A model for biophotons

M. Pitkänen, March 30, 2002.
Department of Physical Sciences, High Energy Physics Division,
PL 64, FIN-00014, University of Helsinki, Finland.
Home address: Kadermonkatu 16,10900, Hanko, Finland.
matpitka@rock.helsinki.fi .
http://www.physics.helsinki.fi/~matpitka/.

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Abstract

The model of biophotons emerged as a natural application of TGD based vision about biosystems. Simple mathematical facts about the decay of the delayed luminescence induced by an external perturbation like light signal, lead to a model in which pairs of positive and negative energy MEs transversal to and moving in opposite directions along DNA strand and it conjugate generate coherent biophotons. What is important is that a rather detailed model for how MEs and supra current circuits interact results. Most importantly, it becomes clear that negative energy MEs, perhaps the most science fictive piece of the new physics predicted by TGD, seem to be there.

1 Introduction

MEs (massless extremals, 'topological light rays') can be carriers of lightlike vacuum currents generating coherent light. Biophotons [11, 12, 13] were the

first proposed identification for this coherent light in living matter (see the chapter "Quantum Antenna Hypothesis" of [6]). In absence of material about biophotons I did not develop these ideas in any quantitative detail. Situation has changed with the development of web and recently I learned from Lian Sidoroff about homepage containing online articles of Fritz-Albert Popp and colleagues about biophotons and related phenomena. I am grateful for Lian also for very useful discussions and keen questions helping me to become and stay conscious about the many poorly understood aspects of the 'great vision'. This homepage is recommended also to the reader and the data used below mostly derive from the articles therein [8, 9, 10].

2 What biophotons are?

The web articles [8, 9, 10] provide the basic facts about biophotons and in the following I summarizes my novice view about biophotons.

2.1 Basic facts

Biophotons have frequencies in the range 200-800 nm (at least). The intensity of biophotons is extremely low: from one photon to few hundred photons/$cm^2 s$, which is 20 orders of magnitude weaker than common fluorescence of photophosphorence. There is evidence for coherent radiation also at longer wave length scales. A far from thermal equilibrium situation is in question: the intensity of photons is about 10^{10} times higher than that associated with the thermal visible photons at body temperature. The spectral density $f(\nu)$ defined as the counterpart of Boltzmann weight is essentially constant. This means that the effective temperature increases linearly with frequency. The experimental work of Popp and colleagues provides support for the view that biophotons are indeed coherent light rather than some waste radiation resulting as a by-product of biological processes [8]. Poisson statistics for the number of photons in coherent state ($p_n = exp(-\alpha)\alpha^n/n!$) is the basic signature for the coherent light and it is found that photon counts obey this distribution.

Since $\tau \sim 1$ nanoseconds is the characteristic time constant for em emissions and absorptions at visible wavelengths, one can argue that the length scale $\mathrm{L} = c\tau \sim 10$ cm defines the length scale below which it is not sensical to speak about localized photon and thus biosystems must be treated as macroscopic quantum systems as far as coherent photons are considered. The timescale means also that 10^9 reactions per second can in principle catalyzed by absorption and emission of single photon in single cell: the typical number of reactions is 10^5 per second inside single cell [8]. If biophotons Bose-Einstein condense at magnetic mirrors (ME-magnetic flux tube pairs), extremely sharp control of biological reactions could be indeed achieved. Of course, if Bose-Einstein condensed biophotons are most important for biocontrol, one cannot exclude the interpretation of the observed biophotons as somekind of leakage radiation from living matter (of course, these biophotons might serve communication purposes).

Even the wavelength of the visible photons, which is somewhat below the cell size, implies that molecules see classical em field like boat sees the sea. One could argue that photons as CP_2 type extremals are essentially pointlike. One the other hand, if MEs are classical correlates for photons or if the classical interaction of atoms and molecules with MEs is additional aspect of their interaction with em fields, this is not the case. The situation is not conceptually completely clear in this respect.

Interference effects provide also support for the notion of macroscopic coherent states. Popp proposes that in a healthy organism constructive interference tends to occur inside cells for biophotons whereas destructive interference takes place outside [9, 13]. Or stating it differently, cells are able to store visible biophotons inside them. For healthy cells the biophoton emission and well as delayed luminescence have been found to increase as a function of cell density

up to some critical density and to decrease above that. For cancer cells the intensity increases indefinitely and nonlinearly [9]. This supports the view that in cancer cell population biophotons leak out and do not properly participate to the biocontrol.

Biophoton emission is a signature of living matter in the sense that the presence of oxidative process accompanies always the emission. This is true also for the delayed luminescence resulting as a delayed response to electromagnetic or some other perturbation. The dependence of the delayed luminescence on temperature suggests that the activation energy for the process controlling photolumiscence is roughly .53 eV [16]: this is rather near to the energy .49 eV believed to be stored in high energy phosphate bond of the ATP molecule (for TGD based model of metabolism see the chapter "Macroscopic quantum coherence and quantum metabolism as different sides of the same coin" of [7]). The experiments involving the insertion of inert molecules to DNA indicate that DNA is the source of biophotons [8, 14]. The spectrum of biophotons and delayed luminescence correlates strongly with various biological processes. For this reason biophotons have several applications to biosearch, food quality control, cancer research, pharmacology and heal prophylaxis.

2.2 Some phenomena related to biophotons

There are several interesting and theoretically challenging phenomena involving biophotons.

a) Delayed luminescence [10, 15, 3] results after an exposure to an external perturbation, which can be light or ultrasound. Delayed luminescence accompanies also biological processes like cell mitosis. The intensity of the coherent light varies from few photons to 10^5 photons/cm^2s. The characteristic feature of the delayed luminescence is hyperbolic ($I(t) \propto 1/(1+\lambda t)$) decay instead of the exponential one expected if incoming light just scatters from the system. The intensity involves oscillatory modulations with respect to a variable u which depends logarithmically on time coordinate ($u = log(1+\lambda t)$). As a function of cell density delayed luminescence increases up to some critical cell density for a healthy cell population and begins to decrease after that. For cancer cell population there is no such critical cell density.

b) Some animal populations can 'see' each other. For instance, when populations of dinoflagellates become to optical contact, they begin to flicker synchronously [16] (also fireflies in mangrove trees in Thailand flicker in a synchronous manner). In TGD framework this could be interpreted as evidence for magnetic mirror bridges connecting the populations such that the MEs associated with visible light propagate along them from population to another one. The bridges could also contain ELF em waves serving as synchronizers in the time scale in which flickering occurs.

c) Bacteria absorb biophotons from nutrition media in a way that the absorption is highest for some critical cell density [9]. Female inbred daphnia in the same developmental stage and about the same size do not display the increasing biophoton emission with increasing number [9]. Rather, a typical interference pattern of emission is observed showing maxima and minima of the biophoton intensity at definite average distances between the animals. This could be seen as evidence for the hypothesis that the pattern of coherent light from DNA serves as kind of hologram representing 4-D template for the self-organization.

3 General TGD based model for coherent biophotons

MEs with lightlike vacuum currents generate coherent photons so that biophotons have a place in TGD Universe. ATP energy about .49 eV and near to the rough estimate .53 eV for the activation energy deduced by studying the tem-

perature dependence of the delayed luminescence [16]. This encourages to think that the MEs are closely related with the process transforming ADP to ATP serving as energy batteries (see the chapter "Biosystems as Superconductors" of [6] for the TGD based model of ATP). This assumption conforms also with the fact that coherent light is associated with the oxidative process.

The empirical data are consistent with the assumption that the MEs are associated with DNA and are perhaps responsible for the electromagnetic expression of the genetic information below cellular length scales. MEs can carry Bose-Einstein condensates of parallel photons and the observed coherent photons represent leakage of the coherent light from cells. Both positive and negative energy MEs are possible and most naturally they are created in a pairwise manner: pairs (which do not form bound states) with a vanishing net energy and momenta are especially interesting since classical conservation laws do not pose any constraints on their creation and annihilation by p-adic-to-real transition. The buy now-pay later energy production by feeding negative energy to the environment might be closely related with the generation of pairs of MEs which vanishing net energy. Also magnetic mirrors with positive and negative energies might be in question.

The constancy of the spectral density of biophotons could be understood in two manners.

a) The coherent light is associated with MEs having lengths long as compared to the wavelength. Coherence length would be about 10 cm from the rate constant of order 1/nanosecond. Frequency discretization would be $\Delta f = 10^{-5} \times f$ with this assumption.

b) MEs have lengths of order wavelength (which are below cell size for visible light) and there is constant distribution for MEs with respect to the direction and length of ME in the length scale interval considered at least. In this case it would be easier to understand that the coherent light in visible range is concentrated inside cells. TGD predicts entire length hierarchy for MEs and at longer wavelengths coherent light is not anymore concentrated inside cells. This option is more in spirit with the general ideas about quantum holograms.

3.1 Constraint to the intensity of the vacuum current

The model allows to deduce constraint to the intensity of the vacuum current. The interaction Lagragian of the vacuum current with the vector potential of the quantized photon field is given by

$$L_{int} = e \int d^4x j \cdot A \tag{1}$$

where the indices of the second quantized vector potential and vacuum current have been dropped away for simplicity and the units $\hbar = c = 1$ are used and e denotes the electromagnetic coupling.

This interaction term describes an infinite number of harmonic oscillators coupled to an external oscillatory force. In each Fourier mode initial vacuum state is transformed to a coherent state which is an eigenstate of the corresponding annihilation operator. By standard calculations [2] one can deduce the expression for the effective classical vector potential defined by the eigenvalues of the annihilation operators is given by

$$\begin{aligned} A(x,t) &= \frac{ie}{(2\pi)^3} \int d^3k \frac{1}{2\omega(k)} exp\left[-ik \cdot x - i\omega(k)t\right] j\left(k, \omega(k)\right) \quad , \\ \omega(k) &= |k| \quad . \end{aligned} \tag{2}$$

The eigenvalues $\alpha(\epsilon, k)$ for the annihilation operator $a(\epsilon, k)$ associated with polarization ϵ is given by the expression

$$\alpha(\epsilon,k) \quad = \quad \frac{ie}{2(2\pi)^3\omega(k)}\epsilon\cdot j(k,\omega(k)) \quad . \tag{3}$$

$\alpha(k)$ indeed has the dimension length to 3/2 as it should be on basis of the commutation relations in the continuous momentum basis. If finite quantization volume with a discrete momentum basis is used, $\alpha(k)$ contains additional $1/\sqrt{V}$ factor guaranteing that the eigenvalues are dimensionless.

The eigenvalues characterizing the coherent states are proportional to the massless Fourier components of the vacuum current so that the intensities of biophotons determining the values of the parameters $\alpha(k)$ allow to deduce the on mass shell Fourier components of the lightlike vacuum current. Of course, the coherent field of photons is superposition of several interfering contributions coming from MEs with lightlike currents and only the sum of these contributions appears in the detected field.

3.2 Sucking force in TGD framework

The mechanism by which sun flowers turn towards Sun as well as the attraction between cells are not very well well-understood processes. Popp and Chang introduce as an explanation an interaction which they call sucking force [9]. The notion is inspired by the assumed analogy with the vacuum cleaner which is a particular kind of a pump. The pressure gradient along the tube of the vacuum cleaner generates airflow towards the tube. Since pumping is always done when dissipative processes are precent, a process involving essentially the dynamics of quantum jumps is in question and the force does not have counterpart at the level of the irreversible classical dynamics.

In case of em fields radiation pressure gradient replaces the ordinary pressure gradient. The counterpart of the tube of vacuum cleaner is naturally a ME along which Bose-Einstein condensed photons propagate and are absorbed at the second end of the tube, most naturally cell in case of visible photons. The pumping implies an attractive force between living systems connected by MEs. This force would be present at all levels of the length scale hierarchy. The force is only between systems having common characteristic frequencies so that they can be connected by MEs. For instance, this force could explain why tDNA carrying aminoacids finds the corresponding mRNA in the translation of DNA to proteins.

The sucked MEs can propagate along larger ME serving as an em bridge to the receiving system and the absorbtion most naturally corresponds to the annhilation with MEs of opposite energy. Both negative and positive energy MEs can be sucked. The sucking of negative energy MEs makes possible very flexible buy now-pay later type energy consumption: the user (say DNA) generates pairs of positive and negative energy MEs and utilizes the positive energy MEs, whereas the negative energy MEs are received by the payer, most naturally mitochondria where they annihilate with the positive energy MEs produced by ATP process. 'Pay later' means, that various perturbations destroy the bound state entanglement later.

4 TGD based model for the delayed luminescence

The TGD based model for the delayed luminescence is based on two mathematical observations:

a) The intensity of coherent photons must be proportional to the number of positive energy MEs and hyperbolic decay results naturally if MEs annihilate pairwise. The most natural possibility is that positive and negative energy MEs annihilate in a pairwise manner, possibly by p-adic-to-real phase transition.

b) Oscillatory behaviour in the variable $u = log(1 + \lambda t)$ results if there is a feedback mechanism generating or destroying ME pairs with a rate which is the time derivative dF/dt of a periodic function $F(u)$.

The essential difference as compared to the models of Popp and Yan [10], is that quantum coherence for photons is not assumed in the time scales of order seconds characterizing the decay of the delayed luminescence.

4.1 Basic observations

Before going to the analytic formulation, it is good to work through the basic mathematical and physical ideas of the model first and connect them with the general vision about homeostasis as manysheeted ionic flow equilibrium.

a) Negative/positive energy ME is a correlate for photon absorption/emission. Thus the distribution of the coherent photons reflects the kinetics for MEs with lengths corresponding to the wavelengths of visible light. MEs and ME pairs are generated by the interaction with the external perburbation, say electromagnetic field. The annihilation of positive and negative energy ME pairs is energetically very natural mechanism changing the number of MEs. There must be an interaction between supra currents and MEs and magnetic induction is very attractive interaction mechanism. The induction current LdI/dt associated with super conducting circuit should generate or destroy MEs or ME pairs with rate which on dimensional grounds must be proportional to $eLdI/dt$.

b) At the level of frequencies hyperbolic decay law predicts a $1/f$ power spectum for frequencies $f \ll \lambda$. $1/f$ noise is almost universal [1] and I have already earlier proposed that the dynamics of the mindlike spacetime sheets, for instance MEs, might explain it (see the chapter "Quantum Model for Control and Coordination").

c) Hyperbolic decay suggests that the interaction involving two MEs is involved since $dI/dt = kI^2$ gives $1/(1 + \lambda t)$ behaviour. The basic reaction would be the annihilation of positive and negative energy MEs with rate proportional to $n_+ \times n_-$. The essential assumption is that in the absence of an external perturbation MEs are generated or annihilated only in pairs. It is essential that given positive energy MEs can annihilate with *any* negative energy ME: hence positive and negative energy MEs cannot appear as only self-annihilating tightly bound pairs. If only annihilation occurs the assumption implies that the difference of $n_+ - n_- = n_0$ for the numbers n_+ and n_- of positive and negative energy MEs is a constant of motion. This can be also interpreted as stating that absorption and emission cancel each other in homeostatic equilibrium. In the asympotic stationary state only n_+ is nonvanishing.

d) A correction periodic with respect to the variable $log(1+\lambda t)$ to the decay rate result if there is additional mechanism generating ME pairs. The rate for the generation of ME pairs must be of the general form

$$\frac{dn(\text{ME pair})}{dt} \quad = \quad \frac{dF(u)}{dt} \quad , \tag{4}$$

where $F(u)$ is a periodic function of the variable $u = \int (n_+ + n_-)dt$

4.2 Concrete physical model

One can develop the physical model further by utilizing the general ideas related to DNA, to the model of nerve pulse and EEG and fractality.

1. External perturbation generates unbound pairs of positive and negative energy MEs propagating in opposite directions along DNA double strand

The external perturbation must generate both negative and positive energy MEs. The most natural option is that MEs are generated in a pairwise manner so that no net energy is feeded to the system. If MEs carry constant transversal

electric and magnetic fields, they must carry effective charges at their boundaries. The rotating wormhole throats at the boundaries of MEs and connecting them to larger spacetime sheets serve as sources of the electric and magnetic field. These larger spacetime sheets could but need *not* be MEs with opposite energy. The annihilation of MEs (ME pairs) must occur dominantly by collisions of MEs (ME pairs) moving in opposite directions (members of the ME pair behave as independent particles after they are created).

One could argue that bound ME pair cannot generate appreciable coherent light since it could be regarded essentially as a dipole like structure with the distance between currents of order CP_2 length. On the other hand, the sheets generate positive resp. negative energy photons so that the net energy generated in this manner is vanishing although the resulting holograms have physically highly nontrivial effects. If this mechanism works in case of wormhole contacts, then the throats of wormhole contacts would generate positive and negative energy photons at appropriate spacetime sheets and would be observable, and perhaps detected long ago.

MEs should be parallel and in very regular spatial configuration in order that their contributions to the coherent light interfere constructively. If MEs are associated with DNA, this might be implied by the regular structure of DNA. The simplest guess is that MEs are parallel to the hydrogen bonds connecting DNA nucleotides. Hence a constructive interference occurs only when DNA is in an unwound state and is thus active. This is certainly the case when DNA is transcribed. The prediction is that also the intronic portions of DNA expressed only electromagnetically must be unwound in the active state. Similar constructive interference is expected in the case of axonal MEs generating coherent light at ELF frequencies.

2. Fractality and DNA-axon connection

Fractality of TGD Universe has already earlier led to the speculation that same basic mechanisms of quantum control are at work at DNA and axonal level.

a) The model of EEG and nerve pulse (see the chapter "Quantum Model for EEG and Nerve Pulse") assumes that ELF MEs propagate along the axon with the phase velocity of EEG which is essentially the conduction velocity of nerve pulses. The model of ATP discussed in the chapter "Biosystems as Superconductors" of [6] suggests that the MEs could actually be parts of magnetic mirrors feeding energy to DNA. The replacement of MEs by magnetic mirrors does not mean any loss of generality.

b) The magnetic flux tubes associated with the magnetic mirrors inside cell and also inside body suggests themselves as providers of the cellular and bodily (fractal) counterparts of the household electricity. The leakage of the supra current from the magnetic flux tubes to the atomic spacetime sheets associated with axons could thus provide at least part of the energy needed to generate nerve pulse: pay now-pay later mechanism could be also involved. The reason for why the ELF MEs (or corresponding magnetic mirrors) serving as TGD counterparts of the propagating EEG waves must move along the axon is that they would not otherwise be able to provide the metabolic energy needed by the moving nerve pulse.

c) Fractality suggests that similar MEs (and magnetic mirrors) propagate along DNA strands but correspond instead of ELF frequencies to visible frequencies. In case of eukaryotes these magnetic mirrors could connect DNA to mitochondria serving as electric power station. The counterparts of nerve pulse sequences would be realized as solitons sequences for Josephson junctions connecting the strands and associated with the hydrogen bonds.

d) The idea that healing corresponds to the time reversal of a biological program realized as a 4-d hologram serving as a template for self-organization means that healing involves the generation of the phase conjugates of the magnetic laser mirrors, that is pairs of parallel negative energy MEs and magnetic

flux tubes. The healing mechanism should operate at DNA level. Since DNA strands are conjugates of each other, it is natural to assume that positive energy MEs propagate along DNA strand and negative energy MEs along its conjugate in opposite directions. This makes possible the annihilation of the positive and negative energy MEs when they meet each other.

e) In the model of EEG propagating positive energy MEs are associated with propagating supra currents and solitons. This suggests that active portions of DNA double strand (perhaps genes) form closed supra current loops: supra current flows along DNA strand and returns back along its conjugate. When DNA is in inactive state hydrogen bonds act as Josephson junctions and both solitonic and nonsolitonic waves associated with the phase differences over junctions can propagate. In the active state DNA unwinds, MEs become parallel to each other generating constructive interference of the coherent radiation, Josephson junctions split, and only Ohmic currents between strands are present and run along atomic spacetime sheets. The unwinding of DNA could be caused by a propagation of a soliton sequence inducing the DNA counterpart of the nerve pulse sequence.

f) The nonvanishing of the intensity of the coherent light in the absence of external perturbations requires symmetry breaking in the sense that one has $(n_+ = n_0, n_- = 0)$ in the stationary situation. This corresponds naturally to the symmetry breaking associated with the functioning of DNA. Only the strand is expressed (chemically or electromagnetically) and the conjugate strand serves as the source of energy. The conjugate strand can give part of the negative energy to the enviroment, most probably to the mitochondria, and the strand is the only user of the positive energy.

3. Holism and reductionism

If negative energy ME serves as a topological correlate for binding energy, the generation of ME pairs means a formation of bound states and thus also the generation of bound state entanglement which survives in the state preparation process. Thus a relevant external perturbation of the system induces the fusion of subselves of self to larger subselves so that system behaves as single coherent whole with attention directed totally to single task. Something like this indeed occurs in emergency situations for both individuals and groups of individuals. When the emergency situation is over, system relaxes and it decomposes into a loose collection of individuals (subselves).

Biosystems are populated by binary structures and the p-adic length scale range in question contains large number of binary pairs of length scales differing by a factor of two. All these binary systems, even brain hemispheres, could apply similar division of electromagnetic labor. The p-adic length scale in case of brain hemispheres is of order 10 cm but, as in case of DNA, the wavelengths of MEs would correspond to the length scale associated with the sensory andother magnetic canvases rather than brain size. If the proposed interpretations are correct, the other brain hemisphere would mainly emit weak coherent ELF em waves a in this wave length range whereas the other one would mainly absorb them and the counterpart of delayed luminescence should occur also now.

The wellknown right/left–holism/reductionism association is consistent with this interpretation. The holistic right brain hemisphere would generate negative energy MEs binding its magnetic bodies to single whole whereas the magnetic body associated with the left brain would represent results of analysis and decay into large number of subselves. In a similar manner, conjugate strand would behave holistically whereas strand would take the role of a reductionistic information processor. Where left brain expresses itself by talking and writing, DNA strand expresses itself chemically by translating itself to aminoacid sequences. Perhaps the generation of bound state entanglement with the surrounding world is how the conjugate strand expresses itself. This entanglement is what binds smaller structures to form larger coherent units. This dichotomy brings unavoidably into mind the secular-religious dichotomy at the level of human soci-

ety. Note that also the association of negative energy MEs with healing by time reversal fits to the picture: healing process is essentially process of becoming whole.

4. Buy now-pay later mechanism

The generation of pairs of positive and negative energy MEs might provide a mechanism generating very rapidly energy in alarm situations (perhaps the exogenous stimulation of cell by visible coherent light is such a situation). This maxim could be called buy now-pay later principle. One can ask whether this energy production mechanism could be involved also now.

a) In present case the natural interpretation for the generation of negative energy MEs is as a generation of bound state entanglement. This of course does not exclude the possibility that buy no-pay later mechanism is also at work. 'Buy now' would mean the generation of positive energy ME associated with DNA strand and the negative energy ME associated with the complementary strand. Vanishing net energy is produced but positive energy would be generated where it is needed, in present case DNA strand, perhaps for transcription process. Negative energy DNA strand could send the negative energy ('debt') to the mitochondria to which the negative energy magnetic mirror could be connected if the idea about cellular household electricity makes sense.

b) The model for the delayed luminescence implies that during the delayed luminescence positive energy MEs are not significantly transformed to other forms of energy nor are negative energy MEs annihilated in mitochondria in appreciable amounts. Thus buy now-pay later process should occur very fast and be followed by the delayed luminescence and DNA would pay the remaining part of its energy bill itself by a gradual annihilation of positive and negative energy MEs.

c) One can ask whether buy now-pay later mechanism used to produce mechanical work with exceptionally high rate in even body scale during emergency situations. Buy now-pay later (or allow someone other to pay!) could also explain the anecdotal stories about the ability of yogis and saints to live for long times without eating anything. This ability would be consistent with the idea that these people are able to generate strong entanglement with the higher spiritual levels of the self hierarchy. It is easy to make quantative estimates. Food contributes to the human metabolism typically the energy of 10^7 J per day. This means average energy consumption of about 100 J/sec. Besides this there are energy resources in the form of fat. Best athletes can jump to the height of about 2 meters, which means that center of mass height coordinate increases by about one meter. The kinetic energy gained in a fraction of second is about Mgh, $h = 1$ meter, and equals to 500 J $M = 50$ kg. The energy gain in a time interval shorter than second is thus by a factor of 5 larger than average energy consumption per second. There is thus no need for buy now-pay later mechanism but it might of course also be involved.

d) The buy now-pay later mechanism could be one aspect of the breaking of symmetry between strand and conjugate strand. Similar mechanism would presumably occur for other binary structures. At axonal positive and negative energy MEs run along the lipid layers of the cell membrane in opposite direction and axon could generate during alarm situations the energy needed for an intense neuronal activity in this manner. Right brain hemisphere in turn could generate bound state entanglement in the length scale of ELF wavelengths. Buy now-pay later would mean that invididual literally gains energy from the society and possibly entire biosphere. Perhaps this energy intake is part of the healing process induced by prayer groups.

e) The hyperbolic decay law and ensuing $1/f$ spectrum for (say) EEG power associated with axon is predicted. Buy now-pay later mechanism provides a very general mechanism producing $1/f$ noise. The universality of $1/f$ noise together with fractality suggests that ME pairs and consciousness are not something specific to living matter.

f) In the chapter "Biosystems as Superconductors" of [6] it was found that,

as far as metabolic constraints are considered, living system has no problems in generating its sensory magnetic canvas by p-adic to real phase transition so that our electromagnetic body in the geometric future would be p-adic, as also the night-time magnetic sensory canvas. This would explain why we remember geometric past but have only plans for the geometric future and also why we are unconscious during night-time (real self would be created as a figure against p-adic background by p-adic-to-real phase transition).

One can however wonder whether the sensory magnetic canvas is stable once it is generated or is the organism forced to regenerate it all the time.

The simplest expectation is that the rate λ for the annihilation of the positive and negative energy magnetic mirrors tubes scales like the inverse of the p-adic time scale:

$$\lambda = \lambda(167)\frac{L(167)}{L(k)} \quad , \quad \lambda(167) \sim 1/sec \quad . \tag{5}$$

EEG waves with frequency of 10 Hz this would give $\lambda \sim 10^{-13}$/second, which corresponds to 10^6 years! Although this estimate is just scaling argument and does not take into account the real situation, it seems that sensory magnetic canvas is stable in ELF wave length range once it is created.

4. Magnetic induction generates or destroys ME pairs

Magnetic induction is the fundamental mechanism for the interaction of MEs and supra current circuits. That magnetic induction should generate MEs is a rather natural assumption since changing current induces radiation and MEs represent topologically quantized counterparts of the classical radiation fields. Periodic oscillations in variable $log(1 + \lambda t)$ result if the magnetic induction (generation of emf in the circuit) for the current is accompanied by generation of MEs such that the number of MEs generated per unit time is proportional to $eLdI/dt$, where I is Josephson current. This is possible only if DNA double strand is unwound and has Josephson junctions only at the other end or both ends. If Josephson currents are the only currents in the circuit one obtains precisely the required type of term to the differential equation for the numbers of the positive and negative energy MEs. Since Josephson current is sinusoidal and has constant intensity, the prediction is that the amplitude of the oscillatory perturbation is constant unless the density of the supra current carriers varies also.

4.3 Hyperbolic decay

The kinetic equations for n_0 and n_- are

$$\frac{dn_+}{dt} = \frac{dn_-}{dt} = -kn_+n_- \quad . \tag{6}$$

This gives

$$n_+ - n_- = n_0 \quad = \quad constant \quad . \tag{7}$$

Thus the difference for the numbers of positive and negative energy MEs is conserved. Using this condition, one can write the equations in the form

$$\frac{dn_+}{dt} \quad = \quad \frac{dn_-}{dt} = kn_+ \times (n_0 - n_+) \quad . \tag{8}$$

The solution of this equation is

$$
\begin{aligned}
& n_+(t) = n_0 A \frac{1}{A-exp(-u)} \ , \quad n_-(t) = n_0 \left[\frac{A}{A-exp(-u)} - 1 \right] \ , \\
& A = \frac{n_+(0)}{n_+(0)-n_0} \ , \qquad\qquad u = n_0 k t \ .
\end{aligned}
\tag{9}
$$

What is nice that the solution approaches asymptotically automatically to $(n_+ = n_0, n_- = 0)$. If n_0 is negative the roles of n_+ and n_- are changed and the solution approaches to $(n_+ = 0, n_- = n_0)$. There are reasons to believe that n_0 defines the number of *positive* energy MEs in the normal situation for the living matter and generating the coherent biophotons.

The small values of the parameter u correspond to

$$
t \ll \frac{1}{n_0 k} \ ,
$$

and since the intensity of coherent light is proportional to n_+ one has in this region the hyperbolic decay

$$
\begin{aligned}
n_+(t) &= n_0 \times \frac{A}{A-1} \times \frac{1}{1+\lambda t} \ , \\
\lambda &= \frac{k}{A-1} \ .
\end{aligned}
\tag{10}
$$

4.4 Periodic corrections to the decay rate

One should understand also the logarithmic oscillations [10] in the time scale of seconds from first principles. This variation must correspond to an endogenous feeback which generates ME pairs just like the exogenous perturbations generate ME pairs. The existence of this kind of process is consistent with the observation of a delayed luminescence associated with various biological functions such as mitosis.

On basis of previous considerations suppose that there is small feedback term at the righthand side of the equation for dn_+/dt of the general form

$$
\frac{dn_+}{dt} = \frac{dn_-}{dt} = -k n_+ n_- + \epsilon \frac{dF}{dt} \ , \quad F = F(\int (n_+ + n_-) dt) \ . \tag{11}
$$

Here ϵ is assumed to be a small parameter. For $n_+ >> n_0$ one has in a good approximation $n_+ + n_- = 2n_+$. For small value of ϵ one can integrate the perturbation in a good approximation to give

$$
\begin{aligned}
& \Delta n_+(t) \simeq \epsilon F(\int (n_+ + n_-) dt) \simeq \epsilon F(\int 2 n_+ dt) \ , \\
& \int 2 n_+ dt \simeq K \times log(1+\lambda t) \ , \qquad\qquad K = 2 \frac{n_0}{\lambda} \times \frac{A}{A-1} \ .
\end{aligned}
\tag{12}
$$

If $F(u)$ is a periodic function then also a periodic logarithmic term results.

The general vision about manysheeted ionic flow equilibrium in which MEs can act as Josephson junctions allows to make guesses about the origin of the feedback term. Suppose that the differential equations for n_+ and n_- contain a term proportional to the net voltage eV over a Josephson junction:

$$
F\left(\int (n_+ + n_-) dt \right) = eV \ . \tag{13}
$$

The motivation for this assumption is the conviction that there must be a coupling between the dynamics for MEs and manysheeted ionic current circuits. Note that the dimensions are same for dn_+/dt and voltage eV in the natural units $\hbar = c = 1$.

The model already discussed indeed produces the required oscillatory behaviour.

a) Suppose that the Josephson junctions are at the ends of the unwound DNA double strand current loop traversing transversally all n_+ positive energy MEs transversal to DNA strand and n_- negative energy MEs transversal to the conjugate strand. Assume also that that both positive and negative energy MEs contributes constant potential difference $-eV_0$ besides oscillating contribution. Note that MEs are not assumed to act as Josephson junctions.

b) Assume that the potential differences over the Josephson junctions are same. The net irrotational potential difference through the junction at the end is thus $n(n_+ + n_-)eV_0/2$.

Under these assumptions the Josephson current through the junction is given by

$$I = I_0 sin\left(\frac{eV_0}{2}\int (n_+ + n_-)dt\right) \quad . \tag{14}$$

This current runs through the entire circuit and adds to the net electric potential difference through the junction a rotational magnetic induction term $\Delta V = LdI/dt$. Also Ohmic and capacitance terms can be present but for simplicity let us assume that they are absent. Under these assumptions one has

$$F\left(\int (n_+ + n_-)dt\right) = eI_0 sin\left(\frac{eV_0}{2}\int (2n_+ - n_0)dt\right) \quad . \tag{15}$$

This term indeed has the required dependence on time and gives in a good approximation a periodic logarithmic term. The prediction is that the amplitude for the intensity of oscillation is constant.

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