

The most recent indications for anomalies from TGD perspective

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Abstract

Some of the most recent experimental indications for anomalies on astrophysics, cosmology, and particle physicists are briefly discussed with an interpretation based on basic predictions of TGD.

1 Cosmological principle questioned

One of the many hypes of the last year was that cosmological principle has been validated above some length scale. In other words, beyond certain length scale universe would appear homogenous and isotropic as cosmological principle assumes. From Wikipedia one learns that the scale is about 4 billion years. Now we learn that cosmological principle is under severe threat: see the popular article [E2]. A structure consisting of quasars with gigantic size of 4 billion light years has been discovered.

What says TGD? The notion of many-sheeted space-time means a revolution in cosmology based on TGD. In TGD cosmological principle is replaced by its fractal variant meaning Russian doll cosmology. In large enough scales space-time sheets are approximately Lorentz invariant (cosmological principle) and can be modeled by Robertson-Walker cosmologies. This is of course approximation using some length scale resolution. Furthermore, R-W cosmologies are vacuum extremals of Kähler action and as such non-physical except as models giving average energy momentum tensor via Einstein's equations. Einstein-Maxwell equations hold true for preferred extremals in all length scales- albeit with G and Λ comes as predictions rather than inputs [K1].

2 Astrophysics and magnetic ropes

Magnetic flux ropes have been discovered in the atmospheres of various planets, including Earth. Now they are discovered also around Venus. They carry superheated plasma gas from the one side of the rope to another one. Earlier I told about magnetic ropes in much longer scales: see Giant dark matter bridge between galaxy clusters discovered. Magnetic flux tubes carrying dark matter would be in question.

Magnetic flux tubes in various scales define a basic prediction of TGD and they would have resulted as gradual thickening of "cosmic" strings predicted to be dominated primordial TGD inspired cosmology. These primordial cosmic strings have strictly 2-D Minkowski space projection. They would be what string model builders should be ore than happy about but unfortunately they have nothing to do with superstrings.

3 A challenge or pulsar theories

The following abstract summarizes the discovery of a pulsar showing behavior which challenges all pulsar emission theories [E3].

Pulsars emit from low-frequency radio waves up to high-energy gamma-rays, generated anywhere from the stellar surface out to the edge of the magnetosphere. Detecting correlated mode changes across the electromagnetic spectrum is therefore key to understanding the physical relationship among the emission sites. Through simultaneous observations, we detected synchronous switching in the radio and x-ray emission properties of PSR B0943+10. When the pulsar is in a sustained radio-”bright” mode, the x-rays show only an un-pulsed, non-thermal component. Conversely, when the pulsar is in a radio-”quiet” mode, the x-ray luminosity more than doubles and a 100 % pulsed thermal component is observed along with the non-thermal component. This indicates rapid, global changes to the conditions in the magnetosphere, which challenge all proposed pulsar emission theories.

The first explanation that comes in mind in TGD framework relies on the notion of magnetic body as a representation for the magnetic field for an object considered. This is topologically quantized and consists of flux tubes and sheets having onion-like structure. In TGD inspired quantum biology magnetic body carrying dark matter as phases with large effective value of Planck constant is the key concept and its size even in the case of human body can be astrophysical. The magnetic body describing the magnetosphere of the pulsar could behave like a single coherent unit even in quantum sense. If it contains dark matter, the outcome could be a coherent non-thermal emission of X rays.

4 Looming dark matter announcements

Lubos Motl has a posting summarizing several anomalous findings. For few years ago so called musket-ball galaxy cluster was discovered and the newest analysis of the data has yielded a surprise [E1] reports cosmology Ph. Student William Dawson in American Astronomical Society meeting 2013.

Two colliding galaxy clusters are in question. Scientists believe that the visible stars in these galaxies make up only about 2 percent of the total mass in the cluster. About 12 percent of the mass is found in hot gas, which shines in X-ray wavelengths, while the remaining roughly 86 percent is made of invisible dark matter. Because the galaxies make up so little of the mass of the system and the spaces between them are so large, they don't really do much of the crashing. Odds are that they will simply sail by one another as the clusters merge. It's mostly the gas that collides, causing it to slow down and fall behind the galaxies as trails. Same is expected in the case of dark matter which should have only gravitational interactions.

Astronomers were also able to make a maps of dark matter in musket ball galaxy using the bending of light in the field the galaxy as a diagnostic tool. The surprise was however that more precise measurements suggest that the dark matter does not behave as it should! The behavior seems also now involve aspects similar to that of the gas phase, which is due to the short range forces—basically electromagnetic. Needless to say, this is in direct conflict with the dominating dark matter paradigm. Does this mean that the dark matter has also other than gravitational interactions with itself?!

TGD based view of dark matter differs from standard one. There is entire hierarchy of dark matter phases corresponding to a hierarchy of effective values of Planck constants. Different levels of the hierarchy correspond to different space-time sheets so that Feynman diagram at given space-time sheet can contain only particles with the same value of effective Planck constant. Therefore dark matter particles in TGD sense can have same mutual interactions as ordinary matter and the particle quantum numbers spectrum can be the same.

A long cosmic string containing galaxies along it like pearls in the necklace is the TGD basic explanation for galactic dark matter manifesting itself as constant velocity spectrum of distant stars. This spectrum follows automatically from the 1-D character of the distribution of magnetic energy of flux tubes identified as dark energy and serving as a source of gravitational field. Also dark matter in the above sense is expected to be present. There are certainly also non-gravitational interactions between the long magnetic strings associated with colliding galactic clusters occurring via Kähler magnetic fields.

5 Dark energy alternatives to Einstein are running of of room

It is known that the expansion of the universe is accelerating. Cosmological constant appearing in Einstein's equations as a fundamental constant is a straight forward formal explanation for the

accelerated expansion. One can also explain cosmological constant in terms of dark energy - or more precisely, in terms of the energy momentum tensor assignable with dark vacuum energy proportional to metric. This dark energy is often called quintessence. The vacuum expectation values of scalar fields determining the cosmological constant gradually change and so does cosmological constant. Remarkably, also proton/electron mass ratio depends on the vacuum expectation values.

It has become now possible to perform accurate enough measurements about proton/electron mass ratio and the recent analysis of the data by Prof. Rodger Thompson that the ratio has not changed at all to one part in then million after a time when the universe was half about its current age, around 7 billion years ago. Huge variety of models for dark energy are excluded and the situation of inflationary scenario is becoming rather gloomy.

What says TGD? In TGD framework p-adic mass calculations in principle predict the proton/electron mass ratio and there are no rolling scalar fields responsible for inflation: there is simply no need for inflation in TGD Universe since quantum criticality explains at general level the flatness of 3-space. Dark energy corresponds to magnetic energy of magnetic flux tubes structures which originate from the primordial cosmology and magnetic tension gives rise to "negative pressure" responsible for accelerated expansion.

As a matter fact, TGD provides several descriptions of the accelerated expansion assignable to different scales of description. Einstein's equations with cosmological term are satisfied by all preferred extremals but G and Λ are now predictions rather than input parameters and depends in principle on space-time sheet. These equations could be called microscopic (the original interpretation was diametrical opposite of this!). Critical cosmology has imbedding as Robertson-Walker cosmology which is unique apart from its duration which is finite and corresponds to accelerated expansion with negative "pressure". Also overcritical cosmologies have finite duration.

6 D0 of the Tevatron reports a potential particle physics anomaly: new indication for M_{89} hadron physics?

D0 of the Tevatron reports a potential new physics anomaly. Below is the abstract of their preprint titled **Measurement of the ratio of differential cross sections $\sigma(p\bar{p} \rightarrow Z+b \text{ jet})/\sigma(p\bar{p} \rightarrow Z+\text{jet})$ in $p\bar{p}$ collisions at $\sqrt{s} = 1.96 \text{ TeV}$ [C1].**

We measure the ratio of cross sections, $\sigma(p\bar{p} \rightarrow Z + b \text{ jet})/\sigma(p\bar{p} \rightarrow Z + \text{jet})$, for associated production of a Z boson with at least one jet. The ratio is also measured as a function of the jet transverse momentum, jet pseudorapidity, Z boson transverse momentum, and the azimuthal angle between the Z boson and the closest jet for events with at least oneb jet. These measurements use data collected by the D0 experiment in Run II of Fermilab's Tevatron $p\bar{p}$. Collider at a center-of-mass energy of 1.96 TeV, and correspond to an integrated luminosity of 9.7 fb^{-1} . The results are compared to predictions from next-to-leading order calculations and various Monte Carlo event generators.

The group reports that they have not been able able to build overall fit for the ratio of differential cross sections with respect to all variables in the entire region studied by using the Monte Carlo programs available.

Also Higgs contributes to the ratio studied via the decays $H \rightarrow \bar{b}$ following associated production of Z and H. If Higgs behaves as standard model Higgs the experiment can be seen as a test of perturbative QCD since apart from Z emission the Feynman graphs involve only strong interaction vertices. Therefore the claimed anomaly could be seen as a further indication for M_{89} hadron physics in TGD framework. SUSY fan might hope that the anomaly could be seen as evidence for a new Higgs like state predicted by $\mathcal{N} = 1$ SUSY in some form.

The Feynman graphs at the second page of W/Z +b jets: discussion of possible improvements and planned/ongoing activities represent the leading QCD contributions for the process $p\bar{p} \rightarrow W + b \text{ jet}$. By replacing W with Z one has the recent situation. In the first graph quark q and antiquark \bar{q} annihilate to Z and gluon g , which produces \bar{b} . In the second graph incoming quark q emits Z and incoming gluon g produces \bar{b} . After that b and q exchange gluon.

Suppose that the decay of M_{89} color magnetic flux tubes representing low energy M_{89} mesons explains the production of correlated charged particle pairs moving in same or opposite directions. The same model predicts that M_{89} gluons and quarks move along the flux tube: effectively one has QCD in 2-D Minkowski space if one considers only gluon exchanges parallel to the flux tube.

The exchanged gluons could be however also transversal to the flux tube if they have large enough transversal momentum.

1. For instance, in 2-D QCD variant of the first diagram could correspond to q and \bar{q} moving in opposite directions along the flux tube and \bar{q} emitting parallel Z and recoiling in opposite direction and after annihilating with q to gluon decaying to \bar{b} .
2. The 2-D QCD variant of the first diagram would correspond to g and q moving in opposite directions. The decays $g \rightarrow \bar{b}$ and $q \rightarrow q + Z$ take place and a gluon moving parallel to flux tube is exchanged between b and q .

These diagrams would represent M_{89} contributions to studied process and might explain the claimed discrepancy. There are several earlier indications for anomalies supporting M_{89} hadron physics. The too high production rate in Higgs decays reported by ATLAS and CMS could be explained in terms of a contribution coming from the decays of M_{89} pion with large width. The evidence for a particle having mass around 135 GeV by Fermi telescope but not consistent with interpretation in terms of decay products of M_{89} meson. The production of M_{89} pions could take place also in the collision of cosmic rays with nuclei in atmosphere generating a phase of M_{89} hadrons.

Particle and Nuclear Physics

- [C1] D0 collaboration. Measurement of the ratio of differential cross sections $\sigma(p\bar{p} \rightarrow Z+b \text{ jet})/\sigma(p\bar{p} \rightarrow Z + \text{jet})$ in $p\bar{p}$ collisions at $\sqrt{s} = 1.96$ TeV. <http://arxiv.org/abs/1301.2233>, 2013.

Cosmology and Astro-Physics

- [E1] Galactic Pile-Up May Point to Mysterious New Dark Force in the Universe. <http://www.wired.com/wiredscience/2013/01/musket-ball-dark-force/>, 2013.
- [E2] R.G. Clowes et al. A structure in the early Universe at $z \sim 1.3$ that exceeds the homogeneity scale of the R-W concordance cosmology. *MNRAS*, <http://mnras.oxfordjournals.org/content/early/2013/01/07/mnras.sts497.full>, 2013.
- [E3] W. Hermsen et al. Synchronous X-ray and Radio Mode Switches: A Rapid Global Transformation of the Pulsar Magnetosphere. *Science* 25 . Vol. 339 no 6118, , <http://www.sciencemag.org/content/339/6118/436.abstract>, 339(6118):436–439, 2013.

Books related to TGD

- [K1] M. Pitkänen. The Recent Vision About Preferred Extremals and Solutions of the Modified Dirac Equation. In *Quantum Physics as Infinite-Dimensional Geometry*. Onlinebook. http://tgdtheory.com/public_html/tgdgeom/tgdgeom.html#dirasvira, 2012.