

# Two steps towards understanding of the origins of life

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## Abstract

Two highly interesting findings providing insights about the origins of life have emerged. The group led by Thomas Carell has made an important step in the understanding the origins of life. They have identified a mechanism leading to the generation of purines A and G which besides pyrimidines A,T (U) are the basic building bricks of DNA and RNA. The crucial step is to make the solution involved slightly acidic by adding protons. For year later I learned that a variant of Urey-Miller experiment with simulation of shock waves perhaps generated by extraterrestrial impacts using laser pulses generates formamide and this in turn leads to the generation of all 4 RNA bases. There is however problem: the early atmosphere was assumed to be reductive and this probably not true.

These findings, in particular the problem due to the reductivity, represent a fascinating challenge for TGD inspired quantum biology. The proposal is that in formamide is the unique amide, which can form stable bound states with dark protons and crucial for the development of life as dark matter-visible matter symbiosis. Local reductivity could be due to the formation of electron rich exclusions zones due to Pollack effect generating also dark protons at magnetic flux tubes. Dark protons would bind stably with unique amine leading to generation of purines and the 4 RNA bases. This would be starting point of life as symbiosis of ordinary matter and dark matter as large  $h_{eff}/h = n$  phases of ordinary matter generated at quantum criticality induced by say extraterrestrial impacts.

## 1 Introduction

Two highly interesting findings providing insights about the origins of life have emerged and it is interesting to see how they fit to the TGD inspired vision.

The group led by Thomas Carell has made an important step in the understanding the origins of life. They have identified a mechanism leading to the generation of purines A and G which besides pyrimidines A,T (U) are the basic building bricks of DNA and RNA. The crucial step is to make the solution involved slightly acidic by adding protons. For year later I learned that a variant of Urey-Miller experiment with simulation of shock waves perhaps generated by extraterrestrial impacts using laser pulses generates formamide and this in turn leads to the generation of all 4 RNA bases.

These findings represent a fascinating challenge for TGD inspired quantum biology. The proposal is that formamide is the unique amide, which can form stable bound states with dark protons and crucial for the development of life as dark matter-visible matter symbiosis. Pollack effect would generate electron rich exclusions zones and dark protons at magnetic flux tubes. Dark protons would bind stably with unique amine leaving its chemical properties intact. This would lead to the generation of purines and the 4 RNA bases. This would be starting point of life as symbiosis of ordinary matter and dark matter as large  $h_{eff}/h = n$  phases of ordinary matter generated at quantum criticality induced by say extraterrestrial impacts. The TGD based model for cold fusion and the recent results about superdense phase of hydrogen identifiable in TGD framework as dark proton sequences giving rise to dark nuclear strings provides support for this picture.

There is however a problem: a reductive environment (with ability to donate electrons) is needed in these experiments: it seems that early atmosphere was not reductive. In TGD framework one can imagine two - not mutually exclusive - solutions of the problem. Either life evolved in underground

oceans, where oxygen concentration was small or Pollack effect gave rise to negatively charged and thus reductive exclusion zones (EZs) as protons were transferred to dark protons at magnetic flux tubes. The function of UV radiation, catalytic action, and of shock waves would be generation of quantum criticality inducing the creation of EZs making possible dark  $h_{eff}/h = n$  phases.

## 2 The first step: binding of dark protons to formamido-pyrimidine

I learned about very interesting discovery related to the problem of understanding how the basic building bricks of life might have emerged. RNA (DNA) has nucleotides A,G,C,U (T) as basic building bricks.

The first deep question is how the nucleotides A,G,C,U, and T emerged.

1. There are two types of nucleotides. Pyrimidines C and T/U (see <http://tinyurl.com/k3vx19b>) have single carbon 6-cycle. Purines A and G (see <http://tinyurl.com/odvqw2p>) in turn have single 6-single and 5-cycle fused attached together along one side. Purines are clearly more complex than pyrimidines.
2. U.K. chemist John Sutherland demonstrated a plausible sequence of steps leading to the emergence of pyrimidines. Purines turned out to be more problematic. Leslie Orgel and colleagues suggested a possible pathway but it produces purines in too tiny amounts.

Now a group led by Thomas Carell in Ludwig Maximilian University have found a more plausible mechanism [I2] (see <http://tinyurl.com/z65kpyo>).

1. Carell and colleagues studied the interaction of biomolecule formamido-pyrimidine (FaPy) with DNA and found that it also reacts to produce purines. Could FaPys have served as predecessors of purines? (For formamide see <http://preview.tinyurl.com/lwqyqnu> and for the class of chemical compounds known as amines see <http://tinyurl.com/mad6c2u>).
2. The first step would have been a copious production of amino-pyrimidines containing several chemical groups known as amines. The problem is that there are so many amines and they normally react indiscriminantly to produce many different compounds. One wants mostly purines so that only one critical amine is wanted.
3. When Carell and his team added some acid to the solution to decrease its pH, a miracle happened. The extra protons from acid attached to the amines of the amino-pyrimidine and made them non-reactive. There was however one exception: just the amine giving rise to purine in its reactions! The reactive amine also readily bonded with formic acid (see <http://tinyurl.com/lmstt7n>) or formamide. Hence it seems that one big problem has been solved.

The second challenge is to understand how the building bricks of RNA and DNA combined to form longer polymers and began to replicate.

1. One prevailing vision is that so called RNA world preceded the recent biology dominated by DNA. The goal has been to achieve generation of RNA sequence in laboratory. Unlike DNA RNA sequences are not stable and long sequences are difficult to generate. DNA in turn replicates only inside cell and the presence of what is known as ordered water seems to be essential for this.
2. This step might involve new physics and chemistry and I have considered the possibility that the new physics involves magnetic bodies and dark proton sequences as a representation of the genetic code at the level of dark nuclear physics. There is no need to add that the fact that dark proton states provide representations for RNA, DNA, tRNA, and amino-acids [K2, K3] looks like a miracle and I find still difficult to believe that it is true and for genetic code. Also the representation of vertebrate code emerges in terms of correspondences of dark proton states.

This suggests that the replication of DNA and takes place at the level of dark proton sequences - dark nuclear strings - serving as a dynamical template for the biological replication. Also transcription and translation would be induced by dark process. Actually all biochemical processes could have as template the dynamics of molecular magnetic bodies and biochemistry would be kind of shadow of deeper dynamics.

3. There is actually support for dark proton sequences. Quite recently I learned about the article of Leif Holmlid and Bernhard Kotzias [C1] (see <http://tinyurl.com/hxbvfc7>) about the superdense phase of hydrogen. In TGD superdense phase has interpretation as dark proton sequences at magnetic flux tubes with the Compton length of dark proton coded by  $h_{eff}/h \simeq 2^{11}$  to electron's Compton length [L1]. Remarkably, it is reported that the superdense hydrogen is super-conductor and super-fluid at room temperatures and even above: this is just what TGD predicts.

The dark protons in TGD inspired quantum biology [L2] should have much longer Compton length of order of the distance between nucleotides in DNA sequences in order to serve as templates for chemical DNA. This gives a dark Compton length of order  $\simeq 3.3$  Angstroms from the fact that there are 10 codons per 10 nm. This gives  $h_{eff}/h \simeq 2^{18}$ .

One can return back to the first step in the genesis of DNA and RNA. The addition of protons to the solution used to model prebiotic environment to make it slightly acidic was the key step. Why?

1. Here cold fusion might help. Cold fusion is claimed to take place in electrolysis involving ionization and charge separation. The electric fields used in electrolysis induce ionization and thus charge separation. For me it has however remained a mystery how electric fields, which are extremely tiny using the typical strength of molecular electric field as standard are able to induce a charge separation. Of course, every chemist worth of his salt regards this as totally trivial problem. I am however foolish enough to consider the possibility that some new physics might be involved.
2. The mechanism causing charge separation could be analogous to or that discovered by Pollack as he irradiated water bounded by a gel phase [I1] [?]: in the recent case the electric field would take the role of irradiation as a feeder of energy. Negatively charged exclusion zones (EZs) were formed and 1/4 of protons went somewhere.

The TGD proposal is that part of protons went to magnetic flux tubes and formed dark proton sequences identifiable as dark nuclear strings. The scaled down nuclear binding energy favours the formation of dark nuclear strings perhaps proceeding as analog of nuclear chain reaction. This picture allows to ask whether dark proton sequences giving rise to a fundamental representation of the genetic code could have been present already in water [L2]!

3. How DNA/RNA could have then formed? Could the protons making the solution acidic be dark so that the proton attaching to the amine would be dark? Could it be that for all amines except the right one the proton transforms to ordinary proton and destroys the chemical reactivity. Could the attached dark proton remain dark just for the correct amine so that the amine would remain reactive and give rise to purine in further reactions? Could A,G,C,T and U be those purines and pyrimidines - or even more general biomolecules - for which the attachment to dark proton does not transform it to ordinary proton and in this manner affect dramatically the chemical properties of the molecule? What is the condition for the preservation of the darkness of the proton?

### **3 Second step: Could shock waves due to extraterrestrial impacts have produced RNA bases?**

About year later I learned about a further interesting finding related to the prebiotic evolution (see the popular article at <http://tinyurl.com/m8npeor>). The conclusion of the research article (see [I3]) is that that the extraterrestrial impacts on Earth's early atmosphere might have generated all 4 RNA bases (see <http://tinyurl.com/kxxc7db>). Also now the formamide is involved and

my layman guess is that the motivation for this comes from the experiment of Carell et al [I2] (see <http://tinyurl.com/z65kpyo>) discussed above. If formamide is generated then it becomes possible to generate formamido-pyridine and from this the RNA bases can be generated.

The experiment was a modern version of Urey-Miller experiment originally intended to simulate the situation at the surface of the early atmosphere modelled as a mixture a water  $H_2O$ , carbon-monoxide  $CO$ , and ammonium  $NH_3$ . The shock waves generated by the impacts were modelled in the experiment using terawatt laser pulses.

In the original Urey-Miller experiment amino-acids were generated. In the modern version of the experiment it was found that also formamide  $CONH_2$  is formed, whose presence under suitable circumstances can lead to the generation of all 4 RNA bases. The presence of UV radiation, shock waves caused by extraterrestrial collisions, or of catalyst is the necessary condition.

In TGD Universe the additional condition could guarantee quantum criticality accompanied by dark  $h_{eff}/h = n$  phases leading to the generation of dark protons and their stable binding with formamido-pyrimidine. The stable binding would not be possible for other amido-pyrimidines since dark protons would transform to ordinary protons for them. All 4 RNA bases would emerge from formamido-pyrimidine. All basic molecules of life could be produced in the reductive atmosphere.

The atmosphere was assumed to be reductive and this is a problem: the best that one can hope is that the early atmosphere was weakly reductive. Chemical compound is reductive (see <http://tinyurl.com/m9cqnob>) if it tends to donate electron. Reduction means receiving electron - and in chemistry hydrogen atom. To obtain a reducing atmosphere (see <http://tinyurl.com/lx4tat2>) one should remove oxygen from it. It however seems that the early atmosphere has contained oxygen and was oxidative rather than reductive. How could one overcome the problem?

1. In the experiment of Carell et al protons were added to reduce the pH of water. The basic experimental rule is that this makes the environment more reductive. The TGD proposal is that it led to a formation of dark proton-amine pair for the amine leading to the formation of purine. Charge separation by Pollack effect [I1] [L2] leading to the generation of dark proton sequences (dark nuclei) at magnetic flux tubes could have been due to the IR radiation, and maybe also by UV radiation, catalytic action, or by shock waves. The presence of electrons in the exclusion zones (EZs) could have made them electron donors and therefore reductive.

The addition of protons in the experiment of Carell reducing the pH of water could have induced a transformation of dark protons at magnetic flux tube to ordinary protons. Dark protons bound to the amines would have transformed to ordinary protons and inducing their chemical inactivity. Only for the amine formamide serving as a precursor of purine the dark proton-amine bound state was stable and remained chemically reactive since dark proton did not affect the properties of visible matter part of the compound. Symbiosis between dark and ordinary matter began. This view conforms also with the vision about the pairing of DNA/RNA and dark DNA/RNA formed by sequences of proton triplets representing DNA/RNA codons [L3]. DNA is indeed negatively charged and dark proton could neutralize it but allow it to remain chemically active.

2. Second possibility is suggested by the conjecture that prebiotic life evolved in the crust of Earth, perhaps in the underground oceans or regions related to volcanoes [K1, L2]. The content of oxygen of this environment could have been much lower than at the surface making it reductive: it would not be possible to even talk about atmosphere. But where did the metabolic energy come from? Could volcanic energy emitted as dark long wave photons with energies in the range of bio-photon energies help here? There are indeed a theories assuming that first life forms emerged from volcanoes. These problems are discussed in [K1, L2] from TGD viewpoint. Note that these two explanations do not exclude each other.

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