ANITA anomaly, JWST observation challenging the interpretation of CMB, star formation in the remnant of a star, and strange super nova explosion

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Abstract

This article was inspired by recent findings challenging the standard model view of physics. The ANITA anomaly challenges the standard model view of particle physics and suggests the existence of dark matter type particles able to penetrate distances of several thousands kilometers through the Earth.

The second puzzling observation is theoretical. The very early large galaxies detected by JWST do not fit easily to the standard cosmology. Their existence also challenges the prevailing view about the origin of the cosmic microwave background (CMB). These galaxies are very active and generate dust and radiation, which is in thermal equilibrium with matter. When thermal decoupling occurs, a background radiation analogous to CMB is generated and the estimate is that it can contribute at least 1.4 per cent to the CMB and even dominate it. This challenges the standard narrative about cosmic evolution. In this article these two findings are discussed from the TGD perspective.

The third unexpected observation is that the white dwarf produced as a remnant of a star seems to be a seat for the formation of planets.

The explanation for the formation of planets in the white dwarf in turn supports the TGD view of stars as analogs of organic life forms which are living and metabolize. Are stars

living, metabolizing systems that are born, flourish, and die?. Do the remnants of a star give rise to a reincarnation of the star generating its own planetary system by these explosions as TGD counterparts for a smooth cosmic expansion? Do stars form networks analogous to multicellular systems communicating using the signals propagating parallel to the monopole flux tubes?

The fourth unexpected observation are the strange findings about supernova SN2021yfj challenging the view that the solar core is the seat of fusion. The TGD based stellar model indeed predicts that energy and solar wind are produced at the surface layer of the star.

1 Introduction

This article discusses some recent anomalies related to particle physics, cosmology and astrophysics.

ANITA is designed to detect neutrinos by the radio wave pulses created by the showers that they generate. There are several events, which can be explained in terms of neutrinos with ultrahigh energies. This conclusion is due to the fact that they penetrate a very long distance through the Earth. Now ANITA has detected events in which the particle possibly causing them should have travelled a distance of thousands of kilometers inside Earth [C1]. This is not possible in standard model physics.

The second puzzling observation is theoretical [E5]. JWST observation of very early galaxies not plausible in standard cosmology forces to challenge the origin of the cosmic microwave background (CMB). These galaxies are very active and generate dust and radiation which is in thermal equilibrium with matter. When the decoupling occurs a background radiation analogous to CMB can be generated and the conservative estimate is that it can contribute at least 1-4 per cent to the CMB and even dominate it. This challenges the standard narrative of cosmic evolution.

The TGD based view challenges the standard cosmological narrative before the formation of galaxies and stars and suggests that their formation began already before the decoupling of the CMB. This view is consistent with the findings of JWST challenging the standard view that gravitational condensation led to the formation of galaxies and stars. This view makes sense because the radiation from distant stars can propagate along monopole flux tubes.

The third unexpected observation is that the white dwarf produced as a remnant of a star seems to be a seat for the formation of planets (see this). Also a rocky planet associated with a dead star is found (see this).

The fourth unexpected observation are the strange findings about supernova SN2021yfj [E3] (see this suggesting in the standard star model that it has lost its surface layers so that only the core remains.

TGD suggests a solution of the ANITA anomaly in terms of phases of the ordinary matter characterized by large effective Planck constant h_{eff} and behaving like dark matter. These phases are not identifiable as galactic dark matter which has an interpretation as a TGD analog of dark energy assignable to what I call cosmic strings. Dark cosmic rays or dark photons could cause the anomalous radio wave pulses.

TGD predicts a cosmology [L13], which differs dramatically from the standard cosmology. The early cosmology would be dominated by cosmic strings, 4-surfaces in $H = M^4 \times CP_2$ having 2-D string world sheet as M^4 projection. In the transition to Einsteinian space-time, cosmic strings would form tangles, thicken and liberate energy transforming to ordinary matter. This process is analogous to inflation but could occur much later and be responsible for the formation of galaxies and stars as tangles of thickened cosmic strings.

TGD also predicts fractal hierarchy of hadron physics characterized by the p-adic length scale. This forces us to ask whether the TGD view of nuclear physics, in particular solar nuclear physics, and even cosmological nucleosynthesis could dramatically differ from the standard narrative [L13, L16]. Therefore it is interesting to try to interpret the findings of James Webb in this perspective.

The explanation for the formation of planets in the white dwarf in turn supports the TGD view of stars as analogs of organic life forms which are living and metabolize [L16]. Are stars living, metabolizing systems that are born, flourish, and die?. Do the remnants of a star give rise to a reincarnation of the star generating its own planetary system by these explosions as TGD counterparts for a smooth cosmic expansion? Do stars form networks analogous to multicellular systems communicating using the signals propagating parallel to the monopole flux tubes?

The strange findings about supernova SN2021yfj, challenging the view that solar core is the seat of fusion, in turn provide support for the TGD based model of star in which energy and solar wind are produced at the surface layer of the star [L16].

2 Could the new ANITA anomaly be due to dark cosmic rays?

ANITA, a balloon-borne radio detector flying over Antarctica was designed to detect neutrinos. Recently, it has however detected something totally unexpected: strange radio pulses rising from beneath the ice (see this). The strange radio waves detected by ANITA came from way below the ice, at angles so steep —like 30 degrees —that they should have traveled through thousands of kilometers of solid rock. Standard physics does not allow this. Pierre Auger Collaboration has carried out a search for the counterparts of events similar to those detected fy ANITA [C1] (see this).

The first particle physics based guess would be that the radio wave pulses originated from a collision of ultrahigh energy neutrinos propagating through the Earth. The neutrino would have interacted with the condensed matter creating relativistic particles, which give rise coherent Cerenkov radiation (see this) at radio wave frequencies. A backwards directed cone at which the emission is maximal would be created. Sonic boom occurring as an object moves with a velocity larger than the sound velocity of the medium is a good analogy.

The Cerenkov radiation is created in condensed matter at energies, which correspond to the frequencies associated with core electronic transitions in condensed matter since the refractive index n is smaller than 1 below these frequencies so that the phase velocity $v_{ph} = c/n$ is smaller than c and therefore below the velocity of the particle. These frequencies correspond to radio frequencies so that the primary signals need not be at radio frequencies.

The interpretation of the events in terms of UHE neutrinos fails. The distance travelled by the neutrino inside the Earth should be 6000-7000 km. The interpretation in terms of ultra heavy neutrinos with energies in the range of .2 EeV ($.2 \times 10^{18} eV$) requires that the neutrino should have travelled 10-12 interaction lengths so that the probability of the events creating the shower by the resulting tau leptons is quite too small. New physics seems to be involved. Particle physicists would propose new extremely weakly interacting particles, perhaps dark matter particles decaying to ordinary particles.

TGD predicts the existence of a hierarchy of phases of ordinary matter with non-standard value of Planck constant h_{eff}, which can be very large so that these phases are quantum coherent in long length scales. These phases behave like dark matter and would reside at the field/magnetic bodies, which are the TGD counterpart for classical fields.

These new phases need not have anything to do with the galactic dark matter in the TGD framework: galactic dark matter would be analogous to dark energy and correspond to magnetic and volume energy associated with what I call cosmic strings [L13]. The observed disappearance of baryonic matter during the cosmic evolution could correspond to a gradual transformation of ordinary protons to dark protons at the field bodies. The $h_{eff} > h$ phases, in particular dark protons and dark photons, are the key players in the TGD inspired quantum biology [L3, L4, L9].

These (effectively) dark particles could propagate along the field (magnetic) body of the Earth and would have a scaled up interaction length proportional to $h_{eff}/h > 1$. Their transformation to ordinary particles with $h_{eff} = h$ would generate the shower. Also the transformation of dark photons to ordinary photons could create pairs of charged particles and lead to a generation of showers.

The identification of dark particles as dark variants of cosmic rays could also explain the unexpected finding of James Webb telescope of very distant galaxies [L13]. In standard cosmology, these galaxies should not be visible. Could the dark radiation arrive along monopole flux tubes connecting stars to the galactic center or even galactic blackhole?

This explanation is of course only the first guess and a lot of work is needed to check whether it works at a quantitative level.

3 Is the origin of the dominant part of CMB really what it is believed to be?

Sabine Hossenfelder talked about a highly interesting recent theoretical finding related to the origin of the cosmic microwave background (CMB) (see this). The Youtube video tells about the article of Gjergo and Kroup [E5] raising the question that the so called early-type galaxies (ETGs) found by James Webb telescope, could give to CMB an additional contribution, which according to the most conservative estimate is 1.4 per cent and can even dominate of the ordinary contribution if present. This could mean a revolution in cosmology and is therefore extremely interesting from the TGD point of view.

3.1 Could CMB contain also non-standard contribution?

Consider first some background.

1. Consider first the standard model for the origin of CMB. The standard cosmology assumes plasma phase. In the very early stages quarks and gluons were free. The nucleosynthesis took place and eventually the formation of atoms became possible as the temperature of plasma consisting mostly of hydrogen was low enough.

   Thermal radiation decoupled from thermal equilibrium and the universe became opaque. The radiation temperature started to decrease like $1/a$, a is the scale factor of the Universe, which in TGD is identifiable as light-cone proper time for causal diamond (CD). The age of the Universe neutralization was about $t_{rec} \sim .379$ My. Later a reheating occured and ionized the atoms and the Universe became transparent. This was due to the formation of stars which generated radiation and the solar wind.

   Some numbers are in order. The recent age of the universe is about $t = 1.4 \times 10^4$ My. The temperature in the decoupling was 3000 K so that $a_0/a(t) = (3/2.75) \times 10^3 \sim 10^3$. $t_0/t \simeq 3.679 \times 10^4$.

2. Very massive early-type galaxies (ETG) were studied theoretically by using the data provided by James Webb telescope. $a_0/a(t) = 1 + z$, z was in the range. They produced dust and radiation in thermal equilibrium with it. When the age of the Universe was was roughly $t(ETG) \sim 500$ My (considerably shorter than $t = 1.4 \times 10^4$ My) the radiation ecoupled from the thermal equilibrium and gave an additional contribution to CMB. The lower bound for the contribution is 1.4 per cent but it could be even of order one and could even dominate.

   ΛCDM view of dark is assumed in the theoretical considerations of [E5] so one must be cautious with comparison with the TGD view. The vision is that rapid star formation generated dust and radiation, which was thermalized. Decoupling from matter occurred and the analog of CMB was generated.

3. This finding does not challenge the Big Bang but can challenge the narrative about how stars and galaxies emerged. This finding could in fact change the entire cosmology of the time before these very rapidly forming galaxies appeared.

   This together with the TGD view of cosmic evolution, forces to challenge the narrative about the cosmic evolution before the nucleosynthesis [L13] and even after that the plasma, formed from hydrogen atoms and light nuclei need not have been present in considerable amounts. The assumption that the gravitational condensation of hydrogen and other atoms give rise to the formation of stars and galaxies, might be wrong.

   Was there any plasma phase? Was there any primordial nucleosynthesis? Was there any CMB in the standard sense? Was there any gravitational condensation of the ordinary matter to form stars?

3.2 TGD view of cosmology and astrophysics

TGD suggests a completely different cosmology and astrophysics before the formation of these strange galaxies [K4, K1, K5] [L7, L8, L13].

1. In the TGD framework, the decay of cosmic strings by forming tangles and thickening would produce ordinary particles as liberated energy giving rise to stars and galaxies. The long cosmic strings would thicken and produce ordinary matter in a way similar to the decay of the vacuum expectations of inflationary fields to ordinary matter. Galaxies and even stars need not form as ordinary matter undergoes gravitational condensation.

   This mechanism together with the zero energy ontology (ZEO) allowing time reversal in ordinary state function reductions, could explain the rapid formation of early-type galaxies. The decay of the cosmic strings could have produced ordinary matter and also stars and galaxies. An elegant explanation for the galactic dark matter and predictions for the flat velocity spectrum of distant stars around galaxies emerges [K4, K1] [L13]. It is not clear whether the primordial plasma, formed from hydrogen atoms and light nuclei, has been present in considerable amounts.

2. Dirac equation for $H = M^4 \times CP_2$, assuming that M^4 has Kähler structure predicts, that colored states, in particular quarks and gluons cannot exist as light particles. Only hadrons and leptons are possible and also their heavier counterparts [L21].

   This distinguishes dramatically between the standard model and TGD. The infinite hierarchy of color partial waves of quarks and leptons gives rise to corresponding hierarchies of massless hadrons and leptons, which generate thermal mass squared by p-adic thermodynamics. There would be no "desert" predicted by GUTs. Quark gluon plasma has not been present in the early Universe. Instead, cosmic strings would have dominated and colored states would have been present only at temperatures was very near to Hagedorn temperature of order CP_2 mass assignable to cosmic strings, 4-D objects with 2-D string world sheet as M^4 projection, which dominated the mass density. Einsteinian space-time with 4-D M^4 projection did not yet exist and was generated in the transition to radiation dominated phase.

3. p-Adically scaled versions of hadron physics are predicted. They correspond to light colorless hadrons formed from fermion modes corresponding to different color partial waves [K2, K3]. This could completely revolutionize the nuclear physics of the Sun [L16].This could also revolutionize the physics of the early Universe, at least before the stabilization of atoms, because quarks and glums would not exist except at temperatures of order CP_2 mass scale, which is of order 10^{-4} Planck masses. This could revolutionize cosmology even after that if the plasma, consisting of protons and light nuclei, is actually created as galaxies and stars were born as tangles of cosmic strings.

4. The decay of cosmic strings to ordinary matter by a step-wise p-adic cooling from Hagedorn temperature determined by CP_2 mass scale [K2, K3]. Last year, I wrote an article considering the possibility that the nuclear physics of the Sun could differ dramatically from the standard view. At the solar surface, the M_{89} hadrons with a mass scale, which is 512 the mass scale of ordinary hadrons, associated with monopole flux tubes connecting Sun to the galactic nucleus would decay into ordinary hadrons and produce solar radiation and the solar wind. The interior of the Sun would be something completely different from what has been assumed, being analogous to the cell nucleus.

   This decay, occurring by p-adic cooling [L16], could produce a plasma consisting of hydrogen atoms and light atoms as galaxies and stars were formed. This plasma would be created much later than has been assumed and would not be primordial! Weinberg's classic "The first 3 minutes" would become a historical curiosity!

This proposal also relates to another key problem of cosmology.

1. After the neutralization of the plasma believed to generate the CMB, the Universe was opaque since the radiation was absorbed by neutral atoms and could not propagate. At this time there were no galaxies and stars yet. A key problem of cosmology is what caused the sudden ionization of the neutral gas, mostly hydrogen, leading to its ionization so that the radiation from very early periods could propagate in the plasma and the Universe became transparent.

   This problem is discussed in the article of Ethan Siegel in Big-Think (see this). According to this article, the finding of the James Webb telescope that large galaxies evolved very fast

in the very early Universe suggests a possible answer: perhaps their formation ionized the neutral gas and made the Universe transparent. Their number is however too small. Isak Wold et al have proposed that smaller galaxies, formed very early, could have generated the ionizing radiation [E4].

2. What about the TGD view of the problem? Could the generation of galaxies in the proposed manner ionize the neutral gas or could it have even created the plasma as an analog of solar wind? Note that the density of neutral gas could have been considerably lower before this stage if the proposed picture is taken seriously. According to the Big-Think article, the generation of ETGs would not have been enough and the generation of small very early galaxies would also be needed.

   Another option suggested by TGD is that light from very early stars arrives along monopole flux tubes forming an analog of a telecommunication network. If the thickness of the flux tube is constant, the intensity of the radiation is not reduced during the travel for a given flux tube and signals from very early times are possible. The light could even arrive as photons which are dark in the sense that they have a large value of the effective Planck constant h_{eff} so that dissipation is small. This option could also solve the new ANITA anomaly due to the observation of radiowave pulses which seem to be created by cosmic rays which have propagate very long distance through Earth [C1].

3.3 Formation of galaxies and stars in the TGD Universe

When the formation of galaxies and stars could have occured in the TGD Universe?

1. In the TGD Universe, one can consider the option that the generation of galaxies occurred before the time and temperature when the recombination and decoupling is assumed to occur in the standard cosmology. This kind of assumption is not consistent with the assumption that the formation of galaxies relies on the gravitational condensation. This assumption conforms with the findings of James Webb, which indeed challenge the standard view.

2. The basic objection is that the decoupling of radiation at $T_{CMB} \sim 3000$ K would make the Universe opaque. However, in the TGD based cosmology the radiation would travel alson the monopole flux tubes forming a network. At a given flux tube there would be no attenuation unlike in the standard view in which the intensity falls like $1/r^2$ with distance. The total energy emission intensity would be the same as in the standard model but the intensity would be peaked at flux tubes. The Universe would not be opaque.

   I have also proposed that stars could form a hyperbolic tessellation at the 3-D cosmic time= constant hyperboloid and the observed gravitational hum could be explained in terms of diffraction and amplification due to the propagation along the flux tubes [L10].

3. The anomalous light curves of supernovae could be understood in this picture. The duration of standard standard candles supernovae should be the same. The duration of the flash can be estimated by taking into account the cosmic redshift implying a scaling of the observed duration by factor $1 + z$. For anomalous standard candles the duration obtained in this way is however shorter than it should be. The redshift is from the distance in turn estimated from the peak intensity assuming the light is emitted isotropically in all directions implying a $1/r^2$ reduction with the distance r. The anomaly can be understood if the distance estimate is shorter than the real distance.

   In the TGD framework, the radiation would arrive along monopole flux tubes forming a network. If there is a flux tube connecting the supernova and the receiver, the intensity is higher than predicted by the standard cosmology and the distance is underestimated so that the estimate for the redshift is too small. This could be seen as a support for the existence of the flux tube network. This also suggests that the matter and radiation produced in the thickening of the flux tubes reducing the dark energy of the flux tube remains inside the thickened flux tubes as particles.

The TGD view of the Sun [L16] gives additional guidelines.

1. TGD predicts of a hierarchy of standard model physics [L24] in 1-1 correspondence with the color partial waves for quarks and leptons appearing as representations of $SU(3)$ acting as isometry group of CP_2 and assumed to be labelled by p-adic mass scales for nucleons [L22, L21].

   The ordinary standard model physics corresponds to Mersenne prime M_{107} labelling the nucleon mass. M_{89} copy would be the next Mersenne prime with a 512 time higher mass scale. A conjecture is that the nucleons of these standard model copies are labelled by ordinary and Gaussian Mersenne primes.

2. The decay of M_{89} hadrons at the dark surface layer of the Sun is proposed to be responsible for the radiation from the Sun and for the solar wind [L16]. A possible interpretation is that the transformation of dark energy of the monopole flux tube to ordinary matter continues at the surface of the Sun. Could the transformation have started from a very large mass scale copy of standard model physics at a very high temperature and proceed step by step with the gradual reductions of the p-adic mass scale eventually leading to M_{89} hadrons which decay to ordinary hadrons at the surface layers of stars.

3. There are intriguing numerical coincidences suggesting the identification of the temperature at which the formation of galaxies and stars took place. Solar surface temperature $T_s = about 5.8 \times 10^3$ K is roughly twice the temperature at which the decoupling of radiation is assumed to have occurred in the standard cosmology. This temperature is much higher than the temperature at which standard physics allows gravitational condensation, JWST has challenged the standard model view: the galaxies seem to be present much earlier than believed to be possible.

   Stellar surface temperature varies in the range 2,000-50,000 K. Photosphere has temperature in the range 4,400-6,000 K and sunspots in the range 3,000-4,800 K. The sunspot temperature equals T_{CMB}. Could one think that the generation of ordinary matter forming stars and galaxies started at a temperature about $T = 2T_{CMB} \simeq 6000$ K and decoupling took place at about T_{CMB}? Could the formation of sunspots correspond to the decoupling? This hypothesis would relate the parameters of stellar physics and cosmology.

   Amusingly, T corresponds to a thermal energy which is essentially the value of metabolic energy quantum in biology. In the TGD framework, life could have emerged at the same time as stars and galaxies emerged [L25].

The popular article with title "Oxygen Has Been Discovered In The Most Distant Known Galaxy JADES-GS-z14-0" (see this) tells that the most distant known galaxy JADES-GS-z14-0 existed about 300 million years after Big Bang. It was discovered by James Webb and ALMA telescope has continued the observations. What is totally surprising is that the stars of JADES-GS-z14-0 have high metallicity. In particular, the oxygen content is 10 times higher than expected. In the standard view of stellar evolution, this requires that the stars have suffered several supernova explosions. This is not possible.

There is an article by Schouws et al in arXiv [E2] with title "Detection of [OIII]88μm in JADES-GS-z14-0 at $z = 14.1793$". Here is the abstract of the article.

We report the first successful ALMA follow-up observations of a secure $z > 10$ JWST-selected galaxy, by robustly detecting (6.6σ) the [OIII]88μ m line in JADES-GS-z14-0 (hereafter GS-z14). The ALMA detection yields a spectroscopic redshift of $z = 14.1793 \pm 0.0007$, and increases the precision on the prior redshift measurement of $z = 14.32^{+0.08}_{-0.20}$ from NIRSpec by $\geq 180\times$. Moreover, the redshift is consistent with that previously determined from a tentative detection (3.6σ) of CIII]1907,1909 ($z = 14.178 \pm 0.013$), solidifying the redshift determination via multiple line detections. We measure a line luminosity of L[OIII]88=$(2.1 \pm 0.5) \times 108 L_{Sun}$, placing GS-z14 at the lower end, but within the scatter of, the local L[OIII]88-star formation rate relation.

No dust continuum from GS-z14 is detected, suggesting an upper limit on the dust-to-stellar mass ratio of $\leq 2 \times 10^{-3}$, consistent with dust production from supernovae with a yield $y_d < 0.3 M_{Sun}$. Combining a previous JWST/MIRI photometric measurement of the [OIII]$\lambda\lambda$ 4959,5007 Å and Hβ lines with Cloudy models, we find GS-z14 to be surprisingly metal-enriched ($Z \in [0.05, 0.2] Z_{Sun}$), a mere 300 Myr after the Big Bang. The detection of a bright oxygen line in GS-z14 thus reinforces the notion that galaxies in the early Universe undergo rapid evolution.

This finding conforms with the general TGD based view of the formation of galaxies and stars [L13, L23]. Galaxies would not be formed by gravitational condensation but by the thickening of tangles of a cosmic string leading to the liberation of energy giving rise to ordinary matter, somewhat like inflation theory. Also the intersections of two cosmic strings and self intersections could be involved and generate galactic nuclei. The model explains the flat galactic rotation curves in terms of dark energy assignable to cosmic strings.

Also stars would be formed by a similar mechanism [**?**]. That no dust continuum created by supernova explosions was observed, is consistent with the assumption that no supernova explosions have occurred as standard model requires in order to explaing the high metallicity.

This explosive process can be considerably faster than the formation by gravitational condensation and dominate in the very early cosmology. TGD leads also to a model of stars based on new physics predicted by TGD and differing dramatically from the standard view [L16] and could change profoundly the views about stellar evolution.

4 About the TGD view for the formation of planet and stars

The model for the star discussed from the TGD point of view in [L16] provides a rather radical view of stars and their formation and leads also to a model for the formation of planets as mini Big Bangs discussed also in [L7, L8].

4.1 Ring Nebula as evidence for the TGD view of planets and stars and their formation

Ethan Siegel posted to BigThink a highly interesting article "Did JWST catch the Ring Nebula forming new planets?" (see this). Planets are observed in the nebula.

I glue here the description of the article almost as such.

1. The standard view is that when hydrogen depletes in the core of the Sun, it will expand to a red giant. Mercury, Venus, and likely also Earth will be devoured. The Oort cloud, Kuiper belt, and possibly even Neptune and Uranus. Therefore the presence of planets in the Ring Nebula is surprising. Finally a white dwarf will form and ionizes the previous ejecta.

2. The observations of JWST of Ring Nebula at a distance about 2000 ly however suggest that the story continues. Ring Nebula possesses a ring, lobes and inner and outer halos. Inside many different chemical elements can be detected. Polar flows of CO^+ ions inside a barrel shaped material are observed. The dying star's remnant is centrally located but a long suspected companion star remains elusive. JWST research, focusing on the Ring Nebula s interior and central regions, is vitally important. The central star is surrounded by a compact dust cloud, revealed at long wavelengths (above ~ 5 microns). These dusty features resemble young protoplanetary and dusty debris disks.

   The formation of planets in this way does not conform with the standard view that planets are formed from a proto-disk. This may mark a new, unforeseen planet-forming phase. Perhaps white dwarf systems spawn new planets, even after dying.

In the TGD based cosmology, the smooth cosmic expansion is replaced with fast explosive events, mini bigbangs, in with the size of the astrophysical objects suddenly increases or it throws out a layer to which a magnetic bubble consisting of a network of monopole flux tubes is formed. This view revolutionizes the view about the formation of planets and smaller structures.

1. The ring nebula discussed in the article having several layers brings to mind the TGD based proposal for the formation of planets. The central star would suffer an explosion throwing out spherical shells from its surface and these shells could (not necessarily) later condense to rings and these in turn would form planets. This mechanism could replace the standard model for the formation of planets as a gravitational condensation of protodisk.

   For magnetic bubbles see this and this. For solar anomalies see this and this.

   Vega is a star with proto disk-like structure but, contrary to the expectations, has no planets [L19].

2. Even the planets could explode and create moons and rings in this way. Moon and Deimos and Phobos, the moons of Mars, could have formed in this kind of explosion [L15, L26, L14].

3. Cambrian Explosion for Earth would have caused expansion of radius of Eartg by factor 2 and led to the bursts of underground oceans containing highly evolved multicellulars to the surface of the Earth [L6, L5].

How could this vision relate to the findings of JWST? It is good to first describe briefly some aspect of the TGD view of astrophysics described in the article "Some solar mysteries" [L16].

1. The article relies on new hadron- and nuclear physics predicted by TGD. In particular, scaled up copies of hadron physics are predicted and M_{89} hadron physics have a mass scale which is 512 times the mass scale of ordinary nucleons [K2, K3].

2. Also involved is zero energy ontology (ZEO) [L2], which solves the basic problem of quantum measurement theory and predicts that the arrow of time changes in "big" state function reductions. This would happen even in astrophysical scales.

3. The number theoretic view of physics [L17, L18, L11, L12, L20] in turn predicts that quantum coherence is possible even in astrophysical scales. Nottale proposed that the notion of gravitational Planck constant $\hbar_{gr}$ makes sense for classical long range gravitational fields and considered a model of the planetary system as an analog of atom [E1]. The value of $\hbar_{gr}$ value is fixed by the Equivalence Principle apart from a dimensionless velocity parameter $\beta_0 = v_0/c$, which for Sun is about 2^{-11}. In the TGD framework, $\hbar_{gr}$ is proposed to be a genuine Planck constant [L1, L3] assignable to phases of the ordinary matter located ad field bodies and behaving like dark matter but not identifiable as galactic dark matter which is more like dark energy associated with cosmic strings in TGD. The proposal generalizes to long range electric fields [L4].

The following "numerical coincidence" is the key observation. White dwarf is a very dense object with a radius of about Earth radius and mass of the order of the mass of the Sun. What could this mean?

1. In the TGD based model of the Sun [L16] gravitational Compton length of the Sun, assuming Nottale's hypothesis for gravitational Planck constant, is very near to the the radius of the Earth. Could white dwarf be seen as a gravitationally dark object with a gravitational Compton length near to the Earth radius, an analog of an elementary particle?

2. In this model, the Sun would receive metabolic energy as M_{89} hadrons identifiable as scaled up copies of ordinary hadrons from the galactic center, possibly from the TGD counterpart of the galactic blackhole and these M_{89} hadrons would decay to ordinary hadrons and produce solar wind and solar radiation. The solar core would be something totally different, perhaps analogous to a cell nucleus.

   Are stars living, metabolizing systems that are born, flourish, and die and whether the remnants of a star can give rise to a reincarnation of the star generating its own planetary system by these explosions as TGD counterparts for a smooth cosmic expansion? Do they form networks analogous to multicellular systems communicating using the signals propagating parallel to the monopole flux tubes?

3. In this framework the stragen observations about white dwarfs combined with the TGD view of the Sun and of the formation of planets inspires several questions. Did the predecessor of the Sun "die" and "reincarnate" as a white dwarf and produce outer planets in its explosion? Did the white dwarf explode and produce the recent Sun and the inner planets?

4.2 Direct support for the TGD based model of star from supernova explosion

There is support for a solid surface of the Sun [E6] and this was one of the many solar anomalies leading to the TGD based proposal for the model of the Sun [L16], in which the stellar surface

would produce and contain elements. I didn't however expect that any other support for the proposal would emerge during my lifetime.

However, the recent news about strange findings about supernova SN2021yfj changed the situation [E3]: see the Nature article, this and the popular article in finnish.

The explosion of supernova SN2021yfj ejected shells rich in silicon, sulphur and argon. These elements should exist in the core of the star, not at its surface if we believe in the standard model of nuclear fusion. Therefore the discovery came as a total surprise.

Here is the abstract of the article titled "Extremely stripped supernova reveals a silicon and sulfur formation site".

Stars are initially powered by the fusion of hydrogen to helium. These ashes serve as fuel in a series of stages transforming massive stars into a structure of shells. These are composed of natal hydrogen on the outside and consecutively heavier compositions inside, predicted to be dominated by He, C/O, O/Ne/Mg and O/Si/S. Silicon and sulfur are fused into iron, leading to the collapse of the core and either a supernova explosion or the formation of a black hole. Stripped stars, in which the outer hydrogen layer has been removed and the internal He-rich or even the C/O layer below it is exposed, provide evidence for this shell structure and the cosmic element production mechanism it reflects. The supernova types that arise from stripped stars embedded in shells of circumstellar material (CSM) confirm this scenario. However, direct evidence for the most interior shells, which are responsible for producing elements heavier than oxygen, is lacking. Here we report the discovery of the supernova SN2021yfj resulting from a star stripped to its O/Si/S-rich layer.

We directly observe a thick, massive Si/S-rich shell, expelled by the progenitor shortly before the supernova explosion. Exposing such an inner stellar layer is theoretically challenging and probably requires a rarely observed mass-loss mechanism. This rare supernova event reveals advanced stages of stellar evolution, forming heavier elements, including silicon, sulfur and argon, than those detected on the surface of any known class of massive stars.

The phrase "extremely stripped" explains why the discovery was so unexpected. The article interprets SN2021yfj as a very rare case having already lost its outer layers by some mechanism, perhaps by an explosion throwing out the outer layers.

Could one understand these findings in the TGD framework?

1. In the TGD based model [L16], the transformation of dark M_{89} nucleons to ordinary nucleons occurs at the surface layer of thickness, which is roughly the Compton length of M_{89} nucleons scaled up by $\hbar_{gr,Sun}/h$ and about Earth radius, of the star. This produces solar wind and radiation energy. The dark M_{89} nucleons at the surface layer would decay to ordinary nucleons, radiation and perhaps also heavier elements by a process that I call p-adic cooling [K2].

2. The consumption of M_{89} hadrons at the surface layer of the Sun requires a compensating a feed of M_{89} hadrons as the analog of metabolic energy feed along monopole flux tubes, most naturally connecting the Sun to the galactic nucleus or blackhole.

   The Sun might be seen as a cell-like system and the interior of the Sun could be very different from what it is believed to be, maybe even analogous to a cell nucleus so that the Sun could be a conscious, intelligent macroscopic quantum system. The thermodynamic model for the core would be simply wrong.

3. The nucleons would suffer dark fusion as the TGD counterpart of "cold fusion" to form heavier elements. The distribution of the elements produced would closely resemble the distribution assumed to be produced in ordinary fusion. This could explain the evidence for the solid surface of the Sun [E6] containing even elements as heavy as iron.

4. What could happen to the elements generated by the dark fusion? A good guess is that they sink to the lower heights in the gravitational field of the Sun so that they have a layered structure, having ordering similar to that assumed in the standard model of the solar core. However, the layered structure would be at the surface of the Sun rather than in the core! In the TGD based model, it would be much easier to explain the findings about SN2021yfj and also the findings of Moshina [E6].

5. TGD also predicts that planets were formed in the explosions throwing out a shell of dark matter at the surface of the star, later suffering a gravitational condensation to a planet [L7]. SN2021yfj could have experienced this kind of explosion, mini Big Bangs throwing out surface layers.

   This would predict that the nearer the planet is to the Sun, the heavier the elements forming it are and the smaller its distance from the Sun is. This conforms with the fact that inner planets are rocky planets and outer giant planets contain mostly light elements. Also SN2021yfj could have planets consisting of elements lighter than those detected.

The fractality of the TGD Universe in both spatial and temporal sense suggest what might be regarded as a generalization of the "ontogeny recapitulates phylogeny" principle (ORP) of biology stating that the evolution of an individual reflects the evolution of the species. The evolution of the astrophysical system by mini Big Bangs could be identified as a fractally scaled down version for the evolution of the cosmos by Big Bang.

1. If taken seriously, this principle could make possible educated guesses about the cosmic evolution, for instance of what happened in the formation of galaxies and stars [L13]. For instance, the lower bound for the temperature of sunspots is 3000 K, which is the temperature at which the decoupling of radiation from matter would have occurred in the standard cosmology. The order of magnitude for the temperature of the photosphere is about 5000 K: was this the cosmic temperature at which the stars were formed?

2. The standard cosmology requires much lower temperature and this could explain the findings of JWST in conflict with the standard cosmology. The Universe would remain transparent since the radiation could propagate along monopole flux tubes connecting astrophysical objects.

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