

%\begin{abstract}

The quantum view about metabolism has developed in two stages. First came the somewhat unbalanced vision about the connection of quantum metabolism and bound state formation. The second breakthrough was the discovery of dark matter hierarchy and associated hierarchy of generalized EEGs.

\vm{\it 1. Quantum metabolism and bound state formation}\vm

Topological self-referentiality states that the topological field quanta of the classical fields associated with a material system provide a concrete representation for a theory about the material system. Actually this principle generalizes and implies an entire hierarchy of representations. An important outcome of the topological self-referentiality is that the `\blockquote{buy-now}` part of the buy now-pay later mechanism for energy production could be understood as a generation of bound states with binding energy liberated as a usable energy. `\blockquote{Pay later}` means that sooner or later thermal noise destroys the bound state.

This observation led to a quantum vision about energy economy in living matter: generation of the macroscopic coherence involving also binding of mental images to larger ones and liberation of a usable energy are different sides of the same coin. Besides, or perhaps even instead, the ordinary metabolism, quantum metabolism should be key element of living matter. Indeed, also ordinary metabolism might be accompanied by the effective over-unity energy production implied by the generation of quantum bound state entanglement: this implies a connection with the claimed over-unity phenomena. This should reflect experimentally as apparently miraculous ability of the organism to cope without the use of the metabolic energy. Anomalies of this kind have been indeed observed at the level of

neuronal metabolism and nano-biology is just challenging the basic assumptions of the Newtonian biology.

This vision can be criticized for over-emphasizing the formation of bound states: also the transitions to bound states with lower energy, say transitions between cyclotron states, can generate metabolic energy.

## \vm{\it 2. Dark matter hierarchy and quantum metabolism}\vm

The new vision about me relies on several new ideas that have emerged during years after writing the first draft of this chapter.

\begin{enumerate} \item There are three different views about macroscopic quantum phases. As large  $\hbar$  phases with scaled up quantum lengths, as high  $T_c$  superconductor like systems, and as negentropically entangled structures (negentropic entanglement is purely TGD based notion and stabilized by Negentropy Maximization Principle). In this chapter arguments supporting the equivalence of these descriptions are developed.

\item The valence electron pairs with spin 1 instead of spin 0 emerge as natural candidates for the counterparts of Cooper pairs generating negentropic entanglement in long length scales. Spin 1 valence electron pairs would generate the magnetic flux tubes along which they propagate and this web of flux tubes would bind proteins to larger structures. The role of the phase transitions changing the value of Planck constant in quantum biology has been discussed already earlier. The fact that bio-molecules – in particular sugars and phosphate molecules – tend to maximize the number of covalent bonds supports this view.

\item The completely accidental observation that dark nucleon states corresponds under rather natural assumptions to DNA, RNA, tRNA, and amino-acid states and that vertebrate genetic code emerges under natural assumptions, leads to the idea that the

dark nuclear physics realization of the genetic machinery is its primary realization and that chemical realization is secondary realization. This suggest that dark nuclei identified as nuclear strings of dark protons serve as templates for DNA, RNA, and amino-acids.

\item This leads to the vision that the basic purpose of metabolic energy is to make possible re-distribution of negentropic entanglement between distant bio-molecules using the reconnection of the magnetic flux tubes generated by spin 1 electron pairs as a control tool. In photosynthesis the incoming photons would suffer a phase transition to dark photons before being absorbed by dark electrons and eventually provide their energy to ATP to be used to re-organize negentropic entanglement assignable to the magnetic flux tubes going via ATP molecule. This picture is inspired also by the vision about DNA as topological quantum computer and leads to a more plausible view about how genetic code is realized.

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\vm{\it 3. Many-sheeted photo-synthesis}\vm

Photosynthesis is a fundamental metabolic function and a many-sheeted model allows to concretize the general ideas about quantum metabolism. What happens in photosynthesis at the level of energy balance seems to be relatively well-understood but the detailed molecular mechanisms remain obscure. Several strange features, such as the appearance of electron pairs, suggest that super-conductivity and atomic and molecular Bose-Einstein condensates are involved. p-Adic length scale hypothesis gives very strong quantitative guidelines in the attempt to understand photosynthesis in many-sheeted space-time, and one ends up to a

general

view about how Bose–Einstein condensates store metabolic energy as zero

point kinetic energy and how this energy is utilized by remote metabolism

by generating negative energy MEs. What is so remarkable is that the resulting simple model of photosynthesis is successful both at qualitative and quantitative level.

I have included in this chapter the earlier variant of the quantum model

developed before 2007 as such to compare it with the recent view about

macroscopic quantum aspects of photosynthesis involving several new ideas.

Note that year 2007 is special in the sense that during 2007 the first

evidence for the quantal nature of photosynthesis emerged.

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