imposed their

Dogma: ***All baryons are 3-quark structures, All mesons are 2-quark structures.***

This excluded **nuclear physics**. And this excluded **atomic physics**, in addition. The construction of models violating this arbitrary doctrine had to be punished by loosing one's reputation as a physicist.

This dogmatism gave an abrupt end to all models describing P-waves as

$$\textbf{orbital excitations} \quad 0_{i'i''} \equiv \sum_{jkl} a^{+}_{i'jkl} b^{+}_{i''jkl}$$

of functions of Dirac's a^+ and b^+ (the label $_i$ is spin, $_{jkl}$ are the "internal" interactions).

With*out* their energy-momentum dependence, however, these pair combinations

$$a^{+}_{i'jkl} b^{+}_{i''jkl}\ ,\ a^{+}_{i'jkl} a^{-}_{i''jkl}\ ,\ b^{+}_{i'jkl} b^{-}_{i''jkl}\ ,\ b^{-}_{i'jkl} a^{-}_{i''jkl}\ , \qquad \text{(summed over jkl)}$$

are equivalent to Dirac's 16 γ-matrices generating **Quantum Gravity** on Einstein's ***bent*** space-time of fully quantized **General** Relativity [2]! Due to that dogma, without any need, fundamental physics amputated itself to the arbitrariness of **Special** Relativity and the variation principle, ignoring GR and QG!

For diagonalization, the *non*-compact ***space-time*** components X_μ need an infinite set of compact eigenstates in QG. Translated into physics, this means applying the **law of great numbers**. This, however, necessarily demands the existence of some

level of "quanta" far below the level of quarks.

The 16 red combinations $a^+_{i'jkl} b^+_{i''jkl}$, etc., had been shown to giving rise to the building blocks of the **non-valence** parts of particles in QG [3] [4], and (when summed over $_{jkl}$) to represent **Dark Matter** [3] [4]: A simple quark, thus, still is *consisting* of a huge number of "quanta" in order to be diagonal to some space-time component!

Last year in Mainz [5], I introduced the ***lepton* flavours** as non-linear structure features:

Flavours are **no quantum numbers.**
They **are non-linear structures**

simple enough to occur more than once within one and the same particle valence. But what, then, about ***hadron* flavours**? Let us consider Dirac's creators $a^+_{\bullet jkl}$ carrying different "rucksacks"**:**

$$a^+_{\bullet jkl}(a^+_{\bullet 212} b^+_{\bullet 212}) \qquad \text{or} \qquad a^+_{\bullet jkl}(a^+_{\bullet 112} b^+_{\bullet 112}) \qquad \text{etc.}$$

each of them coupling to spin=½, *connected with special Young structures (+1,+1,0^5,–1) in 8 dimensions within a U(16,16) Young frame (+2,0^{30},–1)* of the decomposition chain **U(16,16)** $\supset$ $SU(2,2)_{GR}$ x U(8) $\supset$ $\mathbf{SU(2)_{spin}}$ **x** $\mathbf{U(8)}_{\text{"internal"}}$. The characteristic feature of all these constructions is that their *additive* quantum numbers are exactly equal to those of the naked $a^+_{\bullet jkl}$! These constructs may be considered as additional **generations** of the naked starting quant [6]**:**

1. Generation	$a^+_{\bullet jkl}$	up / down
2. Generation	$a^+_{\bullet jkl}(a^+_{\bullet 212} b^+_{\bullet 212} \cos\alpha + a^+_{\bullet 112} b^+_{\bullet 112} \sin\alpha)$	charm / strange
3. Generation	$a^+_{\bullet jkl}(a^+_{\bullet 212} b^+_{\bullet 212} \sin\alpha - a^+_{\bullet 112} b^+_{\bullet 112} \cos\alpha)$	top / bottom
etc.		

The flavoured baryons and mesons, thus, can be easily represented as many-(valence-)quanta constructions, confirming the ancient "angular momentum" and parity assignments of Gell-Mann's contemporaries. For hadrons, hence,

The valence of a flavoured quant should be some 3-quant construct $a^+(a^+b^+)$.

In order to avoid a conflict with that later dogma of "3-quants only" for a baryon, that triple combination arbitrarily had been redefined to represent just one *single* "strange" quark [6]:

$$\lambda^+ \equiv a^+(a^+b^+)$$

giving

$$\Sigma \equiv a^+a^+\lambda^+ \equiv a^+a^+\, a^+(a^+b^+),$$
$$\Xi \equiv a^+\lambda^+\lambda^+ \equiv a^+a^+\, a^+(a^+b^+)\; a^+(a^+b^+),$$

… , and

$$\bar{K} \equiv \lambda^+b^+ \quad \equiv a^+(a^+b^+)b^+,$$

e.g.

By *counting* the appearance of any of such flavour within some particle state, we obtain some integer number. In experiment, there are violations of those counts: flavours appear to be "broken". In our GUT, this may happen, for *hadronic* flavours, in case that such a rucksack is breaking apart into its ordinary constituents, or that such a rucksack is packed together out of ordinary quanta, respectively. This, usually, will happen in "weak" interaction processes. Strictly considered, however, in none of those cases, the conservation of *any quantum number* is violated [6]! *(Parity is discussed with the mathematicians* [7]*.)*

A Δ-resonance will split into a strange triplet by exciting one of its down-quanta, and into a charm triplet by exciting its respective up-quant:

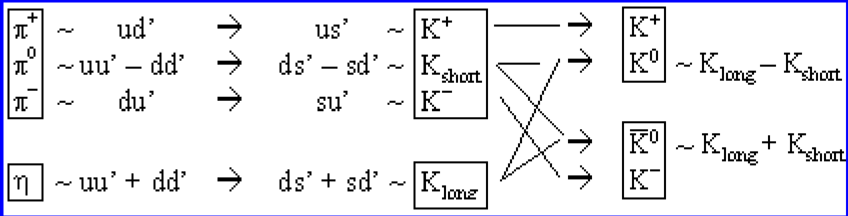
$$(\Delta^{++},\Delta^{+},\Delta^{0},\Delta^{-}) \rightarrow (\Sigma^{+},\Sigma^{0},\Sigma^{-}) \oplus (\Sigma_c^{++},\Sigma_c^{+},\Sigma_c^{0}) .$$

And the nucleon doublet will similarly split into two charge singlets:

$$(p,n) \rightarrow \Lambda \oplus \Lambda_c^{+} .$$

Here, the Σ_c^{++} and the Σ^{-} will carry isospin $I_3 = \pm{}^3/_2$, while the 6 additional particle types are carrying $I_3 = \pm{}^1/_2$.

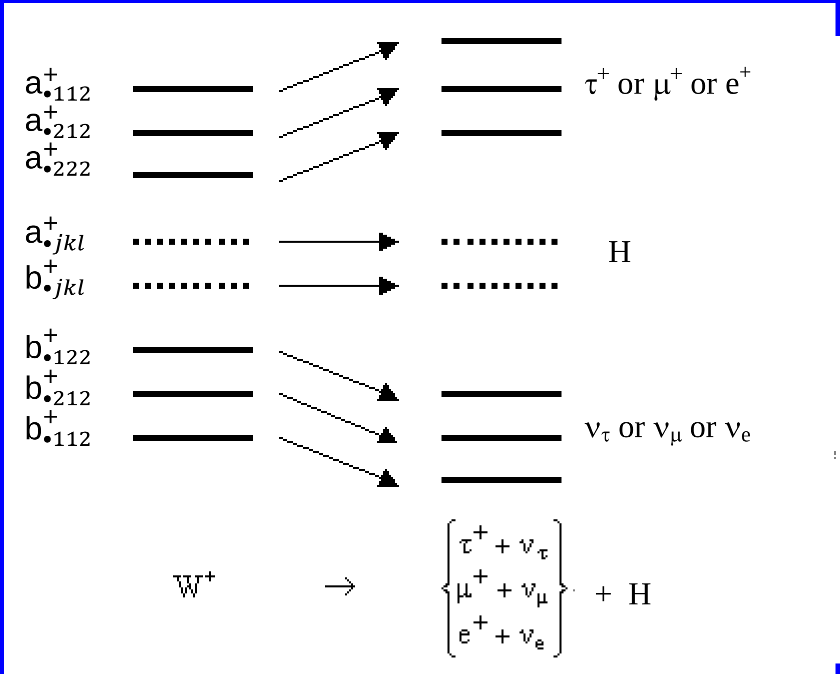
The situation for the pion and the η-meson, when correspondingly excited to the 2 kaons, is



Conventionally, the K and $\overline{K}$ *(right-hand side)* are isodoublets, in our GUT they are an isotriplet + isosinglet *(in the center)*. *(The η-meson, here, still is represented in the conventional 2-quant fashion.)*

According to the GUT model, hence, isospin – when (re)defined correctly [6] – will be absolutely conserved also in all types of "weak" interactions. *(Parity features are discussed with the mathematicians.)* Let me just emphasize, here: All problems are properly solved!

Before treating "weak" reactions [6], let me briefly recall some features of a **weak boson**. Due to its decay mode into a lepton *pair*, a W^+ should contain at least one lepto-nucleus + one antilepto-nucleus. Including a charge correction, these are 3+3 = 6 quanta. By parity, their valence part should be a ***configuration mix*** of this 6-quant meson state with an 8-quant meson state. Their decay into a lepton pair, then, can be reproduced by the rough sketch



The "H", here, refers to a dark matter constituent in one of their non-valence output parts. The upper a^+a^+ are the antilepto-nucleus, the lower b^+b^+ the lepto-nucleus present in a W-meson.

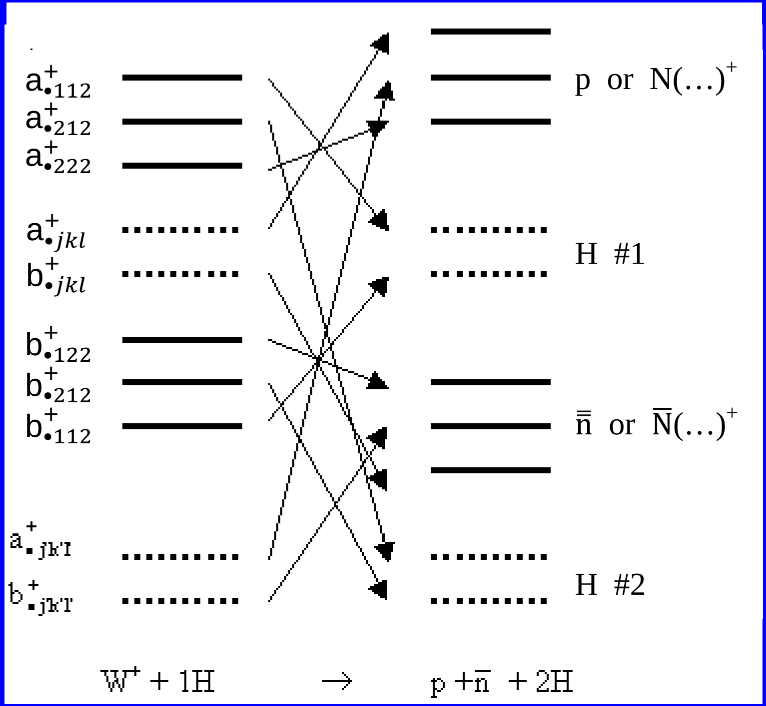
The so called **“maximal ‘violation’ of parity”** is ***no*** ‘violation’, indeed, but a misinterpretation [7] of a correct behaviour of nature by the “standard” model, which is consequently ignoring the existence of a non-valence part within a particle. However,

A valence part is inseparable from its non-valence part !

As constituents within a particle, a certain pair $a^+_{\bullet 222} b^+_{\bullet 122}$ will be mixing by Young more or less intensively with pairs like $a^+_{\bullet 211} b^+_{\bullet 111}$ or even $a^+_{\bullet 212} b^+_{\bullet 112}$, etc., carrying identical linear quantum numbers in summery. The mixing angles are individual characteristics of each particle involved. Correspondingly, we are replacing the dark matter H-pairs [6] in subsequent sketches by those of its versions we shall be needing for the reaction ever in question.

The interpretation of the above drawing also allows to understand the **decay of a muon** as mediated by a W^+ meson**:** The deviating non-linear structure of the anti-muon is compensated by the contragredient non-linear structure of the muon-neutrino. And similarly for other pairs. Thus, the W^+ is in the habit of managing *pairs* of differing lepton generations simultaneously.

Historically, the **β-decay** of the neutron had been the start of “weak” interaction models. For the β-decay, we need one of the additional H-bricks mentioned above, out of the non-valence part of the W^+-meson [6]. The following decay sketch of the W^+ into a nucleon-antinucleon pair will look somewhat confusing. The reason is that I insisted in representing its W^+ part *on its left-hand side* in the identical way as I represented it, above, in the case of its purely leptonic decay.



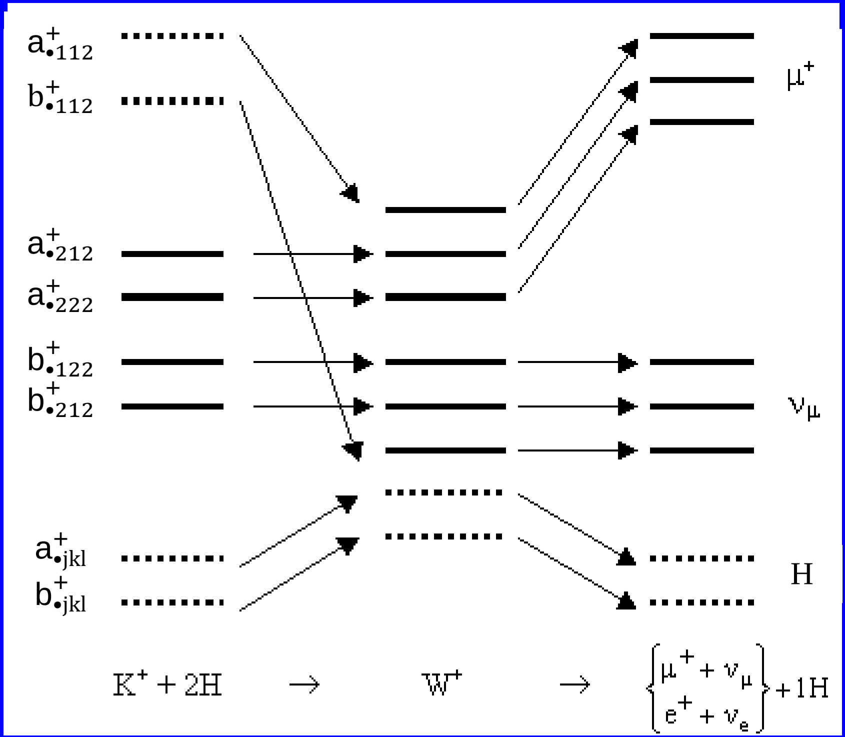
Then, we easily can combine both drawings to that of a neutron decay. You find all that in the internet under **www.q-grav.com**.The out-coming H #1 will add to the non-valence part of one of the out-coming anti/nucleons. Some part of its summed components, however, could as well couple to its valence part, thus generating an excited resonance $(4,0^{14},-1)$ instead of its $(3,0^{14},0)$ ground version! – H #2 looks like running through. In reality, however, its in- and out-coming H's are different ones**:** A chemist would call it a **catalysator-H**. This, again, emphasizes that the simplistic partition of a particle into a valence times a non-valence part is not tenable in the light of group theory! And remember**:**

For all "weak" interactions, too, the strict conservation of all quantum numbers holds!

There are no "broken" quantum numbers! The old $\Delta I = ½$ rule for isospin went into the garbage box. – A K^+ meson will be represented by some adequate arrangement of tensor components:

$$\mathbf{K^+:}\quad a^+_{\bullet 222}(a^+_{\bullet 212}b^+_{\bullet 212} + a^+_{\bullet 112}b^+_{\bullet 112})b^+_{\bullet 122}\ .$$

Working with the pure a^3b^3 component of the W^+, we find its leptonic decay:



The **mixed leptonic decay mode**,

$$\mathbf{K^+ \rightarrow \pi^0 + \mu^+ + \nu_\mu},$$

does it with the a^4b^4 version, instead. Here, the 2nd H does not just run right through but is used for a neutral pion.

The charged **non-leptonic decay modes,**

$$\mathbf{K^+ \rightarrow \pi^+ + \pi^0 + H},$$
$$\mathbf{K^+ \rightarrow \pi^+ + \pi^0 + \pi^0},$$

are both proceeding alike, i.e., by converting either one of the a^+b^+ pairs, $a^+_{\bullet 212}b^+_{\bullet 212}$ or $a^+_{\bullet 112}b^+_{\bullet 112}$, or both, into a π^0, mediated by the internals of the W^+. In the upper case, the third quantum pair in W^+ is internally converted to an H, to be absorbed in one of the out-coming non-valence parts.

The purely charged 3π-decay,

$$\mathbf{K^+ \rightarrow \pi^+ + \pi^+ + \pi^-},$$

then, is to be interpreted as some additional cross-over modification by the “strong” interaction.

Remark**:** The discussion of reactions containing the quanta I had called “exotic” is by far more sophisticated, they need a lecture for their own [8].

When replacing the electrically charged pair $a^+_{\bullet 222}b^+_{\bullet 122}$ by the neutral pair $a^+_{\bullet 222}b^+_{\bullet 222}$ or $a^+_{\bullet 122}b^+_{\bullet 122}$ in the W^+, we obtain the **Z-meson**. By respecting these charge modifications, we obtain the corresponding neutral decay modes – only that, now, the symmetrical modes are properly separated from the antisymmetrical ones.

[1] C. Birkholz, Verhandl. DPG (VI) **50,2**/T 97.5 (Wuppertal, 2015).
[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) **48,2**/T 25.3 (Dresden, 2013).
[5] C. Birkholz, Verhandl. DPG (VI) **49,3**/T 99.5 (Mainz, 2014). See also [6].
[6] 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.
[7] C. Birkholz, Verhandl. DPG (VI) **50,3**/MP 5.1 (Berlin, 2015).
[8] C. Birkholz, Verhandl. DPG (VI) **49,2**/AGPhil 10.1 (Berlin, 2014).

All talks and books, together with additional information on QG and GUT, are collected in **www.**q-grav.com**.**