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Essay

Is there a Scaled Up Variant of Hadron Physics at 0.5 TeV Energy Scale?

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Abstract

p-Adic length scale hypothesis strongly suggests a fractal hierarchy of copies of hadron physics labelled by Mersenne primes. M_{89} hadron physics whose mass scales relates by a factor 512 to that of ordinary M_{107} hadron physics was predicted already for 15 years ago but only now the TeV energy region has been reached at LHC making possible to test the prediction. Pions of any hadron physics are produced copiously in hadronic reactions and their detection is the most probable manner how the new hadron physics will be discovered if Nature has realized them. Neutral pions produce monochromatic gamma pairs whereas heavy charged pions decay to quark pair or intermediate gauge boson and quark pair. The first evidence -or should we say indication- for the existence of M_{89} hadron physics has now emerged from CDF which for more than two years ago provided evidence also for the colored excitations of tau lepton and for leptohadron physics. What CDF has observed is evidence for the production of quark antiquark pairs in association with W bosons and the following arguments demonstrate that the interpretation in terms of M_{89} hadron physics might make sense.

1 First evidence for M_{89} hadron physics?

The first evidence -or should we say indication- for the existence of M_{89} hadron physics has emerged from CDF which for two and half years ago provided evidence also for the colored excitations of tau lepton and for leptohadron physics.

1.1 Has CDF discovered a new boson with mass around 145 GeV?

The story began when The eprint of CDF collaboration [8] reported evidence for a new resonance like state, presumably a boson decaying to a dijet (jj) with mass around 145 GeV. The dijet is produced in association with W boson. The interpretation as Higgs is definitely excluded.

Bloggers reacted intensively to the possibility of a new particle. Tommaso Dorigo gave a nice detailed analysis about the intricacies of the analysis of the data leading to the identification of the bump. Also Lubos and Resonaances commented the new particle. Probably the existence of the bump had been known for months in physics circles. The flow of eprints to arXiv explaining the new particle begun immediately.

One should not forget that 3 sigma observation was in question and that 5 sigma is required for discovery. It is quite possible that the particle is just a statistical fluke due to an erratic estimation of the background as Tommaso Dorigo emphasizes. Despite this anyone who has a theory able to predict something is extremely keen to see whether the possibly existing new particle has a natural explanation. This also provides the opportunity for dilettantes like me to develop the theoretical framework in more detail. We also know from general consistency conditions that New Physics must emerge in TeV scale: what we do not know what this New Physics is. Therefore all indications for it must be taken seriously.

CDF bump did not disappear and the most recent analysis assigns 4.1 sigma signicance to it. The mass of the bump was reported to be at 147 ± 5 GeV. Also some evidence that the entire Wjj system results in a decay of a resonance with mass slightly below 300 GeV has emerged. D0 was however not able to confirm the existence of the bump and the latest reincarnation of the bump is as 2.8 sigma evidence for Higgs candidate in the range 140-150 GeV range and one can of ask whether this is actually evidence for the familiar 145 GeV boson which cannot be Higgs. The story involves many twists and turns and teaches how cautiously theoretician should take also the claims of experimentalists. In the following I pretend that the 145 GeV bump is real but this should not confuse the reader to believe that this is really the case.

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1.2 Why an exotic weak boson a la TGD cannot be in question?

For the inhabitant of the TGD Universe the most obvious identification of the new particle would be as an exotic weak boson. The TGD based explanation of family replication phenomenon predicts that gauge bosons come in singlets and octets of a dynamical SU(3) symmetry associated with three fermion generations (fermion families correspond to topologies of partonic wormhole throats characterized by the number of handles attached to sphere). Exotic Z or W boson could be in question.

If the symmetry breaking between octet and singlet is due to different value of p-adic prime alone then the mass would come as an power of half-octave of the mass of Z or W. For W boson one would obtain 160 GeV only marginally consistent with 145 GeV. Z would give 180 GeV mass which is certainly too high. The Weinberg angle could be however different for the singlet and octet so that the naive p-adic scaling need not hold true exactly.

Note that the strange forward backward asymmetry in the production of top quark pairs [7, 11] might be understood in terms of exotic gluon octet whose existence means neutral flavor changing currents as discussed in this chapter.

The *extremely* important data bit is that the decays to two jets favor quark pairs over lepton pairs. A model assuming exotic Z -called Z'- produced together with W and decaying preferentially to quark pairs has been proposed as an explanation [10]. Neither ordinary nor the exotic weak gauge bosons of TGD Universe have this kind of preference to decay to quark pairs so that my first guess was wrong.

1.3 Is a scaled up copy of hadron physics in question?

The natural explanation for the preference of quark pairs over lepton pairs would be that strong interactions are somehow involved. This suggests a state analogous to a charged pion decaying to W boson two gluons annihilating to the quark pair (box diagram). This kind of proposal is indeed made in Technicolor at the Tevatron [12]: the problem is also now why the decays to quarks are favored. Techicolor has as its rough analog second fundamental prediction of TGD that p-adically scaled up variants of hadron physics should exist and one of them is waiting to be discovered in TeV region. This prediction emerged already for about 15 years ago as I carried out p-adic mass calculations and discovered that Mersenne primes define fundamental mass scales.

Also colored excitations of leptons and therefore leptohadron physics are predicted [6]. What is amusing that CDF discovered towards the end of 2008 what became known as CDF anomaly giving support for tau-pions. The evidence for electro-pions and mu-pions had emerged already earlier (for references see [6]). All these facts have been buried underground because they simply do not fit to the standard model wisdom. TGD based view about dark matter is indeed needed to circumvent the fact that the lifetimes of weak bosons do not allow new light particles. There is also a long series of blog postings in my blog summarizing development of the TGD based model for CDF anomaly.

As should have become already clear, TGD indeed predicts p-adically scaled up copy of hadron physics in TeV region and the lightest hadron of this physics is a pion like state produced abundantly in the hadronic reactions. Ordinary hadron physics corresponds to Mersenne prime $M_{107} = 2^{107} - 1$ whereas the scaled up copy would correspond to M_{89}. The mass scale would be 512 times the mass scale 1 GeV of ordinary hadron physics so that the mass of M_{89} proton should be about 512 GeV. The mass of the M_{89} pion would be by a naive scaling 71.7 GeV and about two times smaller than the observed mass in the range 120-160 GeV and with the most probable value around 145 GeV as Lubos reports in his blog. $2 \times 71.7GeV = 143.4$ GeV would be the guess of the believer in the p-adic scaling hypothesis and the assumption that pion mass is solely due to quarks. It is important to notice that this scaling works precisely only if CKM mixing matrix is same for the scaled up quarks and if charged pion consisting of u-d quark pair is in question. The well-known current algebra hypothesis that pion is massless in the first approximation would mean that pion mass is solely due to the quark masses whereas proton mass is dominated by other contributions if one assumes that also valence quarks are current quarks with rather small masses. The alternative which also works is that valence quarks are constituent quarks with much higher mass scale.

According to p-adic mass calculations the mass of pion is just the sum of mass squared for the quarks composing. If one assumes that u and d quarks of M_{89} hadron physics correspond to $k = 93$ (top corresponds to $k = 94$, the mass of these quarks is predicted to be 103 GeV whereas the pion mass is predicted to be 144.3 GeV (the argument will be discussed in detail later). My guess based on deep ignorance about the experimental side is that this signature should be easily testable: one should try to detect mono-chromatic gamma pairs with gamma ray energy around 72.2 GeV.

1.4 The simplest identification of the 145 GeV resonance

The picture about CDF resonance has become (see the postings Theorists vs. the CDF bump and More details about the CDF bump by Jester [15]. One of the results is that leptophobic Z' can explain only 60 per cent of the production rate. There is also evidence that Wjj corresponds to a resonance with mass slightly below 300 GeV as naturally predicted by technicolor models [26].

The simplest TGD based model indeed relies on the assumption that the entire Wjj corresponds to a resonance with mass slightly below 300 GeV for which there is some evidence as noticed. If one assume that only *neutral pions* are produced in strong non-orthogonal electric and magnetic fields of colliding proton and antiproton, the mother particle must be actually second octave of 147 GeV pion and have mass somewhat below 600 GeV producing in its possibly allowed strong decays pions which are almost at rest for kinematic reasons. Therefore the production mechanism could be exactly the same as proposed for two and one half year old CDF anomaly and for the explanation of DAMA events and DAMA-Xenon100 discrepancy,

1. This suggests that the mass of the mother resonance is in a good accuracy two times the mass of 145 GeV bump for which best estimate is 147 ± 5 GeV. This brings in mind the explanation for the two and half year old CDF anomaly in which tau-pions with masses coming as octaves of basic tau-pion played a key role (masses were in good approximation $2^k \times m(\pi_\tau)$, $m(\pi_\tau) \simeq 2m_\tau$, $k = 1, 2$. The same mechanism would explain the discrepancy between the DAMA and Xenon100 experiments.

2. If this mechanism is at work now, the mass of the lowest M_{89} pion should be around 73 GeV as the naivest scaling estimate gives. One can however consider first the option for which lightest M_{89} has mass around 147 GeV so that the 300 GeV resonance could correspond to its first p-adic octave. This pion would decay to W and neutral M_{89} pion with mass around 147 GeV in turn decaying to two jets. At quark level the simplest diagram would involve the emission of W and exchange of gluon of M_{89} hadron physics. Also the decay to Z and charged pion is possible but in this case the decay of the final state could not take place via annihilation to gluon so that jet pair need not be produced.

3. One could also imagine the mother particle to be ρ meson of M_{89} hadron physics with mass in a good approximation equal to pion mass. At the level of mathematics this option is very similar to the technicolor model of CDF bump based also on the decay of ρ meson discussed in [26]. In this model the decays of π to heavy quarks have been assumed to dominate. In TGD framework the situation is different. If π consists of scaled up u and d quarks, the decays mediated by boson exchanges would produce light quarks. In the annihilation to quark pair by a box diagram involving two gluons and two quarks at edges the information about the quark content of pion is lost. The decays involving emission of Z boson the resulting pion would be charged and its decays by annihilation to gluon would be forbidden so that Wjj final states would dominate over Zjj final states as observed.

4. The strong decay of scaled up pion to charged and neutral pion are forbidden by parity conservation. The decay can however proceed by via the exchange of intermediate gauge boson as a virtual particle. The first quark would emit virtual W/Z boson and second quark the gluon of the hadron physics. Gluon would decay to a quark pair and second quark would absorb the virtual W boson so that a two-pion final state would be produced. The process would involve same vertices as the decay of ρ meson to W boson and pion. The proposed model of the two and one half year old CDF anomaly and the explanation of DAMA and Xenon100 experiments assumes cascade like decay of pion at given level of hierarchy to two pions at lower level of hierarchy and the mechanism of decay should be this.

Consider next the masses of the M_{89} mesons. Naive scaling of the mass of ordinary pion gives mass about 71 GeV for M_{89} pion. One can however argue that color magnetic spin-spin splitting need not obey scaling formula and that it becomes small because if is proportional to eB/m where B denotes typical value of color magnetic field and m quark mass scale which is now large. The mass of pion at the limit of vanishing color magnetic splitting given by m_0 could however obey the naive scaling.

1. For (ρ, π) system the QCD estimate for the color magnetic spin-spin splitting would be

   $$(m(\rho), m(\pi)) = (m_0 + 3\Delta/4, m_0 - \Delta/4) \ .$$

   p-Adic mass calculations are for mass squared rather than mass and the calculations for the mass splittings of mesons [5] force to replace this formula with

   $$(m^2(\rho), m^2(\pi)) = (m_0^2 + 3\Delta^2/4, m_0^2 - \Delta^2/4) \ . \tag{1.1}$$

   The masses of ρ and ω are very near to each other: $(m(\rho), m(\omega) = (.770, .782)$ GeV and obey the same mass formula in good approximation. The same is expected to hold true also for M_{89}.

2. One obtains for the parameters Δ and m_0 the formulas

   $$\Delta = [m^n(\rho) - m^n(\pi)]^{1/n} \ , \ m_0 = [(m^2(\rho) + 3m(\pi)^2)/4]^{1/n} \ . \tag{1.2}$$

   Here $n = 1$ corresponds to ordinary QCD and $n = 2$ to p-adic mass calculations.

3. Assuming that m_0 experiences an exact scaling by a factor 512, one can deduce the value of the parameter Δ from the mass 147 GeV of M_{89} pion and therefore predict the mass of ρ_{89}. The results are following

   $$m_0 = 152.3 \ GeV \ , \ \Delta = 21.3 \ GeV \ , \ m(\rho_{89}) = 168.28 \ GeV \tag{1.3}$$

   for QCD model for spin-spin splitting and

   $$m_0 = 206.7 \ GeV \ , \ \Delta = 290.5 \ GeV \ , \ m(\rho_{89}) = 325.6 \ GeV \ . \tag{1.4}$$

   for TGD model for spin-spin splitting.

4. Rather remarkably, there are indications from D0 [13] for charged and from CDF [13, 14] for neutral resonances with masses around 325 GeV such that the neutral one is split by .2 GeV: the splitting could correspond to $\rho - \omega$ mass splitting. Hence one obtains support for both M_{89} hadron physics and p-adic formulas for color magnetic spin-spin splitting. Note that the result excludes also the interpretation of the nearly 300 GeV resonance as ρ_{89} in TGD framework.

5. This scenario allows to make estimates also for the masses other resonances and naive scaling argument is expected to improve as the mass increases. For (K_{89}, K^*_{89}) system this would predict mass $m(K_{89}) > 256$ GeV and $m(K^*_{89}) < 456.7$ GeV.

The nasty question is why the octaves of pion are not realized as a resonances in ordinary hadron physics. If they were there, their decays to ordinary pion pairs by this mechanism would very slow.

1. Could it be that also ordinary pion has these octaves but are not produced by ordinary strong interactions in nucleon collisions since the nucleons do not contain the p-adically scaled up quarks fusing to form the higher octave of the pion. Also the fusion rate for two pions to higher octave of pion would be rather small by parity breaking requiring weak interactions.

2. The production mechanism for the octaves of ordinary pions, for M_{89} pions in the collisions of ordinary nucleons, and for leptohadrons would be universal, namely the collision of charged particles with cm kinetic energy above the octave of pion. The presence of strong non-orthogonal electric and magnetic fields varying considerably in the time scale defined by the Compton time of the pion is necessary since the interaction Lagrangian density is essentially the product of the abelian instanton density and pion field. In fact, in [26] it is mentioned that 300 GeV particle candidate is indeed created at rest in Tevatron lab -in other words in the cm system of colliding proton and antiproton beams.

3. The question is whether the production of the octaves of scaled up pions could have been missed in proton-proton and proton antiproton collisions due to the very peculiar kinematics: pions would be created almost at rest in cm system [6]. Whether or not this is the case should be easy to test. For a theorists this kind of scenario does not look impossible but at the era of LHC it would require a diplomatic genius and authority of Witten to persuade experimentalists to check whether low energy collisions of protons produce octaves of pions!

There is also the question about the general production mechanisms for M_{89} hadrons.

1. Besides the production of scalar mesons in strong non-orthogonal magnetic and electric fields also the production via annihilation of quark pairs to photon and weak bosons in turn decaying to the quarks of M_{89} hadron physics serves as a possible production mechanism. These production mechanisms do not give much hopes about the production of nucleons of M_{89} physics.

2. If ordinary gluons couple to M_{89} quarks, also the production via fusion to gluons is possible. If the transition from M_{107} hadron physics corresponds to a phase transition transforming M_{107} hadronic space-time sheets/gluons to M_{89} space-time sheets/gluons, M_{107} gluons do not couple directly to M_{89} gluons. In this case however color spin glass phase for M_{107} gluons could decay to M_{89} gluons in turn producing also M_{89} nucleons. Recall that naive scalings for M_{89} nucleon the mass 481 GeV. The actual mass is expected to be higher but below the scaled up Δ resonance mass predicted to be below 631 GeV.

1.5 How could one understand CDF-D0 discrepancy concerning 145 GeV resonance?

The situation concerning 145 GeV bump has become rather paradoxical. CDF claims that 145 GeV resonance is there at 4.3 sigma level. The new results from D0 however fail to support CDF bump [25] (see Lubos, Jester, and Tommaso).

This shows only that either CDF or D0 is wrong, not that CDF is wrong as some of us suddenly want to believe. My own tentative interpretation -not a belief- relies on bigger picture provided by TGD and is that both 145 GeV, 300 GeV, and 325 GeV resonances are there and have interpretations in terms of π and its p-adic octave, ρ, and ω of M_{89} hadron physics. I could of course be wrong. LHC will be the ultimate jury.

In any case, neither CDF and D0 are cheating and one should explain the discrepancy rationally. Resonaances mentions different estimates for QCD background as a possible explanation. What one could say about this in TGD framework allowing some brain storming?

1. There is long history of this kind of forgotten discoveries having same interpretation in TGD framework. Always pionlike states-possibly coherent state of them- would have been produced in strong non-orthogonal magnetic and electric fields of the colliding charges and most pion-like states predicted to be almost at rest in cm frame.

   Electro-pions were observed already at seventies in the collisions of heavy nuclei at energies near Coulomb wall, resonances having interpretation as mu-pions about three years ago, tau-pions detected by CDF for two and half years ago with refutation coming from D0, now DAMA and Cogent observed dark matter candidate having explanation in terms of tau-pion in TGD framework but Xenon100 found nothing (in this case on can understand the discrepancy in TGD framework). The octaves of M_{89} pions would represent the last episode of this strange history. In the previous posting universality of the production mechanism forced to made the proposal that also the collisions of ordinary nuclei could generate octaves of ordinary pions. They have not been observed and as I proposed this might due to the peculiarity of the production mechanism.

What could be a common denominator for this strange sequence of almost discoveries? Light colored excitations of leptons can be of course be argued to be non-existent because intermediate boson decay widths do not allow them but it is difficult to believe that his would have been the sole reason for not taking leptopions seriously.

2. Could the generation of a pionic coherent state as a critical phenomenon very sensitive to the detailed values of the dynamical parameters, say the precise cm energies of the colliding beams? For leptopions a phase transition generating dark colored variants of leptons (dark in the sense having non-standard value of Planck constant) would indeed take place so that criticality might make sense. Could also M_{89} quarks be dark or colored excitations of ordinary quarks which are dark? Could the $M_{107} \rightarrow M_{89}$ phase transition take place only near criticality? This alone does not seem to be enough however.

3. The peculiarity of the production mechanism is that the pion like states are produced mostly at rest in cm frame of the colliding charges. Suppose that the cm frame for the colliding charged particles is not quite the lab frame in D0. Since most dark pions are produced nearly at rest in the cm frame, they could in this kind of situation leave the detector before decaying to ordinary particles: they would behave just like dark matter is expected to behave and would not be detected. The only signature would be missing energy. This would also predict that dark octaves of ordinary pions would not be detected in experiments using target which is at rest in lab frame.

4. This mechanism is actually quite general. Dark matter particles decaying to ordinary matter and having long lifetime remain undetected if they move with high enough velocity with respect to laboratory. Long lifetime would be partially due to the large value of $\hbar$ and relativistic with respect to laboratory velocities also time dilation would increases the lifetime. Dark matter particles could be detected only as a missing energy not identifiable in terms of neutrinos. A special attention should be directed to state candidates which are nearly at rest in laboratory.

An example from ordinary hadron physics is the production of pions and their octaves in the strong electric and magnetic field of nuclei colliding with a target at rest in lab. The lifetime of neutral pion is about 10^{-8} seconds and scaled up for large $\hbar$ and by time dilation when the colliding nucleons have relativistic energies. Therefore the dark pion might leave the measurement volume before decay to two gammas when the the target is at rest in laboratory. It is not even clear whether the gammas need to have standard value of Planck constant.

For the second octave of M_{89} pion the lifetime would be scaled down by the ratio of masses giving a factor 2^{11} and lifetime of order $.5 \times 10^{-11}$ seconds. Large $\hbar$ would scale up the lifetime. For non-relativistic relativistic velocities the distance travelled before the decay to gamma pair would $L = (\hbar/\hbar_0) \times (v/c) \times 1.1$ mm.

If also the gamma pair is dark, the detection would require even larger volume. TGD suggests strongly that also photons have a small mass which they obtain by eating the remaining component of Higgs a la TGD (transforming like 1+3 under vectorial weak SU(2)). If photon mass defines the upper bound for the rate for the transformation to ordinary photons, dark photons would remain undetected.

1.6 Higgs or a pion of M_{89} hadron physics?

D0 refuted the 145 GeV bump and after this it was more or less forgotten in blogs, which demonstrates how regrettably short the memory span of blog physicists is. CDF reported it in Europhysics 2011 and it seems that the groups are considering seriously possible explanations for the discrepancy. To my opinion the clarification of his issue is of extreme importance.

The situation changed at the third day of conference (Saturday) when ATLAS reported about average 2.5 sigma evidence for what might be Higgs in the mass range 140-150 GeV. The candidate revealed itself via decays to WW in turn decaying to lepton pairs. Also D0 and CDF told suddenly that they have observed similar evidence although the press release had informed that Higgs had been located to the mass range 120-137 GeV. There is of course no reason to exclude the possibility that the decays of 145 GeV resonance are in question and in this case the interpretation as standard model Higgs would be definitely excluded. If the pion of M_{89} physics is in question it would decay to WW pair instead of quark pair producing two jets. Since weak decay is in question one an expect that the decay rate is small.

If this line of reasoning is correct, standard model Higgs is absent. TGD indeed predicts that the components of TGD Higgs become longitudinal components of gauge bosons since also photon and graviton gain a small mass. This however leaves the two Higgses predicted by MSSM under consideration. The stringent lower bounds for the masses of squarks and gluinos of standard SUSY were tightened in the conference and are now about 1 TeV and this means that the the basic argument justifying MSSM (stability of Higgs mass against radiative corrections) is lost.

The absence of Higgs forces a thorough re-consideration of the fundamental ideas about particle massivation. p-Adic thermodynamics combined with zero energy ontology and the identification of massive particles as bound states of massless fermions is the vision provided by TGD.

1.7 Short digression to TGD SUSY

Although the question about TGD variant of SUSY is slightly off-topic, its importance justifies a short discussion. Although SUSY is not needed to stabilize Higgs mass, the anomaly of muonic g-2 suggests TGD SUSY and the question is whether TGD SUSY could explain it.

1. Leptons are characterized by Mersennes or Gaussian Mersennes: $(M_{127}, M_{G,113}, M_{107})$ for (e, μ, τ). If also sleptons correspond to Mersennes of Gaussian Mersennes, then (selectron, smuon, stau) should correspond to $(M_{89}, M_{G,79}, M_{61})$ is one assumes that selectron corresponds to M_{89}. Selectron mass would be 250 GeV and smuon mass 13.9 TeV. g-2 anomaly for muon [2] suggests that the mass of selectron should not be much above .1 TeV and M_{89} fits the bill. Valence quarks correspond to the Gaussian Mersenne $k \leq 113$, which suggests that squarks have $k \geq 79$ so that squark masses should be above 13 TeV. If sneutrinos correspond to Gaussian Mersenne $k = 167$ then sneutrinos could have mass below electron mass scale. Selectron would remain the only experiment signature of TGD SUSY at this moment.

2. One decay channel for selectron would be to electron+ sZ or neutrino+ sW. sZ/sW would eventually decay to possibly virtual Z+ neutrino/W+neutrino: that is weak gauge boson plus missing energy. Neutralino and chargino need not decay in the detection volume. The lower bound for neutralino mass is 46 GeV from intermediate gauge boson decay widths. Hence this option is not excluded by experimental facts.

3. If the sfermions decay rapidly enough to fermion plus neutrino, the signature of TGD SUSY would be excess of events of type lepton+ missing energy or jet+ missing energy. For instance, lepton+missing jet could be mis-identified as decay products of possibly exotic counterpart of weak gauge boson. The decays of 250 GeV selectron would give rise to decays which might be erratically interpreted as decays of W' to electron plus missing energy. The study of CDF at $\sqrt{s}$= 1.96 TeV in p-pbar collisions excludes heavy W′ with mass below 1.12 TeV [20]. The decay rate to electron plus neutrino must therefore be slow.

   There are indications for a tiny excess of muon + missing energy events in the decays of what has been tentatively identified as a heavy W boson W^{prime} (see Figure 1 of [19]). The excess is regarded as insignificant by experimenters. W^{prime} candidate is assumed to have mass 1.0 TeV or 1.4 TeV. If smuon is in question, one must give up the Mersenne hypothesis.

1.8 The mass of u and d quarks of M_{89} physics

While updating the chapter about the p-adic model for hadronic masses [5] I found besides some silly numerical errors also a gem that I had forgotten. For pion the contributions to mass squared from color-magnetic spin-spin interaction and color Coulombic interaction and super-symplectic gluons cancel and the mass is in excellent approximation given by the $m^2(\pi) = 2m^2(u)$ with $m(u) = m(d) = 0.1$ GeV in good approximation. That only quarks contribute is the TGD counterpart for the almost Goldstone boson character of pion meaning that its mass is only due to the massivation of quarks. The value of the p-adic prime is $p \simeq 2^k$, with $k(u) = k(d) = 113$ and the mass of charged pion is predicted with error of .2 per cent.

If the reduction of pion mass to mere quark mass holds true for all scaled variants of ordinary hadron physics, one can deduce the value of u and d quark masses from the mass of the pion of M_{89} hadron physics and vice versa. The mass estimate is 145 GeV if one identifies the bump claimed by CDF [22] as M_{89} pion. Recall that D0 did not detect the CDF bump [25] (I have discussed possible reasons for the discrepancy in terms of the hypothesis that dark quarks are in question). From this one can deduce that the p-adic prime $p \simeq 2^k$ for the u and d quarks of M_{89} physics is $k = 93$ using $m(u,93) = 2^{(113-93)/2}m(u,113)$, $m(u,113) \simeq .1$ GeV. For top quark one has $k = 94$ so that a very natural transition takes place to a new hadron physics. The predicted mass of $\pi(89)$ is 144.8 GeV and consistent with the value claimed by CDF. What makes the prediction non-trivial is that possible quark masses comes as as half-octaves meaning exponential sensitivity with respect to the p-adic length scale.

The common mass of $u(89)$ and $d(89)$ quarks is 102 GeV in a good approximation and quark jets with mass peaked around 100 GeV should serve as a signature for them. The direct decays of the $\pi(89)$ to M_{89} quarks are of course non-allowed kinematically.

1.9 A connection with the top pair backward-forward asymmetry in the production of top quark pars?

One cannot exclude the possibility that the predicted exotic octet of gluons proposed as an explanation of the anomalous backward-forward asymmetry in top pair production correspond sto the gluons of the scaled up variant of hadron physics. M_{107} hadron physics would correspond to ordinary gluons only and M_{89} only to the exotic octet of gluons only so that a strict scaled up copy would not be in question. Could it be that given Mersenne prime tolerates only single hadron physics or leptohadron physics?

In any case, this would give a connection with the TGD based explanation of the backward-forward asymmetry in the production of top pairs also discussed in this chapter. In the collision incoming quark of proton and antiquark of antiproton would topologically condense at M_{89} hadronic space-time sheet and scatter by the exchange of exotic octet of gluons: the exchange between quark and antiquark would not destroy the information about directions of incoming and outgoing beams as s-channel annihilation would do and one would obtain the large asymmetry. The TGD based generalized Feynman diagram would involve an exchange of a gluon represented by a wormhole contact. The first wormhole throat would have genus two as also top quark and second throat genus zero. One can imagine that the top quark comes from future and then travels along space-like direction together with antiquark wormhole throat of genus zero a and then turns back to the future. Incoming quark and antiquark perform similar turn around [2].

This asymmetry observed found a further confirmation in Europhysics 2011 conference [23]. The obvious question is whether this asymmetry could be reduced to that in collisions of quarks and antiquarks. Tommaso Dorigo tells that CMS has found that this is not the case, which suggests that the phenomenon might be assignable to valence quarks only.

2 Other indications for M_{89} hadron physics

Also other indications for M_{89} hadron physics have emerged during this year and although the fate of these signals is probably the usual one, they deserve to be discussed briefly.

2.1 Bumps also at CDF and D0?

It seems that experimentalists have gone totally crazy. Maybe new physics is indeed emerging from LHC and they want to publish every data bit in the hope of getting paid visit to Stockholm. *CDF* and ATLAS have told about bumps and now Lubos [13] tells about a new 3 sigma bump reported by

D0 collaboration at mass 325 GeV producing muon in its decay producing W boson plus jets [24]. The proposed identification of bump is in terms of decay of t′ quark producing W boson.

Lubos mentions also second mysterious bump at 324.8 GeV or 325.0 GeV reported by CDF collaboration [21] and discussed by Tommaso Dorigo [14] towards the end of the last year. The decays of these particles produce 4 muons through the decays of two Z bosons to two muons. What is peculiar is that two mass values differing by .2 GeV are reported. The proposed explanation is in terms of Higgs decaying to two Z bosons. TGD based view about new physics suggests strongly that the three of four particles forming a multiplet is in question.

One can consider several explanations in TGD framework without forgetting that these bumps very probably disappear. Consider first the D0 anomaly alone.

1. TGD predicts also higher generations but there is a nice argument based on conformal invariance and saying that higher particle families are heavy. What "heavy" means is not clear. It could of mean heavier that intermediate gauge boson mass scale. This explanation does not look convincing to me.

2. Another interpretation would be in terms of scaled up variant of top quark. The mass of top is around 170 GeV and p-adic length scale hypothesis would predict that the mass should equal to a multiple of half octave of top quark mass. Single octave would give mass of 340 GeV. The deviation from predicted mass would be 5 per cent.

3. The third interpretation is in terms of ρ and ω mesons of M_{89}. By assuming that the masses of M_{89} π and ρ in absence of color magnetic spin-spin splitting scale naively in the transition from M_{107} to M_{89} physics and by determining the parameter characterizing color magnetic spin-spin splitting from the condition that M_{89} pion has 157 GeV mass, one predicts that M_{89} ρ and ω have same mass 325.6 GeV in good approximation The .2 GeV mass difference would have interpretation as $\rho-\omega$ mass difference. In TGD framework this explanation is unique.

2.2 Indications for M_{89} charmonium from ATLAS

Lubos commented last ATLAS release about dijet production. There is something which one might interpret as the presence of resonances above 3.3 TeV [see Fig. 2) of the article] [17]. Of course, just a slight indication is in question, so that it is perhaps too early to pay attention to the ATLAS release. I am however advocating a new hadron physics and it is perhaps forgivable that I am alert for even tiniest signals of new physics.

In a very optimistic mood I could believe that a new hadron physics is being discovered (145 GeV boson could be identified as charged pion and 325 GeV bumps could allow interpretation as kaons). With this almost killer dose of optimism the natural question is whether this extremely slight indication about new physics might have interpretation as a scaled up J/Ψ and various other charmonium states above it giving rise to what is not single very wide bump to a family of several resonances in the range 3-4 TeV by scaling the 3-4 GeV range for charmonium resonances. For instance, J/Ψ decay width is very small, about .1 MeV, which is about $.3\times10^{-4}$ of the mass of J/Ψ. In the recent case direct scaling would give decay of about 300 MeV for the counterpart of J/Ψ if the decay is also now slow for kinematic reasons. For other charmonium resonances the widths are measurement in per cents meaning in the recent case width of order of magnitude 30 GeV: this estimate looks more reasonable as the first estimate.

One can also now perform naive scalings. J/Ψ has mass of about 3 GeV. If the scaling of ordinary pion mass from .14 GeV indeed gives something like 145 GeV then one can be very naive and apply the same scaling factor of about 1030 to get the scaled up J/Ψ; with mass of order 3.1 TeV. The better way to understand the situation is to assume that color-magnetic spin spin splitting is small also for M_{89} charmonium states and apply naive scaling to the mass of J/Ψ; to get a lower bound for the mass of its M_{89} counterpart. This would give mass of 1.55 TeV which is by a factor 1/2 too small. p-Adic mass calculations lead to the conclusion that c quark is characterized by $p\simeq2^k$, $k=104$. Naive scaling would give $k=104-18=86$ and 1.55 TeV mass for J/Ψ. Nothing however excludes $k=84$ and the lower bound 3.1 TGD for the mass of J/Ψ. Since color magnetic spin-spin splitting is smaller for M_{89} pion, same is expected to be true also for charmonium states so that the mass might well be around 3.3 TeV.

2.3 Blackholes at LHC: or just bottonium of M_{89} hadron physics?

The latest Tommaso Dorigo's posting has a rather provocative title: The Plot Of The Week - A Black Hole Candidate. Some theories inspired by string theories predict micro black holes at LHC. Micro blackholes have been proposed as explanation for certain exotic cosmic ray events such as Centauros, which however seem to have standard physics explanation.

Without being a specialist one could expect that evaporating black hole would be in many respects analogous to quark gluon plasma phase decaying to elementary particles producing jets. Or any particle like system, which has forgot all information about colliding particles which created it- say the information about the scattering plane of partons leading to the jets as a final state and reflecting itself as the coplanarity of the jets. If the information about the initial state is lost, one would expect more or less spherical jet distribution. The variable used as in the study is sum of transverse energies for jets emerging from same point and having at least 50 GeV transverse energy. QCD predicts that this kind of events should be rather scarce and if they are present, one can seriously consider the possibility of new physics.

The LHC document containing the sensational proposal is titled Search for Black Holes in pp collisions at $\sqrt{s} = 7$ TeV [16] and has the following abstract:

An update on a search for microscopic black hole production in pp collisions at a center-of-mass energy of 7 TeV by the CMS experiment at the LHC is presented using a 2011 data sample corresponding to an integrated luminosity of 190 pb1. This corresponds to a six-fold increase in statistics compared to the original search based on 2010 data. Events with large total transverse energy have been analyzed for the presence of multiple energetic jets, leptons, and photons, typical of a signal from an evaporating black hole. A good agreement with the expected standard model backgrounds, dominated by QCD multijet production, has been observed for various multiplicities of the final state. Stringent model-independent limits on new physics production in high-multiplicity energetic final states have been set, along with model-specific limits on semi-classical black hole masses in the 4-5 TeV range for a variety of model parameters. This update extends substantially the sensitivity of the 2010 analysis.

The abstract would suggest that nothing special has been found but in sharp contrast with this the article mentions black hole candidate decaying to 10 jets with total transverse energy S_T. The event is illustrated in the figure 3 of the article. The large number of jets emanating from single point would suggest a single object decaying producing the jets.

Personally I cannot take black holes as an explanation of the event seriously. What can I offer instead? p-Adic mass calculations rely on p-adic thermodynamics and this inspires obvious questions. What p-adic cooling and heating processes could mean? Can one speak about p-adic hot spots? What p-adic overheating and over-cooling could mean? Could the octaves of pions and possibly other mesons explaining several anomalous findings including CDF bump correspond to unstable over-heated hadrons for which the p-adic prime near power of two is smaller than normally and p-adic mass scale is correspondingly scaled up by a power of two?

The best manner to learn is by excluding various alternative explanations for the 10 jet event.

1. M_{89} variants of QCD jets are excluded both because their production requires higher energies and because their number would be small. The first QCD three-jets were observed around 1979 [27]. $q-\overline{q}-g$ three-jet was in question and it was detected in e^+e^- collision with cm energy about 7 GeV. The naive scaling by factor 512 would suggest that something like 5.6 TeV cm energy is needed to observed M_{89} parton jets. The recent energy is 7 TeV so that there are hopes of observing M_{89} three- jets in decays of heavy M_{89}. For instance, the decays of charmonium and bottonium of M_{89} physics to three gluons or two-gluons and photon would create three-jets.

2. Ordinary quark gluon plasma is excluded since in a sufficiently large volume of quark gluon plasma so called jet quenching [9] occurs so that jets have small transverse energies. This would be due to the dissipation of energy in the dense quark gluon plasma. Also ordinary QCD jets are predicted to be rare at these transverse energies: this is of course the very idea of how black hole evaporation might be observed. Creation of quark gluon plasma of M_{89} hadron physics cannot be in question since ordinary quark gluon plasma was created in p-anti-p collision with cm energy of few TeV so that something like 512 TeV of cm energy might be needed!

3. Could the decay correspond to a decay of a blob of M_{89} hadronic phase to M_{107} hadrons? How this process could take place? I proposed for about 15 years ago [2] that the transition from M_{89} hadron physics to M_{107} hadron physics might take place as a p-adic cooling via a cascade like process via highly unstable intermediate hadron physics. The p-adic temperature is quantized and given by $T_p = n/log(p) \simeq n/klog(2)$ for $p \simeq 2^k$ and p-adic cooling process would proceed in a step-wise manner as $k \rightarrow k+2 \rightarrow k+4+...$ Also $k \rightarrow k+1 \rightarrow k+2+..$ with mass scale reduced in powers of $\sqrt{2}$ can be considered. If only octaves are allowed, the p-adic prime characterizing the hadronic space-time sheets and quark mass scale could decrease in nine steps from M_{89} mass scale proportional to $2^{-89/2}$ octave by octave down to the hadronic mass scale proportional $2^{-107/2}$ as $k = 89 \rightarrow 91 \rightarrow 93... \rightarrow 107$. At each step the mass in the propagator of the particle would be changed. In particular on mass shell particles would become off mass shell particles which could decay.

   At quark level the cooling process would naturally stop when the value of k corresponds to that characterizing the quark. For instance b quark one has $k(b) = 103$ so that 7 steps would be involved. This would mean the decay of M_{89} hadrons to highly unstable intermediate states corresponding to $k = 91, 93, ..., 107$. At every step states almost at rest could be produced and the final decay would produce large number of jets and the outcome would resemble the spectrum blackhole evaporation. Note that for u, d, s quarks one has $k = 113$ characterizing also nuclei and muon which would mean that valence quark space-time sheets of lightest hadrons would be cooler than hadronic space-time sheet, which could be heated by sea partons. Note also that quantum superposition of phases with several p-adic temperatures can be considered in zero energy ontology.

   This is of course just a proposal and might not be the real mechanism. If M_{89} hadrons are dark in TGD sense as the TGD based explanation of CDF-D0 discrepancy suggests, also the transformation changing the value of Planck constant is involved.

4. This picture does not make sense in the TGD inspired model explaining DAMA observations and DAMA-Xenon100 anomaly, CDF bump discussed in this chapter and two and half year old CDF anomaly [6]. The model involves creation of second octave of M_{89} pions decaying in stepwise manner. A natural interpretation of p-adic octaves of pions is in terms of a creation of over-heated unstable hadronic space-time sheet having $k = 85$ instead of $k = 89$ and p-adically cooling down to relatively thermally stable M_{89} sheet and containing light mesons and electroweak bosons. If so then the production of CDF bump would correspond to a creation of hadronic space-time sheet with p-adic temperature corresponding to $k = 85$ cooling by the decay to $k = 87$ pions in turn decaying to $k = 89$. After this the decay to M_{107} hadrons and other particles would take place.

Consider now whether the 10 jet event could be understood as a creation of a p-adic hot spot perhaps assignable to some heavy meson of M_{89} physics. The table below is from [1, 4] and gives the p-adic primes assigned with constituent quarks identified as valence quarks. For current quarks the p-adic primes can be much large so that in the case of u and d quark the masses can be in 10 MeV range (which together with detailed model for light hadrons supports the view that quarks can appear at several p-adic temperatures).

1. According to p-adic mass calculations [4] ordinary charmed quark corresponds to $k = 104 = 107-3$ and that of bottom quark to $k = 103 = 107-4$, which is prime and correspond to the second octave of M_{107} mass scale assignable to the highest state of pion cascade. By naive scaling M_{89} charmonium states (Ψ would correspond to $k = 89-3 = 86$ with mass of about 1.55 TeV by direct scaling. $k = 89-4 = 85$ would give mass about 3.1 GeV and there is slight evidence for a resonance around 3.3 TeV perhaps identifiable as charmonium. Υ (bottonium) consisting of $b\overline{b}$ pair correspond to $k = 89-4 = 85$ just like the second octave of M_{89} pion. The mass of M_{89} Υ meson would be about 4.8 TeV for $k = 85$. $k = 83$ one obtains 9.6 TeV, which exceeds the total cm energy 7 TeV.

2. Intriguingly, $k = 85$ for the bottom quark and for first octave of charmonium would correspond to the second octave of M_{89} pion. Could it be that the hadronic space-time sheet of Υ is heated to the p-adic temperature of the bottom quark and then cools down in a stepwise manner? If so, the decay of Υ could proceed by the decay to higher octaves of light M_{89} mesons in a process involving two steps and could produce a large number jets.

3. For the decay of ordinary Υ meson 81.7 per cent of the decays take place via ggg state. In the recent case they would create three M_{89} parton jets producing relativistic M_{89} hadrons. 2.2 per cent of decays take place via γgg state producing virtual photon plus M_{89} hadrons. The total energies of the three jets would be about 1.6 TeV each and much higher than the energies of QCD jets so that this kind of jets would serve as a clearcut signature of M_{89} hadron physics and its bottom quark. Note that there already exists slight evidence for charmonium state. Recall that the total transverse energy of the 10 jet event was about 1 TeV.

   Also direct decays to M_{89} hadrons take place. η' +anything- presumably favored by the large contribution of $b\bar{b}$ state in η'- corresponds to 2.9 per cent branching ratio for ordinary hadrons. If second octaves of η' and other hadrons appear in the hadron state, the decay product could be nearly at rest and large number of M_{89} would result in the p-adic cooling process (the naive scaling of η' mass gives .5 TeV and second octave would correspond to 2 TeV.

4. If two octave p-adic over-heating is dynamically favored, one must also consider the first octave of of scaled variant of J/Ψ state with mass around 3.1 GeV scaled up to 3.1 TeV for the first octave. The dominating hadronic final state in the decay of J/Ψ is $\rho^{\pm}\pi^{\mp}$ with branching ratio of 1.7 per cent. The branching fractions of $\omega\pi^+\pi^+\pi^-\pi^-$, $\omega\pi^+\pi^-\pi^0$, and $\omega\pi^+\pi^+pi^-$ are 8.5×10^{-3} 4.0×10^{-3}, and 8.6×10^{-3} respectively. The second octaves for the masses of ρ and π would be 1.3 TeV and .6 TeV giving net mass of 1.9 TeV so that these mesons would be relativistic if charmonium state with mass around 3.3 TeV is in question. If the two mesons decay by cooling, one would obtain two jets decaying two jets. Since the original mesons are relativistic one would probably obtain two wide jets decomposing to sub-jets. This would not give the desired fireball like outcome.

   The decays $\omega\pi^+\pi^+\pi^-\pi^-$ (see Particle Data Tables would produce five mesons, which are second octaves of M_{89} mesons. The rest masses of M_{89} mesons would in this case give total rest mass of 3.5 TeV. In this kind of decay -if kinematically possible- the hadrons would be nearly at rest. They would decay further to lower octaves almost at rest. These states in turn would decay to ordinary quark pairs and electroweak bosons producing a large number of jets and black hole like signatures might be obtained. If the process proceeds more slowly from M_{89} level, the visible jets would correspond to M_{89} hadrons decaying to ordinary hadrons. Their transverse energies would be very high.

q	d	u	s	c	b	t
n_q	4	5	6	6	59	58
s_q	12	10	14	11	67	63
$k(q)$	113	113	113	104	103	94
$m(q)/GeV$	.105	.092	.105	2.191	7.647	167.8

Constituent quark masses predicted for diagonal mesons assuming $(n_d, n_s, n_b) = (5, 5, 59)$ and $(n_u, n_c, n_t) = (5, 6, 58)$, maximal CP_2 mass scale($Y_e = 0$), and vanishing of second order contributions.

To sum up, the most natural interpretation for the 10-jet event in TGD framework would be as p-adic hot spots produced in collision.

2.4 Has CMS detected λ baryon of M_{89} hadron physics?

In his recent posting Lubos tells about a near 3-sigma excess of 390 GeV 3-jet RPV-gluino-like signal reported by CMS collaboration in article Search for Three-Jet Resonances in p-p collisions at $\sqrt{s} = 7$ TeV [18]. This represents one of the long waited results from LHC and there are good reason to consider it at least half-seriously.

Gluinos are produced in pairs and in the model based on standard super-symmetry decay to three quarks. The observed 3-jets in question would correspond to a decay to uds quark triplet. The decay would be R-parity breaking. The production rate would however too high for standard SUSY so that something else is involved if the 3 sigma excess is real.

2.4.1 Signatures for standard gluinos correspond to signatures for M_{89} baryons in TGD framework

In TGD Universe gluinos would decay to ordinary gluons and right-handed neutrino mixing with the left handed one so that gluino in TGD sense is excluded as an explanation of the 3-jets. In TGD framework the gluino candidate would be naturally replaced with $k = 89$ variant of strange baryon λ decaying to uds quark triplet. Also the 3-jets resulting from the decays of proton and neutron and Δ resonances are predicted. The mass of ordinary λ is $m(\lambda, 107) = 1.115$ GeV. The naive scaling by a factor 512 would give mass $m(\lambda, 107) = 571$ GeV, which is considerably higher than 390 GeV. Naive scaling would predict the scaled up copies of the ordinary light hadrons so that the model is testable.

It is quite possible that the bump is a statistical fluctuation. One can however reconsider the situation to see whether a less naive scaling could allow the interpretation of 3-jets as decay products of M_{89} λ-baryon.

2.4.2 Massivation of hadrons in TGD framework

Let us first look the model for the masses of nucleons in p-adic thermodynamics [5].

1. The basic model for baryon masses assumes that mass squared -rather than energy as in QCD and mass in naive quark model- is additive at space-time sheet corresponding to given p-adic prime whereas masses are additive if they correspond to different p-adic primes. Mass contains besides quark contributions also "gluonic contribution" which dominates in the case of baryons. The additivity of mass squared follows naturally from string mass formula and distinguishes dramatically between TGD and QCD. The value of the p-adic prime $p \simeq 2^k$ characterizing quark depends on hadron: this explains the mass differences between baryons and mesons. In QCD approach the contribution of quark masses to nucleon masses is found to be less than 2 per cent from experimental constraints. In TGD framework this applies only to sea quarks for which masses are much lighter whereas the light valence quarks have masses of order 100 MeV.

   For a mass formula for quark contributions additive with respect to quark mass squared quark masses in proton would be around 100 MeV. The masses of u, d, and s quarks are in good approximation 100 MeV if p-adic prime is $k = 113$, which characterizes the nuclear space-time sheet and also the space-time sheet of muon. The contribution to proton mass is therefore about $\sqrt{3} \times 100$ MeV.

   Remark: The masses of u and d sea quarks must be of order 10 MeV to achieve consistency with QCD. In this case p-adic primes characterizing the quarks are considerably larger. Quarks with mass scale of order MeV are important in nuclear string model which is TGD based view about nuclear physics [3].

2. If color magnetic spin-spin splitting is neglected, p-adic mass calculations lead to the following additive formula for mass squared.

   $$M(baryon) = M(quarks) + M(gluonic) \ , \ M^2(gluonic) = nm^2(107) \ . \tag{2.1}$$

   The value of integer n can almost predicted from a model for the TGD counterpart of the gluonic contribution [5] to be $n = 18$. $m^2(107)$ corresponds to p-adic mass squared associated with the Mersenne prime $M_{107} = 2^{107} - 1$ characterizing hadronic space-time sheet responsible for the gluonic contribution to the mass squared. One has $m(107) = 233.55$ MeV from electron mass $m_e \simeq \sqrt{5} \times m(127) \simeq 0.5$ MeV and from $m(107) = 2^{(127-107)/2} \times m(127)$.

3. For proton one has

   $$M(quarks) = (\sum_{quarks} m^2(quark))^{1/2} \simeq 3^{1/2} \times \ \ 100 \ \ MeV$$

   for $k(u) = k(d) = 113$ [5].

2.4.3 Super-symplectic gluons as TGD counterpart for non-perturbative aspects of QCD

A key difference as compared to QCD is that the TGD counterpart for the gluonic contribution would contain also that due to "super-symplectic gluons" besides the possible contribution assignable to ordinary gluons.

1. Super-symplectic gluons do not correspond to pairs of quark and and antiquark at the opposite throats of wormhole contact as ordinary gluons do but to single wormhole throat carrying purely bosonic excitation corresponding to color Hamiltonian for CP_2. They therefore correspond directly to wave functions in WCW ("world of classical worlds") and could therefore be seen as a genuinely non-perturbative objects allowing no description in terms of a quantum field theory in fixed background space-time.
2. The description of the massivation of super-symplectic gluons using p-adic thermodynamics allows to estimate the integer n characterizing the gluonic contribution. Also super-symplectic gluons are characterized by genus g of the partonic 2-surface and in the absence of topological mixing $g = 0$ super-symplectic gluons are massless and do not contribute to the ground state mass squared in p-adic thermodynamics. It turns out that a more elegant model is obtained if the super-symplectic gluons suffer a topological mixing assumed to be same as for U type quarks. Their contributions to the mass squared would be $(5, 6, 58) \times m^2(107)$ with these assumptions.
3. The quark contribution $(M(nucleon) - M(gluonic))/M(nucleon)$ is roughly 82 per cent of proton mass. In QCD approach experimental constraints imply that the sum of quark masses is less that 2 per cent about proton mass. Therefore one has consistency with QCD approach if one assumes that the light quarks correspond to sea quarks.

2.4.4 What happens in $M_{107} \rightarrow M_{89}$ transition?

What happens in the transition $M_{107} \rightarrow M_{89}$ depends on how the quark and gluon contributions depend on the Mersenne prime.

1. One can also scale the "gluonic" contribution to baryon mass which should be same for proton and λ. Assuming that the color magnetic spin-spin splitting and color Coulombic conformal weight expressed in terms of conformal weight are same as for the ordinary baryons, the gluonic contribution to the mass of $p(89)$ corresponds to conformal weight $n = 11$ reduced from its maximal value $n = 3 \times 5 = 15$ corresponding to three topologically mixed super-symplectic gluons with conformal weight 5 [5]. The reduction is due to the negative colour Coulombic conformal weight. This is equal to $M_g = \sqrt{11} \times 512 \times m(107)$, $m(107) = 233.6$ MeV, giving $M_g = 396.7$ GeV which happens to be very near to the mass about 390 GeV of CMS bump. The facts that quarks appear already in light hadrons in several p-adic length scales and quark and gluonic contributions to mass are additive, raises the question whether the state in question corresponds to p-adically hot $(1/T_p \propto log(p) \simeq klog(2)$ gluonic/hadronic space-time sheet with $k = 89$ containing ordinary quarks giving a small contribution to the mass squared. Kind of overheating of hadronic space-time sheet would be in question.
2. The option for which quarks have masses of thermally stable M_{89} hadrons with quark masses deduced from the questionable 145 GeV CDF bump identified as the pion of M_{89} physics does not work.
    (a) If both contributions scale up by factor 512, one obtains $m(p, 89) = 482$ GeV and $m(\lambda) = 571$ GeV. The values are too large.
    (b) A more detailed estimate gives the same result. One can deduce the scaling of the quark contribution to the baryon mass by generalizing the condition that the mass of pion is in a good approximation just $m(\pi) = \sqrt{2}m(u, 107)$ (Goldstone property). One obtains that u and d quarks of M_{89} hadron physics correspond to $k = 93$ whereas top quark corresponds to $k = 94$: the transition between hadron physics would be therefore natural. One obtains

$m(u,89) = m(d,89) = 102$ GeV in good approximation: note that this predicts quark jets with mass around 100 GeV as a signature of M_{89} hadron physics.

The contribution of quarks to proton mass would be $M_q = \sqrt{3} \times 2^{(113-93)/2} m(u,107) \simeq 173$ GeV. By adding the quark contribution to gluonic contribution $M_g = 396.7$ GeV, one obtains $m(p,89) = 469.7$ GeV which is rather near to the naively scaled mass 482 GeV and too large. For $\lambda(89)$ the mass is even larger: if $\lambda(89) - p(89)$ mass difference obeys the naive scaling one has $m(\lambda,89) - m(p,89) = 512 \times m(\lambda,107) - m(p,107)$. One obtains $m(\lambda,89) = m(p,89)+m(s,89)-m(u,89) = 469.7+89.6$ GeV $= 559.3$ GeV rather near to the naive scaling estimate 571 GeV. This option fails.

Maybe I would be happier if the 390 GeV bump would turn out to be a fluctuation (as it probably does) and were replaced with a bump around 570 GeV plus other bumps corresponding to nucleons and Δ resonances and heavier strange baryons. The essential point is however that the mass scale of the gluino candidate is consistent with the interpretation as λ baryon of M_{89} hadron physics. Quite generally, the signatures of R-parity breaking standard SUSY have interpretation as signatures for M_{89} hadron physics in TGD framework.

References

Books related to TGD

[1] M. Pitkänen. Massless states and particle massivation. In *p-Adic Length Scale Hypothesis and Dark Matter Hierarchy.* Onlinebook. `http://tgd.wippiespace.com/public_html/paddark/paddark.html#mless`, 2006.

[2] M. Pitkänen. New Particle Physics Predicted by TGD: Part I. In *p-Adic Length Scale Hypothesis and Dark Matter Hierarchy.* Onlinebook. `http://tgd.wippiespace.com/public_html/paddark/paddark.html#mass4`, 2006.

[3] M. Pitkänen. Nuclear String Hypothesis. In *p-Adic Length Scale Hypothesis and Dark Matter Hierarchy.* Onlinebook. `http://tgd.wippiespace.com/public_html/paddark/paddark.html#nuclstring`, 2006.

[4] M. Pitkänen. p-Adic Particle Massivation: Elementary Particle Masses. In *p-Adic Length Scale Hypothesis and Dark Matter Hierarchy.* Onlinebook. `http://tgd.wippiespace.com/public_html/paddark/paddark.html#mass2`, 2006.

[5] M. Pitkänen. p-Adic Particle Massivation: Hadron Masses. In *p-Adic Length Scale Hypothesis and Dark Matter Hierarchy.* Onlinebook. `http://tgd.wippiespace.com/public_html/paddark/paddark.html#mass3`, 2006.

[6] M. Pitkänen. The Recent Status of Lepto-hadron Hypothesis. In *p-Adic Length Scale Hypothesis and Dark Matter Hierarchy.* Onlinebook. `http://tgd.wippiespace.com/public_html/paddark/paddark.html#leptc`, 2006.

Particle Physics

[7] Evidence for a Mass Dependent Forward-Backward Asymmetry in Top Quark Pair Production. `http://arxiv.org/abs/1101.0034`.

[8] Invariant Mass Distribution of Jet Pairs Produced in Association with a W boson in ppbar Collisions at $\sqrt{s} = 1.96$ TeV. `http://arxiv.org/abs/1104.0699`.

[9] Jet quenching. `http://en.wikipedia.org/wiki/Jet_quenching`.

[10] Light Z' Bosons at the Tevatron. `http://arxiv.org/abs/arXiv:1103.6035`.

[11] Measurement of the Forward Backward Asymmetry in Top Pair Production in the Dilepton Decay Channel using 5.1 fb^{-1}. `http://www-cdf.fnal.gov/physics/new/top/2011/DilAfb/`.

[12] Technicolor at the Tevatron. `http://arxiv.org/abs/1104.0976`.

[13] D0: 2.5-sigma evidence for a 325 GeV top prime quark. `http://motls.blogspot.com/2011/04/d0-3-sigma-evidence-for-325-gev-top.html`, 2011.

[14] If That Were A Higgs At 200 GeV... `http://www.science20.com/quantum_diaries_survivor/if_were_higgs_200_gev`, 2011.

[15] More details about the CDF bump. `http://resonaances.blogspot.com/2011/06/more-details-about-cdf-bump.html`, 2011.

[16] CMS colaboration. Search for Black Holes in pp collisions at $\sqrt{s} = 7$ TeV. `http://cms-physics.web.cern.ch/cms-physics/public/EXO-11-021-pas.pdf`, 2011.

[17] ATLAS collaboration. Update of the Search for New Physics in the Dijet Mass Distribution in 163 pb^{-1} of pp Collisions at $\sqrt{s} = 7$ TeV Measured with the ATLAS Detector. `http://cdsweb.cern.ch/record/1355704/files/ATLAS-CONF-2011-081.pdf?version=1`.

[18] ATLAS collaboration. Search for Three-Jet Resonances in p-p collisions at $\sqrt{s} = 7$ TeV. `http://arxiv.org/abs/1107.3084`, 2011.

[19] ATLAS collaboration. Search for W′ boson decaying to a muon and neutrino in pp collisions at $\sqrt{s} = 7$ TeV. 2011.

[20] CDF collaboration. Search for a new heavy gauge boson W with event signature electron+missing transverse energy in ppbar collisions at $\sqrt{s}$=1.96 TeV.

[21] CDF Collaboration. Observation of Z0Z0 llll at CDF. `http://www-cdf.fnal.gov/physics/ewk/2009/ZZllll/ZZWeb/cdf9910_ZZ_4leptons_public.pdf`, 2011.

[22] CDF Collaboration. Searches for the Higgs Boson. `http://blois.in2p3.fr/2011/transparencies/punzi.pdf`, 2011.

[23] D0 collaboration. Forward-backward asymmetry in top quark-antiquark production. `http://www-d0.fnal.gov/Run2Physics/WWW/results/final/TOP/T11O/T11O.pdf%`.

[24] D0 Collaboration. Search for a fourth generation t' quark in ppbar collisions at sqrts=1.96 TeV. `http://arxiv.org/abs/1104.4522`, 2011.

[25] D0 collaboration. Study of the dijet invariant mass distribution in $p\overline{p} \to W(\to l\nu) + jj$ final states at $\sqrt{s} = 1.96$ TeV. `http://www-d0.fnal.gov/Run2Physics/WWW/results/final/HIGGS/H11B`, 2011.

[26] A. Martin E. J. Eichten, K. Lane. Technicolor at Tevatron. `http://arxiv.org/abs/1104.0976`, 2011.

[27] P. Söding. On the discovery of the gluon. *Eur. Phys. J. H*, pages 3–28, 2010.