Report

Indications for the Breaking of Universality in B Meson Decays

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Abstract

There are some indications for the breaking of leptonic universality of both neutral and charged weak currents coming from the decays of B mesons. TGD predicts family replication phenomenon not only for fermions but also for bosons. Higher generation bosons would have fermion couplings depending on lepton and quark generation implying breaking of the universality in both quark and lepton sector. In the case of Z boson there are indications for a state with the predicted mass.

1 Introduction

Lepton and quark universality of weak interactions is a basic tenet of the standard model. Now the first indications for the breaking of this symmetry have been found.

1. Lubos (`http://motls.blogspot.fi/2015/08/lhcb-2-sigma-violation-of-lepton.html`) tells that LHCb has released a preprint with title "Measurement of the ratio of branching ratios $(B_0 \rightarrow D^* + \tau\nu)/(B_0 \rightarrow D^* + \mu\nu)$" [2]. The news is that the measured branching ratio is is about 33 per cent instead of 25 percent determined by mass ratios if standard model is correct. The outcome differs by 2.1 standard deviations from the prediction so that it might be a statistical fluke.

2. There are also indications for second B^0 anomaly discovered at LHCb (`http://www.nature.com/news/lhc-signal-hints-at-cracks-in-physics-standard-model-1.18307`). B mesons have to long and short-lived variants oscillating to their antiparticles and back - this relates to CP breaking. The surprise is that the second B meson - I could not figure out was it short- or long-lived - prefers to decay to $e\nu$ instead of $\mu\nu$.

3. There are also indications for the breaking of universality [1] (`http://arxiv.org/abs/1406.6482`) from $B^+ \rightarrow K^+e^+e^-$ and $B^+ \rightarrow K^+\mu^+\mu;^-$ decays.

2 Explanation in terms of leptonic CKM mixing fails

In TGD framework my first - and wrong - guess for an explanation was CKM mixing for leptons [3]. TGD predicts that also leptons should suffer CKM mixing induced by the different mixings of topologies of the partonic 2-surfaces assignable to charged and neutral leptons. The experimental result would give valuable information about the values of leptonic CKM matrix. What new this brings is that the decays of W bosons to lepton pairs involve the mixing matrix and CKM matrix whose deviation from unit matrix brings effects anomalous in standard model framework.

The origin of the mixing would be topological - usually it is postulated in completely ad hoc manner for fermion fields. Particles correspond to partonic 2-surfaces- actually several of them but in the case of fermions the standard model quantum numbers can be assigned to one of the partonic surfaces so that its topology becomes especially relevant. The topology of this partonic 2- surface at the end of causal diamond (CD) is characterized by its genus - the number of handles attached to sphere - and by its conformal equivalene class characterized by conformal moduli.

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Electron and its muon correspond to spherical topology before mixing, muon and its neutrino to torus before mixing etc. Leptons are modelled assuming conformal invariance meaning that the leptons have wave functions - elementary particle vacuum functionals - in the moduli space of conformal equivalence classes known as Teichmueller space.

Contrary to the naive expection mixing alone does *not* explain the experimental finding. Taking into account mass corrections, the rates should be same to different charged leptons since neutrinos are *not* identified. That mixing does not have any implications follows from the unitary of the CKM matrix.

3 Explanation in terms of higher weak bosons generations might work

The next trial is inspired by a recent very special di-electron event and involves higher generations of weak bosons predicted by TGD leading to a breaking of lepton universality. Both Tommaso Dorigo (`http://www.science20.com/a_quantum_diaries_survivor/a_3_tev_dielectron_event_by_cms-157052`) and Lubos Motl (`http://motls.blogspot.fi/2015/09/cms-29-tev-electron-positron-pair.html`) tell about a spectacular 2.9 TeV di-electron event not observed in previous LHC runs. Single event of this kind is of course most probably just a fluctuation but human mind is such that it tries to see something deeper in it - even if practically all trials of this kind are chasing of mirages.

Since the decay is leptonic, the typical question is whether the dreamed for state could be an exotic Z boson. This is also the reaction in TGD framework. The first question to ask is whether weak bosons assignable to Mersenne prime M_{89} have scaled up copies assignable to Gaussian Mersenne M_{79}. The scaling factor for mass would be $2^{(89-89)/2} = 32$. When applied to Z mass equal to about .09 TeV one obtains 2.88 TeV, not far from 2.9 TeV. Eureka!? Looks like a direct scaled up version of Z!? W should have similar variant around 2.6 TeV.

TGD indeed predicts exotic weak bosons and also gluons.

1. TGD based explanation of family replication phenomenon in terms of genus-generation correspondence [3] forces to ask whether gauge bosons identifiable as pairs of fermion and anti-fermion at opposite throats of wormhole contact could have bosonic counterpart for family replication. Dynamical SU(3) assignable to three lowest fermion generations/genera labelled by the genus of partonic 2-surface (wormhole throat) means that fermions are combinatorially SU(3) triplets. Could 2.9 TeV state - if it would exist - correspond to this kind of state in the tensor product of triplet and antitriplet? The mass of the state should depend besides p-adic mass scale also on the structure of SU(3) state so that the mass would be different. This difference should be very small.

2. Dynamical SU(3) could be broken so that wormhole contacts with different genera for the throats would be more massive than those with the same genera. This would give SU(3) singlet and two neutral states, which are analogs of $\eta\prime$ and η and π^0 in Gell-Mann's quark model. The masses of the analogs of η and π^0 and the the analog of $\eta\prime$, which I have identified as standard weak boson would have different masses. But how large is the mass difference?

3. These 3 states are expected top have identical mass for the same p-adic mass scale, if the mass comes mostly from the analog of hadronic string tension assignable to magnetic flux tube. connecting the two wormhole contacts associates with any elementary particle in TGD framework (this is forced by the condition that the flux tube carrying monopole flux is closed and makes a very flattened square shaped structure with the long sides of the square at different space-time sheets). p-Adic thermodynamics [4] would give a very small contribution genus dependent contribution to mass if p-adic temperature is $T = 1/2$ as one must assume for gauge bosons ($T = 1$ for fermions). Hence 2.95 TeV state could indeed correspond to this kind of state.

4. Can one imagine any pattern for the Mersennes and Gaussian Mersennes involved? Charged leptons correspond to electron (M_{127}), muon ($M_{G,113}$) and tau (M_{107}): Mersenne- Gaussian Mersenne-Mersenne. Does one have similar pattern for gauge bosons too: M_{89} - $M_{G,79}$ - M_{61}?

The orthogonality of the 3 weak bosons implies that their charge matrices are orthogonal. As a consequence, the higher generations of weak bosons do not have universal couplings to leptons and quarks. The breaking of universality implies a small breaking of universality in weak decays of hadrons due to the presence of virtual $M_{G,79}$ boson decaying to lepton pair. These anomalies should be seen both in the weak decays of hadrons producing $L\nu$ pairs via the decay of virtual W or its partner $W_{G,79}$ and via the decay of virtual Z of its partner $Z_{G,79}$ to L^+L^- . Also $\gamma_{G,79}$ could be involved.

This could explain the three anomalies associated with the neutral B mesons, which are analogs of neutral K mesons having long- and short-lived variants.

1. The two anomalies involving W bosons could be understood if some fraction of decays takes place via the decay $b \rightarrow c + W_{G,79}$ followed by $W_{G,79} \rightarrow L\nu$. The charge matrix of $W_{G,79}$ is not universal and CP breaking is involved. Hence one could have interference effects, which increase the branching fraction to $\tau\nu$ or $e\nu$ relative to $\mu\nu$ depending on whether the state is long- or short-lived B meson.

2. The anomaly in decays producing charged lepton pairs in decays of B^+ does not involve CP breaking and would be due to the non-universality of $Z_{G,79}$ charge matrix.

TGD allows also to consider leptoquarks as pairs of leptons and quarks and there is some evidence for them too! I wrote about this an article [5]. Also indications for M_{89} and $M_{G,79}$ hadron physics with scaled up mass scales is accumulating [6]. It seems that TGD is really there and nothing can prevent it showing up, and QCD is shifting to the verge of revolution [**?**]. I predict that next decades in physics will be a New Golden Age as colleagues finally wake up.

References

[1] LHCb collaboration. Test of lepton universality using $b^+ \rightarrow k^+l^+l^-$ decays. http://arxiv.org/abs/1406.6482, 2014.

[2] LHCb collaboration. Measurement of the ratio of branching ratios $(b_0 \rightarrow d^* + \tau\nu_\tau)/(b_0 \rightarrow d^* + \mu\nu_\mu)$. http://arxiv.org/abs/1506.08614, 2015.

[3] M. Pitkänen. Construction of elementary particle vacuum functionals. In *p-Adic Physics*. Onlinebook. http://tgdtheory.fi/public_html/padphys/padphys.html#elvafu, 2006.

[4] M. Pitkänen. Massless states and particle massivation. In *p-Adic Physics*. Onlinebook. http://tgdtheory.fi/public_html/padphys/padphys.html#mless, 2006.

[5] M. Pitkänen. Have lepto-quarks been observed in the decays of B mesons? http://tgdtheory.fi/public_html/articles/leptoquark.pdf, 2015.

[6] M. Pitkänen. What is the role of Gaussian Mersennes in TGD Universe? http://tgdtheory.fi/public_html/articles/MG79.pdf, 2015.