What is the role of Gaussian Mersennes in TGD Universe?

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June 20, 2019

Abstract

The hypothesis that Gaussian Mersennes together with ordinary Mersenne primes could define fundamental time and length scales in TGD Universe is discussed. p-Adic fractality suggests the existence of scaled variants of both hadron - and electro-weak physics associated with at least some Mersennes and Gaussian Mersennes. Both ATLAS and CMS have reported evidence for a 2 TeV bump at 3.5 sigma local significance level. The bump decays to weak bosons and hadronic dijets. The possibility that the bump could correspond to the neutral and charged pions of $M_{G,79}$ hadron physics - a scaled up copy of ordinary hadron physics - is considered and found to be in qualitative agreement with the data about the bump.

1 Gaussian Mersennes and p-adic length scale hypothesis

The following arguments demonstrate as a by-product that Gaussian Mersennes define p-adic length scales having identification as fundamental length scales in cosmology, astrophysics, biology, nuclear physics, and ultrahigh energy elementary particle physics: perhaps even at energies reachable at LHC. The largest Gaussian Mersenne defines slightly longer time scale than the age of the Universe appearing as the parameter in the model for oscillations and this Gaussian Mersenne could explain why just this time scale appears. What is remarkable the age of the Universe would correspond to a length scale analogous to length scales fundamental in TGD inspired quantum biology and one can wonder whether this has a deeper meaning. What is also remarkable, that the p-adic Compton lengths for dark electron define the fundamental scales. Does this mean that dark electrons or their p-adically scaled down variants are important in all these scales?

p-Adic length scale hypothesis [K1] states that primes slightly below powers of two are physically preferred ones. Mersenne primes $M_n = 2^n - 1$ obviously satisfy this condition optimally. The proposal generalizes to Gaussian Mersenne primes $M_{G,n} = (1+i)^n - 1$ (http://primes.utm.edu/glossary/xpage/GaussianMersenne.html). It is now possible to understand preferred p-adic primes as so called ramified primes of an algebraic extension of rationals to which the parameters characterizing string world sheets and partonic 2-surfaces belong. Strong form of holography is crucial: space-time surfaces are constructible from these 2-surfaces: for p-adic variants the construction should be easy by the presence of pseudo-constants. In real sector very probably continuation is possible only in special cases. In the framework of consciousness theory the interpretation is that in this case imaginations (p-adic space-time surfaces) are realizable. Also p-adic length scale hypothesis can be understood and generalizes: primes near powers of any prime are preferred.

The definition of p-adic length scale is a convention to some degree.

1. One possible definition for L_p is as Compton length for the smallest mass possible in p-adic thermodynamics for a given prime if the first order contribution is non-vanishing.

2. Second definition is the Compton length $L_{p,e}$ for electron if it would correspond to the prime in question: in good approximation one has $L_p = \sqrt{5} \times L_{p,e}$ from p-adic mass calculations. If p-adic length scale hypothesis is assumed ($p \simeq 2^k$) one has $L_{p,e} \equiv L(k,e) = 2^{(k-127)/2} L_e$, where L_e is electron Compton length (electron mass is .5 MeV). If one is interested in Compton time $T(k,e)$, one obtains it easily from electrons Compton time .1 seconds (defining fundamental

biorhythm) as $T(k,e) = 2^{(k-2*127)/2} \times .1$ seconds. I will mean with p-adic length scale $T(k,e) \simeq \sqrt{5}T(k)$ in the following.

Mersenne primes $M_n = 2^n - 1$ are as near as possible to power of two and are therefore of special interest.

1. Mersenne primes corresponding to $n \in \{2,3,5,7,13,17,19,31,61\}$ are out of reach of recent accelerators.
2. $n = 89$ characterizes weak bosons and suggests a scaled up version of hadron physics which should be seen at LHC. There are already several indications for its existence.
3. $n = 107$ corresponds to hadron physics and tau lepton.
4. $n = 127$ corresponds to electron. Mersenne primes are clearly very rare and characterize many elementary particle physics as well as hadrons and weak bosons. The largest Mersenne prime which does not define completely super-astrophysical p-adic length scale is M_{127} associated with electron.

Gaussian Mersennes (complex primes for complex integers) are much more abundant and in the following I demonstrate that corresponding p-adic time scales might seem to define fundamental length scales of cosmology, astrophysics, biology, nuclear physics, and elementary physics. I have not previously checked the possible relevance of Gaussian Mersennes for cosmology and for the physics beyond standard model above LHC energies: there are as many as 10 Gaussian Mersennes besides 9 Mersennes above LHC energy scale suggesting a lot of new physics in sharp contrast with the GUT dogma that nothing interesting happens above weak boson scale- perhaps copies of hadron physics or weak interaction physics. The list of Gaussian Mersennes is following.

1. $n \in \{2,3,5,7,11,19,29,47,73\}$ correspond to energies not accessible at LHC. $n = 79$ might define new copy of hadron physics above TeV range -something which I have not considered seriously before. The scaled variants of pion and proton masses (M_{107} hadron physics) are about 2.2 TeV and 16 TeV. Is $M_{G,79}$ hadron physics visible at LHC?: in the next section the possibility that it might have been already seen at LHC, is discussed.
2. $n = 113$ corresponds to nuclear physics. Gaussian Mersenne property and the fact that Gaussian Mersennes seem to be highly relevant for life at cell nucleus length scales inspires the question whether $n = 113$ could give rise to something analogous to life and genetic code. I have indeed proposed realization of genetic code and analogs of DNA, RNA, amino-acids and tRNA in terms of dark nucleon states.
3. $n = 151, 157, 163, 167$ define 4 biologically important scales between cell membrane thickness and cell nucleus size of 2.5 μm. This range contains the length scales relevant for DNA and its coiling.
4. $n = 239, 241$ define two scales $L(e,239) = 1.96 \times 10^3$ km and $L(e,241) = 3.93 \times 10^3$ km differing by factor 2. Earth radius is 6.3×10^3 km, outer core has radius 3494 km rather near to L(2,241) and inner core radius 1220 km, which is smaller than 1960 km but has same order of magnitude. What is important that Earth reveals the two-core structure suggested by Gaussian Mersennes.
5. $n = 283$: $L(283) = .8 \times 10^{10}$ km defines the size scale of a typical star system. The diameter of the solar system is about $d = .9 \times 10^{10}$ km.
6. $n = 353$: $L(353,e) = 2.1$ Mly, which is the size scale of galaxies. Milky Way has diameter about .9 Mly.
7. $n = 367$ defines size scale $L(267,e) = 2.8 \times 10^8$ ly, which is the scale of big voids.
8. $n = 379$: The time scale $T(379,e) = 1.79 \times 10^{10}$ years is slightly longer than the recently accepted age of the Universe about $T = 1.38 \times 10^{10}$ years and the nominal value of Hubble time $1/H = 1.4 \times 10^{10}$ years. The age of the Universe measured using cosmological scale parameter $a(t)$ is equal to the light-cone proper time for the light-cone assignable to the causal diamond is shorter than t.

For me these observations are shocking and suggest that number theory is visible in the structure of entire cosmos. Standard skeptic of course labels all this as numerology. Only understood fact is fact. TGD indeed allows to understand these facts.

2 Could $M_{G,79}$ hadron physics be seen at LHC?

Gaussian Mersennes $M_{G,n} = (1+i)^n - 1$ (http://primes.utm.edu/glossary/xpage/GaussianMersenne.html) are much more abundant than ordinary Mersennes and corresponding p-adic time scales seem to define fundamental length scales of cosmology, astrophysics, biology, nuclear physics, and elementary physics [K2]. There are as many as 10 Gaussian Mersennes besides 9 Mersennes above LHC energy scale suggesting a lot of new physics in sharp contrast with the GUT dogma that nothing interesting happens above weak boson scale- perhaps copies of hadron physics or weak interaction physics. In the following I consider only those Gaussian Mersennes possibly interesting from the point of view of very high energy particle physics.

$n \in \{2, 3, 5, 7, 11, 19, 29, 47, 73\}$ correspond to energies not accessible at LHC. $n = 79$ might define new copy of hadron physics above TeV range -something which I have not considered seriously before. The scaled variants of pion and proton masses (M_{107} hadron physics) are about 2.2 TeV and 16 TeV. Is it visible at LHC is a question mark to me.

Few weeks later after writing this I saw the posting of Lubos Motl suggesting that $M_{G,79}$ pion might have been already seen! Lubos Motl tells about a bump around 2(!)TeV energy observed already earlier at ATLAS and now also at CMS (http://motls.blogspot.fi/2015/07/symmetry-magazine-papers-about-2-tev-w.html: see the article "Something goes bump" (http://www.symmetrymagazine.org/article/july-2015/something-goes-bump-in-the-data in Symmetry Magazine. The local significance of the bump is about 3.5 sigma and global significance about 2.5 sigma. Bump decays to weak bosons.

Many interpretations are possible. An interpretation as a new Higgs like particle has been suggested. Second interpretation - favored by Lubos - is as right-handed W boson predicted by left-right- symmetric variants of the standard model. If this is correct interpretation, one can forget about TGD since the main victory of TGD is that the very strange looking symmetries of stanardad model have an elegant explanation in terms of CP_2 geometry, which is also twistorially completely unique and geometrizes both electroweak and color quantum numbers.

Note that the masses masses of $M_{G,79}$ weak physics would be obtained by scaling the masses of ordinary M_{89} weak bosons by factor $2^{(89-79)/2)} = 512$. This would give the masses about 2.6 TeV and 2.9 TeV.

There is however an objection. If one applies p-adic scaling $2^{(107-89)/2} = 2^9$ of pion mass in the case of speculated M_{89} hadron physics, M_{89} pion should have mass about 69 GeV (this brings in mind the old and forgotten anomaly known as Aleph anomaly at 55 GeV). I proposed that the mass is actually an octave higher and thus around 140 GeV: p-adic length scale hypothesis allows to consider octaves. Could it really be that a pion like state with this mass could have slipped through the sieve of particle physicists? Note that the proton of M_{89} hadron physics would have mass about .5 TeV.

I have proposed [?] that M_{89} hadron physics has made itself visible already in heavy ion collisions at RHIC and in proton- heavy ion collisions at LHC as strong deviation from QCD plasma behavior meaning that charged particles tended to be accompanied by particles of opposite charged in opposite direction as if they would be an outcome of a decay of string like objects, perhaps M_{89} pions. There has been attempts - not very successful - to explain non-QCD type behavior in terms of AdS/CFT. Scaled up variant of QCD would explain them elegantly. The findings from LHC during this year will probably clarify this issue.

Lubos (http://motls.blogspot.fi/2015/07/the-2-tev-lhc-excess-could-prove-string.html) is five days later more enthusiastic about superstring inspired explanation of the bump than the explanation relying on left-right symmetric variant of the standard model. The title of the posting of Lubos is "*The 2 TeV LHC excess could prove string theory*". The superstringy model [C1] involves as many as six superstring phenomenologists as chefs (http://arxiv.org/pdf/1507.05299v1.pdf) and the soup contains intersecting branes, anomalies, and large extra dimensions corresponding to scale of 20 TeV as ingredients.

The article gives further valuable information about the bump also for those who are not terribly interested on intersecting branes and addition of new anomalous factors to the standard model gauge group. The following arguments show that the information is qualitatively consistent with the TGD based model.

1. Bump is consistent with both ZZ, WZ, and according to Lubos also Zγ final states and is in the range 1.8-2.1 TeV. Therefore bump could involve both charged and neutral states. If the bump corresponds to neutral elementary particle such as new spin 1 boson Z' as proposed by superstring sextet, the challenge is to explain ZZ and Zγ bumps. WZ pairs cannot result from primary decays.

2. There is dijet excess, which is roughly by a factor of 20 larger than weak boson excesses. This would suggest that some state decays to quarks or their excitations and the large value of QCD coupling strength gives rise to a the larger excess. This also explains also why no lepton excess is observed.

   For the superstring inspired model the large branching fraction to hadronic dijets suggesting the presence of strong interactions is a challenge: Lubos does not comment this problem. Also the absence of leptonic pairs is problematic and model builders deduce that Z' suffers syndrome known as lepto-phobia.

3. Neutral and charged $M_{G,79}$ pions can decay to virtual $M_{G,79}$ or M_{89} quark pair annihilating further to a pair of weak bosons (also $\gamma\gamma$ pair is predicted) or by exchange of gluon to $M_{G,79}$, M_{89} (or M_{107}) quark pair producing eventually the dijet. This would explain the observations qualitatively. If the order of magnitude for the relative mass splitting between neutral and charged $M_{G,79}$ pion is same as for ordinary pion one, the relative splitting if of order $\Delta M/M \simeq 1/14$ - less that 10 per cent meaning $\Delta M < .2$ TeV. The range for the position of the bump is about .3 TeV.

4. The predictions of TGD model are in principle calculable. The only free parameter is the $M_{G,79}$ color coupling strength so that the model is easy to test.

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