

TGD view of the paradoxical findings of the James Webb telescope

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Abstract

It seems the findings of the James Webb telescope are bound to force a revolution in cosmology and perhaps in astrophysics in general. The very early cosmology looks surreal in the conceptual framework of the standard cosmology and one might speak of time paradox. Most distant galaxies are visible before the time of reionization in which the universe should have become transparent to radiation. The physical ages of cosmologically youngest stars and galaxies can be dramatically higher than they should be. In particular, globular star clusters, which are very old formations, are found. The abundances of various atoms vary inside galaxies and star clusters although they should not. Complex hydrocarbons (PAHs) are present and appear in regions where there are no stars of star formation but not in the regions where there is star formation. Obviously, these findings challenge many basic assumptions of recent day physics, in particular the notion of time. I have discussed the general TGD based explanation of these paradoxical findings already earlier, and in this article I will consider the new findings.

1 Introduction

It is fair to say that the findings of the James Webb telescope are bound to force a revolution in cosmology and perhaps in astrophysics in general. A mass extinction of the fashionable theories, which have dominated the theory landscape during the last 4 decades, seems unavoidable.

The view of the very early cosmology provided by the James Webb telescope looks surreal in the conceptual framework of the standard cosmology. Most distant galaxies are visible before the time of reionization in which the universe should have become transparent to radiation. The physical ages of cosmologically youngest stars and galaxies can be dramatically higher than they should be. In particular, globular star clusters, which are very old formations, are found. One might speak of a time paradox.

The James Webb telescope can detect the detailed structure of individual galaxies and even star clusters. The abundances of various atoms vary inside galaxies and globular star clusters although they should not. Complex hydrocarbons (PAHs) are present and appear in regions where there are no stars of star formation but not in the regions where there is star formation [?]

Obviously, these findings challenge several basic assumptions of recent day physics, in particular the notion of time. I have discussed the general TGD based explanation of these paradoxical findings already earlier [L13, L11], and in this article I will consider the new findings.

The conceptual framework involves geometric and number theoretic views complementary to each other. Geometric view relies on the TGD view of space-time as a 4-surface in $H = M^4 \times CP_2$ obeying holography and on zero energy ontology (ZEO), which replaces standard ontology and predicts that the arrow of time changes in the counterparts of ordinary state function reductions.

The number theoretic view of TGD [L2, L3], which is complementary to the geometric view of TGD, predicts a hierarchy of phases of ordinary matter labelled by effective Planck constant $h_{eff} = nh_0$, where n corresponds to the dimension of an extension of rational associated with the polynomial with integer coefficients determining region of space-time as 4-surface in M^8 and by $M^8 - H$ duality in $H = M^4 \times CP_2$ [L8, L9]. In particular, gravitational quantum coherence is predicted in astrophysical scales. Gravitational Planck constant $\hbar_{gr} = GMm/\beta_0$, originally introduced by Nottale [E1], quantifies this notion [L12].

The emerging TGD view of cosmology and astrophysics is discussed in various articles [L4, L5, L11, L14, L15].

2 The findings of the James Webb telescope concerning very early Universe

The list of the discoveries of the James Webb telescope is rather impressive (rb.gy/8gjh2). There is also a popular article "12 amazing James Webb Space Telescope discoveries across the universe" (rb.gy/rdj0c). The list includes discoveries related to galaxies and globular star clusters in the very early universe, star formation, exoplanets, in particular hot Jupiters, protoplanets, and brown dwarfs.

The Youtube video (see rb.gy/j52ux) in LAB360 with the title "James Webb Telescope Detects more than 700 Galaxies at the Edge of Our Universe" summarizes some of the basic findings of the James Webb telescope concerning the very early Universe.

2.1 Summary of the findings of the James Webb telescope

The existence of more than 700 galaxies a few hundred million years after BB is in sharp conflict with the standard Big Bang Model although it is consistent with the cosmic expansion. Distance measurements indeed use cosmic redshift to deduce the distances of the galaxies. In any case, the James Webb telescope is profoundly shaking the foundations of cosmology. It seems that one can safely forget the standard story about the formation of stars and galaxies and also inflation as the generally accepted story of what happened before that.

In the standard picture, the epoch of reionization starts 1 billion years after the BB as the fog of gas is cleared by reionization so that photons can propagate. No signals would arrive from the epoch preceding reionization. These 700 galaxies should not be there since they are too young, existing 370-500 million years after BB.

The mass of the galaxy serves as a measure for the age of the galaxy but 6 galaxies with age .5 Gy and 10 times bigger than the Milky Way have been found! This makes one wonder, what will be found when one goes farther back in time?

JW can see galaxies as extended objects with visible structures and this provides a lot of additional information about the composition of these too-early birds.

1. Complex organic molecules, found also in smoke/fog, were found [E3]: this is 1 billion years too early! These molecules, polycyclic aromatic hydrocarbons (PAHs) (rb.gy/cx751), are big molecules, containing hundreds of atoms. What adds to the mystery, is that PAHs were found in regions where there are no stars or star formation but not in regions where stars are forming! PAH world hypothesis states that PAHs have played a key role in prebiotic life leading the emergence of RNAs (rb.gy/z6vma).
2. Also the locations of these molecules can be determined by JW in terms of their spectra. The distribution of the molecules is not uniform as one might expect. These galaxies can have the same mass as the Milky Way. The mass serves as a measure for the age of the galaxy but the age of these galaxies, according to standard cosmology, is only 10 percent of that of the Milky Way. This creates a paradox.

3. One particular galaxy, GN-z11 (rb.gy/gx9fh) is observed as it existed 13.3 Gy ago.
 - (a) GN-z11 is found to contain an exceptionally high proportion of nitrogen and abundance of stars.
 - (b) Birth of globular star clusters (rb.gy/xezay) have been found in GN-z11. This finding is especially paradoxical since they are regarded as very old objects! The compositions of O,N, Na, and Al vary inside globular clusters. These anomalies have been known for a long time (rb.gy/8rdew). One however expects that the stars of the cluster should have the same origin and age in the early universe.
 - (c) Also supermassive stars (rb.gy/o0y36), having masses of few hundred solar masses, have been found in globular clusters. Multiple globular clusters have been found.

2.2 What theoretical implications the discoveries might have?

The findings of the James Webb telescope could be fatal for the fashionable theories related to standard cosmology. Inflationary scenario is the predecessor of radiation dominated cosmology which was once thought to be understood and it is difficult to think that it could survive if the cosmic evolution at the later period differs dramatically from the expectations.

One of the possible victims of the mass extinction of theories is Λ CDM model of cold dark matter, which has been the guiding cosmology for decades. Professor Boylan-Kolchin's paper, "Stress testing CDM with high-redshift galaxy candidates" published in Nature Astronomy [E2] (<https://www.nature.com/articles/s41550-023-01937-7>) discusses the constraint posed by the James Webb findings. The problem is that both the stellar and galactic masses are limited by the baryonic reservoir and the detected unexpectedly large number of massive stars and galaxies is at the very edge of these limits.

3 TGD explanation of the paradoxical findings of the James Webb telescope about very early Universe

What goes wrong with the standard cosmology? Could TGD inspired cosmology suggest an answer?

3.1 Zero energy ontology

Consider first zero energy ontology (ZEO) and the TGD view of dark matter. TGD suggests that the prevailing view about the notion of time is wrong. TGD forces a new ontology of quantum theory, which I call zero energy ontology (ZEO) [L7].

1. Causal diamond (CD) as a state-determined and dynamical quantization volume has two boundaries and zero energy states are in fermionic degrees of freedom superpositions of pairs of 3-D states associated with these two.
2. Zero energy states corresponds also to superpositions of space-time surfaces connecting the two boundaries of CD. By the almost deterministic holography implied by the 4-D general coordinate invariance, the space-time analogs 4-D analogs of Bohr orbits of particles as 3-D surfaces. In ZEO, subjective time and geometric time are not the same thing but are strongly correlated. This new ontology solves the basic paradox of quantum measurement theory.
3. There are two kind of state functions reductions (SFRs): "Small" SFRs (SSFRs) corresponding to repeated measurements in Zeno effect and "big" SFRs (BSFRs) corresponding to ordinary SFRs. CD has two kind of boundaries; active and passive. In SSFRs, the active boundary and states at it change whereas the passive boundary and the states at it remain unaffected. This is the counterpart of the Zeno effect: the state changes slightly but the arrow of time is preserved. SSFRs also correspond to weak measurements in quantum optics.

In BSFRs the arrow of time changes. BSFR occurs when the set of observables measured in SSFR at the active boundary of CD does not commute with those measured earlier at the

passive boundary of CD. CD increases in size in a statistical sense during the sequence of SSFRs since the active boundary drifts farther from the passive one. This gives rise to the correlation of subjective time a sequence of SSFRs with geometric time a distance between the tips of CD.

3.1.1 Hierarchy of dark matters as $h_{eff} = nh_0$ phases of ordinary matter

TGD also predicts quantum coherence in arbitrarily long scales and gravitational quantum coherence corresponds to the longest, even astrophysical, coherence scales since gravitational interaction has infinite range and is unscreened [L12]. The gravitational Planck constant introduced by Nottale [E1] characterizes the monopole flux tubes connecting astrophysical objects. Along these flux tubes dark gravitons mediating gravitational interaction and also other dark particles propagate. This has important implications in TGD inspired biology since the gravitational magnetic bodies of Sun, planets and perhaps even Moon become key players in TGD inspired quantum biology.

TGD leads also to a view of dark energy identified as classical energy assignable to string like objects that I call cosmic strings. Their thickening to monopole flux tubes lead to vision about the formation of galaxies, stars and planets differing in many respects dramatically from the standard view [L4, L5, L11, L14, L15]. In particular, galactic dark matter would be associated with long cosmic strings formed as thickenings of the cosmic strings to monopole flux tubes.

The change of arrow of time in BSFR implies dramatic effects even in astrophysical scales. Even astrophysical objects can live forth and back in geometric time. The ageing in the physical sense occurs in both directions of geometric time so that the physical age is total time spent in this moving forth and back. Since the passive boundary is stationary, the physical ageing in ZEO is faster than ageing in the standard ontology.

3.2 TGD view of the anomalies

Consider now a slightly more detailed the explanation of the various anomalies.

3.2.1 Time anomalies

Consider first the time anomalies.

1. ZEO explains stars and galaxies older than the Universe.
2. ZEO also predicts the variation of the ages of galaxies and stars in the very early Universe. Since galaxies and stars can be born at different periods in this life forth and back in geometric time, they can have different ages in the sense of ZEO. This explains why the abundances of atoms associated with the stars of star clusters are found to vary. The life forth and back in time also explains the appearance of globular star clusters, which are very old and are not possible in standard cosmology.

3.2.2 PAHs in the very early Universe

What about PAHs, which appear in the regions where star formation does not occur and do not appear in the region containing stars?

1. The TGD view of nuclear physics, originally inspired by the findings about "cold fusion", and based on the notion of dark nuclei, identified scaled up analogs of ordinary nuclei, leads to a model of prestellar evolution based on dark fusion (explaining also "cold fusion" [L6, L1, L10]).
"Dark" means that the nucleons of these nuclei have non-standard values of Planck constant $h_{eff} = nh_0$. In the number theoretic vision of TGD, integer n has interpretation as the dimension of extension of rationals associated with the polynomial with integer coefficients, which defines the space-time region [L8, L9, L16].
2. Dark fusion generates dark nuclei as sequences of dark protons at monopole flux tubes having size scale of electron Compton length. Their binding energy is much smaller than the binding energy of the ordinary nuclei. Dark nuclei can therefore transform to ordinary nuclei and

liberate most of the nuclear binding energy in the process, this give rise to "cold fusion". The temperature of the dark fusion region increases in the process and eventually reaches the temperature at which ordinary nuclear fusion can start.

Even chemistry and complex molecules can emerge before the ordinary nuclear fusion is ignited. This could explain the presence of PAHs, in particular their presence in regions, where there is no star formation or stars.

3. James Webb telescope has also found complex organic molecules, such as methanol and ethanol, in pre-stellar ice in the molecular cloud Chamaeleon I located 630 light year away ([rb.gy/d3q0s](https://arxiv.org/abs/2303.10036)). Contrary to expectations, this finding suggests that many star and planetary systems developing in Chamaeleon I contain molecules in a fairly advanced chemical state. This would indicate that the presence of precursors to prebiotic chemicals in planetary systems is a typical outcome of star formation rather than a peculiarity of our solar system.

In the TGD framework, dark fusion could produce heavier elements before the ignition of the ordinary nuclear fusion and lead also to a development of complex chemistry [L1, L10]. This could resolve some mysteries related to the abundances of nuclei such as the origin of nuclei heavier than Fe and also the anomalous abundances of some lighter nuclei. Also objects like brown dwarfs ([rb.gy/41kp5](https://arxiv.org/abs/2303.10036)), called planets, which failed to become stars, could have emerged in this way. James Webb has also identified numerous protostars, which have not yet reached the ignition temperature ([rb.gy/6hsax](https://arxiv.org/abs/2303.10036)): they could be similar objects. TGD however suggests that planets could have formed by an explosion throwing out an outermost layer of the stellar magnetic body as a magnetic bubble consisting of monopole flux tubes carrying dark matter, which would then transform to ordinary matter in a process starting with dark fusion [L14, L15].

3.2.3 How signals from the period preceding the reionization are possible at all?

One reason is that there was a reionization. TGD also allows us to consider the possibility that the signals arrive as dark photons along monopole flux tubes of a cosmic flux tube network acting as an analog of the nervous system. Also in the TGD based model of the brain, dark photon signals propagating between the central nervous system and magnetic body play a key role.

I have considered the findings of James Webb telescope from the TGD point of view in [L13, L11]). The TGD view of cosmology and astrophysics is discussed in various articles [L4, L5, L11, L14, L15].

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