Life in Venus? What says TGD?

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Contents

1 Introduction **1**

2 Could there be sulfuric life in Venus? **2**
2.1 Basic fact about Venus and Venusian atmosphere 2
2.2 Some data items about the role of sulfur in terrestrial biology 3
2.3 The minimal option for a sulphur based life in Venus 4
2.4 More radical options for sulfuric life at Venus 6
2.5 Comparing the two radical options 6

Abstract

Evidence for life in a rather unexpected place - Venus - has emerged. The atmosphere of Venus shows signs of phosphine PH_3 - the analog of ammonium NH_3 -, which cannot be produced by inorganic processes. There are small amounts of phosphine in the Earth's atmosphere and has an organic origin. Same might be true in the case of Venus. Perhaps simple bacterial life is in question. Is it in the atmosphere or somewhere deeper in an open question. TGD based vision about quantum biology suggests several options.

The most conservative option suggested by TGD relies on the analogy between H_2S and water. The magnetic body (MB) of H_2S realizing also dark variants of basic bio-molecules could play the same role as the MB of water. First proto cell membrane would have formed and led to the development of O-S separation so that the interior of the proto cell would have consisted mostly of water allowing ordinary bio-molecules to evolve.

One can consider also the replacement $O \rightarrow S$ occurs in the basic bio-molecules- DNA, RNA,tRNA, and amino acids. This would leave cell membrane as such. A less plausible replacement (O,N,P) $\rightarrow$ (S,P,As) shifting life downwards along the Periodic Table is also discussed.

1 Introduction

Evidence for life in a rather unexpected place - Venus - has emerged [I3]: see the popular article in Scientic American (`https://cutt.ly/qfD973w`). The atmosphere of Venus shows signs of phosphine PH_3 - the analog of ammonium NH_3 -, which cannot be produced by inorganic processes. There are small amounts of phosphine in the Earth's atmosphere and has an organic origin. Same might be true in the case of Venus. Perhaps simple bacterial life is in question. Is it in the atmosphere or somewhere deeper in an open question.

One can find from Wikipedia that phosphine has the chemical formula PH_3. In inorganic chemistry it is very difficult to form phosphine from phosphate $(PO_4)^{-3}$ which is central in living matter. Somehow reduction must occur: the double valence bonds O=P of phosphates must in the final situation ordinary valence bonds in PH_3.

TGD predicts that all planets have life in their interior. This would solve the Fermi paradox. Also Earth's life would have evolved in the interior and emerged to the surface in the Cambrian Explosion when a large number of multicellulars emerged as if nowhere. The reason would have been a rather fast increase of Earth radius by factor 2: in TGD cosmology continuous expansion for astrophysical objects is replaced by a sequence of fast expansions followed by steady non-expanding states [L3, L2]. Whether the phosphine could emerge from the interior of Venus is an interesting question.

TGD also predicts a new kind of chemistry involving the notions of magnetic body (MB) carrying dark matter identified as phases of ordinary matter with effective Planck constant $h_{eff} = nh_0$ ($h = 6h_0$), which can have very large values. Also the notions of acid resp. base and reduction and oxidation would involve dark protons resp. Dark valence electrons but in biosystems these notions would become fundamental. For instance, in Pollack effect exclusion zones as regions in which every fourth proton goes to a magnetic flux tube as a dark proton would be formed. For pH = 7 the fraction 10^{-7} of protons would be dark! In biology dark protons, electrons, and also dark ions would be fundamental.

MB would be the "boss" controlling the ordinary biomatter using dark cyclotron photon signals and resonance as a control tool. This new chemistry relying on what I call number theoretical (or adelic) physics would be central for the basic biomolecules such as DNA, RNA, tRNA, and amino acids having dark analogs accompanying them. The phosphates of DNA nucleotides with negative charges would be neutralized by dark protons and dark proton triplets would define a fundamental realization of the genetic code. Also amino-acids would be accompanied by dark proton (actually dark hydrogen) triplets.

Transforming protons to dark protons in Pollack effect requires an energy feed: IR photons do the job best. This means that dark protons carry metabolic energy and in ATP there could be 3 dark protons neutralizing the negative charges of phosphates. Together with dark electrons associated with valence bonds this would explain the questionable notion of high energy phosphate bond. ATP → ADP would transform one dark proton to ordinary one and break a valence bond, which for a dark electron has an abnormally high energy. Both of them would give energy. If there is life in Venus, one might expect that both these new phenomena predicted by TGD are involved. TGD based vision about quantum biology suggests several options.

The most conservative option suggested by TGD relies on the analogy between H_2S and water. The magnetic body (MB) of H_2S realizing also dark variants of basic bio-molecules could play the same role as the MB of water. First proto cell membrane would have formed and led to the development of O-S separation so that the interior of the proto cell would have consisted mostly of water allowing ordinary bio-molecules to evolve.

One can consider also the replacement $O \rightarrow S$ occurs in the basic bio-molecules- DNA, RNA,tRNA, and amino acids. This would leave cell membrane as such. A less plausible replacement (O,N,P) → (S,P,As) shifting life downwards along the Periodic Table is also discussed.

2 Could there be sulfuric life in Venus?

One can find an article (`https://cutt.ly/QfGhpoV`) about the chemistry involved with phosphine. Not only there exists no known in-organic manners to produce phosphine in Venusian atmosphere but also the biological pathways for the production of phosphine in the Earth's atmosphere by bacteria are unknown. Note that these bacteria are non-aerobial: I do not know whether S replaces O in their metabolism.

Could the new chemistry predicted by TGD and based on dark protons and dark electrons be involved? Dark protons carry metabolic energy - Pollack effect producing dark protons indeed requires energy feed - and the transformation of one of 3 dark protons in ATP → ADP would liberate metabolic energy. Could an analog of this metabolic mechanism help the formation of phosphine?

2.1 Basic fact about Venus and Venusian atmosphere

One learns from Wikipedia (`https://cutt.ly/DfGhuid`) basic facts about Venus.

1. Venus is one of the four terestral planes meaning that it has a rocky body like Earth. Surface gravity is .904 g, surface pressure is 91 atm, and surface temperature corresponding to .0740 eV (eV = 10^4 K), which happens to be rather near to cell membrane potential.

   In clouds at heights 50-60 km from Venusian surface, the temperature is between 0 and 50 ^{circ}C. The assumption that these regions contain the PH_3 is theoretically justified if the life in question is similar to that in Earth.

2. Venusian atmosphere 95 per cent CO_2. There is 3.5 per cent N, 150 ppm SO_2, 70 ppm Ar, 20 ppm waer wapr, 17 ppm CO_2, 12 pp, He, 7 ppm Ne, .1-.6 ppm HCl, 0.01 - 0.05 HF.

2.2 Some data items about the role of sulfur in terrestrial biology

There is a nice article "Sulfur: Fountainhead of life in the Universe?" by Benton Clark at the page of Nasa [I2] (`https://cutt.ly/qfGsIST`) giving a summary about sulfur and - as the title suggests - implicitly proposing that sulfur based life might have preceded the recent life.

1. Table 1 gives an overview about the cosmochemisty of sulfur. Note that in Sun S/Si ratio is .5.

   Remark: Even Sun has been proposed as a possible seat of life. The general vision about dark matter as a master controlling ordinary matter and dark proton sequences at magnetic flux tubes providing a universal realization of genetic code allows to consider the possibility of life at temperatures much higher than at Earth.

2. The role of sulfur in planetary evolution is discussed. The abundance of S is as high as 15 per cent in the Earth's core. Earth's crust contains 500 ppm of S and volcanic emissions are rich in sulphur. Sea water is rich in sulfate (SO_4) ions. Table 2 two lists various sulfur compounds in volcanic emissions.

3. Sulfur compounds are discussed. Sulfur can have several valence states including oxidation numbers -2,0+2,+4,+6 and sulfur can appear in compounds with several valence numbers. By this transversality sulphur could have an important role in autotrophic metabolism involving only chemical energy sources.

   Remark: The valence of given atom in molecule (`https://cutt.ly/QfGhaCL`) is the number of valence electrons, which the atom has. For instance, the double bond corresponds to 2 units of valence. Atomic valences characterize the topology of the valence bond network assigned with the molecule. Oxidation state, which can be negative, is a more precise measure telling how many valence electrons the atom has gained or lost. In the TGD framework the valence bond network would correspond to a flux tube network.

4. The role of sulfur in biochemistry is central. Sulfur plays major roles in energy transduction, enzyme action, and as a necessary constituent in certain biochemicals. The latter include important vitamins (biotin, thiamine), cofactors (CoA, CoM, glutathione), and hormones. Table 4 given also here summarizes the biological utilization of sulfur compounds.

   - Energy source (sulfate reduction, sulfide oxidation)
   - Photosynthesis (non-O2 -evolving)
   - Amino acids (met, cys):
   - Protein conformation (disulfide bridges)
   - Energy storage (APS, PAPS)
     These are analogous to AMP and ADP. Could one think of generalization of the TGD view for ATP $\rightarrow$ ADP to PAPS $\rightarrow$ APS as a basic metabolic mechanism? It might be that APS and PAPS do not survive in the Venusian atmosphere.
   - Enzyme Prosthetic group, (Fe-S proteins)
   - Unique biochemicals (CoA, CoM, glutathione, biotin, thiamine, thiocyanate, penicillin, vasopressin, insulin).

5. The role of sulfur in the biogeochemical cycle is illustrated in Figure 1. In autotrophic energy metabolism, which does not have organic compounds as sources of energy, sulfur compounds are involved. One can distinguish between sulfur bacteria, sulfate reducers, and sulfur oxidizers. For sulfur bacteria the photosynthesis proceeds - not by splitting H_2O as in the case of green plants and algae - but by splitting H_2S to obtain H atoms: H_2S replaces water. Sulfate (SO_4) reducers liberate energy by increasing the oxidation numbers of S and O ($Na_2SO_4 \rightarrow Na_2S+4H_2O$). Sulfur oxidizers ($H_2S + 2(O2)_2 \rightarrow H_2SO_4)$) reduce the oxidation number of S.

6. SH-group is important for the catalytic function of many enzymes. -S-S link stabilizing systeine is important in establishing the tertiary structure of proteins. Fe-S appear as a prosthetic group (non-peptide group) in enzymes known as iron-sulfur proteins.

7. The presence ecosystems at the mouths of active hydrothermal submarine vents not depending on photosynthesis suggests a chemosynthetic energy source. These communities however require oxidesres and thus photosynthesis in the surface layers. Table 6 lists sulfur based energy sources for biological systems.

2.3 The minimal option for a sulphur based life in Venus

Before speculating it is good to summarize the basic facts. Venus has a lot of H_2S - analog of water H_2O in its atmosphere. Also CO_2 is present as also nitrogen N. There is a could layer rich in H_2S and having temperature and pressure very much like at Earth. The environment is extremely acidic and this is a real challenge for terrestrial life forms. There exists however extreme terrestrial extremal acidophiles. They are bacteria.

The idea is to replace O with S in some basic molecules of life and processes to overcome the acidity problem. What are these molecules and processes?

1. Could other biomolecules remain as such and could the cell membrane shield the DNA and proteins inside it against sulphur acid? The outer ends of lipids are hydrophobic: could they be also H_2S-phobic?

2. Could H_2S replace water in some sense in Venusian life? Could water as an environment of the cell be replaced with H_2S?

What could the replacement of the water environment with H_2S mean?

1. Could photosynthesis rely on the splitting of H_2S rather than H_2O? Ordinary photosynthesis takes place inside the cell interior and involves ordinary proteins in enzymes and sugars as products. This would however require the presence of H_2S is in the cell interior. This does not look a plausible option without a profound change of the chemistry inside the cell replacing perhaps O with S in basic biomolecules such as DNA, RNA and proteins? This suggests that the photosynthesis inside Venusian bacterial cells occurs in the usual manner.

2. The TGD based quantum biology also involves the notion of magnetic body (MB) as a controller of the biological body. Could H_2S have the same role in Venusian prebiotic life as H_2O in the terrestrial prebiotic life?

   In the terrestrial life according to the TGD magnetic body (MB) of the water with hydrogen bonds is accompanied by flux tubes appearing with various values of $h_{eff} > h$ for dark protons. This would make water a multiphase system providing water with its very special thermo-dynamical properties at the temperature range 0-100 C.

   The flux tubes carrying dark protons sequences generated in the Pollack effect creating negatively charged exclusion zones (EZs) would realize the dark analog of genetic code: the negatively charged cell is an example of this kind of EZ.

   Water memory and the entire immune system would basically rely on these flux tube structures. DNA would be accompanied by parallel dark analog and the same would be true for RNA, tRNA, and amino acids. Water would be living even before the emergence of the chemical life and MB would control the chemical life.

   Could also H_2S allow dark hydrogen bonds and Pollack effect? Could the basic difference with respect to terrestrial life be that cells live in H_2S rather than in H_2O?

The separation of O *resp.* S to proto cell interior *resp.* exterior is required for the most conservative option. This requires a formation of lipid membrane like structures consisting of hydrocarbons isolating the interior from exterior and taking care of the separation. This requires charge separation by Pollack effect and solar radiation could provide this energy. H_2S must be replaced with H_2O in the proto cell interior. As a physicist I can only speculate about the possible chemistry of the process. For sulfur and its chemistry see the Wikipedia article (https://en.wikipedia.org/wiki/Sulfur). The following proposal is by a non-professional and very probably not correct as such. The basic challenge is however obvious: generate proto cell membrane and transform H_2S to H_2O inside it by reaction which in the optimal situation do not require catalyst but might require energy feed as solar radiation.

1. How the double lipid layer of the proto cell membrane separating S- and O-worlds could have formed? The formation of hydrocarbons of form C_nH_{2n} appearing as building blocks of lipids had to take place - perhaps only from CO_2 and H_2S. Note that that SO_2 is the third most significant atmospheric gas in Venus and could have been be produced in this process and participate it. SO_2 has been detected also in volcanoes and one can consider the possibility that the mono-cellular life in volcanoes could have evolved by the same mechanism as in Venus clouds.

   Did something like $CO_2 + H_2S \rightarrow CH_2 + SO_2$ necessarily accompanied by a polymerization of CH_2 to C_nH_{2n} occur? Also in the proto cell interior hydrocarbons could have formed by this mechanism. The consumption of CO_2 in the proto cell interior would have induced a further flow of CO_2 from the proto cell exterior and generated more SO_2 which could have flown out or been used for other processes.

2. How was the H_2S inside the proto cell membrane replaced with H_2O? Assume that sulphur dioxide SO_2 is generated in the formation of hydrocarbons. Is the reaction $SO_2 + 2H_2S \rightarrow 2H_2O + 2S$ favoured by $T\Delta S$ or $SO_2 + 2H_2S \rightarrow 2H_2O + S_2$ favoured by ΔE in $\Delta G = \Delta E - T\Delta S$ a plausible option? Note that elemental S is hydrophobic and some bacteria generate pieces of sulfur inside them. One can also consider the possibility that the sulphur in the final state forms S_8 units: the valence bonds in S_8 make the reaction energetically more favored but entropically less favored.

3. What about oxygen? Ordinary photosynthesis could have produced O_2 by the splitting of the water. One can also ask whether the reaction $X + CO_2 \rightarrow CS_2 + O_2$ with $X = 2S$ or $X = S_2$ have generated molecular oxygen O_2 in the proto cell interior and whether carbon di-sulfide CS_2 as the analog of CO_2 could have flown outside the proto cell membrane?

4. How to overcome the possible activation energy barriers for various reactions involved? Suppose that solar radiation indeed generates dark protons from H_2S by a generalization of Pollack effect [I1, I4] by creating fourth phase of H_2S having stoichiometry $H_{1.5}S$ - as Pollack might put it. As the dark protons transform to ordinary protons, they liberate energy and this energy could make possible to overcome the activation energy barrier. This would not be new in TGD framework: in biochemistry according to TGD the energy liberated by ATP$\rightarrow$ ADP would transform one of the 3 dark protons of ATP to ordinary proton and liberate energy as metabolic energy quantum to overcome activation energy barrier.

The O-S separation would drive CO_2 from the exterior to interior and bring it back as CS_2 and replace S with O in the interior. Proto cell membrane would emerge before the standard chemical realisation of the genetic code. The usual hen-egg problem "Which came first, cell membrane or genes?" is avoided since the dark variant of the genetic code would be represented using sequences of dark proton triplets representing the analogs of DNA, RNA, tRNA, and amino acids. Also the other two hen-egg problems: "Which came first, metabolism or genetic code?" and "Which came first, metabolism or cell membrane?" would be circumvented. The fact that the lipids of the cell membrane involve phosphates with negative charge suggests that they are accompanied by dark protons and genetic code has a 2-D variant assignable to the lipid lattice as 2-D dark proton lattice and decomposing to 1-D sequences [L1, ?]. The ordinary chemical genetic code would emerge later than this realisation after the emergence of basic biomolecules in the protocell interior.

2.4 More radical options for sulfuric life at Venus

There are also other options based on a radical modification of the chemistry of the ordinary life. They look less realistic from TGD point of view (which has been changing on daily basis during this week!).

1. Venus receives a lot of sunlight but one can ask whether photosynthesis be replaced with chemisynthesis? Chemical energy would be liberated in cycles involving sulfur containing compounds with varying degrees of oxidation of sulphur would liberate chemical energy as metabolic energy. At the bottoms of terrestrial oceans there are lifeforms around volcanoes, which might have this kind of metabolism.

2. **Option I** below: The extreme adicity of the Venusian atmosphere is the basic problem and the data about the composition of Venusian atmosphere suggest that O should be replaced with S in basic bio-molecules and water should be replaced with hydrogen sulfide H_2S (about bacteria producing H_2S see this), which is a gas smelling like rotten egg and produced in the decay of organic matter. Note however that CO_2 dominates in the Venusian atmosphere so that the replacement of O with S can be criticized. Carbon compounds can survive in the cloud to which PH_3 is assigned. The atmosphere contains also N.

   One can ask whether the exterior of the proto cell for the minimal option discussed above could have deloped a life based on the replacedment of O with S.

3. **Option II** below: This option is radical and probably non-realistic but as a mathematician I cannot resist its formal beauty. Could Venusian life be obtained by shifting terrestrial life one row downwards along the right end of the Periodic Table so that basic elements O, N, P of terrestrial life would be replaced with their chemical analogs S, P, As?

   Remark: Phosphine PH_3 reported to smell like rotten fish would be the counterpart of ammonia NH_3 giving pee its aroma and would have a similar role for Option II.

   Si has boiling point .1687 eV to be compared with the surface temperature .0740 eV - note however that also carbon is solid up to very high temperature and also many hydrocarbons are solids physiological temperatures. Arsenic (As) is fused by some bacteria as a metabolite and one might think that the analog of the higher energy phosphate bond obtained by replacement (O,P) $\rightarrow$ (S,As). The basic objection is that the Venusian atmosphere contains a lot of C and in CO_2 and N so that Option I seems to be enough. PH_3 is produced also by the terrestrial bacteria.

Below the radical options I and II are discussed but one must bear in mind that the replacement of H_2O with H_2S in photosynthesis for bacterial life might be enough if lipid layers of cell membrane are also H_2S-phobic.

2.5 Comparing the two radical options

It is interesting to look explicitely for the modifications of the basic biomolecules for the proposed options.

1. Consider first amino-acids (`https://cutt.ly/7fGhfsj`). The replacements would be O $\rightarrow$ S for Option I and (O $\rightarrow$ S, N $\rightarrow$ P, P $\rightarrow$ As) for Option II. This would allow a realization of analogs of nucleotides and amino-acids providing representations for their dark analogs realized in terms of dark proton sequences.

   Amino acid has the structure X-(Y-R)-Z, X= NH_2, Y=C-H, Z= O=C-OH. R is the varying amino-acid residue and X,Y,Z define the constant part. The replacements would be

   Option I: Z=O=C-OH $\rightarrow$ S=C-SH

   Option II: X=C=NH_2 $\rightarrow$ PH_2, Y= C-H$\rightarrow$ Si-H. Z= O=C-OH $\rightarrow$ S=Si-SH.

   In the formation of peptide one has replacement X= $\rightarrow$ C-N-H and Z$\rightarrow$ O=C-O-C. This would give replacemens:

   Option I: X= $\rightarrow$ C-N-H and Z$\rightarrow$ S=C-S -C.

   Option II: X$\rightarrow$Si-P-H and Z$\rightarrow$ S=Si-S-Si for Option II.

   In the TGD framework amino-acids would be accompanied by dark proteins with sulfuric analogs of amino-acids pairing with dark proton triplets: the dark amino-acid would be same and couple with amino-acids having the residues for with energy resonance coupling is possible.

Cyclotron excitation of dark proton triplet and excitation of R would couple resonantly: the transition of dark photon triplet would generate dark photon triplet transforming to ordinary photon and exciting the R to excited state. This would select the possible residues.

The first guess is that they are obtained by the proposed replacement too. The dark protons coming from NH_2 and one dark proton coming from C-N-H would do so also for the Option I. Amino-acid residues contain as a rule OH and O= and would be replaced with SH and S=. Note that for met and cys are the only amino acids containing S.

For Option II dark protons would come from PH_2 and Si-P-H for option II and would be neutralized by dark electrons to give rise to dark hydrogens.

2. For DNA (`https://cutt.ly/OfGhhWs`) the replacements would be following

   Option I: O $\rightarrow$ S in sugar 5-ring and in nucleotides

   Option II: (C, O, N) $\rightarrow$ (Si, S, P) in sugar 5-ring and nucleotides and $PO_4 \rightarrow AsS_4$.

3. Similar replacements would be carried in metabolic energy currencies AXP, X= M,D,T and GXP having also role as storages of metabolic energy. Saccharides like $C_6H_{12}O_6$ as chemical energy storages would have analogs obtained by replacement

   Option I: O $\rightarrow$ S

   Option II: (C,O,N) $\rightarrow$ (Si, S, P).

4. In the lipids of cell membrane there would be no changes for Option I and for Option to one would have (C $\rightarrow$ Si, $PO_4 \rightarrow AsS_4$).

Option I is clearly favored over Option II if the Venusian life resides in clouds at height of 50-60 km, in particular by the possibility of having cell membrane identical that for the terrestrial life. However, in the TGD framework the most plausible option does not involve any changes in the basic biochemistry of life. The only change is the replacement of water with H_2S as the environment of the bacterial cells. Dark protons and dark photons make possible communications between bacterial cells even in the acidic environment.The empirical test is whether the Pollack effect is possible also for H_2S.

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