Dark photons from transitions of dark valence electrons as origin of bio-photons, and their interaction with carcinogens

M. Pitkänen
Email: matpitka6@gmail.com.
http://tgdtheory.com/.

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Abstract

The possible role of bio-photons in living matter is becoming gradually accepted by biologists and neuroscientists. Bio-photons serve as a diagnostic tool and it seems that their intensity increases in non-healthy organism. I have proposed that bio-photons emerge from what I call dark photons, which are ordinary photons but have non-standard value $h_{eff} = nh_0$ of Planck constant.

In this article the consequences of the hypothesis that dark photons emerging from the transitions of dark valence electrons of any atom possessing lonely unpaired valence electron could give rise to part of bio-photons in they decays to ordinary photons. The hypothesis is developed by considering a TGD based model for a finding, which served as a starting point of the work of Popp: the irradiation of carcinogens with light at wavelength of 380 nm generates radiation with wavelength 218 nm so that the energy of the photon increases in the interaction. Also the findings of Veljkovic about the absorption spectrum of carcinogens have considerably helped in the development of the model.

The outcome is a proposal for dark transitions explaining the findings of Popp and Veljkovic. The spectrum of dark photons also suggests a possible identification of metabolic energy quantum of .5 eV and of the Coulomb energy assignable to the cell membrane potential. The possible contribution to the spectrum of bio-photons is considered, and it is found that spectrum differs from a smooth spectrum since the ionization energies for dark valence electrons depending on the value of h_{eff} as $1/h_{eff}^2$ serve as accumulation points for the spectral lines. Also the possible connections with TGD based models of color vision and of music harmony are briefly discussed.

Contents

1 Introduction

The possible role of bio-photons in living matter is becoming gradually accepted by biologists and neuroscientists. It seems that the intensity of bio-photon emission increases in sick organisms and bio-photons are used as a diagnostic tool. Fritz Popp (see `http://tinyurl.com/y7assha7`) started his work with bio-photons with some observations about the interaction of UV light with carcinogens [I1] (see `http://tinyurl.com/y76a9fo4`). Veljckovic (`http://tinyurl.com/yatedje8`) has also published results suggesting correlations between carcinogenity and the absorption spectrum of photons in UV (ultraviolet).

I have proposed that bio-photons emerge as ordinary photons from what I call dark photons, which differ from ordinary photons in that they have non-standard value $h_{eff} = nh_0$ of Planck constant [K9, K10]. Also other particles - electrons, protons, ions,..., can be dark in this sense.

One of the mysteries of biology, which mere biochemistry cannot explain, is that living systems behave coherently in macroscopic scales. The TGD explanation for this is that dark particles forming Bose-Einstein condensates (BECs) and super-conducting phases at magnetic flux tubes of what I call magnetic body possess macroscopic quantum coherence due to the large value of h_{eff}. This quantum coherence would force the coherent behavior of living matter. I have already earlier developed rather concrete models for bio-photons [K9, K10] on basis of this assumption.

In the sequel I will discuss bio-photons from a new perspective by starting from bio-photon emission as a signature of a morbid condition of organism. The hypothesis is that in sick organism dark photons tend to transform to bio-photons in absence of metabolic feed increasing the value of h_{eff}. Hence BECs of dark photons and also of other dark particles decay and this leads to a loss of quantum coherence.

A further hypothesis is that at least a considerable part of bio-photons emerge in the transformations of dark photons emitted in the transitions of lonely dark valence electron of any atom able to have such. Since dark electron has a scaled up orbital radius, it sees the rest of atom as a unit charge and its spectrum is in good approximation hydrogen spectrum. Therefore the corresponding part of the spectrum of bio-photons would be universal in accordance with quantum criticality.

This picture allows to develop some ideas about quantum mechanisms behind cancer in TGD framework.

1.1 Some basic notions related to carcinogens

Before continuation it is good to clarify some basic notions. Toxins are poisonous substances created in metabolism. Carcinogens (`http://tinyurl.com/ybphtjqg`) are substances causing cancer, which often cause damage to DNA and induce mutations (mutagenicity).

Free radicals (see `http://tinyurl.com/y9bxoqjz`) provide a basic example about carcinogens. They have one un-paired valence electron and are therefore very reactive. The un-paired electron has a strong tendency to pair with an electron and steals it from some molecule. The molecule providing the electron is said to oxidize and free radical to act as oxidant. The outcome is a reaction cascade in which carcinogen receives electron but electron donor becomes highly reactive. Anti-oxidants stop the reaction cascade by getting oxidized to rather stable molecules (`http://tinyurl.com/omb7kc9` and `http://tinyurl.com/ydeloxcn`).

Benzo[a]pyrene (BAP) $C_{20}H_{12}$ (see `http://tinyurl.com/y8etnmwb`) is one example of carcinogen. It contains several carcinogenic rings and is formed as a product of incomplete burning and reacts with powerful oxidizers. As such BAP is not free radical but its derivatives $BAP^{\pm}$ obtained by one-electron reduction or oxidation are such (see `http://tinyurl.com/yb7am8tk`).

There are also carcinogens such as bentzene, which as such is not dangerous. What happens is that to the carbon at the ends of bentzene's double bond binds single oxygen atom and so called epoxy bond is formed. This molecule penetrates to the DNA chain and causes damage. Perhaps the fact that DNA nucleotide also contains aromatic 6-rings relates to this.

The emission of bio-photons (see `http://tinyurl.com/ol39rqx`) increases if carcinogens such as oxidants are present. The idea is that bio-photons could be relevant concerning the understanding of the problem. It has been proposed that bio-photons could be created when anti-oxidants interact with molecules generating triplet states (spin 1) which decay by photon emission. The photons generated in this manner would have discrete spectrum whereas bio-photons seem to have continuous and rather featureless spectrum. Therefore this model must be taken with caution.

It could be that the origin of bio-photons is not chemical. If so, carcinogens would not produce bio-photons in ordinary atomic or molecular transitions. They could be however induce generation of bio-photons indirectly. The understanding of bio-photons might help to understand the mechanisms between carcinogenic activity. I have discussed bio-photons from TGD view in [K9, K10].

1.2 Some basic notions of TGD inspired quantum biology

In the sequel I try to develop a necessarily speculative picture about carcinogen action on basis of TGD based quantum about biology [K7, K8]. The goal is to develop the general theory by developing a concrete model for a problem.

Magnetic flux tube and field body/magnetic body are basic notions of TGD implied by the modification of Maxwellian electrodynamics [K7, K1, K6]. Actually a profound generalization of space-time concept is in question. Magnetic flux tubes are in well-defined sense building bricks of space-time - topological field quanta - and lead to the notion of field body/magnetic body as a magnetic field identity assignable to any physical system: in Maxwell's theory and ordinary field theory the fields of different systems superpose and one cannot say about magnetic field in given region of space-time that it would belong to some particular system. In TGD only the effects on test particle for induced fields associated with different space-time sheets with overlapping M^4 projections sum.

The hierarchy of Planck constants $h_{eff} = n \times h_0$, where h_0 is the minimum value of Planck constant, is second key notion. h_0 need not correspond to ordinary Planck constant h and both the observations of Randell Mills [L3] and the model for color vision [L8] suggest that one has $h = 6h_0$. The hierarchy of Planck constants labels a hierarchy of phases of ordinary matter behaving as dark matter.

Magnetic flux tubes would connect molecules, cells and even larger units, which would serve as nodes in (tensor-) networks [B1] [L2]. Flux tubes would also serve as correlates for quantum entanglement and replace wormholes in ER-EPR correspondence proposed by Leonard Susskind and Juan Maldacena in 2014 (see `http://tinyurl.com/y7za98cn` and `http://tinyurl.com/ydckw5u7`). In biology and neuroscience these networks would be in a central role. For instance, in brain neuron nets would be associated with them and would serve as correlates for mental images [L4, L9]. The dynamics of mental images would correspond to that for the flux tube networks.

1.3 The proposed model briefly

In the sequel the basic hypothesis will be that dark photons emerging from the transitions of dark valence electrons of any atom possessing lonely unpaired valence electron could give rise to part of bio-photons in they decays to ordinary photons. The hypothesis is developed by considering a TGD based model for a finding, which served as a starting point of the work of Popp (see `http://tinyurl.com/y76a9fo4`): the irradiation of carcinogens with light at wavelength of 380 nm generates radiation with wavelength 218 nm so that the energy of the photon increases in the interaction. Also the findings of Veljkovic about the absorption spectrum of carcinogens [I2] (`http://tinyurl.com/yatedje8`) have considerably helped in the development of the model.

The outcome is a proposal for dark transitions explaining the findings of Popp and Veljkovic. The spectrum of dark photons also suggests a possible identification of metabolic energy quantum of .5 eV and of the Coulomb energy assignable to the cell membrane potential. The possible contribution to the spectrum of bio-photons is considered, and it is found that spectrum differs from a smooth spectrum since the ionization energies for dark valence electrons depending on the value of h_{eff} as $1/h_{eff}^2$ serve as accumulation points for the spectral lines. Also the possible connections with TGD based models of color vision and of music harmony (see [L8, L1, L11]) are briefly discussed.

2 About the modelling of the basic findings of Popp and Veljkovic

The popular article about starting point of Popp's research work (see http://tinyurl.com/y76a9fo4) tells that one can assign to carcinogens such as benzo[a]pyrene (polycyclic aromatic compound - a wave length $\lambda_i = 380$ nm. Carcinogen absorbs this wavelength and radiates photons with a shorter wavelength $\lambda_f = 218$ nm. In the following I try to understand what could happen in this process. I also consider the observations of Veljkovic [I2] and their relationship to the findings of Popp.

2.1 General TGD picture

The zeroth order iterate for TGD interpretation of the action of free radicals would be following. Free radicals lead to the destruction of dark phases with non-standard value of h_{eff}. These phases include Bose-Einstein condensates of various kinds and super-conducting phases. The process leads to an emission of dark photons which transform to ordinary photons identified as bio-photons in the phase transition $h_{eff} \rightarrow h$. For instance, this happens as vegetable ageing and bio-photon emission is indeed used as a tool to determine the age of vegetable.

How the stealing of electrons by free radical electrons could induce the negative biological effects?

1. Quantum coherence is essential for what it is to be living matter. Bio-system is full of different kinds of Bose-Einstein condensates (BECs) and superconducting phases [K3, K4]. Electronic super-conductivity is one of the most important examples. There are also cyclotron BECs for proton Cooper pairs and biologically important bosonic ions or of the Cooper pairs of fermionic ions such as Ca^{2+}, Mg^{2+}, Fe^{2+}, Na^+, K^+, Cl^-. The value of h_{eff}/h_0 for these BECs would be rather large being in the range $10^{12} - 10^{15}$. In this case h_{eff} can be identified as gravitational Planck constant h_{gr} assignable to the magnetic flux tubes mediating gravitational interaction [K5, K2, K12, K11] [L7]. This would guarantee that cyclotron energies proportional to h_{eff} in endogenous magnetic field $B_{end} = 2/5B_E$, where $B_E = .5$ Gauss is the magnetic field of Earth, are above thermal energy at physiological temperature so that dark cyclotron photons can have biological effects.

2. Hydrogen bonds are central for the chemistry of water and living matter. The atoms able to form hydrogen bonds (O,N,...) possess so called lonely electron pair meaning that neither electron belongs to a valence bond.

   A possible TGD picture would be following. Hydrogen bond can be assigned with magnetic flux tube at which there is a delocalized proton, which can be also dark ($h_{eff} = n \times h_0 > h$). The lonely electron pair forms a Cooper pair. The electrons of the Cooper pair are at the members of a flux tube pair. Flux tubes are parallel but magnetic fluxes are in opposite directions if Cooper pair has spin 0. Spin 1 would correspond to fluxes in the same direction. Hydrogen bonds and their scaled up (by $h_{eff}/h_0 = n$) dark versions would correspond to flux tube pairs.

   The physics of water is plagued by anomalies. It has become recently clear that water must involve two phases. In TGD framework [L10] water would have dark fraction involving dark flux tubes carrying dark protons and electrons and this would allow to understand the anomalies. Intriguingly, the anomalies are strongest at physiological temperature.

3. The basic mechanism behind cancer could be following. Free radicals steal electrons and this leads to the destruction of quantum coherence as electronic Cooper pairs are destroyed and super-conductivity is lost. $h_{eff}/h_0 = n$ is reduced. This number can be regarded as a kind

of IQ assignable to flux tube and one could speak about intelligence characterizing flux tube network. More precise interpretation is that the higher the value of h_{eff}/h_0 is, the higher the ability to generate conscious information is. System can also destroy information: in quantum ethics this means doing something evil!

Remark: A little additional comment, which might irritate physicalist. TGD inspired theory of consciousness [L5] suggests strongly the emergence of ethics at fundamental quantum level. Quantum ethics is simple and universal: doing good is to increase the conscious information of the Universe about itself. This conforms with the fact that doing evil forces secrecy and the Universe loses conscious information.

The networks formed by molecules connected by flux tubes serving as correlates for quantum entanglement decay as the Planck constant at flux tubes becomes normal and they reconnect to form short loops. The community of molecules/cells decomposes into individuals, whose basic purpose degenerates to replication. Cancer is the outcome.

4. The general picture could be that the value of h_{eff}:n is reduced due to the transitions $h_{eff,i} \rightarrow h_{eff,f} < h_{eff,i}$ induced by the free radical stealing electrons. It is quite possible that the valence electron of free radical is dark.

5. What could happen in the stealing of electron? The valence electron of carcinogen (say free radical) must be dark in order that it gets on the flux tube at which Cooper pair is. Electron could be kind of Troyan horse getting to the flux tube associated with the hydrogen bond and then would react with Cooper pair splitting it and the resulting pair of electrons would consist of ordinary ordinary electrons.

2.2 Basic observation

The starting point is a reaction, in which the irradiation of carcinogen produces radiation with higher photon energy. In the example consider the incoming photon has wavelength $\lambda_i = 380$ nm and energy a $E_i = 3.27$ eV, which is just at the border 3.26 eV of violet and ultraviolet. The outgoing wavelength is $\lambda_f = 218$ n, and the corresponding energy is $E_f = 5.69$ eV and therefore in UV. As such this photon does not cause harm to say DNA.

I understand this kind of reaction is rather generally occurring for carcinogens and toxins. This suggests that the action of toxins and carcinogens is universal and relies on mechanism not depending strong the molecule considered. Understanding this on basis of standard chemistry is challenging.

I also understand that the energy 3.27 eV is special in biology and might relate to the communication between cells and that carcinogenic action somehow spoils this communications. It is also known that the emission of bio-photons in presence of carcinogen increases. If these photons are actually dark photons then dark photon BE condensate could be lost in the process and lead to a reduction of quantum coherence.

2.3 Possible detailed models for the observations of Popp

TGD based model for bio-catalysis assumes that catalyst and substrate are connected by flux tube or flux tube pair and that one can associate to this object a resonance frequency. One can ask whether carcinogen could act like catalyst.

2.3.1 Dark valence electrons behave like electrons of dark hydrogen atom

What could happen in the above process?

1. What looks strange is that the energy of final state photon is higher than initial state photon. Naively one would expect just the opposite.

   Could it be that the atom in the initial state is - in some sense not necessarily possible in standard atomic physics - in an excited state and the absorption of incoming photons makes it even more excited state. In the final state atoms returns to ground state in some sense - not necessary that of standard atomic physics. This is like jumping upwards from balcony and dropping down.

2. Electronic excitation energies for atoms must be in question. The energy scale is however too small for the transitions of hydrogen atom and even more so for those of heavier atoms. The ground state binding energy of hydrogen atom is 13.6 eV. For other atoms the energies of inner electrons are proportional Z_{eff}^2, where Z_{eff} is the effective charge of nucleus, which is screened by electrons in full shells so that Z_{eff} is considerably reduced for valence electrons.

3. How could one understand the universality? Suppose that an unpaired valence electron is in question and that it is dark. For any atom dark valence electron has orbital radius scaled up by factor $(h_{eff}/h)^2 = (n/6)^2$ so that dark valence electron sees effective nuclear charge Z_{eff}=1 and behaves like an electron of hydrogen atoms apart from small corrections coming from the mass of the nucleus! In the sequel I will call any atom with one dark valence electron (or possibly even several of them) dark hydrogen atom.

4. One can therefore assume that one has effectively transitions of dark electron of hydrogen with $h_{eff}/h = n/6 > 1$. The binding energy scale would be reduced by a factor $(h/h_{eff})^2 = (n_0/n)^2 = (6/n)^2$.

   Remark: The assumption $h = n_0 \times h_0$ raises of course bewilderment. It is however quite possible that h is not the minimal value of h_{eff}. In fact, the experiments of Randel Mills suggest $h = 6h_0$ [L3]. Mills observed that hydrogen can have states for which binding energy scale is larger than normally: the would correspond to $h_{eff} = nh_0$, $n < 6$.

Remark: Recall that carcinogens are free radicals with un-paired valence electrons. These valence electrons would be dark.

2.3.2 Model I

What could be the simplest model for the reaction considered? The valence electron of dark hydrogen have spin and in ground state it could be in $n_P = 1$ tilassa (n_P is principal quantum number usually denoted by n). As it absorbs photon it can go to $n_P = 1$ state with larger value of n. One could imagine a two step process

$$(n_1, n_P) = (7, 1) \rightarrow (n_2 = 8, 1) \rightarrow (n_3 = 6, 1) \ .$$

Could the incoming and outgoing energies be identified as energies for the transitions involved. The energies are 2.43 eV ja 5.95 eV. The actual values are 3.27 eV ja 5.69 eV. I have not found better fit so that Model I fails.

2.3.3 Model II

Let us assume a lonely dark valence electron seeing the atom effectively as hydrogen. The key observation is that $h_{eff}/h = 2$ corresponds to $n = 12 = 2 \times n_0 = 12$ with ionization energy $E_I(n = 12) = 3.4$ eV. This is not far from $E_{12} = 3.27$ eV.

Could an almost ionization from the $n = 12$ ground state with $n_P = 1$ to state $n_P = m$ occur and be followed to a state with $n < 12$ state, possibly ground state with $n_P = 1$ with an emission of photon with energy $E_{23} = 5.69$ eV $> E_{12} = 3.27$ eV? One would have $(n_i = 12, 1) \rightarrow (n_i = 12, m) \rightarrow (n_f, 1)$.

1. It is easy to see that one can have only $n_f = 9$ giving $h_{eff}/h = n_f/n_0 = n_f/6 = 3/2$. This would give ionization energy $E_I(i, n = 9) = 6.0$ eV.

2. One should have $E_{23}/E_I(n = 9) = E_{12}/E_I(n = 12) = 3.27/3.4 = .96$. The ratio of excitation energy and ground state energy would be same for initial and final state. The transition to the state $n_P = 5$ predicts $r = E_{12}/E_I(n = 12)1 - 1/25 == .96$. The prediction is correct.

   For the final state photon the prediction would be $E_{23} = (3.27/3.4) \times 6$ eV $= 5.77$ eV . The actual value is 5.69 eV. The error of the prediction is about 2 per cent.

Notice that the dark hydrogen model is extremely general and explains why so many carcinogens have this same signature. One must however notice that the orbital radius of the dark electron must be larger than that of other electrons for a screening to unit charge to take place. In the earlier applications I have assumed that the principal quantum number n_P dark valence electron is not smaller than that for the valence electrons of the ordinary atom. For hydrogen atom the condition gives no constraints but for k:th row of the periodic table one must have $n_P \geq k$. In the above model $n_P = 1$ would require that hydrogen atom is in question. Only H and C atoms are present in carbohydrates and C has no lonely valence electrons to that the condition is automatically satisfied for them.

2.4 A model for the observations of Veljkovic

There is also an article of Veljkovic about carcinogens [I2] (`http://tinyurl.com/yatedje8`). The article tells that the wavelength range is 206-248 nm: this would correspond to the energy range 6.1-5.0 eV in UV. On the other hand, it is noticed that the most carcinogenic wavelength range is 232-278 nm, which would correspond to the energy range 5.3-4.5 eV in UV. It would seem to me that there is a mistake in the article of Veljkovic: the upper end for wavelength range should be either 248 nm or 278 nm for both ranges. Could it be that the maximal wavelength range is 206-278 nm? TGD based model supports this interpretation as will be found.

In the first table of the article (see `http://tinyurl.com/yatedje8`) 4 absorption wavelengths have been listed for the molecules appearing in it and on basis of the summary only the lowest wavelengths can be carcinogenic.

Veljkovic does not mention the wavelength 380 nm. This suggests that this wavelength is not carcinogenic as such. On basis of what has been said the transition

$$(n = 12, 380\ nm) + X \rightarrow (n = 9, 218\ nm) + X$$

would take place. X could be a atom in bio-molecule or in carcinogen as was assumed. It is enough that dark valence electron is in question. This process would transform dark $n = 12$ photon to dark $n = 9$ photon. $(n = 12, n_P = 1)$ dark electron would go to the intermediate state $(n = 12, n_P = 5)$ and from it to $(n = 9, n_P = 1)$ dark valence electron. The reduction of h_{eff}/h_0 would mean a reduction of "biological IQ" for both dark photons and dark electrons. Could this be enough for carcinogenic effect?

One could argue, that the any molecule containing an atom with dark $n = 12$ valence electron makes it carcinogenic. This cannot be true. Carcinogen must have some additional property. Could it be that $(n = 9, 218\ nm)$ dark photons transforms to bio-photon, which is absorbed by the an ordinary electron of carcinogen, so that biological IQ is reduced further. The transformation to ordinary photon followed by absorption would be single quantum process. Note that the absorber could be also second carcinogen atom for which the absorbing valence electron is ordinary. Carcinogenicity would follow from the existence of an ordinary electronic state, which can be excited by the photon produced $(n = 12, 380\ nm) + X \rightarrow (n = 9, 218\ nm) + X$.

Assume that the transitions are those of ordinary electrons of the carcinogen. For some value of $h_{eff}/h_0 = n$ the energy range 5.0-6.1 eV could correspond to spectral lines for dark transitions of some kind creating the absorbed photons transforming to bio-photons in absorption. One can imagine two options.

Option I: The spectral lines could coincide for those for the transitions of dark hydrogen from excited state to ground state or excited state. This model turns out to be too simple to explain the observations of Veljkovic.

Option II: The spectral lines could co-incide for to those for Popp's transitions $(n = 12, n_P = 1) \rightarrow (n = 12, n_{P,i} > 1) \rightarrow n(n = 9, n_{P,f} \geq 1)$. This model can explains the observations of Veljkovic satisfactorily and suggests also a possible interpretation for the metabolic energy quantum and Coulomb energy assignable to the membrane potential. Again only dark valence electron of hydrogen atom can be considered and this is the only possibility for hydrocarbons.

2.4.1 Option I

The transition energies of dark hydrogen characterized by n are given by

$$\frac{\Delta E}{E_H} = (\frac{6}{n})^2 [\frac{1}{n_{P,f}^2} - \frac{1}{n_{P,i}^2}] \quad . \tag{2.1}$$

The simplest option is that the transition takes place to the ground state with $n_{P,f} = 1$.

For what value of $h_{eff}/h_0 = n$ energy range 5.0-6.1 eV could correspond to the spectral lines of dark hydrogen? Ionization energy for dark hydrogen gives the largest energy and it should be around $E_{max} = 6.1$ eV. If ionization does not take place, photon energy is lower and could correspond to energies in the range 5.0-6.1 eV. With these assumptions one obtains

$$E_H(n) = E_H \times (\frac{h}{h_{eff}})^2 = E_H \times (\frac{6}{n})^2 = E_{max} \ , \quad E_{max} = 6.1 \text{ eV} \ , \quad E_H = 13.6 \text{ eV} \ . \tag{2.2}$$

This gives $n^2 = 80.26$ so that n is very near to $n = 9$ and $h_{eff} = 3h/2$. $n = 9$ gives upper bound $E_{max} = 6.04$ eV. Also other energies could correspond to the transitions of dark hydrogen. The transition would be of for ($n_P \rightarrow n_P = 1$) and the energy of the emitted photon would satisfy the condition

$$\Delta E = E_{max}(1 - n_P^{-2}) = E_{min} = 5.0 \text{ eV} \ . \tag{2.3}$$

This would give $1/n_P^2 = 1/6$ in a reasonable approximation. This cannot be true. What if one uses as the lower bound the energy $E_{min} = 4.5$ eV, which corresponds to 278 nm. This would give $m = 2$ for $E_{max} = 6$ eV! The maximal range 206-278 nm would correspond to the emission spectrum for the transition to the ground state. Getting dark counterparts for the absorbtion energies listed by Veljkovic does not however seem probable since there is only single integer valued parameter available.

2.4.2 Option II

The energy of the photon is difference of $n_f = 9$ and $n_i = 12$ excitation energies characterized by $n_{P,f}$ ja $n_{P,i}$. The general formula for the transition energy ΔE allowing n_f and n_i to be arbitrary reads as

$$\Delta E = [\frac{1}{n_{P,f}^2}(\frac{6}{n_f})^2 - \frac{1}{n_{P,i}^2}(\frac{6}{n_i})^2]E_H \ . \tag{2.4}$$

For $n_i = 12$ with $h_{eff} = 2h$ and $n_f = 9$ with $h_{eff} = 3h/2$ one obtains the formula

$$\Delta E = [\frac{4}{9n_{P,f}^2} - \frac{1}{4n_{P,i}^2}]E_H \ , \quad E_H = 13.6 \text{ eV} \ . \tag{2.5}$$

Consider first the dependence of ΔE on n_i for given n_i.

1. Consider first the situation for $n_{P,f} = 1$.

   (a) ΔE is largest at the limit $n_{P,i} \rightarrow \infty$: this gives $\Delta E = (4/9)E_H = 6.04$ eV ($\lambda = 205$ nm), which corresponds to the upper bound for energies deducible from the results of Veljkovic. This energy is also largest possible since the scale of ΔE is proportional to $1/n_{P,f}^2$.

   (b) One obtains minimum of ΔE for for $n_{P,i} = 1$ as $\Delta E = 2.64$ eV ($\lambda = 469$ nm, blue). One therefore obtains has a band [2.64 ,6.04] eV of lines become dense at its UV end.

   (c) For $n_{P,i} = 2$ gives ($\Delta E = 5.19$ eV, $\lambda = 239$ nm). The wavelength is near to the lower bound of the wavelength range 232-278 nm mentioned by Veljkovic. For $n_{P,i} = 3$ one obtains ($\Delta E = 5.67$ eV, $\lambda = 219$ nm). The wavelength approaches to the limit 205 nm at the limit $n_{P,i} \rightarrow \infty$. The wave lengths are very densely spaced for large values of $n_{P,i}$ could well correspond in good enough approximation to the wavelengths near the lower boundary of the wavelength range given by Veljkovic.

2. $n_{P,f} = 2$ gives the upper bound $\Delta E = 1.5$ eV for ($n_{P,i} \rightarrow \infty$ in near infrared ($\lambda = 821$ nm). Lower bound $\Delta E = .67$ eV is obtained for $n_{P,i} = 2$. One has therefore band [.67,1.5] eV with density of lines getting dense in near infrared. Quite generally, for $n_{P,f} \geq 2$ ΔE is below UV range and arbitrary small values of ΔE are possible for large enough values of $n_{P,f}$.

3. $n_{P,f} = 3$ gives the upper bound $\Delta E \leq .67$ eV for ($n_{P,i} \to \infty$ and lower bound $\Delta E = .294$ eV for $n_{P,i} = 3$. Metabolic energy quantum with value of .5 eV is included in this range of energies and $n_{P,f} = 9$ gives $\Delta E = 4.45$ eV.

Consider next the minimal values of the energy for given $n_{P,f}$.

1. The condition $\Delta E \geq 0$ gives $n_{P,f} \leq 4n_i/3$. For $(n_{P,f}, n_{P,i}) = k(4,3)$ one has $\Delta E = 0$. For $n_{P,f}$ integer nearest to but smaller than $n_{P,f} = 4n_{P,i}/3 - 1$ one has smallest value of ΔE for given $n_{P,i}$. The following formula for ΔE for $n_{P,f} = 4n_{P,i}/3 - 1$ is true for $n_{P,i} = 3k$:

$$\Delta E_{in}(n_{P,i}) = [\frac{4}{9}\frac{1}{(4k-1)^2} - \frac{1}{36k^2}]E_H \simeq \frac{E_H}{72k^3} \simeq \frac{.19 \text{ eV}}{k^3} \text{ for } k \to \infty \ . \quad (2.6)$$

2. For $k = 1$ ($n_{P,i} = 3$) one obtains ($\Delta E = .66$ eV,$\lambda = 1879$ nm). ΔE is slightly higher than the nominal value .5 eV of the metabolic energy quantum.

3. For $k = 2$ ($n_{P,i} = 6$) one obtains $\Delta E = .065$ eV, which corresponds to a typical membrane potential.

To summarize, Popp transition energies of dark valence electrons of dark hydrogen atom might explain not only the energies listed by Veljkovic but also metabolic energy quantum and Josephson energy assignable to cell membrane in TGD based model of cell membrane as generalized Josephson junction.

2.5 Could the dark photons from Popp transitions transform to bio-photons?

Bio-photons do not seem to be produced by molecular transitions although they can induce molecular transitions about which the transitions of carcinogens would be and example. I have proposed earlier that bio-photons include dark cyclotron photons with harmonic oscillator spectrum. Spectra for several strengths of magnetic field are required to get a quasi-continuum believed to characterize bio-photons. For dark cyclotron photons also the value of $h_{eff} = h_{gr}$ would be very large [K12] [L7]. The photons emitted in the transitions of dark valence electrons with relatively small value of h_{eff} serve also as a candidate for dark photons transforming to bio-photons. They could be assigned to the parts of the magnetic body with relatively small size scale (say flux tubes connecting cells) unlike those with large value of h_{eff} and wavelengths even of order those of EEG photons.

Bio-photons include also visible wave length range. Do the transitions of dark hydrogen allow to cover this range? Besides the above kind of transitions reducing h_{eff}/h, one can also consider the transitions increasing it. One might argue that the transitions responsible for color vision are of latter type since negentropy increase is involved.

The following **Tables 1** and **2** describe the energies of emitted photons in processes $(n_i \to n_f)$ with $n_{P,i} = 1$ in the case that they are kinematically possible. n_i and n_f are allowed to vary in the range $(9, ..., 17)$ so that transitions which either increase or reduce h_{eff}/h, or leave it unaffected, are allowed.

Remark: The condition $n_{P,i} > k$, where k is principle quantum number for the valence electrons of ordinary atom must be satisfied. In the case of hydrogen ($k = 1$) however $nP, i = 1$ is possible and hydrocarbons are in special role. Similar condition must be satisfied by $n_{P,f}$: the transitions with $n_{P,i} \leq n_{P,f}$ are always possible. The possibility that the initial state and final state atoms are not the same atom cannot be excluded. The energy difference due to different nuclear masses is rather small so that could be even different kind of atoms.

1. The rows of the tables with fixed n_i give the minimum value $n_{P,f,min}$ of $n_{P,f}$ determined by the condition that the photon energy ΔE is positive, the energy ΔE_{min} in this case, and the maximum ΔE_{max} for which final state electron is free ($n_{P,f} \to \infty$. The transitions for $n_{P,f} < n_{P,f,min}$ can occur in reversal time direction as absorption.

2. By changing the roles of n_i and n_f and of $n_{P,i} = 1$ and $n_{P,f}$, the same table gives some transition energies with final state electron in the ground state ($n_{P,f} = 1$). The table also gives minimal absorption energies ΔE_{min} *resp.* maximal absorption energies ΔE_{min} as function of n_i and $n_{P,i,max}$ *resp.* $n_{P,i,max}$. Note that the transitions for $n_{P,i} < n_{P,i,min}$ for which photon energy would be negative can occur in reversal time direction as emission.

From the tables one learns that the energies of photons in visible regions can be covered by the scaled variants of the spectra but the regions near the ends have a low density of lines.

1. The densities of the spectral lines increase towards the maximal energies $\Delta E_{max}/eV \in (1.69, 1.91, 2.18, 2.5, 2.90, 3.40, 4.05, 4.90, 6.04)$ associated with $17 \geq n_i \geq 9$). The upper ends of the frequency range for $n_i + 1$ are above the lower ends for n_i so that the ranges of energies overlap. The deviation from un-evenness can be testable someday as detection technologies develop.

2. As a rule, the spectra for the transitions reducing h_{eff} begin at $n_{P,f} = 2$ since the lowest state would correspond to negative energy. The transition can be however realized in opposite direction as as a transition increasing h_{eff}. I have added to ΔE_{min} column (fourth column) the energy of this transition in brackets.

   I have added to ΔE_{min} column (fourth column) 2 spectral lines in brackets to show where the visible part of the spectrum begins in these cases. The reader can compare the spectrum to the data given about the spectrum of visible light (see `http://tinyurl.com/q8yqea9`).

A couple of comments about the interpretation of the spectrum is in order.

1. The maximum energies for the bands intersecting visible range are $\Delta E \in (1.69, 1.91, 2.18, 2.5, 2.90, 3.40)$ labelled by $17 \geq\geq n_i \geq 12$). Note that upper end of violet is 3.26 eV and belongs to the band [2.55, 3.40] eV containing blue. Could these 6 bands becoming infinitely dense towards their upper ends correspond to the 6 color-complement color pairs red-green, blue yellow and white-black pair included? Could different values of n_i characterize color qualia? Could the ends of the bands be identified as "nominal" wavelengths for the basic colors? Note that I have constructed a model for color vision relying on the transitions of dark electrons in [L8].

2. I have also suggested that music harmony could emerge at the level of fundamental physics [L1, L11], in particular the model for dark genetic code [L6] leads to 12-note scale. An interesting questions is whether the ratios for the frequencies associated with $\Delta E \in (1.69, 1.91, 2.18, 2.5, 2.90, 3.40)$ could correspond to simple music scale. The ratios of the energies to the smallest energy are given by $(1.00, 1.13, 1.29, 1.5, 1.72, 2.01)$. In even tempered scale with the notes of 12-note scale coming as $f_n/f_0 = 2^{n/12}$ one obtains for the pentatonic scale C,D,E,G,A,C appearing in Chinese music the frequencies ratios $(1.00, 1.12, 1.26, 1.50, 1.68, 2.00)$. The deviations are few per cent.

3 Possible general mechanisms for the action of carcinogen

In the following some general guesses for the effect of carcinogens are discussed and after that a model based on the findings of Popp and Veljkovic is discussed.

3.1 Some general ideas

Consider first some guesses.

1. The dark photons of BEC can be absorbed and reduce also reduce the value of n for dark electrons: for instance, in the above example one has $n_i = 12 \rightarrow n_f = 9$.

2. This reduction of n for catalyst and return to its original value possibly requiring metabolic energy would be the basic mechanism of bio-catalysis. It would liberate temporarily metabolic energy allowing to overcome the potential wall slowing down the reaction considered.

n_i	n_f	$n_{P,f,min}$	$\Delta E_{min}/eV$	$\Delta E_{max}/eV$
9	9	2	4.53	6.04
9	10	1	1.15 (4.82,5.50)	6.04
10	9	2	(1.15) 3.38	4.90
10	10	2	3.67	4.90
10	11	1	0.85 (3.88,4.45)	4.90
11	9	2	(2.00) 2.54	4.05
11	10	2	(0.85) 2.82	4.05
11	11	2	3.03	4.05
11	12	1	0.65 (3.20,3.67)	4.05
12	9	2	(2.64) 1.89	3.40
12	10	2	(1.50) 2.18	3.40
12	11	2	(0.65) 2.39	3.40
12	12	2	2.55	3.40
12	13	1	0.50 (2.68,3.08)	3.40
13	9	2	(3.15) 1.39	2.90
13	10	2	(2.00) 1.67	2.90
13	11	2	(1.15) 1.89	2.90
13	12	2	(0.50) 2.05	2.90
13	13	2	2.17	2.90
13	14	1	0.40 (2.27,2.62)	2.90
14	9	2	(3.55) 0.99	2.50
14	10	2	(2.40) 1.27	2.50
14	11	2	(1.55) 1.49	2.50
14	12	2	(0.90)1.65	2.50
14	13	2	(0.40) 1.77	2.50
14	14	2	1.87	2.50
14	15	1	0.32 (1.95,2.26)	2.50

Table 1: Table represents minimal and maximal dark photon energies $\Delta E_{min}/eV$ and $\Delta E_{max}/eV$ for transitions $(n_i, n_{P,i}) \rightarrow (n_f, n_{P,f})$ in the range $n_i \in [9, 14]$. In the column for $\Delta E_{min}/eV$ numbers in brackets give for $n_f = 1$ rows the $n_{P,i} = 2, 3$ transition energies and for $n_{P,f} = 2$ rows transition energy for the reverse transition $(1, 1) \rightarrow (1, 1)$.

n_i	n_f	$n_{P,f,min}$	$\Delta E_{min}/eV$	$\Delta E_{max}/eV$
15	9	2	(?) 0.66	2.18
15	10	2	((2.72) 0.95	2.18
15	11	2	(1.87) 1.16	2.18
15	12	2	(1.22) 1.33	2.18
15	13	2	(0.72) 1.45	2.18
15	14	2	(0.32) 1.55	2.18
15	15	2	1.63	2.18
15	16	1	0.26 (1.70,1.96)	2.18
16	9	2	(4.13) 0.40	1.91
16	10	2	(2.98) 0.69	1.91
16	11	2	(2.13) 0.90	1.91
16	12	2	(1.49) 16	1.91
16	13	2	(0.98) 1.19	1.91
16	14	2	(0.59) 1.29	1.91
16	15	2	(0.26) 1.37	1.91
16	16	2	1.43	1.91
16	17	1	0.22 (1.40,1.72)	1.91
17	9	2	(4.35) 0.18	1.69
17	10	2	(3.20) 0.47	1.69
17	11	2	(2.35) 0.68	1.69
17	12	2	(1.71) 0.84	1.69
17	13	2	1.20) 0.97	1.69
17	14	2	(0.80) 17	1.69
17	15	2	(0.48) 1.15	1.69
17	16	2	(0.22) 1.22	1.69
17	17	2	1.27	1.69
17	18	1	0.18 (1.32,1.53)	1.69

Table 2: Table represents minimal and maximal dark photon energies $\Delta E_{min}/eV$ and $\Delta E_{max}/eV$ for transitions $(n_i, n_{P,i}) \rightarrow (n_f, n_{P,f})$ in the range $n_i \in [15, 17]$. In the column for $\Delta E_{min}/eV$ numbers in brackets give for $n_f = 1$ rows the $n_{P,i} = 2, 3$ transition energies and for $n_{P,f} = 2$ rows transition energy for the reverse transition $(1, 1) \rightarrow (1, 1)$.

Carcinogens would imitate other biomolecules in that they would have dark electrons. This might help to get into bio-molecules in this manner (consider bentzene as example). Dark lonely unpaired valence electrons would be in fundamental role. Their transitions would produce a universal spectrum playing a key role in the bio-control.

3. If 3.27 eV:n photons emerge t $n = 12$ BEC assignable to organism, the presence of carcinogen would lead to a loss of the BEC and production of bio-photons.

If this is the case, the spectra for the transitions $(n_i, n_{P,i} \rightarrow (n_f, n_{P,f})$ of dark hydrogen atom would define the central frequencies and key energies of bio-control. There would be infinite number of these corresponding to all transitions $(n_1, n_{P,1}) \rightarrow (n_2, n_{P_2})$. Energy difference and at the same time the spectrum of biologically important photons would contain the transition energies of dark hydrogen atom:

$$E((n_i, n_{P,i} \rightarrow (n_f, n_{P,f}) = \frac{1}{n^2}[\frac{1}{n_f^2}\frac{1}{n_{P,f}^2} - \frac{1}{n_i^2}\frac{1}{n_{P,i}^2}] \times E_I(H) \quad , \quad E_H = 13.6 \ eV \quad . \tag{3.1}$$

One can say, that these spectra produce a fractal, since they are obtained from each other by scaling using rational number. Here the value of n can be such that the energies are in visible and UV range corresponding to the energy spectrum of bio-photons. The dynamics of living matter would be universal, which conforms with quantum criticality.

One could think that if molecule has in its ordinary spectrum a line coinciding with some energy in above spectrum, the molecule defines a potential carcinogen. All atoms with un-paired valence electron, which can be dark would be potential parts of carcinogen. Some additional condition must be satisfied for a molecule to be a carcinogen: the existence of ordinary transition with energy in the dark photon spectrum could be this condition. There are also other frequency spectra such as cyclotron transitions and also these could couple to carcinogens.

3.2 A proposal for the carcinogenic mechanism inspired by the observations of Popp and Veljkovic

This picture encourages to consider a rather simple mechanism for cancer as a loss of quantum coherence due to the decay of Bose-Einstein condensate of dark photons caused by the presence of carcinogen molecules. Also super conductivity possibly associated with dark valence electrons might be lost. Carcinogen would absorb the $n = 9$ dark photons ($\lambda = 218$ nm) generated from $n = 12$ dark photons (for instance for $\lambda = 380$ nm) by Popp mechanism.

Dark photon, call it A, would transform with certain rate $k_{A \rightarrow B}$ to ordinary photon (bio-photon). Bio-photon would transform with rate $k_{B \rightarrow A}$ to dark photon. Carcinogen molecule would absorb bio-photons B with rate k_C. The situation is analogous to a chemical reaction in which second components leaks out from the system by reacting with a third component, whose concentration is assumed to be large. The outcome is that both A and B approach to zero and BEC is lost.

For the densities of photons obtains the equations

$$\begin{aligned} \frac{dA}{dt} &= k_{B \rightarrow A}B - k_{A \rightarrow B}A \quad , \\ \frac{dB}{dt} &= -k_{B \rightarrow A}B + k_{A \rightarrow B}A - k_C B \quad . \end{aligned} \tag{3.2}$$

The equations are linear and the solution is sum of two exponent terms with rather free coefficients (A and B must be positive).

The general form for the equations is

$$\begin{aligned} \frac{dA}{dt} &= k_1 B - k_2 A \quad , \\ \frac{dB}{dt} &= -k_3 B + k_2 A \quad . \end{aligned} \tag{3.3}$$

One has

$$k_1 = k_{B\to A} \ , \quad k_2 = k_{A\to B} \quad k_3 = k_{B\to A} + k_C \ . \tag{3.4}$$

One has $k_3 > k_1$ since B is absorbed by carcinogen.

By using the ansatz

$$A = A_0 exp(-kt) \ , \quad B = B_0 exp(-kt) \ . \tag{3.5}$$

one obtains a homogenous linear group of two equations and the solutions for k are determined by the vanishing of the determinant of the matrix defining the group

$$k_\pm = \frac{k_1+k_3}{2} \pm \frac{1}{2}\sqrt{(k_3+k_1)^2 - 4(k_3+k_2)k_1} \ . \tag{3.6}$$

The general solution is of the form

$$\begin{pmatrix} A \\ B \end{pmatrix} = \sum_\pm a_\pm exp(-k_\pm t) \begin{pmatrix} \frac{k_2}{k_\pm + k_1} \\ 1 \end{pmatrix} \ . \tag{3.7}$$

Both A and B approach zero with an exponential rate.

4 Appendix: Number theoretical characterization of the photon spectrum from dark valence electron transitions

The spectrum for the lines of dark photons from the hydrogen-like transitions of dark valence electron can be characterized number theoretically. The reason is that given transition energy is characterized by a pair (k_i, k_f) of products integers $k_i = n_i n_{P,i}$ and $k_f = n_f n_{P,f}$ as

$$\frac{\Delta E}{E_H} = \frac{1}{k_i^2} - \frac{1}{k_f^2} \ . \tag{4.1}$$

For given k_i *resp.* k_f all its decompositions to a product of integers define one possible initial *resp.* final state. The spectral density is sum of energy conserving delta functions each multiplied by the number of transitions with the energy consider. This number is proportional to the product $N(k_i)N(k_f)$ for the numbers of these decompositions for k_i and k_f. The spectral density function has therefore a large value when both k_i and k_f have large number of factors.

Could the photons produced in this kind of transitions could be of special physical and biological significance? This could be the case if the number of allowed pairs (n_i, n_f) and $(n_{P,i}, n_{P,f})$ is large enough. Whether this could be the case is an open question. In any case it is interesting to look what this would imply.

One has always the decompositions $(n = 1, n_P = k)$ and $(n = k, n_P = 1)$ and for prime values of k only these decompositions exist. For non-prime values of k there are also decompositions to a product of integers different from k and 1. The number $N(k)$ of factorizations of k into a product of two integers is given by the number of different factors of k. Elementary argument showing that the number of decompositions of p^r equals to $N(p^r) = r+1$ shows that $N(k)$ is obtained from the prime decomposition $k = \prod p_i^{r_i}$ of k as

$$N(k) = \prod_i (r_i + 1) \ , \quad k = \prod_i p_i^{r_i} \ . \tag{4.2}$$

For numbers k_i having large number of different factors the number of product decompositions is large. For prime values of k_i there are only two compositions. For instance, factorial $k = r! = 1\times 2 ... \times r$ the number of decompositions is large. Powers $k = p^r$ have $N(k) = r+1$ decompositions. Perfect numbers $P = M_p 2^{p-1}$ $(M_p = 2^p - 1)$ have large number of composition due to the large power of 2 involved.

An interesting question is, for which kind of integers the number of factors divided by integer is maximal.It is known that $N(n)$ satisfied the inequality $N(n) \leq 2^{1.5379 log(n)/log(log(n))}$ and that equation holds true for $N = 6,983,776,800$ (see http://tinyurl.com/yar9kdfd and http://tinyurl.com/y7nvfce5). I do not know whether the equation is true for some other integers.

Assuming that all transitions have the same probability to appear (an assumption very probably non-realistic), one can write the spectral density function as the density of states per energy as a sum of energy conserving delta functions multiplied by the number $N(k_i)N(k_f)$ of transition with this energy

$$\frac{dN}{dE} = \sum_{k_i,k_f} N(k_i)N(k_f)\delta(E - E_{k_i \to k_f} \quad . \tag{4.3}$$

Therefore the pairs (k_i, k_f) with both integers having large number of factors could be of special interest. In a more realistic treatment each delta function contains an additional weight factor telling the probability for the particular transition to occur.

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REFERENCES

Theoretical Physics

[B1] Preskill J et al. Holographic quantum error-correcting codes: Toy models for the bulk/boundary correspondence. Available at: http://arxiv.org/pdf/1503.06237.pdf, 2015.

Biology

[I1] Popp FA. Electronic structure and carcinogenic activity of 3,4-benzopyrene and 1,2-benzopyrene. *Z Naturforsch B.*, 27(7):850–863, 1972.

[I2] Veljkovic V and Lalovic DI. Correlation between the carcinogenicity of organic substances and their spectral characteristics. *Experientia*, 34(10):1342–1343, 1978.

Books related to TGD

[K1] Pitkänen M. Magnetic Sensory Canvas Hypothesis. In *TGD and EEG*. Online book. Available at: http://www.tgdtheory.fi/tgdhtml/tgdeeg.html#mec, 2006.

[K2] Pitkänen M. Quantum Astrophysics. In *Physics in Many-Sheeted Space-Time*. Online book. Available at: http://www.tgdtheory.fi/tgdhtml/tgdclass.html#qastro, 2006.

[K3] Pitkänen M. Quantum Model for Bio-Superconductivity: I. In *TGD and EEG*. Online book. Available at: http://www.tgdtheory.fi/tgdhtml/tgdeeg.html#biosupercondI, 2006.

[K4] Pitkänen M. Quantum Model for Bio-Superconductivity: II. In *TGD and EEG*. Online book. Available at: http://www.tgdtheory.fi/tgdhtml/tgdeeg.html#biosupercondII, 2006.

[K5] Pitkänen M. TGD and Astrophysics. In *Physics in Many-Sheeted Space-Time*. Online book. Available at: http://www.tgdtheory.fi/tgdhtml/tgdclass.html#astro, 2006.

[K6] Pitkänen M. *TGD and EEG*. Online book. Available at: http://www.tgdtheory.fi/tgdhtml/tgdeeg.html, 2006.

[K7] Pitkänen M. Quantum Mind, Magnetic Body, and Biological Body. In *TGD based view about living matter and remote mental interactions*. Online book. Available at: http://www.tgdtheory.fi/tgdhtml/tgdlian.html#lianPB, 2012.

[K8] Pitkänen M. *TGD Based View About Living Matter and Remote Mental Interactions*. Online book. Available at: http://www.tgdtheory.fi/tgdhtml/tgdlian.html, 2012.

[K9] Pitkänen M. Are dark photons behind biophotons? In *TGD based view about living matter and remote mental interactions*. Online book. Available at: http://www.tgdtheory.fi/tgdhtml/tgdlian.html#biophotonslian, 2013.

[K10] Pitkänen M. Comments on the recent experiments by the group of Michael Persinger. In *TGD based view about living matter and remote mental interactions*. Online book. Available at: http://www.tgdtheory.fi/tgdhtml/tgdlian.html#persconsc, 2013.

[K11] Pitkänen M. Criticality and dark matter. In *Hyper-finite Factors and Dark Matter Hierarchy*. Online book. Available at: http://www.tgdtheory.fi/tgdhtml/neuplanck.html#qcritdark, 2014.

[K12] Pitkänen M. Quantum gravity, dark matter, and prebiotic evolution. In *Genes and Memes*. Online book. Available at: http://www.tgdtheory.fi/tgdhtml/genememe.html#hgrprebio, 2014.

Articles about TGD

[L1] Pitkänen M. Geometric theory of harmony. Available at: http://tgdtheory.fi/public_html/articles/harmonytheory.pdf, 2014.

[L2] Pitkänen M. Holography and Quantum Error Correcting Codes: TGD View. Available at: http://tgdtheory.fi/public_html/articles/tensornet.pdf, 2016.

[L3] Pitkänen M. Hydrinos again. Available at: http://tgdtheory.fi/public_html/articles/Millsagain.pdf, 2016.

[L4] Pitkänen M. Artificial Intelligence, Natural Intelligence, and TGD. Available at: http://tgdtheory.fi/public_html/articles/AITGD.pdf, 2017.

[L5] Pitkänen M. Re-examination of the basic notions of TGD inspired theory of consciousness. Available at: http://tgdtheory.fi/public_html/articles/conscrit.pdf, 2017.

[L6] Pitkänen M. About dark variants of DNA, RNA, and amino-acids. Available at: http://tgdtheory.fi/public_html/articles/darkvariants.pdf, 2018.

[L7] Pitkänen M. About the physical interpretation of the velocity parameter in the formula for the gravitational Planck constant . Available at: http://tgdtheory.fi/public_html/articles/vzero.pdf, 2018.

[L8] Pitkänen M. Dark valence electrons and color vision. Available at: http://tgdtheory.fi/public_html/articles/colorvision.pdf, 2018.

[L9] Pitkänen M. Emotions as sensory percepts about the state of magnetic body? Available at: http://tgdtheory.fi/public_html/articles/emotions.pdf, 2018.

[L10] Pitkänen M. Maxwells lever rule and expansion of water in freezing: two poorly understood phenomena. Available at: http://tgdtheory.fi/public_html/articles/leverule.pdf, 2018.

[L11] Pitkänen M. New results in the model of bio-harmony. Available at: http://tgdtheory.fi/public_html/articles/harmonynew.pdf, 2018.