

The ideas related to prebiotic evolution have developed rather rapidly after the discovery of the hierarchy of Planck constants around 2003 providing a general manner to understand living organisms as macroscopic quantum systems.

\begin{enumerate}

\item Magnetic body as carrier of dark matter realized as phases with non-standard value  $\hbar_{\text{eff}} = n \times \hbar$  of Planck constant is the key concept in the developments and brings to the description of the living matter a third level besides organism and environment. This has led to developments in the model of EEG as communication tool between biological and magnetic body and led to the interpretation of bio-photons as decay products of dark EEG photons. Also bio-superconductivity is now reasonably well-understood and the model for cell membrane as Josephson junction is generalized to include cyclotron energy besides difference in Coulomb energy. Square root of thermodynamics inspired by Zero Energy Ontology suggests itself as a proper description of Josephson junctions defined by transmembrane proteins. The dark genetic code seems to have so strong explanatory power that it must be taken seriously.

\item Another thread of development relates to the ideas about hierarchy of Planck constants. The findings of Nottale suggest that planets correspond to Bohr orbits with gigantic gravitational Planck constant. It took quite a time to realize that the same predictions follow if  $\hbar_{\text{gr}}$  is associated with pairs formed by microscopic systems and Sun and that in this case the values of  $\hbar_{\text{gr}}$  could be identified with those of  $\hbar_{\text{eff}}$ .

\item Already during first years emerged the idea that the Planck constant characterizes magnetic flux tubes connecting two systems and depends on the quantum numbers of the systems assignable to the interactions in question. Therefore one can speak also about  $\hbar_{\text{em}}$  assignable to electromagnetic interactions. A vision developed stating that when interaction gets too strong,  $\hbar_{\text{eff}}$  increases so that the perturbation series in powers of  $1/\hbar_{\text{eff}}$  converges and perturbation theory works. At space-time level this means non-determinism, which is key feature of the basic variational

principle: the space-time sheets connecting initial and final 3-surface at boundaries of CD are  $n$ -sheeted for  $h_{\text{eff}} = n \times h$  and the sheets co-incide at ends.

\item The model of water memory and homeopathy has led to an evolution of ideas relating to the development of immune system and bio-catalysis. The latest steps of progress were induced by the realization that the replication of magnetic body could be behind that of DNA and cell, the discovery of fourth phase of water and exclusion zones (EZs) by Pollack et al, and by the observation that anomalously high gravimagnetic Thomson field implied by large value of gravitational Planck constant could explain the anomalously large mass measured for electronic Cooper pairs in rotating super-conductor.

\item Zero energy ontology (ZEO) and adelic physics emerged years after the writing of the first version of this chapter. Adelic physics provided a mathematical justification for the hierarchy of Planck constants and  $p$ -adic physics. ZEO led to a view about biological evolution as a "must" and reduced allowed to understand self-organization in terms of a new view about quantum measurement predicting time reversal in ordinary state function reductions.

\end{enumerate}

The model for water memory and homeopathy is discussed and shown to lead to a general model for how immune system and bio-catalysis could have developed from their dark primordial versions, how dark proteins might have emerged as concrete representations for invader molecules making it possible to make the invader non-dangerous by attaching to its magnetic body, how DNA and genetic code could have emerged as symbolic representations for the magnetic bodies of invader molecules and later as symbolic representation of the magnetic body of the system itself. ZEO implies that actually time evolution of the magnetic body can be coded by DNA and protein folding could provide a concrete representation for this time evolution.

The vision is applied in various situations.

\begin{enumerate}

\item A model for proto-cell as EZ is discussed.

\item M. Root-Bernstein and R. Root-Bernstein proposed the rather brilliant idea that ribosome was the first self-replicator. The idea is discussed and compared to the TGD framework where the natural solution to all hen-egg problems of biology is provided by the predicted dark variants of the basic bio-molecules. The dark variants of replication, transcription, translation, and metabolism would have been part of the fundamental physics and their chemical realizations would have emerged as a kind of shadow dynamics, mimicry.

\item RNA world has also the problem with phosphorylation crucial for metabolic machinery. Proteins are absent and ribozymes are catalysts formed from RNA but they catalyze typically only the reversal of phosphorylation.

The challenge is to circumvent the problem and the proposal considered suggests that a molecule known as di-amido-phosphate (DAP) could have solved the problem. TGD based view is that both the cell membrane and all basic biomolecules could have emerged more or less simultaneously by pairing with their dark variants. Also the basic catalytic mechanisms would have been present at the level of dark matter as  $h_{\text{eff}}=nh_0$  phases.

**Remark:** If one wants to believe in a TGD variant RNA world, ZE0 could come in the rescue. ZE0 predicts time reversal in ordinary state function reduction. Could phosphorylation result as a time reversed process? This question is however not considered.

\item Evidence for life in a rather unexpected place – Venus – has emerged. The atmosphere of Venus shows signs of phosphine  $\text{PH}_3$  – the analog of ammonium  $\text{NH}_3$  –, 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  $\text{H}_2\text{S}$  and water. The magnetic body (MB) of  $\text{H}_2\text{S}$  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.

\item Multi-local viruses are mysterious from the point of view of ordinary biology. The DNA, RNA, and proteins of these viruses divides into segments located at different host cells and can self-assemble back to the ordinary virus. Various partitions of the virus are possible. TGD based view about space-time and quantum theory

allows to understand these viruses as connected entities at the level of magnetic body (MB).

\item There is evidence for oil droplets as a primitive life form. The basic objection is that droplets have no genetic code and do not replicate. The TGD inspired model for dark nucleons however predicts that the states of dark nucleon are in one-one correspondence with DNA, RNA, tRNA, and amino-acid molecules and that vertebrate genetic code is naturally realized. The question is whether the realization of the genetic code in terms of dark nucleon strings might provide the system with genetic code and whether the replication could take place at the level of dark nucleon strings rather than droplets. TGD inspired quantum model of biology leads to a model for oil droplets as a primitive life form. In particular, a proposal for how dark genes could couple to chemistry of oil droplets is developed.

\end{enumerate}