

Bio-Systems as Conscious Holograms

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Contents

1	Introduction	5
1.1	The notion of conscious hologram	6
1.2	Time mirror mechanism	6
1.3	Biophotons	7
1.4	The work of William Tiller	7
2	Conscious hologram	8
2.1	What are the basic properties of conscious hologram?	8
2.1.1	Distributed information storage	8
2.1.2	Continuity	8
2.2	Stereo consciousness and the notion of conscious hologram	8
2.3	Questions	9
2.3.1	How is it possible to abstract any conscious information at all from the self-hologram?	9
2.3.2	What physical process corresponds to the formation of a conscious hologram?	10
2.3.3	What about the notions of reference beam and static hologram?	11
2.3.4	How to avoid the problems caused by finite temperature?	11
2.4	Self-referentiality and space-time topology	12
2.4.1	Does physical system provide a representation for a theory about physical system?	12
2.4.2	Possible biological implications of topological self reference	14
2.5	Comparison of Maxwellian and TGD views about classical gauge fields	15
2.5.1	Superposition of fields in terms of flux quanta	16
2.5.2	The basic objection against TGD	17
2.5.3	Time varying magnetic fields described in terms of flux quanta	18
2.5.4	The notion of conscious hologram	19
2.5.5	Topology of fields and topological field quantization	21

3	Phase conjugation, negative energy topological light rays, and time mirror mechanism	21
3.1	Do negative energy space-time sheets have counterparts in quantum field theory?	21
3.1.1	Is phase conjugation properly understood in quantum field theories?	21
3.1.2	Phase conjugation and irreversibility	22
3.2	Is the TGD view about phase conjugate waves consistent with the existent wisdom?	22
3.2.1	Basic mechanism producing phase conjugate waves	22
3.2.2	Over unity effects and error correction	23
3.2.3	TGD based description for the interference of reference beams	24
3.2.4	Phase conjugate photons and dark matter hierarchy	25
4	Bio-photons	25
4.1	What bio-photons are?	25
4.2	Some phenomena related to bio-photons	26
4.3	General TGD based model for coherent bio-photons	26
4.3.1	Bio-photons and MEs	27
4.3.2	Bio-photons as a signature of dark matter hierarchy	27
4.3.3	About the anatomy of dark MEs	27
4.3.4	Constraint to the intensity of the vacuum current	28
4.3.5	Sucking force in TGD framework	28
4.4	The interpretation of biophotons and EEG as decay products of dark Josephson radiation	29
4.5	TGD based model for the delayed luminescence	29
4.5.1	Basic observations	30
4.5.2	Concrete physical model	30
4.5.3	Hyperbolic decay	32
4.5.4	Periodic corrections to the decay rate	33
4.5.5	TGD inspired modification of the model of Popp and Yan for the delayed luminescence	34
4.6	Kirlian effect	35
5	Bio-photons, radio waves, and genetic regulation	36
5.1	Frequency spectrum of radio waves	36
5.2	Basic questions	37
5.3	How to understand the spectrum?	37
5.4	Many-sheeted radio-wave laser excited by ordinary laser light	38
5.4.1	He-Ne laser produces miracle wave length	39
5.4.2	The energy of photons from He-Ne laser corresponds to the zero point kinetic energy of electron at $k_2 = 73$ space-time sheet	39
5.4.3	The correlation between the polarizations of radio-waves and laser photons	39
5.4.4	Quantum coherence produces intense radio wave and ELF laser beams	39
5.4.5	Phantom DNA effect	40
5.5	Is the radio wave band structure for wheat seed a scaled-up version of the band structure of EEG?	40
6	Conscious hologram and remote mental interactions	41
6.1	Big vision	41
6.2	Sketch for what could happen in a typical remote viewing experiment	42
6.3	Why it is so difficult to take remote mental interactions seriously?	43
6.3.1	Pessimistic view: evolution as a gradual de-entanglement?	44
6.3.2	Optimistic view: evolution as an emergence of un-selfish selves?	44
6.4	About the physiological correlates of anomalous cognition	45
6.5	Local sidereal time, geomagnetic fluctuations, and remote mental interactions	45
6.5.1	Support for the role of magnetospheric consciousness	46
6.5.2	Is there an ELF signal from the special direction masked usually by the geomagnetic noise?	46
6.5.3	What is the origin of the interstellar magnetic field?	47
6.5.4	Connections with other effects?	48

6.6	DelaWarr camera	49
7	The experimental work of William Tiller about intentional imprinting of electronic devices	49
7.1	Experimental arrangement	49
7.2	Basic experimental findings	50
7.2.1	Direct effects of the intentional action	50
7.2.2	”Conditioning” of the laboratory	50
7.3	Explanation of the pH oscillations in terms of the general model of intentional action .	51
7.3.1	Intentional action induces magnetic self-organization of the control device and target	51
7.3.2	Scaling law of homeopathy and frequencies of pH-oscillations and microwaves .	51
7.3.3	The mechanism of intentional action	52
7.3.4	Do the three peak frequencies for pH-oscillations correspond directly to three microwave frequencies by scaling law?	53
7.3.5	Correlation between pH and temperature oscillations and protonic zero point kinetic energy	53
7.3.6	Sensitivity to the external magnetic field	53
7.3.7	Phantom effect	54
7.3.8	The effects on random number generators	54
7.4	The effects caused by the quartz crystal	55
7.4.1	Does the spatial profile of T-oscillations correspond to a standing wave resulting as an interference pattern of microwaves?	55
7.4.2	Does the quartz crystal act as an amplifier?	55
7.4.3	Are population inverted many-sheeted masers involved?	56
7.4.4	Scaling law of homeopathy is satisfied	56
7.5	Relating Tiller’s hypothesis to TGD framework	56
7.5.1	Are electro-weak and color symmetries exact for classical gauge fields in living matter?	56
7.5.2	Classification of phases of matter by the dimension of CP_2 projection	56
7.5.3	Does intentional action generate wormhole magnetic fields and homological monopoles?	56
7.6	A model for the findings based on hierarchy of large Planck constants	57
8	Formation of holograms by time mirror mechanism as a key mechanism of intentional action?	58
8.1	Four-wave interaction as a mechanism of intentional action	58
8.1.1	Are probe and conjugate beams responsible for remote metabolism needed to construct standardized holograms?	58
8.1.2	Scaling law and and the role of low frequency MEs as inducers of moving standing wave patterns	59
8.1.3	What the interference of reference waves really means?	59
8.2	Plasma oscillation patterns as generalized holograms	59
8.2.1	Examples of plasma oscillations	60
8.2.2	Metabolic synchrony	60
8.2.3	Plasmoids as life forms	61
8.3	Nerve pulse generation and holograms	62
8.3.1	Is f_l variable or not?	62
8.3.2	Two manners to achieve rate coding	62
8.3.3	Is the pulse rate quantized?	63
8.3.4	The identification of the standing wave in the case of nerve pulse	63
8.3.5	Intentional action, memory, and holograms	64
8.4	Generalized four-wave interaction in relation to some other anomalies	64

9	Formation of holograms by time mirror mechanism as a key mechanism of intentional action?	65
9.1	Four-wave interaction as a mechanism of intentional action	66
9.1.1	Are probe and conjugate beams responsible for remote metabolism needed to construct standardized holograms?	66
9.1.2	Scaling law and the role of low frequency MEs as inducers of moving standing wave patterns	66
9.1.3	What the interference of reference waves really means?	66
9.2	Plasma oscillation patterns as generalized holograms	67
9.2.1	Examples of plasma oscillations	67
9.2.2	Metabolic synchrony	68
9.2.3	Plasmoids as life forms	68
9.3	Nerve pulse generation and holograms	69
9.3.1	Is f_l variable or not?	69
9.3.2	Two manners to achieve rate coding	70
9.3.3	Is the pulse rate quantized?	70
9.3.4	The identification of the standing wave in the case of nerve pulse	70
9.3.5	Intentional action, memory, and holograms	71
9.4	Generalized four-wave interaction in relation to some other anomalies	71
10	How to test the basic vision?	73
10.1	Leakage of supra currents as basic mechanism	73
10.2	Time reversal for the leakage of supra currents	73
10.3	Controlling metabolism by IR laser beams and DNA functioning by maser beams?	74
10.4	How to choose senders and receivers?	74
10.5	How to test the notion of conscious hologram?	75

Abstract

The notion of conscious hologram is TGD based generalization of the idea about brain as a hologram. In nutshell, the notion of conscious hologram follows from the topological field quantization. Classical fields and matter form a Feynmann diagram like structure consisting of lines representing matter (say charged particles) and bosons (say photons). The matter lines are replaced by space-time sheets representing matter (elementary particles, atoms, molecules,...), and virtual bosons are replaced by topological light rays ("mass-less extremals", MEs). Also magnetic flux tubes appear and together with MEs they serve as correlates for bound state quantum entanglement.

The internal lines of the Feynmann diagram are analogous to wave guides and the classical fields and coherent light propagating along these wave guides interfere at the space-time sheets representing the vertices of the Feynmann diagram and the "points" of the conscious hologram. The formation of the hologram corresponds to the self-organization induced by the leakage of supra currents to smaller (say atomic) space-time sheets. This leakage is induced by the high frequency MEs propagating along low frequency MEs serving as correlates for quantum entanglement. The 3-D stereovision associated with ordinary hologram is generalized to stereo consciousness resulting, when the mental images associated with different 'points' of conscious hologram fuse to single mental image. Central nervous system can be regarded as a conscious hologram of this kind.

Time mirror mechanism is a key element of intentional action. The notion of four-wave interaction generalizes: the interference pattern of oppositely moving reference waves forming an archetypal standing wave (possibly moving as in case of nerve pulse) can be replaced by any synchronously oscillating periodic spatial pattern. Plasma waves for which the frequency does not depend on wave vector are ideal candidates for holograms in the generalized sense. Living matter is full of this kind of holograms: besides plasma oscillations associated with biologically important ions, also Z^0 plasma oscillations associated with atoms and molecules can define holograms. p-Adic length scale hypothesis predicts a hierarchy of plasma frequencies related by powers $2^{3k/4}$ so that even so called "non-living matter" could build this kind of sensory representations based on plasma oscillations.

p-Adic length scale hypothesis and dark matter hierarchy allow to quantify the notion of conscious hologram. The hierarchy of generalized EEGs associated with the dark matter hierarchy allows to propose concrete mechanism of remote mental interactions playing a key role also in the interaction of magnetic bodies with the biological body. Experimental findings related to anomalous pre-cognition support the view that even galactic magnetosphere acts as a conscious entity receiving sensory input from bio-sphere and controlling it.

Bio-photons provide an application of the general theory. Simple mathematical facts about the delayed luminescence induced by an external perturbation combined with the model for a hierarchy of dark EEGs assignable to that of Josephson junctions, lead to a model in which positive and negative energy MEs transversal to DNA strand and representing dark photons generate coherent bio-photons via de-coherence. Rather detailed quantitative models for how MEs and supra current circuits interact and how bio-photons are generated during the gene expression emerge.

Peter Gariaev and his group have discovered a radio wave emission from DNA induced by laser light. The model explaining delayed luminescence covers also this phenomenon: now the decay of dark photons with energies above thermal threshold to radio-wave photons rather than de-coherence would be the mechanism. The findings allow an explanation in terms of a many-sheeted laser action, and a rather detailed view about how bio-system acts as a many-sheeted laser at a wide wave-length range emerges.

William Tiller in Stanford University has carried out impressive experimental work with what he calls intention imprinted electronic devices (IIED), and his results challenge that standard assumption that the intentions of experimenter do not affect the experimental apparatus. The analysis of the work of Tiller in the conceptual framework of TGD leads to the conclusion that four-wave interaction, which is a basic mechanism to produce phase conjugate waves (negative energy topological light rays), serves also as a basic mechanism of intentional action. This leads to a unified view allowing to see EEG and nerve pulse as a particular realization of four-wave interaction.

1 Introduction

The idea about brain as hologram is very attractive but it is not easy to give precise and testable content for this notion. This chapter is devoted to the question in what precise sense living matter can be regarded as a hologram.

1.1 The notion of conscious hologram

At the level of quantum TGD the notion of quantum gravitational hologram emerges naturally in the sense that 3-surfaces code for data about pieces of 4-surfaces just like 2-dimensional hologram plates codes data about a 3-dimensional image. Classical non-determinism of the basic variational principle however implies that TGD based physics does not reduce to the moment of big bang. Massless extremals which are topological counterparts of light rays in TGD could provide a realization of this idea. Unfortunately, this notion of hologram is yet quite too abstract to be applicable to the concrete modelling of living matter.

Even more, the basic challenge is to generalize the notion of the ordinary hologram to that of a *conscious* hologram, about which bio-holograms would be examples. The notion of quantum gravitational hologram is defined at the level of geometric, purely physical existence whereas conscious holograms exist at the level of subjective existence defined by the sequence of quantum jumps and giving rise to the self hierarchy. Of course, these two notions of hologram must be closely related.

The notion of conscious hologram combines the saint and sinner aspects of consciousness to single concept: macro-temporal quantum coherence due to the generation of bound state entanglement and giving rise to co-operation on one hand, and the dissipative self-organization giving rise to Darwinian selection and competition on the other hand.

In nutshell, the notion of conscious hologram follows from the topological field quantization. Classical fields and matter form a Feynmann diagram like structure consisting of lines representing matter (say charged particles) and bosons (say photons). The matter lines are replaced by space-time sheets representing matter (elementary particles, atoms, molecules,...), and virtual bosons are replaced by topological light rays ("mass-less extremals", MEs). Also magnetic flux tubes appear and together with MEs they serve as correlates for bound state quantum entanglement.

The classical fields associated with MEs interfere only at the nodes, where they meet, and one has a hologram like structure with nodes interpreted as the points of a hologram. Thus one avoids the loss of information caused by the interference of all signals everywhere. This aspect is crucial for understanding the role of em fields in living matter and brain. The MEs corresponding to 'real photons' are like laser beams entering the hologram and possibly reflected from it. What is new that the nodes can be connected by 'virtual photon' MEs also analogous to laser beams. Hence also 'self-holograms' with no laser beam from external world are possible (brain without sensory input).

The hologram has a fractal structure: there are space-time sheets at space-time sheets and high frequency MEs propagating effectively as mass-less particles inside low frequency MEs serving as quantum entangling bridges of even astrophysical length. The particle like high frequency MEs induce 'bridges' between magnetic flux tubes and atomic space-time sheets at the receiving end. This makes possible the leakage of supra currents from magnetic flux tubes to atomic space-time sheets analogous to the exposure of film producing hologram. The leakage induces dissipation, self-organization, and primitive metabolism as a cyclic flow of ionic currents between the two space-time sheets, and thus a Darwinian selection of the self-organization patterns results. Under certain conditions the leakage followed by dropping back to the larger space-time sheet can also give rise to a many-sheeted laser. The low frequency MEs are responsible for the bound state entanglement, macroscopic quantum coherence and co-operation whereas high frequency MEs are responsible for self-organization and competition.

The 3-D vision associated with ordinary holograms generalizes to stereo consciousness resulting in the fusion of mental images associated with the points of conscious hologram.

1.2 Time mirror mechanism

Time mirror mechanism involves reflection of laser beam in time direction. The negative energy phase conjugate photons from geometric future are time reflected as positive energy photons to the direction of geometric future. These photons could be also dark photons, or more generally, dark electro-weak gauge bosons, gluons, or even gravitons. The large values of \hbar make possible time mirror mechanism in arbitrarily long time and length scales since photon energies can be above thermal energy for arbitrarily low frequencies.

Time reflection provides a mechanism of long term memory as communications with the geometric past and a mechanism of metabolism in the case that the system of the geometric past is population reversed laser. The proposed mechanism of intentional action relies on time mirror mechanism. Dark matter hierarchy makes possible remote mental interactions in arbitrarily long time and length scales.

The control of the biological body by the magnetic body (there is actually a hierarchy of them) provides the basic everyday example of remote mental interaction. The strange time delays of consciousness discovered by Libet can be interpreted as being due to the communications between biological and magnetic body.

1.3 Biophotons

The general vision developed in [K5] suggests how bio-systems could generate holograms in much more concrete sense than the wetty and hot and noisy character of this environment would suggest: even mechanisms generating laser beams could be there. Bio-photons are excellent candidates for the coherent light generated in living matter. An alternative identification is as de-coherence products of dark photons generated by living matter.

The findings of Peter Gariaev and collaborators [I9] provide a new support for the notion of many-sheeted DNA. The findings also lead to a concrete model for how bio-photons affect many-sheeted DNA, and in this manner induce a generation of coherent radio waves and ELF waves. Moreover, a concrete model for how bio-systems act as many-sheeted lasers at various wavelengths emerges.

1.4 The work of William Tiller

William Tiller in Stanford University has carried out impressive experimental work with what he calls intention imprinted electronic devices (IIED), and his results challenge that standard assumption that the intentions of experimenter do not affect the experimental apparatus [J16, J17, J18]. The analysis of the work of Tiller in the conceptual framework of TGD leads to the conclusion that four-wave interaction, which is a basic mechanism to produce phase conjugate waves (negative energy topological light rays), serves also as a basic mechanism of intentional action. When the two oppositely reference beams have slightly different frequencies. A first principle explanation for the scaling law of homeopathy, which involves a pair of high and low frequencies and an excitation moving with a sub-luminal velocity, emerges.

Time mirror mechanism involving probe wave and its phase conjugate are needed to get the energy to build this kind of hologram. The archetypal holograms defined by the standing waves resulting as interference patterns of reference waves moving in opposite directions can be regarded as basic building blocks for the symbolic representations of sensory data. Nerve pulse patterns reflect the basic aspects underlying four-wave interactions. Pairs of ELF and microwave frequencies are necessary in order to have moving standing wave patterns serving as correlates for the neuronal synchrony: hence one can understand the role of EEG and kHz oscillations. Rate coding results from the possibility to choose the frequency of the microwaves responsible for the hologram. Also Ca_{++} waves and other ionic waves should define archetypal symbolic representations of the sensory data.

The notion of hologram generalizes. The quintessence of standing waves is that they correspond to synchronous coherent oscillations of the entire system. Ionic plasma oscillations occur with the same frequency irrespective of the wave vector and thus they define ideal holograms in the sense that the same pattern occurs repeatedly. Ordinary matter is completely Z^0 ionized and therefore Z^0 plasma frequencies are ideal for generating living holograms. As a matter fact, the observation that Z^0 plasma frequency of water corresponds to energy .44 eV, the basic metabolic energy currency, put the bell ringing. Various biologically important ions define also plasma frequencies. p-Adic length scale hypothesis predicts entire hierarchy of plasma frequencies coming as powers of $2^{3k/4}$. Thus the prediction about hierarchy of holograms is readily testable.

In the sequel the basic ideas of the many-sheeted quantum control are summarized, the notion of conscious hologram is introduced, phase conjugation and time mirror mechanism is discussed, a concrete model for bio-photons and for how living system acts as a many-sheeted laser emerging from the experimental findings of Peter Gariaev and his group [I8] is described, and the application to remote mental interactions and various tests of the concept are discussed at the general level. The chapter ends with the detailed model for the findings of William A. Tiller and vision about how four-wave interaction generalizes.

2 Conscious hologram

The notion of conscious hologram gives hopes about a unified description of living matter and remote mental interactions.

2.1 What are the basic properties of conscious hologram?

To proceed it is good to ask what are the basic features of ordinary holograms possessed also by conscious holograms.

2.1.1 Distributed information storage

The most fundamental and biologically attractive property of hologram is the distributed character of the information storage in the sense that a small piece of hologram represents satisfactorily the same image as entire hologram. This makes information storage very robust. This condition is very general and is satisfied by the neurons of cortex which receive information from a large number of neurons, and it would seem that neurons are good candidates for points of a 3-D conscious hologram. The fractality of the TGD universe allows an entire hierarchy of hologram structures corresponding to the hierarchies of space-time sheets and of selves.

2.1.2 Continuity

The neighboring points of the hologram store almost the same information. Also in the case of a primitive organisms like salamanders each neuron of brain seems to represent almost the same information (even when salamander's brain is shuffled like a pack of cards, salamander recovers and preserves its memories [J12]). This would suggest that single neuron forms a hologrammic image about a considerable part of brain. This could apply at the level of any cell and body parts to which it belongs.

The assumption that cells are like points of hologram plate would explain why cell replication is the basic architectonic principle in the living matter. Quite generally, the structures which appear as almost identical copies, say proteins, DNA triplets, cell nuclei, cells, and the millimeter sized information processing units in cortex, are good candidates for 'points' of a conscious hologram. The TGD based view about higher levels of the self hierarchy suggests that even individual organisms of a given species correspond to the points of conscious holograms representing higher multi-brained conscious entities. Also various body organs, brains, substructures of brain,....., and even the DNAs of a given species could form similar collective conscious entities.

2.2 Stereo consciousness and the notion of conscious hologram

Ordinary holograms are 3-dimensional. This is made possible by the preservation of the phase information achieved by the interference between reference beam and the beam scattered from the object. On the other hand, ordinary stereo vision results somehow from two slightly different views about the same visual field provided by the retinas. In TGD inspired theory of consciousness stereo-consciousness results, when different sub-selves bound-state entangle to single sub-self: each sub-self gives rise to a view about (possibly) the same object of perceptive field. The entanglement of right and left visual fields so that separate visual fields fuse to single 3-D visual field is a special case of this. When the sensory fields are too different, stereo consciousness is not sensible. In this kind of situation sensory rivalry results so that either left or right hemisphere determines the conscious-to-us percept. This is analogous to the 'alike likes alike' rule of Sheldrake [I21] characterizing morphic resonance. In particular, during sleep a large number of sufficiently similar brains could quantum entangle to give a stereo view about 'human condition'.

The question is whether the hologram mechanism understood in a sufficiently abstract sense could be consistent with the generation of stereo consciousness by bound-state entanglement. This seems to be the case. The entangling systems would correspond to the points of a conscious hologram, neurons, cells or some other structures. The survival value provided by stereo consciousness explains why populations of almost similar living systems have resulted in evolution. The geometric correlate for the bound state entanglement is the formation of join along boundaries bonds, say magnetic flux tubes and MEs. These join along boundaries bonds imply classical coherence necessary for the hologram

property in the ordinary sense, as well as macroscopic and macro-temporal quantum coherence in the time scale defined by the lifetime of the bound state.

MEs are TGD counterparts of topological light rays and the classical fields propagating along them are natural candidates for generating self-hologram as a system which defines its own hologrammic image. This requires that a given basic unit is connected by join along boundaries bonds to a large number of other units and receives classical information from and quantum entangles with them in the hologrammic state. When bound state quantum entanglement is not present, system is in a 'reductionistic mode' and decomposes into separate sub-selves. Classically this corresponds to the de-coherence of the classical fields associated with the units and absence join along boundaries bonds connecting the units of the conscious hologram.

The experimental findings of Russian researchers about bio-holograms [I12] support the notion of conscious hologram. Kirlian images taken from say fingertips are studied. What is found is that the simultaneous electrical stimulation of some body part, say inner ear, affects the spectrum of visible light in the Kirlian image of the finger tip. Even more, it is possible to abstract the image of the stimulated body part from the pattern of the visible light in Kirlian image.

2.3 Questions

At least the proposed basic aspects seem to be worth of taking into account in an attempt to generalize the notion of hologram to that of self-hologram or conscious hologram. Several questions however remain to be answered.

2.3.1 How is it possible to abstract any conscious information at all from the self-hologram?

Ordinary hologram is completely diffuse and does not contain visual information as such and reference beam is needed to generate the 3-dimensional picture. In case of a self-hologram this mechanism need not work, since even the notion of reference beam is questionable. In the case of an ideal self-hologram every part of the hologram receives fields from all the other parts and there are actually large number of fields interfering at a given point of the hologram. There are two ways to circumvent the problem: hologram is not ideal and there is a symmetry breaking input from external world.

1. *Self-holograms are somewhere between ordinary photo and ideal hologram*

Self-hologram is not ideal one: not every unit is connected with every other unit and self-hologram is expected to be somewhere between the ordinary photo and ideal hologram. A given block of units receives information about some other blocks of units and forms a hologram about the field patterns sent by those blocks. For instance, these blocks could correspond to cortical features associated with a given sensory modality and firing synchronously. Topologically this means that these blocks of units are connected by a large number join along boundaries bonds whereas the number of join along boundaries bonds to the other units is relatively small. Thalamo-cortical and cortico-thalamic connections provide a basic example of this. Topographical connections from sensory organs to thalamus and from thalamus to the primary sensory areas correspond to the geometric optics limit in which interference effects are minimized. Diffuse connections from brain stem responsible for controlling general alertness correspond to the second extreme.

2. *Breaking of symmetry by inputs from external world*

Self-hologram receives input from the external world via what might be called primary sensory organs (in generalized sense). This information is shared holographically by join along boundaries bonds connecting the primary sensory organs to other units. This breaks the symmetry between units even in the case that ideal self-hologram is in question. When some unit receives strong stimulation and self-organizes vigorously, it also sends much stronger stimuli to the other units. Hence the contribution of this unit to the experiences of other units can dominate and other units tend to experience the same experience as the strongly stimulated unit.

For instance, in the case of bio-holography [I12] by Kirlian imaging the electrical stimulation of the inner ear implies that the input from the inner ear to the finger tip starts to dominate over the input from the other body parts. This picture conforms with the general facts about conscious experience. When the sensory input breaking the symmetry is absent as in case of a deep meditative

state, a holistic state of one-ness in which mind is 'empty' results. On the other hand, when a highly emotional mental image is present, this mental image dominates over the other mental images. The emotional content of the mental image obviously measures how strongly it contributes to the self-hologram. The fact that information molecules responsible for emotions are scattered around the entire body, encourages to think that it is indeed the entire body which experiences emotions, and that limbic brain is more like a primary emotional organ. Emotional expression would result from the quantum communication of emotions from the limbic brain to the body which now takes the same role as brain in case of sensory input.

3. In what sense mental functions are localized?

This picture is consistent with the finding that the localization of mental functions to various parts of brain seems to make sense. As already noticed, one can divide the units of the self-hologram into two classes: those which receive primary stimulus, and those which receive only secondary stimuli. This division can be made at several levels. Primary sensory organs viz. other parts of CNS, thalamus viz. cortex, primary sensory areas viz. higher sensory areas are examples of divisions of this kind. The possibility of this kind of division means that the assumption about the localization of consciousness to brain and various mental functions to various parts of brain, although basically wrong, defines a reasonable 'as-if' theory. The units which receive the primary stimuli replace functional units in the hologrammic view about brain. Artificial stimulation of, say, cortical neurons can artificially make them the primary sensory organs and the fact that this kind of stimulation can induce memories and complex hallucinations, suggests that these neurons indeed have complex conscious experiences differing from our experiences only in that the stereo consciousness aspect is not present.

2.3.2 What physical process corresponds to the formation of a conscious hologram?

Ordinary hologram plate results, when the reference beam and the beam scattered from an object interfere and induce a local change in the transparency of the film. This change is proportional to the local intensity of the incoming light. In the case of a self-hologram the reference beam and the light scattered from the object are replaced by the interference of the classical radiation fields propagating along MEs and converging to a given unit like light rays to retina. Hologram results locally if one assumes that the classical radiation resulting in the interference induces some physical change proportional to the net intensity of the classical radiation field, and provided that the units are connected by join along boundaries bonds to form a macroscopic quantum bound state.

Conscious experience involves a formation of self-organizing mental images. A very general mechanism inducing self-organization is the leakage of ions from the super-conducting magnetic flux tubes to the atomic space-time sheets, where the ions dissipate their energy, and end back to the magnetic flux tubes sooner or later. In case of protons this process corresponds to the fundamental step in the metabolic ADP-ATP cycle. Very probably the process occurs for other ions and perhaps even for molecules, and in this generates EEG waves by the mechanism proposed in [K11] .

This process occurs only if 'bridges' between atomic space-time sheets and magnetic flux tubes are somehow created. If the number of bridges formed is proportional to the total intensity of the classical radiation entering into the unit along various topological light rays converging to it, a hologram like structure results.

A concrete interpretation for this mechanism is suggested by various findings related to the role of microwaves in living matter. Microwaves with energies of quanta not too much above the gap energy of bio-super-conductor, generate 'bridges' between magnetic flux tubes and atomic space-time sheets inducing the breaking of super-conductivity and local self-organization. This mechanism gives rise to the many-sheeted ionic flow equilibrium defining dynamical control circuitry taking care of quantum homeostasis. The scaling law of homeopathy leads to the view that ELF MEs serve as quantum entanglers, em bridges connecting units of a conscious hologram, and that microwave MEs propagate along them like mass-less particles along ELF MEs, and induce self-organization at the receiving end. The interference of the classical fields associated with microwave MEs in the region with size considerably smaller than wavelength to guarantee effective point-likeness would give rise to single point of the hologram.

Both the fractality of TGD Universe and the findings of bio-holography [I12] suggest that the mechanism is much more general. Also MEs with lengths in wavelength range of visible light and radio frequency (RF) MEs in kHz range define low-high frequency pairs of MEs. The electric voltage

associated with say finger tip and oscillating at about kHz frequency defines the RF ME to which RF MEs from various body parts converge and fuse with. Along RF MEs propagate the visible MEs with lengths coming as multiples of the wave lengths of visible light. The interference occurs in a region of size smaller than wavelength of visible light. When some body part is stimulated electrically, it emits a large number of visible MEs ending down to the fingertip and contributing to the Kirlian image.

As noticed, the sizes of the basic hologrammic units corresponding to a given wavelength must be smaller than the wavelength to guarantee effective point-likeness. The experiments of Gariaev [19] demonstrate that the illumination of DNA with a visible laser light generates radio waves with frequencies up to MHz with frequencies in kHz range having especially strong intensities, which suggest that the wavelength range associated with the visible light corresponds to sub-cellular structures, DNA being the most natural candidate in this respect. Also the findings about bio-holograms [I12], and the fact that kHz frequency corresponds to the duration of nerve pulse and to the frequency of neuronal synchrony support this identification. The units associated with microwave MEs must have sizes in the length scale range 1 mm-300 mm and millimeter sized structures in cortex (cortex has thickness of order millimeter).

Also larger structures of cortex are candidates for hologrammic units at the level of multi-brained collective consciousness. Magnetospheric sensory representations would naturally correspond to this kind of multi-brained conscious holograms and various parts of brain and also body parts could give rise to what might be regarded as a species consisting of individuals and possessing collective consciousness. Scaling law makes this hypothesis quantitative and assigns to a structure with a given size an ELF frequency responsible for the entanglement with magnetosphere.

2.3.3 What about the notions of reference beam and static hologram?

The view about holograms as generated by a simple reference beam and the beam representing information is too simplistic to be applied as such to conscious hologram. For instance, the number of interfering beams is large since each ME converging to given unit of self-hologram corresponds to a particular beam. However, in a situation in which single ME gives a dominating contribution, the remaining MEs collectively interfere to what might be regarded as a counterpart for a slowly varying reference beam.

Under certain conditions it is also possible to talk about quasi-static conscious hologram. There are two time scales involved: the lifetime τ_B of the macroscopic bound state defined by the hologram, and the lifetime τ_s of the 'bridges' connecting atomic space-time sheets and larger space-time sheets. If these time scales are longer than the duration of the stimulation from the active units of hologram, quasi-static hologram results. At the level of conscious experience the reference beam could be interpreted as the background whereas the dominating contribution to conscious experience would correspond to the figure.

p-Adic length scale hierarchy suggests the presence of a hierarchy of time scales corresponding to the lifetimes of these bridges, and synaptic strengths might be seen as quasi-static conscious holograms resulting in this manner. If this is the case, the breaking of super conductivity and dissipation should be a crucial element of synaptic activity. The fact that the dendrites are responsible for most ohmic losses in the neural circuitry [E1] conforms with the idea that the breaking of super-conductivity occurs dominantly in the dendrites. The age hierarchy for quasi-static holograms would correspond to a hierarchy of supra current leakages occurring from various space-time sheets labelled by p-adic primes. The effect of various neural transmitters and information molecules might be understood as a generation of bridges between space-time sheets characterized by the duration of the effect. The more lasting the effect is, the larger the corresponding space-time sheet would be. This conforms with the fact that information molecules with long lasting effect are responsible for emotions and moods, which are indeed whole-body effects.

2.3.4 How to avoid the problems caused by finite temperature?

The basic objection against the notion of conscious hologram is that thermal fluctuations destroy the quantum coherence for sub-thermal photon (boson) energies. In the standard physics framework this would have fatal consequences.

Before the realization that Planck constant is most naturally dynamical and quantized in TGD Universe [K27, K4], the hypothesis was that the sheets of many-sheeted space-time are thermally

isolated in a good approximation so that the temperatures of large space-time sheets can remain very low for long periods of time. This would allow to circumvent the thermal constraint. A more elegant solution working also for the isothermal case is that large space-time sheets correspond to large values of Planck constant implying that for any given frequency there exist infinite number of levels in dark matter hierarchy such that photon energy is above thermal energy. Dark matter hierarchy would therefore make universe quite literally a conscious hologram.

The stimulus leading to the ideas about dark matter hierarchy and large \hbar came from the observations suggesting that gravitationally bound states of dark matter correspond to a gigantic value of Planck constant [K24, K4], [E4]. This suggests that also dark gravitons are there and make universe a hologram in astrophysical and cosmological length scales. These ideas lead to a precise proposal for how the hierarchy of Planck constant is realized in terms of the book like structure of generalized imbedding space as well as to a proposal for a spectrum of Planck constants [K7].

TGD inspired quantum biology and number theoretical considerations suggest preferred values for $r = \hbar/\hbar_0$. For the most general option the values of \hbar are products and ratios of two integers n_a and n_b . Ruler and compass integers defined by the products of distinct Fermat primes and power of two are number theoretically favored values for these integers because the phases $\exp(i2\pi/n_i)$, $i \in \{a, b\}$, in this case are number theoretically very simple and should have emerged first in the number theoretical evolution via algebraic extensions of p-adics and of rationals. p-Adic length scale hypothesis favors powers of two as values of r .

One can however ask whether a more precise characterization of preferred Mersennes could exist and whether there could exist a stronger correlation between hierarchies of p-adic length scales and Planck constants. Mersenne primes $M_k = 2^k - 1$, $k \in \{89, 107, 127\}$, and Gaussian Mersennes $M_{G,k} = (1+i)k - 1$, $k \in \{113, 151, 157, 163, 167, 239, 241, \dots\}$ are expected to be physically highly interesting and up to $k = 127$ indeed correspond to elementary particles. The number theoretical miracle is that all the four p-adic length scales with $k \in \{151, 157, 163, 167\}$ are in the biologically highly interesting range 10 nm-2.5 μ m). The question has been whether these define scaled up copies of electro-weak and QCD type physics with ordinary value of \hbar . The proposal that this is the case and that these physics are in a well-defined sense induced by the dark scaled up variants of corresponding lower level physics leads to a prediction for the preferred values of $r = 2^{k_d}$, $k_d = k_i - k_j$.

This proposal will be referred to as Mersenne hypothesis and it leads to strong predictions about EEG since it predicts a spectrum of preferred Josephson frequencies for a given value of membrane potential and also assigns to given value of \hbar a fixed size scale having interpretations as size scale of body part or magnetic body.

2.4 Self-referentiality and space-time topology

The notion of self-referentiality is one of the deepest and most fascinating notions of mathematics but for some reason it has not caught the full attention of physicists. I encountered the mystic variant of this notion during my 'great experience' (the idea about living system as a computer sitting at its own terminal) and a more mathematical variant of the idea for a year or two later while reading the book "Gödel, Escher, Bach" of Douglas Hofstadter. It took however more than fifteen years before I managed to identify a possible concrete realization of the notion in TGD based physics. Although topological self-referentiality is only loosely related to the notion of conscious hologram, it deserves to be discussed here.

2.4.1 Does physical system provide a representation for a theory about physical system?

MEs and magnetic mirrors play a key role in TGD based model of living matter. The connection with standard chemistry has been however lacking. It seems that some deep principle is needed to build this connection. The hints about the big principle come from the following observations related to the topological field quantization implying what might be called Bohr orbitology for the classical fields.

1. TGD predicts the existence of negative energy space-time sheets, in particular MEs. The prediction is based solely on the assumption that the space-time is representable as a 4-surface.
2. One can understand gravitational binding energy only if negative energy MEs represent this energy. This suggests that binding energy of a system has a very concrete representation as a negative energy MEs.

3. Quantum entanglement has as a geometric correlate join along boundaries bonds, in particular MEs and possibly also magnetic mirrors. Only the entanglement associated with the bound states is stable against the state preparation process leading to a maximally unentangled state in each quantum jump.
4. Classical superposition for em fields could mimic quantum superposition for states. The multiples of the fundamental frequency for ME could represent the BE condensate of bosons with energy defined by the fundamental frequency $f = c/L$.
5. The phase increments of the CP_2 coordinates around closed loops could represent phase increments of spinor fields and super-conducting order parameters around them as suggested in [K12].
6. Join along boundaries bonds can represent even half-odd integer spin topologically. The join along boundaries bonds connecting 3-surface to a larger 3-surface get entangled in 2π rotation but in 4π rotation no entanglement results : this is due to the fact that the bonds provide a representation for the homeotopy group of 3-dimensional rotation group. A good manner to visualize the situation is to think of a cube inside a larger cube with threads connecting the corresponding vertices of the cubes. An interesting question is whether also spin and statistics connection could be represented classically somehow.
7. Dark matter hierarchy would make possible the concrete realization of self-referentiality. The fact that for a given energy the size of the space-time sheet scales as \hbar suggests a hierarchical structure for self representations in the sense that given level of dark matter hierarchy provides representations of lower levels. These representations would be abstractions, space-time averages with too small details smoothed out. This is just what our brains in general and theory builders in particular are doing all the time. What is new that Nature itself would be constructing these idealizations so that the idealizations of reality provided by various levels of dark matter hierarchy would be an essential element of reality.

These observations suggests a far-reaching generalization. Perhaps many-sheeted space-time allows the system to represent in its own structure the theory about itself. All theoretical concepts usually thought to have rather ethereal existence would have a concrete topological representation. These representations would exist already at the elementary particle level. Not only bio-molecules, but even hadrons, would be accompanied by a topological representation about their theory analogous to a written language. p-Adic-to-real transition would actualize this theory. Thus not only cognition but also symbolic representations of thoughts would be present in all length scales.

This idea of self-referentiality is actually an essential part of the basic philosophy of TGD. TGD inspired theory of consciousness implies that the Cartesian division to a world and theory about it is an illusion. Quantum histories, which are TGD counterparts for the solutions of field equations *are* the reality, there is no need to postulate any 'real' reality behind them since conscious experience is associated between quantum jumps between quantum histories rather than the 'real' reality. 'Ontogeny recapitulates phylogeny' principle states that quantum histories have geometric and topological correlates at space-time level. This is just what the idea about topological representation of a theory about the system as a part of the system itself means. System could consist of a hierarchy of levels such that $N + 1$:th level represents N :th level. Or perhaps more precisely, what results in the interaction of N :th level systems.

In atomic and molecular physics the basic implications would be following.

1. Atoms and bio-molecules would carry a representation about their own theory based on MEs. Since MEs carry light like four-momentum, they should appear as pairs of parallel MEs with opposite momenta and with frequency corresponding to one half of the binding energy: $f = E_B/2$. The frequencies associated with ME come as multiples of its fundamental frequency $f = c/L$, L the length of ME. This dictates to a high degree the lengths of the MEs associated with a given binding energy. The most natural length corresponds to the wave length defined by one half of the binding energy. In the spirit of Bohr orbitology justified by the allowing only preferred extremals of Kähler action with the property that there exists infinite number of deformations with a vanishing second variation, one can also require that ME pair has a

classical energy equal to the binding energy: this requirement correlates the field strength and the thickness of the negative energy MEs.

2. Atomic binding energies would correspond to MEs with wave lengths in UV region. The binding energies of typical covalent bonds would give rise to MEs with lengths in wave length region which corresponds to UV and visible light. The binding energies of hydrogen bonds in turn would give rise to MEs with lengths which correspond to wave lengths in the near infrared, cell size would be the typical length scale.
3. In the case of a potential well, such as the one associated with a harmonic oscillator or constant magnetic field, a natural representation would be in terms of positive energy ME allowing various harmonics. Vibrational and rotational frequencies would correspond to infrared and micro-wave region and magnetic energies to ELF region. The idea that these frequencies correspond to high level representations for the system is of course already now a basic element of TGD inspired theory of consciousness and conforms fully with the idea about topological self reference.

2.4.2 Possible biological implications of topological self reference

The notion of topological self-referentiality, if correct, means the possibility to combine enormous amount of knowledge from biochemistry to build a concrete view about em bodies of molecules and about how living matter represents itself in its own structure. One could also try to identify the chemical counterparts for the special frequencies predicted by the p-adic length scale hypothesis. One might even hope that one could at some level understand how such very high level phenomena like written language emerge from the topological self-referentiality. What is so interesting is that the hypothesis connects various length scales. For instance, the binding energies of atoms with nuclear charges $Z \sim 10$ are in keV range and correspond to MEs with size of order nanometer. Perhaps even the structure of condensed matter is partly coded into the representation of the binding energies of atoms.

Some examples of the possible consequences in biological length scales deserve to be mentioned.

1. The many-sheeted structure associated with a molecule would provide a representation for the molecule identifiable as its electromagnetic signature introduced in the theories of homeopathy and water memory. And not only this: this structure would also serve as a 4-D dynamical hologram serving as a photograph-like template for the self-organization of matter around the molecule. This would mean effective reductionism, but obviously only effective.
2. Genetic code would be a highly developed form of this representation. It would involve the negative energy MEs associated with various atomic and molecular binding energies. Especially important negative energy MEs would be in the visible region and associated with the covalent bonds and in the near infrared associated with the hydrogen bonds connecting DNA nucleotides together. Also the MEs associated with rotational and vibrational degrees of freedom are expected to be very important and for them liquid crystal blocks of water could serve as mimickers and amplifiers. The transparency of water to visible frequencies (covalent bonds have energies 4.7 eV in UV region) means that water is an ideal medium in the visible region for communications by MEs since coherent visible light can propagate long distances with attenuation caused only by the absorption by bio-molecules.

This picture gives a justification for the suggestion of Peter Gariaev that DNA is accompanied by laser mirror pairs [18]. The negative energy ME pairs associated with various binding energies would correspond to the laser mirror pairs. This picture differs slightly from the earlier proposal for the realization of genetic code involving orthogonal pairs of MEs associated with each nucleotide giving rise to 4 different pairs of polarizations and suggests a simpler realization in which the four polarization pairs associated with a pair of parallel MEs would realize the genetic code in a given length scale.

Topological self-referentiality allows also to understand what happens in over-unity energy production and these insights might be also crucial for the understanding of how life has evolved as a parallel development of macroscopic quantum bound states and the ability to metabolize. The components of the system can bind mutually or with the environment and negative energy space-time sheets represent binding energy. Bound state energy is liberated as a usable energy. The resulting bound states

have entanglement irreducible under state function preparation process: this makes possible fusion of sub-selves to larger sub-selves. The bound states correspond to space-time sheets having typical sizes given by the p-adic length scale hypothesis and the process means basically space-time engineering. The typical wave length of the radiation emitted in the process gives estimate for the electromagnetic or gravitational size of the bound state. In ELF frequency range the electromagnetic size is of order Earth size.

Electrolytic processes are especially interesting from the point of view of over-unity energy production. For instance, the production of hydrogen molecules in the electrolysis of water might be accompanied by the formation of large bound states of water molecules and the liberation of the binding energy as a usable energy. The signature for the process is simple: the energy liberated is larger than the energy deduced from the binding energies of water and hydrogen molecules. Rather interestingly, the hydrogen bond energy deduced from the evaporation energy per water molecule is .485 eV and is very near to the photon energy $E(167) = .4844$ eV corresponding to p-adic length scale $L(167) = 256L(151)$ for $L(151) = 10$ nm: $k = 167$ is one of the four subsequent p-adic length scales $k = 151, 157, 163, 167$ which correspond to Gaussian Mersennes. Perhaps cold fusion involves both the nuclear fusion by Trojan horse mechanism and the formation of large scale bound states.

Biology provides an important area of applications and as already found the model of bio-photons leads to a concrete model for the generation of pairs of positive and negative energy MEs at DNA level. Bio-molecules and cells are indeed bound states of macroscopic size. The first form of life evolved under conditions in which electrolytic processes occurred: perhaps bound state formation led to the generation of bio-molecules and cells. What is nice that the development of long range order (negative energy MEs) would have been automatically accompanied by the development of metabolism (positive energy MEs!).

Sol-gel transition crucial for the cellular locomotion is a particular example of this process. Thus a natural path to follow in the attempts to build new energy technologies is to try to mimic what living nature has already achieved. This kind of energy production would be also wasteless and support evolution. Quantum spin glass analogy means that Kähler action has an enormous almost ground state degeneracy and only classical gravitational energy differentiates between different ground states. Thus the classical gravitational binding and also the generation of coherent gravitons by MEs might have a role to play in the quantum physics of living matter. A rough order of magnitude estimate for the gravitational binding energy for a blob of water having size $L(k)$ is

$$E_{gr} \sim \frac{GM^2}{L(k)} = G\rho^2 L(k)^5 \sim \frac{Gm_p^2}{L(137)} \frac{L(k)}{L(137)^5} \simeq 2^{-127} 2^{5/2(k-137)} \frac{1}{L(137)} .$$

Gravitational binding energy is larger than the p-adic energy $\pi/L(k)$ for $L(k = 179) \simeq .169$ mm. In the range $L(163) = 640$ nm and $L(167) = 2.56$ μ m gravitational binding frequency varies between 1 Hz and 1 kHz, that is over EEG range up to the maximal frequency of nerve pulses. For $k = 157$ and $k = 151$ the gravitational binding frequency corresponds to a time scale of 9 hours and 100 years respectively so that the time scales relevant for life are spanned by the Gaussian Mersennes. Perhaps gravitonic MEs carrying vanishing em fields accompany the basic building blocks of the cell. Neither the connection with EEG is excluded.

2.5 Comparison of Maxwellian and TGD views about classical gauge fields

In TGD Universe gauge fields are replaced with topological field quanta. Examples are topological light rays, magnetic flux tubes and sheets, and electric flux quanta carrying both magnetic and electric fields. Flux quanta form a fractal hierarchy in the sense that there are flux quanta inside flux quanta. It is natural to assume quantization of Kähler magnetic flux. Braiding and reconnection are basic topological operations for flux quanta.

One important example is the description of non-perturbative aspects of strong interactions in terms of reconnection of color magnetic flux quanta carrying magnetic monopole fluxes [K10, K15]. These objects are string like structures and one can indeed assign to them string world sheets. The transitions in which the thickness of flux tube increases so that flux conservation implies that part of magnetic energy is liberated unless the length of the flux quantum increases, are central in TGD inspired cosmology and astrophysics. The magnetic energy of flux quantum is interpreted as dark energy and magnetic tension as negative "pressure" causing accelerated expansion.

This picture is beautiful and extremely general but raises challenges. How to describe interference and linear superposition for classical gauge fields in terms of topologically quantized classical fields? How the interference and superposition of Maxwellian magnetic fields is realized in the situation when magnetic fields decompose to flux quanta? How to describe simple systems such as solenoidal current generating constant magnetic field using the language of flux quanta?

2.5.1 Superposition of fields in terms of flux quanta

The basic question concerns the elegant description of superposition of classical fields in terms of topological field quanta. What it means that magnetic fields superpose.

1. In Maxwell's linear theory the answer would be trivial but not now. Linear superposition holds true only inside topological light rays for signals propagating in fixed direction with light velocity and with same local polarization. The easy solution would be to say that one considers small perturbations of background space-time sheet and linearizes the theory. Linearization would apply also to induced gauge fields and metric and one would obtain linear superposition approximately. This does not look elegant. Rather, quantum classical correspondence requires the space-time counterpart for the expansion of quantum fields as sum of modes in terms of topological field quanta. Topological field quanta should not lose their identity in the superposition.
2. In the spirit of topological field quantization it would be nice to have topological representation for the superposition and interference without any linearization. To make progress one must return to the roots and ask how the fields are operationally defined. One has test particle and it experiences a gauge force in the field. From the acceleration of the test particle the value of field is deduced. What one observes is the superposition of gauge forces, not of gauge fields.
 - (a) Let us just assume that we have two space-time sheets representing field configurations to be effectively superposed. Suppose that they are "on top" of each other with respect to CP_2 degrees of freedom so that their M^4 volumes overlap. The points of the sheets representing the field values that would sum in Maxwell's theory are typically at distance of CP_2 radius of about 10^4 Planck lengths. Wormhole contacts representing the interaction between the field configurations are formed. Hence the analog of linear superposition does not hold true exactly. For instance, amplitude modulation becomes possible. This is however not essential for the argument.
 - (b) Test particle could be taken to be fermion which is simultaneously topologically condensed to both sheets. In other words, fermionic CP_2 type almost vacuum extremal touches both sheets and wormhole throats at which the signature of the induced metric changes is formed. Fermion experiences the sum of gauge forces from the two space-time sheets through its wormhole throats. From this one usually concludes that superposition holds true for the induced gauge fields. This assumption is however not true and is also unnecessary in the recent case. In case of topological light rays the representation of modes in given direction in terms of massless extremals makes possible to realize the analogy for the representation of quantum field as sum of modes. The representation does not depend on approximate linearity as in the case of quantum field theories and therefore removes a lot of fuzziness related to the quantum theory. In TGD framework the bosonic action is indeed extremely non-linear.
3. This view about linear superposition has interesting implications. In effective superposition the superposed field patterns do not lose their identity which means that the information about the sources is not lost - this is true at least mathematically. This is nothing but quantum classical correspondence: it is the decomposition of radiation into quanta which allows to conclude that the radiation arrives from a particular astrophysical object. It is also possible to have superposition of fields to zero field in Maxwellian sense but in the sense of TGD both fields patterns still exist. Linear superposition in TGD sense might allow testing using time dependent magnetic fields. In the critical situation in which the magnetic field created by AC current passes through zero, flux quanta have macroscopic size and the direction of the flux quantum changes to opposite.

2.5.2 The basic objection against TGD

The basic objection against TGD is that induced metrics for space-time surfaces in $M^4 \times CP_2$ form an extremely limited set in the space of all space-time metrics appearing in the path integral formulation of General Relativity. Even special metrics like the metric of a rotating black hole fail to be imbeddable as an induced metric. For instance, one can argue that TGD cannot reproduce the post-Newtonian approximation to General Relativity since it involves linear superposition of gravitational fields of massive objects. As a matter fact, Holger B. Nielsen- one of the very few colleagues who has shown interest in my work - made this objection for at least two decades ago in some conference and I remember vividly the discussion in which I tried to defend TGD with my poor English.

The objection generalizes also to induced gauge fields expressible solely in terms of CP_2 coordinates and their gradients. This argument is not so strong as one might think first since in standard model only classical electromagnetic field plays an important role.

1. Any electromagnetic gauge potential has in principle a local imbedding in some region. Preferred extremal property poses strong additional constraints and the linear superposition of massless modes possible in Maxwell's electrodynamics is not possible.
2. There are also global constraints leading to topological quantization playing a central role in the interpretation of TGD and leads to the notions of field body and magnetic body having non-trivial application even in non-perturbative hadron physics. For a very large class of preferred extremals space-time sheets decompose into regions having interpretation as geometric counterparts for massless quanta characterized by local polarization and momentum directions. Therefore it seems that TGD space-time is very quantal. Is it possible to obtain from TGD what we have used to call classical physics at all?

The imbeddability constraint has actually highly desirable implications in cosmology. The enormously tight constraints from imbeddability imply that imbeddable Robertson-Walker cosmologies with infinite duration are sub-critical so that the most pressing problem of General Relativity disappears. Critical and over-critical cosmologies are unique apart from a parameter characterizing their duration and critical cosmology replaces both inflationary cosmology and cosmology characterized by accelerating expansion. In inflationary theories the situation is just the opposite of this: one ends up with fine tuning of inflaton potential in order to obtain recent day cosmology.

Despite these and many other nice implications of the induced field concept and of sub-manifold gravity the basic question remains. Is the imbeddability condition too strong physically? What about linear superposition of fields which is exact for Maxwell's electrodynamics in vacuum and a good approximation central also in gauge theories. Can one obtain linear superposition in some sense?

1. Linear superposition for small deformations of gauge fields makes sense also in TGD but for space-time sheets the field variables would be the deformations of CP_2 coordinates which are scalar fields. One could use preferred complex coordinates determined about $SU(3)$ rotation to do perturbation theory but the idea about perturbations of metric and gauge fields would be lost. This does not look promising. Could linear superposition for fields be replaced with something more general but physically equivalent?
2. This is indeed possible. The basic observation is utterly simple: what we know is that the *effects* of gauge fields superpose. The assumption that fields superpose is un-necessary! This is a highly non-trivial lesson in what operationalism means for theoreticians tending to take these kind of considerations as mere "philosophy".
3. The hypothesis is that the superposition of effects of gauge fields occurs when the M^4 projections of space-time sheets carrying gauge and gravitational fields intersect so that the sheets are extremely near to each other and can touch each other (CP_2 size is the relevant scale).

A more detailed formulation goes as follows.

1. One can introduce common M^4 coordinates for the space-time sheets. A test particle (or real particle) is identifiable as a wormhole contact and is therefore pointlike in excellent approximation. In the intersection region for M^4 projections of space-time sheets the particle forms topological sum contacts with all the space-time sheets for which M^4 projections intersect.

2. The test particle experiences the sum of various gauge potentials of space-time sheets involved. For Maxwellian gauge fields linear superposition is obtained. For non-Abelian gauge fields gauge fields contain interaction terms between gauge potentials associated with different space-time sheets. Also the quantum generalization is obvious. The sum of the fields induces quantum transitions for states of individual space time sheets in some sense stationary in their internal gauge potentials.
3. The linear superposition applies also in the case of gravitation. The induced metric for each space-time sheet can be expressed as a sum of Minkowski metric and CP_2 part having interpretation as gravitational field. The natural hypothesis that in the above kind of situation the effective metric is sum of Minkowski metric with the sum of the CP_2 contributions from various sheets. The effective metric for the system is well-defined and one can calculate a curvature tensor for it among other things and it contains naturally the interaction terms between different space-time sheets. At the Newtonian limit one obtains linear superposition of gravitational potentials. One can also postulate that test particles moving along geodesics in the effective metric. These geodesics are not geodesics in the metrics of the space-time sheets.
4. This picture makes it possible to interpret classical physics as the physics based on effective gauge and gravitational fields and applying in the regions where there are many space-time sheets which M^4 intersections are non-empty. The loss of quantum coherence would be due to the effective superposition of very many modes having random phases.

The effective superposition of the CP_2 parts of the induced metrics gives rise to an effective metric which is not in general imbeddable to $M^4 \times CP_2$. Therefore many-sheeted space-time makes possible a rather wide repertoire of 4-metrics realized as effective metrics as one might have expected and the basic objection can be circumvented. In asymptotic regions where one can expect single sheetedness, only a rather narrow repertoire of "archetypal" field patterns of gauge fields and gravitational fields defined by topological field quanta is possible.

The skeptic can argue that this still need not make possible the imbedding of a rotating black hole metric as induced metric in any physically natural manner. This might be the case but need of course not be a catastrophe. We do not really know whether rotating blackhole metric is realized in Nature. I have indeed proposed that TGD predicts new physics in rotating systems. Unfortunately, gravity probe B could not check whether this new physics is there since it was located at equator where the new effects vanish.

2.5.3 Time varying magnetic fields described in terms of flux quanta

An interesting challenge to describe time dependent fields in terms of topological field quanta which are in many respects static structures (for instance, flux is constant). The magnetic fields created by time dependent currents serves as a good example from which one can generalize. In the simplest situation the magnetic field strength experiences time dependent scaling. How to describe this scaling?

Consider first the scaling of the magnetic field strength in flux tube quantization.

1. Intuitively it seems clear that the field decomposes into flux quanta, whose M^4 projections can partially overlap. To get a connection to Maxwell's theory one can assume that the average field intensity is defined in terms of the flux of the magnetic field over a surface with area S . For simplicity consider constant magnetic field so that one has $B_{ave}S = \Phi = n\Phi_0$, where Φ_0 is the quantized flux for a flux tube assumed to have minimum value Φ_0 . Integer n is proportional to the average magnetic field B_{ave} . B_{ave} must be reasonably near to the typical local value of the magnetic field which manifest itself quantum mechanically as cyclotron frequency.
2. What happens in the scaling $B \rightarrow B/x$. If the transversal area of flux quantum is scaled up by x the flux quantum is conserved. To get the total flux correctly, the number of flux quanta must scale down: $n \rightarrow n/x$. One indeed has $(n/x) \times xS = nS$. This implies that the total area associated with flux quanta within total area S is preserved in the scaling.
3. The condition that the flux is exact integer multiple of Φ_0 would pose additional conditions leading to the quantization of magnetic flux if the total area can be regarded as fixed. This need not to be true.

Consider as the first example slowly varying magnetic field created by an alternating running in current in cylindrical solenoid. There are flux tubes inside the cylindrical solenoid and return flux tubes outside it flowing in opposite direction. Flux tubes get thicker as magnetic field weakens and shift from the interior of solenoid outside. For some value x of the time dependent scaling $B \rightarrow B/x$ the elementary flux quantum Φ_0 reaches the radius of the solenoid. Quantum effects must become important and make possible the change of the sign of the elementary flux quantum. Perhaps quantum jump turning the flux quantum around takes place. After this the size of the flux quantum begins to decrease as the magnitude of the magnetic field increases. At the maximum value the size of the flux quantum is minimum.

This example generalizes to the magnetic field created by a linear alternating current. In this case flux quanta are cylindrical flux sheets for which magnetic field strength and thickness oscillators with time. Also in this case the maximum transversal area to the system defines a critical situation in which there is just single flux sheet in the system carrying elementary flux. This flux quantum changes its sign as the sign of the current changes.

2.5.4 The notion of conscious hologram

In TGD inspired theory of consciousness the idea about living system as a conscious hologram [K1] is central. It is of course far from clear what this notion means. The notions of interference and superposition of fields are crucial for the description of the ordinary hologram. Therefore the proposed general description for the TGD counterpart for the superposition of fields is a natural starting point for the more precise formulation of the notion of conscious hologram.

1. Consider ordinary hologram first. Reference wave and reflected wave interfere and produce an interference pattern to which the substrate of the hologram reacts so that its absorption coefficient is affected. When the substrate is illuminated with the conjugate of the reference wave, the original reflected wave is generated. The modification of the absorption coefficient is assumed to be proportional to the modulus squared from the sum of the reflected and reference waves. This implies that the wave reflected from the hologram is in good approximation identical with the original reflected wave.
2. Conscious hologram would be dynamical rather than static. It would be also quantal: the quantum transitions of particles in the fields defined by the hologram would be responsible for the realization of the interference pattern as a conscious experience. The previous considerations actually leave only this option since the interference of classical fields does not happen. Reference wave and reflected wave correspond now to any field configurations. The charged particles having wormhole contacts to the space-time sheets representing the field configurations experience the sum of the fields involved, and this induces quantum jumps between the quantum states associated with the situation in which only the reference wave is present.

This would induce a conscious experience representing an interference pattern. The reference wave can also correspond to a flux tube of magnetic body carrying a static magnetic field and defining cyclotron states as stationary state. External time dependent magnetic field can replace reflected wave and induces cyclotron transitions. Also radiation fields represented by MEs can represent the reference wave and reflected wave. If there is need for the "reading" of the hologram it would correspond to the addition of a space-time sheet carrying fields which in good approximation have opposite sign and same magnitude as those in the sheet representing reference wave so that the effect on the charged particles reduces to that of the "reflected wave". This step might be un-necessary since already the formation of hologram would give rise to a conscious experience. The conscious holograms created when the hologram is created and when the conjugate of the reference wave is added give rise to two different conscious representations. This might have something to do with holistic and reductionistic views about the same situation.

3. One can imagine several realizations for the conscious hologram. It seems that the realization at the macroscopic level is essentially four-dimensional. By quantum holography it would reduce at microscopic level to a hologram realized at the 3-D light-like surfaces defining the surfaces at which the signature of induce metric changes (generalized Feynman diagrams having also macroscopic size - anyons [K19]) or space-like 3-surfaces at the ends of space-time sheets at the two light-like boundaries of CD . Strong form of holography implied by the strong form

of general coordinate invariance requires that holograms correspond to collections of partonic 2-surfaces in given measurement resolution. This could be understood in the sense that the charged particles defining the substrate can be described mathematically in terms of the ends of the corresponding light-like 3-surfaces at the ends of *CDs*. The cyclotron transitions could be thought of as occurring for particles represent as partonic 2-surfaces topologically condensed at several space-time sheets.

One can imagine several applications in TGD inspired quantum biology.

1. One can develop a model for how certain aspects of sensory experience could be understood in terms of interference patterns for signals sent from the biological body to the magnetic body. The information about the relative position of the magnetic body and biological body would be coded by the interference patterns giving rise to conscious sensory percepts. This information would represent geometric qualia [K9] giving information about distances and angles basically. There would be a magnetic flux tube representing the analog of the reference wave and magnetic flux tube carrying the analog of reflected wave which could represent the effect of neural activity. When the signal changes with time, cyclotron transitions are induced and conscious percept is generated. In principle it there is no need not compensate for the reference wave although also this is possible.
2. The natural first guess is that EEG rhythms (and those for its fractal generalization) represent reference waves and that the frequencies in question are either harmonics of cyclotron frequencies or linear combinations of these and Josephson frequency assignable to cell membrane (and possibly its harmonics). The modulation of membrane potential would induce modulations of Josephson frequency and if large enough would generate nerve pulses. These modulations would define the counterpart of the reflected wave. The flux tubes representing unperturbed magnetic field would represent reference waves.
3. For instance, the motion of the biological body changes the signal at the space-time sheets carrying the signal and this generates cyclotron transitions giving rise to a conscious experience. Perhaps the sensation of having a body is based in this mechanism. The signals could emerge from directly from cells: it could be that this sensation corresponds to lower level selves rather than us. Second option is that nerve pulses to brain induce the signals sent to the our magnetic body.
4. The motion of biological body relative to biological body generates virtual sensory experience which could be responsible for the illusions like train illusion and the unpleasant sensory experience about falling down from cliff by just imagining it. OBEs could be also due to the virtual sensory experiences of the magnetic body. One interesting illusion results when one swims long time in windy sea. When one returns to the shore one has rather long lasting experience of being in sea. Magnetic body gradually learns to compensate the motion of sea so that the perception of the wavy motion is reduced. At the shore this compensation mechanism however continues to work. This mechanism represents an example of adaptation and could be a very general mechanism. Since also magnetic body uses metabolic energy, this mechanism could have justification in terms of metabolic economy.

Also thinking as internal, silent speech might be assigned with magnetic body and would represent those aspects of the sensory experience of ordinary speech which involve quantum jumps at magnetic body. This speech would be internal speech since there would be no real sound signal or virtual sound signal from brain to cochlea.

5. Conscious hologram would make possible to represent phase information. This information is especially important for hearing. The mere power spectrum is not enough since it is same for speech and its time reversal. Cochlea performs an analysis of sounds to frequencies. It is not easy to imagine how this process could preserve the phase information associated with the Fourier components. It is believed that both right and left cochlea are needed to abstract the phase difference between the signals arriving to right and left ear allowing to deduce the direction of the source neural mechanisms for this has been proposed but these mechanism are not enough in case of speech. Could there exists a separate holistic representation in which sound wave as

a whole generates a single signal interfering with the reference wave at the magnetic body and in this manner represents as a conscious experience the phase?

6. Also the control and reference signals from the magnetic body to biological body could create time dependent interference patterns giving rise to neural response initiating motor actions and other responses. Basically the quantum interference should reduce the magnitude of membrane resting potentials so that nerve pulses would be generated and give rise to motor action. Similar mechanism would be at work at the level of sensory receptors - at least retina. The generation of nerve pulses would mean kind of emergency situation at the neuronal level. Frequency modulation of Josephson radiation would be the normal situation.

2.5.5 Topology of fields and topological field quantization

3 Phase conjugation, negative energy topological light rays, and time mirror mechanism

Negative energy topological light rays having phase conjugate laser waves as standard physics counterparts provide the fundamental control mechanism in the TGD based model of living matter and appears in practically every mechanism of consciousness as a basic step. In the sequel its the relationship of negative energy MEs to phase conjugate waves is discussed in detail.

3.1 Do negative energy space-time sheets have counterparts in quantum field theory?

Negative energy topological light rays seem to correspond to phase conjugate laser waves. In particular, the experiments of Feinberg [D2] are consistent with the transparency of matter for phase conjugate laser beams with photon energies above thermal energy. In optics phase conjugation requires optically non-linear system [D6]. For instance, in usual hologram the matter is optically non-linear in the sense that dielectric constant depends on the external electric field so that the electromagnetic radiation induces a change of the refraction coefficient which in turn codes for the hologram.

The dynamics of classical fields is indeed extremely nonlinear in TGD: the topological field quantization is one of the most dramatic outcomes of this non-linearity. Whether the phenomenological models for phase conjugate waves and for their generation are enough in TGD framework is an open question. The mechanism based for the generation of negative energy topological light rays based on short pulses to be discussed in this section does not seem to reduce to the framework of non-nonlinear optics.

There are also questions of principle involved.

3.1.1 Is phase conjugation properly understood in quantum field theories?

At the level of quantum physics negative energy photons would correspond to a system quantized in such a manner that both bosonic and fermionic annihilation and creation operators have changed their roles. Negative energy photons and fermions do not correspond to (non-existing) "anti-photons" and anti-fermions. Using the terminology of Dirac's bra-ket formalism: negative energy systems are like bras if positive energy photons are kets. Kets and bras correspond to Hilbert space and linear functionals defined in it. The space of bras is actually not equivalent with that of kets but in a well defined sense a more general concept. This conforms with the role of negative energy space-time sheets in TGD inspired theory of consciousness.

In quantum field theories time reversal transforms creation operators for fermions to creation operators for anti-fermions. Vacuum state is not changed. Time reversal in TGD sense would transform ket vacuum to bra vacuum so that the earlier creation operators annihilate the new vacuum state and genuine negative energy states result. This would suggest that negative energy states are something genuinely new and a genuine outcome of the many-sheeted space-time concept allowing either bra and ket type vacuum at a given space-time sheet. This difference might relate to matter-antimatter asymmetry whose origin is one of the deepest problems of cosmology. Perhaps dynamics favors space-time sheets containing negative energy matter instead of antimatter.

3.1.2 Phase conjugation and irreversibility

One interesting aspect associated with negative energy topological light rays is that they seem to be irreversible systems. On the other hand, phase conjugation can be used to eliminate perturbations on signal caused by thermal noise since the evolution proceeds from perturbed to non-perturbed signal. This could be seen as an objection against TGD based interpretation stating that topological light rays are essentially non-dissipative structures of classical physics.

The objection can be circumvented. Classical-quantum correspondence implies that space-time physics mimics also the dissipative aspects of quantum dynamics defined by quantum jump sequences. The classical non-determinism of the basic variational principle makes this possible. Classical fields are non-dissipative structures are even able to represent information about dissipation, analogous to a written text telling a story about growth, flourishing, and decay. In fact, in TGD framework space-time itself provides symbolic classical representations for quantum jump sequences determining the subjective, experienced reality. The implications of this representative aspect for biology are highly non-trivial. For instance, phase conjugate waves could provide a fundamental mechanism of healing and error correction.

3.2 Is the TGD view about phase conjugate waves consistent with the existent wisdom?

A priori it is not obvious that the TGD based identification of phase conjugate waves as negative energy photons/topological light rays is consistent with what is known about phase conjugate waves. The best manner to check this is to translate the standard physics description of the basic mechanisms producing phase conjugate waves to the language of TGD. This should also provide new insights about how self-organization by the emission of negative energy photons proceeds in non-linear media.

3.2.1 Basic mechanism producing phase conjugate waves

There are two basic mechanisms producing phase conjugate waves. The physics believed to be behind these mechanisms is summarized in an enjoyable manner in the book of D. M. Pepper [D6] , and in the review article of V. V. Shunov and B. Ya. Zeldovich [D7] , who are pioneers of optical phase conjugation. The mechanisms rely on four-wave mixing and stimulated Brillouin scattering. Both mechanisms can be modelled using the notion of a dynamical hologram. In TGD framework dynamical hologram can be regarded as a spontaneously generated self-organizing hologram resulting by the emission of negative energy photons. The reference laser beam is quite generally pulsed. This raises the question whether the phase conjugate photons are produced by negative energy scalar wave pulses inducing negative energy "acceleration radiation" as the (em- or Z^0 -) charged particles are accelerated at the space-time sheets representing scalar wave pulses.

1. Four-wave mixing

Consider first four-wave mixing. The basic observation is that already in the case of ordinary hologram a phase conjugate beam is generated when the reference beam irradiating the hologram has a direction opposite to that of the original reference beam. The idea is to replace the static hologram with a dynamic hologram by utilizing reference beams moving in opposite directions simultaneously besides the probe beam coming from the object, so that the beams used to construct and read the hologram are simultaneously present. Either reference beam can be thought of as being scattered from the interference pattern created by the other beams and producing the phase conjugate wave. The resulting phase conjugate wave moves in a direction opposite to the probe beam, just as in the case of the ordinary hologram. The dynamic hologram is created in the non-linear medium whose properties are affected by the interference pattern formed by the beams.

TGD description would be that the interference of the three beams induces self-organization of the non-linear medium to a higher energy state representing the dynamic hologram and that this occurs by the emission of the phase conjugate wave having negative energy. This means the breaking of the second law of thermodynamics. The phase conjugate waves are dissipative structures but the dissipation takes place in a reversed direction of geometric time. To be precise, classical fields can be seen as symbolic representations for the dissipation at quantum level and possible by the non-determinism of Kähler action. This explains the strange features of phase conjugate waves.

2. *Stimulated Brillouin scattering*

Stimulated Brillouin scattering was first discovered to produce phase conjugate waves [D7] by Boris Ya. Zeldovich and his colleagues, the Russian pioneers of optical phase conjugation. Only single incoming reference beam is used and the secondary reference beam in the opposite direction appears spontaneously. In this case three-wave scattering without probe beam is in question and interference pattern is solely due to the interference of the reference beams. The dynamical hologram is realized as an acoustic wave pattern from which either reference beam can be said to scatter. The phase conjugate wave is generated only above a critical power feed for the incoming beam. The incoming beam can be distorted in the directions transversal to the primary beam by allowing it to traverse an inhomogeneous glass plate. The resulting phase conjugate beam traverses back through the inhomogeneous glass plate and turns out to be free of any distortions. Obviously this demonstrates the occurrence of the time reversal.

The standard description for what happens runs as follows.

1. The process is initiated by the scattering of photons from thermal phonons in the direction of the primary reference beam and reversing thus their direction. By energy conservation the frequency difference for the two light beams corresponds to the frequency of the acoustic wave: $\Delta\omega/\omega = v/c$, where v is the sound velocity.
2. Acoustic wave generates a periodic longitudinal density gradient such that the zones of low and high density are at a distance of *half* wave length: this follows from the fact that the scattered phonons receive *twice* the momentum of photon. In this kind of situation total reflection occurs from each layer and this amplifies the secondary light beam which in turn amplifies the sound wave. A more familiar example of total reflection is the reflection of light on water having oil layer at its surface. The varying thickness of this layer gives rise to a rainbow like appearance of the scattered light. Also a phase conjugate beam is created in the process.

In TGD framework situation can be seen as a self-organization process in which the self-organizing acoustic wave gains energy by emitting negative energy photons: obviously an over unity energy production breaking the second law of thermodynamics is in question. One could even say that non-linear medium builds a primitive sensory representation of the interference pattern.

1. At the first step the photons of the primary reference beam are scattered and generate a weak secondary reference beam in an opposite direction. The resulting interference pattern in turn excites a weak acoustic wave.
2. The acoustic wave amplifies itself when phonons emit pairs of positive and negative energy photons with energies $E_1 > 0$ and $E_2 < 0$ such that the sum of their energies corresponds to the energy E_{ph} gained by the phonon: $E_1 - |E_2| = E_{ph}$. The rate of this process is proportional to the numbers N_+ and N_- of positive and negative energy photons already present in the state: the mechanism of induced emission is at work. Positive energy photons amplify the induced reference beam and negative energy photons amplify the phase conjugate wave. Also in this case one can say that the non-linear medium builds up spontaneously a dynamical hologram about the interference pattern.

The emission of negative energy photons makes possible over unity effects claimed by free energy enthusiasts. Over unity effects need not be in conflict with the standard wisdom that phase conjugate waves utilize the energy of pumping laser or probe beam. In the case of stimulated Brillouin scattering the negative energy photons are received by the population inverted lasers producing the reference beam with the consequence that particles drop to the ground state without emission of positive energy photons. In the case of 4-wave mixing the negative energy photons could be received by the laser producing the probe beam. An interesting possibility is that negative energy beams could be produced also in the direction of reference beam and pump energy from the corresponding lasers.

3.2.2 Over unity effects and error correction

The emission of negative energy photons makes possible over unity effects claimed by free energy enthusiasts. Over unity effects need not be in conflict with the standard wisdom that phase conjugate

waves utilize the energy of pumping laser or probe beam. In the case of stimulated Brillouin scattering the negative energy photons are received by the population inverted lasers producing the reference beam with the consequence that particles drop to the ground state without emission of positive energy photons. In the case of 4-wave mixing the negative energy photons could be received by the laser producing the probe beam. An interesting possibility is that negative energy beams could be produced also in the direction of reference beam and pump energy from the corresponding lasers.

Error correction of a signal defines a variant of the time mirror mechanism. In this case positive and negative energy signals are actually at different sides of the time mirror. The positive energy photons of the signal to be corrected annihilate with the negative energy photons of the phase conjugate signal which comes from the geometric future and is a temporal mirror image of the positive energy signal. The pulsed phase conjugate mirror would be an analog a sequence of ordinary mirrors. Pulses create a temporal sequence of time mirrors most naturally located at the ends of pulses so that positive energy photons from N :th pulse annihilate with the negative energy photons from $N + 1$:th pulse.

3.2.3 TGD based description for the interference of reference beams

It is interesting to find whether TGD allows the field pattern resulting as a superposition of reference beams moving in opposite direction as a solution of field equations. Topological light rays do not allow this kind of field patterns. As a special case this field pattern corresponds to a transversal standing wave of form $\cos(\omega t) \times \cos(\omega z)$ (using units $c = 1$). Waves for which the interference pattern moves (say in the case of stimulated Brillouin scattering), result when the frequencies are different. These field patterns are obtained as Lorentz transforms of the standing wave pattern.

Since the Kähler current vanishes for this kind of waves the field equations state that the contraction of the energy momentum tensor with the second fundamental form vanishes. It will be found that the field equations reduce to massless wave equation in the approximation that classical gravitational effects are negligible. It is however not clear whether this kind of solution is possible as genuinely asymptotic self-organization pattern having a precisely vanishing Kähler current.

The solution ansatz is based on the assumption that the CP_2 projection belongs to the homologically non-trivial geodesic sphere S^2 of CP_2 . Let the standard spherical coordinates of S^2 be $(U \equiv \cos(\theta), \Phi)$. Let M^4 coordinates be (t, z, x, y) , The task is to imbed the electric field representing a standing wave and having components

$$E_i = \epsilon_i \times \cos(\omega t) \times \cos(\omega z) , \quad (3.1)$$

as a four-surface to $X^4 \subset M_+^4 \times S^2$. The polarization vector ϵ_i lies in the (x, y) -plane.

The 4-vector potential associated with this field is

$$A_\mu = \frac{\epsilon_\mu}{\omega} \times \sin(\omega t) \times \cos(\omega z) . \quad (3.2)$$

Note that the scalar potential $\phi = A_t$ vanishes. The induced Kähler gauge potential is of form

$$A_\mu = U \partial_\mu \Phi , \quad (3.3)$$

and from this the simplest ansatz (fixed only apart from a canonical transformation of CP_2) reproducing A_μ is

$$U = a \times \sin(\omega t) \times \cos(\omega z) , \quad \Phi = b \times \epsilon_\mu x^\mu , \quad ab = \frac{1}{\omega} . \quad (3.4)$$

In the approximation that the induced metric is flat, action density vanishes, and the energy momentum tensor has only the longitudinal components T^{tt} and T^{zz} and is proportional to the flat metric. Field equations reduce to massless wave equation in longitudinal degrees of freedom: $D^2 u = 0$ and $D^2 \Phi = 0$, $D = \partial_t^2 - \partial_z^2$. For the proposed solution ansatz they are satisfied identically.

The fact that solution has a 2-dimensional CP_2 projection means that it represents a self-organization pattern with dissipation only due to the possible non-vanishing of the Kähler 4-current and characterized by the strength of classical gravitational interaction. Classical gravitation might imply a non-vanishing Kähler four-current.

3.2.4 Phase conjugate photons and dark matter hierarchy

Negative energy phase conjugate photons with energies above threshold propagate in matter virtually without any attenuation. Photons below thermal threshold are masked and phase conjugate photons with wavelengths longer than the thermal wavelength absorption becomes a problem since they are absorbed. Dark matter hierarchy allows to circumvent this problem and for given thermal energy arbitrarily long wavelengths are possible for both photons and their phase conjugate. This is of key importance since remote mental interactions between magnetic and biological body are star actors in the TGD based model of living matter. There is evidence that remote mental interactions involve even galactic length scales [J14]. Same might hold true in the case of ordinary bio-control since time mirror mechanism makes possible instantaneous control although the controlling part of magnetic body is at huge temporal distance in geometric future.

4 Bio-photons

MEs (massless extremals) can be carriers of light like vacuum currents generating coherent light. Bio-photons [I5, I10, I18] were the first proposed identification for this coherent light in living matter [K16]. In absence of material about bio-photons 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 home page containing online articles of Fritz-Albert Popp and colleagues about bio-photons 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 [J5].

4.1 What bio-photons are?

The web articles [J5] provide the basic facts about bio-photons and in the following I summarize my novice view about bio-photons.

Bio-photons have frequencies in the range 200-800 nm (at least). The intensity of bio-photons is extremely low: from one photon to few hundred photons/ cm^2s , 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 bio-photons are indeed coherent light rather than some waste radiation resulting as a by-product of biological processes [J5]. 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 wave lengths, one can argue that the length scale $L = c\tau \sim 10$ cm defines the length scale below which it is not sensible to speak about localized photon and thus bio-systems 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 [J5]. If bio-photons 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 bio-photons are most important for bio-control, one cannot exclude the interpretation of the observed bio-photons as somekind of leakage radiation from living matter (of course, these bio-photons might serve communication purposes).

Even the wave length 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 bio-photons whereas destructive interference takes place outside [I19, I18]. Or stating it differently, cells are able to store visible bio-photons inside them. For healthy cells the bio-photon 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 after that. For cancer cells the intensity increases indefinitely and nonlinearly [I19]. This supports the view that in cancer cell population bio-photons leak out and do not properly participate to the bio-control.

Bio-photon 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 photoluminescence is roughly .53 eV [I1] : this is rather near to the energy .49 eV stored in the ATP molecule. The experiments involving the insertion of inert molecules to DNA indicate that DNA is a source of bio-photons [I7] , [J5] . The spectrum of bio-photons and delayed luminescence correlates strongly with various biological processes. For this reason bio-photons have several applications to bio-search, food quality control, cancer research, pharmacology and heal prophylaxis.

4.2 Some phenomena related to bio-photons

There are several interesting and theoretically challenging phenomena involving bio-photons.

1. Delayed luminescence [I23, I17] 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/cm²s. 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.
2. Some animal populations can 'see' each other. For instance, when populations of dinoflagellates become to optical contact they begin to flicker synchronously [I1] (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 serves as synchronizers in the time scale in which flickering occurs.
3. Bacteria absorb bio-photons from nutrition media in a way that the absorption is highest for some critical cell density [I19]. Female inbred daphnia in the same developmental stage and about the same size do not display the increasing bio-photon emission with increasing number [I19]. Rather, a typical interference pattern of emission is observed showing maxima and minima of the bio-photon 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.

4.3 General TGD based model for coherent bio-photons

MEs with light like vacuum currents indeed generate coherent photons so that bio-photons indeed 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 temperature dependence of the delayed luminescence [I1] . This encourages to think that the MEs are closely related with the process transforming ADP to ATP serving as energy batteries (see [K11] for the TGD based model of ATP). This assumption conforms also with the fact that coherent light is associated with the oxidative process.

4.3.1 Bio-photons and MEs

The empirical data are consistent with the assumption that the MEs are associated with DNA (at least) and are perhaps responsible for the electromagnetic expression of the genetic information below cellular length scales (and corresponding scaled up dark length scales since there is no reason to exclude the dark variants of MEs).

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. It must be emphasized that also magnetic mirrors with positive and negative energies might be in question.

4.3.2 Bio-photons as a signature of dark matter hierarchy

Dark matter hierarchy allows perhaps the most plausible interpretation of bio-photons and is also in spirit with the general ideas about quantum holograms. The model of EEG (actually hierarchy of them) based on dark matter hierarchy [K5] assumes that the basic structures assignable to cell have fractal scaled up variants at higher levels of dark matter hierarchy. These higher level structures could generate dark photons with energies in the range corresponding to visible photons.

At the k_d^{th} level of the hierarchy predicted by Mersenne hypothesis the wavelength of photon is scaled up by a factor 2^{k_d} with possible values of k_d fixed by the Mersenne hypothesis [K5] so that communications using "visible dark" light become possible in arbitrarily long length scales. The model for cell membrane as a sensory receptor leads to the identification of these photons in terms of dark Josephson radiation and EEG and biophotons have identification in terms of decay products of dark Josephson photons.

MEs would have lengths of order wave length (which are below cell size for visible light), and there would be a constant distribution of MEs with respect to the direction and length of ME in the scaled up length scale interval corresponding to wavelengths of visible light. The scaled up wavelengths would correspond to the distances between source and receiver of bio-photons and $k_d \equiv 0$ would correspond to intracellular bio-photons assignable to MEs connecting sub-cellular structures having distance distribution which is more or less constant. The higher level contributions would tend to smooth out the wavelength distribution even if this is not strictly the case.

The general vision about quantum control of motor actions and sensory representations is consistent with the interpretation of positive energy MEs as space-time correlates for the emission of photons responsible for communications and negative energy MEs as correlates for phase conjugate photons involved with generalized motor control. In this framework bio-photons could result from the de-coherence of $k_d > 0$ dark photons and also as a leakage of $k_d = 0$ photons from cell interior. The synchronous flickering of dinoflagellates suggests $k_d > 0$ bio-photons are indeed present.

4.3.3 About the anatomy of dark MEs

MEs at the k_d^{th} level of dark matter hierarchy correspond to $r = 2^{k_d}$ -fold covering of M^4 , which are analogs of multi-sheeted Riemann surfaces (note that the meaning of "sheet" in this context is different from that in the context of many-sheeted space-time). Each sheet of the covering corresponds to scaled up variant of the space-time sheet associated with ordinary photon with r -fold size scale and classical energy E/r . This allows to interpret the formula $E = \hbar(k)f = r\hbar_0 f$ at space-time level.

r -fold MEs could be generated by r -sheeted magnetic flux sheets containing Bose-Einstein condensates of bosonic ions in quantum coherent manner such that each sheet is responsible for one sheet of r -fold ME.

The decay to ordinary photons can occur in two manners.

1. In de-coherence a downwards scaling of the structure by a factor $1/r$ and collapse to a single sheeted structure with energy E representing ordinary photon occurs. Since frequency is replaced with rf and \hbar by \hbar_0 , energy does not change.
2. The multi-sheeted structure could also decay to r single sheeted structures with energy E/r .

4.3.4 Constraint to the intensity of the vacuum current

The decomposition of dark MEs to r ordinary MEs cannot correspond to the generation of coherent photons by vacuum current since the frequencies involved would be much lower than the frequencies $\sim 10^{14}$ Hz associated with the visible light. Thus one can restrict the consideration to $k_d = 0$ case. This process might however also occur as the experimental findings of Gariaev [I9] about laser light induced radio-wave emission to be discussed in the next section indicate.

The source of photons at the second end of ME is responsible for the Bose-Einstein condensate of photons associated with ME. These photons are not observed unless some kind of leakage occurs at the receiving end of ME: suppose that this does not happen. Physical intuition suggests that the light-like vacuum currents associated with MEs generate coherent states of ordinary photons and that these photons leak out and give rise to the observed bio-photons. MEs lose their energy in the process and become eventually vacuum extremals.

These assumptions allow to deduce a constraint to the intensity of the vacuum current associated with ME.

The interaction Lagrangian of the vacuum current with the vector potential of the quantized photon field is given by

$$L_{int} = e \int d^4x j \cdot A \quad (4.1)$$

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 [B1] one can deduce the expression for the effective classical vector potential defined by the eigenvalues of the annihilation operators is given by

$$\begin{aligned} A(x, t) &= \frac{ie}{(2\pi)^3} \int d^3k \frac{1}{2\omega(k)} \exp[-ik \cdot x - i\omega(k)t] j(k, \omega(k)) \ , \\ \omega(k) &= |k| \ . \end{aligned} \quad (4.2)$$

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

$$\alpha(\epsilon, k) = \frac{ie}{2(2\pi)^3\omega(k)} \epsilon \cdot j(k, \omega(k)) \ . \quad (4.3)$$

$\alpha(k)$ 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 bio-photons determining the values of the parameters $\alpha(k)$ allow to deduce the on mass shell Fourier components of the light like vacuum current. Of course, the coherent field of photons is superposition of several interfering contributions coming from MEs with light like currents and only the sum of these contributions appears in the detected field.

4.3.5 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 [I19]. 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 present, 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 tRNA 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 absorption most naturally corresponds to the annihilation 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.

4.4 The interpretation of biophotons and EEG as decay products of dark Josephson radiation

The foregoing considerations have been classical in the sense that MEs have been taken as a model for biophotons. The model of EEG [K5] leads to the prediction that cell membranes act as Josephson junctions generating Josephson radiation. If the cell membrane is assumed to be almost vacuum extremal which brings in classical Z^0 field proportional to em field and raises the energy scale of Josephson junction from .07 eV for neuron to UV range. The electromagnetic charge of ion must be replaced with effective charge which is non-vanishing also for neutral atoms and molecules.

The energies of dark photons involved are in visible and UV range for most ions in the range of resting potentials just as the energies of bio-photons. The model also predicts correctly the peak frequencies of maximal sensitivity for the four kinds of photoreceptors. The frequencies are inversely proportional to the value of Planck constant characterizing the cell membrane. Quite generally, the value of Planck constant characterizes the evolutionary level of neuron.

Both EEG photons and biophotons can be identified as decay products of dark Josephson photons producing either a bunch of EEG photons or single biophoton. The frequency modulation of Josephson frequencies provides a general coding of sensory percepts and other information in terms of Josephson radiation communicating this data to the magnetic body. This modulation could also explain the observed periodic modulations.

4.5 TGD based model for the delayed luminescence

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

1. 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.
2. Oscillatory behavior in the variable $u = \log(1 + \lambda t)$ results if there is a feedback mechanism generating or destroying MEs or MEs with a rate which is the time derivative dF/dt of a periodic function $F(u)$. The interaction with supra currents via magnetic induction could be the mechanism in question.

The essential difference as compared to the models of Popp and Yan [I20], whose TGD variant will be also considered below, is that quantum coherence for photons is not assumed in the time scales of order seconds characterizing the decay of the delayed luminescence.

4.5.1 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 many-sheeted ionic flow equilibrium.

1. 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 wave lengths of visible light. MEs and ME pairs are generated by the interaction with the external perturbation, 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 $eLdI/dt$.
2. At the level of frequencies hyperbolic decay law predicts a $1/f$ power spectrum for frequencies $f \ll \lambda$. $1/f$ noise is almost [E2] [D1] and I have already earlier proposed that the dynamics of the mind like space-time sheets, for instance MEs, might explain it [K17, K18] .
3. Hyperbolic decay suggests that the interaction involving two MEs is involved since $dI/dt = kI^2$ gives $1/(1 + \lambda t)$ behavior. 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 asymptotic stationary state only n_+ is non-vanishing.
4. 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

$$\frac{dn(\text{ME pair})}{dt} = \frac{dF(u)}{dt} , \quad (4.4)$$

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

4.5.2 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. *The events preceding delayed luminescence*

The general view about how magnetic bodies control biological body and receive sensory data from it suggests how external perturbation induces delayed luminescence. External perturbation induces sensory communications to a relevant magnetic body at some level of dark matter hierarchy. Magnetic bodies react and induce generalized motor action which at DNA level means expression of some genes requiring the unwinding of some portions of DNA. Delayed luminescence is associated with this portion and corresponds to Josephson radiation of photons at various levels of dark matter hierarchy.

2. *How delayed luminescence is induced?*

Popp and Yan have proposed two models of the delayed luminescence based on time dependent harmonic oscillator in time dependent driving force [I20]. Both models are constructed by hand to produce the hyperbolic decay law using the flexibility of harmonic oscillator Hamiltonian. The objection is that the frequency parameter in the first model producing the hyperbolic decay law is in

ELF range whereas photons have frequencies in the visible range. The authors consider also a model based on two coupled harmonic oscillators reproducing the oscillatory behavior. The problem now is that the model does not seem to approach to the first model at any limit.

Dark matter hierarchy allows to invent a modification of the harmonic oscillator model so that it overcomes the worst difficulties of principle associated with the models [I20] and allows also a concrete physical interpretation.

1. The presence of dark matter hierarchy justifies the assumption that the coherence of the harmonic oscillators at visible frequencies (with a natural time scale of 10^{-14} seconds) is maintained in time scales of minutes: nanosecond would look the maximally optimistic assumption about coherence time in the standard physics context. For instance, coherence time of 2 minutes would correspond to the dark matter levels with $r = 2^{k_d}$, $k_d = 56$.
2. Bio-photons would result as an outcome of the de-coherence of dark Josephson photons associated with MEs corresponding to frequencies $1/f \sim$ few minutes to a single-sheeted MEs corresponding to visible ordinary light. The hyperbolic decay rate and its logarithmic oscillatory behavior are still put in by hand but the model to be discussed can explain these features.
3. A possible TGD based interpretation for the frequency modulation is that frequency corresponds to a voltage over Josephson junction. The variation of the voltage over Josephson junction is in turn analogous to that occurring during nerve pulse and the change of sign for the voltage would have a natural interpretation in terms of the generation of negative energy MEs. Josephson radiation would thus generate both positive and negative energy dark MEs.

This would mean that the basic frequency $\omega_J = Q_{eff}eV$ of Josephson would vary slowly and induce a variation of the fundamental frequency of Josephson radiation over the range of visible frequencies (actually also lower frequencies can be present but with smaller intensity). This frequency would in turn define the fundamental frequency associated with the coherent light emitted by MEs and the variation would explain why the spectrum covers smoothly over the range of visible frequencies.

4. The connection with nerve pulse generation suggests that an analog of nerve pulse propagating along DNA double strand accompanies the unwinding of the double strand. The general model for the quantum control by magnetic body [K5] would suggest that the magnetic body generates W ME inducing charge entanglement between magnetic body and DNA double strand (or either of the strands). When the state function reduction of this entanglement leads to a state in which double strand (or either strand) has an anomalous em charge, double strand becomes unstable against unwinding and in this process positive and negative energy neutral MEs are generated.
5. The unwound portion of DNA double strand acts as a Josephson junction at $k_d = 0$ level of hierarchy and generating visible Josephson radiation for which MEs are space-time correlates. Bio-photons correspond to coherent photons generated by the vacuum currents associated with $k_d = 0$ MEs. The Josephson junction has scaled up dark variants just as the cell membrane and similar process occurs also at the higher levels of dark matter hierarchy just as in the case of cell membrane [K5]. Dark variants of visible photons at various levels of dark matter hierarchy are generated.

3. *Josephson radiation has positive and negative energy MEs as space-time correlates*

During gene expression period when unwinding of DNA double strand occurs, both negative and positive (inertial) energy MEs must be generated and negative energy MEs could be assigned with the change of the sign of voltage over the Josephson junction.

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 space-time sheets serve as sources of the electric and magnetic field. These larger space-time 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. Annihilation would mean at the level of photons (CP_2 type extremals) that positive and negative energy CP_2 type extremals would fuse to wormhole contact by topological sum.

The resulting two light-like causal horizons assignable to the wormhole contact would carry quantum numbers of photon and its phase conjugate. The resulting ME pairs 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.

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 unwound DNA, this might be implied by the regular structure of unwound DNA. The simplest guess is that MEs are orthogonal to the DNA strands. 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.

Interesting questions relate to the interpretation of the positive and negative energy MEs. One possibility is that negative energy MEs suck energy from metabolic sources. At $k_d = 0$ level the sources would be mitochondria. If positive energy MEs are interpreted in terms of sensory communications. What comes in mind are communications with basic building bricks of RNA molecules needed in the transcription and cyclotron frequencies of DNA and RNA nucleotides could serve as their signatures.

4. Could magnetic induction generates or destroy MEs?

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.

4.5.3 Hyperbolic decay

The kinetic equations for n_+ and n_- are

$$\frac{dn_+}{dt} = \frac{dn_-}{dt} = -kn_+n_- . \quad (4.5)$$

This gives

$$n_+ - n_- = n_0 = \text{constant} . \quad (4.6)$$

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

$$\frac{dn_+}{dt} = \frac{dn_-}{dt} = kn_+ \times (n_0 - n_+) . \quad (4.7)$$

The solution of this equation is

$$n_+(t) = n_0 A \frac{1}{A - \exp(-u)} , \quad n_-(t) = n_0 \left[\frac{A}{A - \exp(-u)} - 1 \right] , \quad (4.8)$$

$$A = \frac{n_+(0)}{n_+(0) - n_0} , \quad u = n_0 k t .$$

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 bio-photons.

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

$$\begin{aligned} n_+(t) &= n_0 \times \frac{A}{A-1} \times \frac{1}{1+\lambda t} , \\ \lambda &= \frac{k}{A-1} . \end{aligned} \quad (4.9)$$

The non-vanishing 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 environment, most probably to the mitochondria, and the strand is the only user of the positive energy.

4.5.4 Periodic corrections to the decay rate

One should understand also the logarithmic oscillations [I20] in the time scale of seconds from first principles. This variation must correspond to an endogenous feedback 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

$$\frac{dn_+}{dt} = \frac{dn_-}{dt} = -kn_+n_- + \epsilon \frac{dF}{dt} , \quad F = F(\int(n_+ + n_-)dt) . \quad (4.10)$$

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

$$\begin{aligned} \Delta n_+(t) &\simeq \epsilon F(\int(n_+ + n_-)dt) \simeq \epsilon F(\int 2n_+ dt) , \\ \int 2n_+ dt &\simeq K \times \log(1 + \lambda t) , \quad K = 2 \frac{n_0}{\lambda} \times \frac{A}{A-1} . \end{aligned} \quad (4.11)$$

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

The general vision about many-sheeted 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:

$$F\left(\int(n_+ + n_-)dt\right) = eV . \quad (4.12)$$

The motivation for this assumption is the conviction that there must be a coupling between the dynamics for MEs and many-sheeted 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 behavior.

1. 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 $-eV_0$ along strand besides oscillating contribution. Note that MEs are not assumed to act as Josephson junctions between strands.

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

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

$$I = I_0 \sin \left(\frac{eV_0}{2} \int (n_+ + n_-) dt \right) . \quad (4.13)$$

This current runs through the entire circuit and induces 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

$$F \left(\int (n_+ + n_-) dt \right) = eI_0 \sin \left(\frac{eV_0}{2} \int (2n_+ - n_0) dt \right) . \quad (4.14)$$

This term 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.

4.5.5 TGD inspired modification of the model of Popp and Yan for the delayed luminescence

As discussed earlier, the basic objection against the model of delayed luminescence proposed by Popp and Yan [I20] is the long coherence time of order few minutes. For instance, $k_d = 56$ level of dark matter hierarchy allows 2 minute time scale. The hyperbolic decay law can in turn be understood in terms of annihilation of positive and negative energy MEs, and the annihilation of MEs induced by magnetic induction interaction having interpretation in terms of absorption of photons explains logarithmic oscillations as a signature of Josephson current.

This picture suggests that a modification of the model of Popp and Yan [I20] could make sense also in TGD framework. The physical picture of the model is that the frequencies of the visible photons are frequency modulated slowly in ELF time scale and the modulation function depends logarithmically on time. Physically this would correspond to the modulation of the lengths of the MEs which generate the coherent visible light so that frequency scale varies. The amplitude of the frequency modulation must be below measurement resolution. This model predicts that the temporal behavior of the intensity is same for all visible frequencies.

Frequency modulation means the addition of a small and slowly varying part to the visible frequency. The modulation is a logarithmic function

$$u(t) = \log(1 + \lambda t)$$

of time. The parameter λ characterizes the hyperbolic decay rate and is of order few Hz typically. The functional form of the modulation is ad hoc.

The frequency modulation of the visible frequency ω_0 reads as

$$\begin{aligned} \omega(t) &= \omega_0 + \omega_1 \times F(u) , \\ F(u) &= u + f(u) . \end{aligned} \quad (4.15)$$

where $f(u)$ is periodic function: also this assumption is ad hoc. $\omega_1 \ll \omega_0$ guarantees that modulation is small: the variation of the frequency ω_0 should be below the experimental frequency resolution.

Consider now a quantitative model for this based on the modification of the discussion in [I20]. The Hamiltonian for the time dependent harmonic oscillator driven by time dependent force and having time dependent vacuum energy $\beta(t)$ reads as [I16]

$$H(t) = \omega(t)a^\dagger a + fa^+ + \bar{f}a + \beta(t) . \quad (4.16)$$

Standard commutation relations are satisfied and coherent states are eigen states of annihilation operator ($a|\alpha\rangle = \alpha|\alpha\rangle$) and the eigenvalues of annihilation operator satisfies same equation of motion as the annihilation operator:

$$\frac{d\alpha}{dt} = i\omega(t)\alpha + f(t) . \quad (4.17)$$

The general solution of this equation is

$$\begin{aligned} \alpha(t) &= \exp(-i\phi(t)) \left[\alpha(0) + \int_0^t f(t_1) \exp(i\phi(t_1)) dt_1 \right] , \\ \phi(t) &= \int \omega(t) dt = \omega_0 t + \omega_1 \int F(1 + \lambda t) dt . \end{aligned} \quad (4.18)$$

Energy is constant of motion for coherent states (homeostatic equilibrium), that is $\omega n = \omega_0 n_0$ which gives

$$n(t) = n_0 \frac{\omega_0}{\omega(t)} . \quad (4.19)$$

This gives for the intensity of the light in delayed emission

$$\begin{aligned} I(t) &\propto \frac{dn}{dt} = -\frac{n_0 \omega_0}{\omega^2} \frac{d\omega}{dt} \\ &= -\frac{n_0 \omega_0 \omega_1}{\omega^2} \frac{dF}{du} \frac{1}{1 + \lambda t} \end{aligned} \quad (4.20)$$

The amplitude of frequency modulation should be below experimental resolution so that one has $\omega(t) \simeq \omega_0$ in excellent approximation. This gives the approximate expression

$$\frac{dn}{dt} \simeq -\frac{n_0 \omega_1}{\omega_0} \frac{dF}{du} \frac{1}{1 + \lambda t} \quad (4.21)$$

The simplest choice for $F(u)$ is $F(u) = u$ and gives hyperbolic decay. If $F(u)$ is of form $F(u) = u + \lambda_1 \sin(u)$, an oscillatory behavior

$$\frac{dn}{dt} \simeq -\frac{n_0 \omega_1}{\omega_0} [1 + \lambda_1 \cos(\log(1 + \lambda t))] \frac{1}{1 + \lambda t} \quad (4.22)$$

results.

4.6 Kirlian effect

Kirlian effect [I4] is a candidate for one particular instance of the proposed $f_{ELF} \rightarrow f_h$ transformation. Kirlian photography uses high voltage in kV range alternating at frequencies of order kHz. The frequency is 1024 Hz in so called gas discharge visualization method (GDV) developed by Korotkov [I13] . The Kirlian response of living matter differs from the response of non-living matter in that it varies in much wider limits and correlates with the state of organism. Thus it seems that the explanation as a mere passive coronal discharge cannot be correct. The presence of water is essential for the effect and for some reason this has led to skeptics to announce that effect involves nothing which would not be understood by standard skeptic science.

Korotkov [I13] believes that GDV involves a holistic psycho-physiological rather than a purely local biological response which should be same for living and non-living matter. Korotkov has developed

GDV as a diagnostic tool using the hypothesis that GDV picture is kind of a hologram reflecting the state of the entire organism. GDV seems to indeed serve as a rough diagnostic tool allowing to deduce with certain reliability whether organism is healthy or not [I4]. The idea about DNA as a hologram is consistent with Korotkov's vision.

The frequency used in GDV is very near to the resonance frequency of synchronous neuronal firing. This suggests that the process involves neural activity and genetic expression as assumed also in the model for the discovery of Gariaev that laser light at 2 eV photon energies induces delayed emission of radio-waves. In this case the emitted light could be bio-photons resulting from the de-coherence of dark photons, for instance ELF photons at $k_d = 47$ level of dark matter hierarchy for 5 Hz frequency [K5]. This would conform also with the continuum of the emitted spectrum.

5 Bio-photons, radio waves, and genetic regulation

Bio-systems could generate holograms in much more concrete sense than the wetty and hot and noisy character of this environment would suggest: even mechanisms generating laser beams could be there. The findings of Peter Gariaev and collaborators described in the article "The spectroscopy of bio-photons in non-local genetic regulation" [I9] provide a new support for the notion of many-sheeted DNA. The findings also lead to a concrete model for how bio-photons affect many-sheeted DNA, and in this manner induce a generation of coherent radio waves and ELF waves. Moreover, a concrete model for how bio-systems act as many-sheeted lasers at various wavelengths emerges.

In polarizing laser-radio wave spectroscopy (PLR-spectroscopy) laser light scatters from the target substance. In the experiments of Gariaev *et al* red light ($\lambda = 632.8$ nm, 1.9595 eV) generated by He-Ne laser is used. There are two orthogonal polarizations correlated in intensity in such a manner that the total intensity remains constant. After the interaction of one mode with the target substance, the reflected light is returned to the optical resonator, where the re-distribution of the intensity of these modes occurs. One of the laser modes, at a certain mode of generation, is able during the interaction with the target substance to induce modulated radio waves of a wide spectrum correlated with the modulations of the optical modes of the laser radiation. The modulation depends on rotational fluctuations of micro-structural components (say, domains of crystals) and of their optical activity. The PLR-spectrum is present also for in-organic materials. For biological targets there is spectral memory effect present, which means that the radio wave radiation continues even when the laser beam is not present anymore.

The general situation is very similar to that encountered in the case of delayed luminescence [I23], and an attractive assumption is that laser light acts as an external perturbation inducing gene expression requiring unwinding of DNA which involves generation of dark photons at various levels of dark matter hierarchy as Josephson radiation. Also cyclotron radiation from magnetic bodies is expected to be present just and the interpretation in terms of scaled up variants of EEG [K5] might make sense. Dark photons at $r = k_d^{th}$ level of dark matter hierarchy correspond to 2^{k_d} -sheeted MEs and their decay to single-sheeted MEs representing ordinary coherent light with frequency $f(k) = f/r$ yields ELF and VLF photons.

5.1 Frequency spectrum of radio waves

The frequency interval of the radio emission settles down at the 1 MHz. The PLR-spectrum is depicted in figures 1 and 2 of [I9] for apofillit crystal. The frequency spectrum for the radio waves has a modulated fractal structure suggesting that spectrum is superposition of spectra which consist of harmonics $n_1 f_h - n_2 f_l$ of higher frequency f_h modulated by harmonics of scaled down frequency $f_l = x f_h$. Almost identical copies of a piece of length about

$$\Delta f \sim 100 \text{ Hz}$$

appear in a sequence as the pictures 1 and 2 of [I9] for the spectrum of apofillit crystal in 1560-1860 Hz range demonstrate. This suggests the presence of harmonics of basic frequencies perhaps shifted by a constant amount. Cyclotron and spin flip transitions in magnetic field suggest itself.

There is also gross structure consisting of peaks in scale of kHz suggesting harmonics of frequency of order kHz. For wheat seed (picture 3 of [I9]) the strongly expressed frequency ranges are identified as 800-900 Hz (to my personal opinion the band is 300-900 Hz), 1700-1900 Hz, 2400-2600 Hz, 3600-3800

Hz (to my personal opinion a wider frequency range 1700-2200 Hz is strongly expressed). There is also strongly expressed frequency band below 300 Hz. Also the spectrum of high polymerization DNA sample from calf thymus (picture 4 of [I9]) shows a clear peak at 2400-2600 Hz and less pronounced peaks at lower frequencies.

The radio wave radiation from DNA samples is accompanied by specific effects on bio-systems such as ab-normally fast germination and re-vitalization of seeds. Thus it seems that the radio wave radiation is able to restore the genetic control apparatus and the vitality of the seeds.

5.2 Basic questions

The model proposed by Gariaev *et al* [I9] for the PLR effect is based on the phenomenological notion of photon localization dating back to the experimental findings made 1985 [D5] suggesting that photon beam can be concentrated in a narrow tube under some circumstances. This is strongly reminiscent of ME (massless extremal), which is essentially 'topological light ray' along which photons propagate. MEs are the basic element in TGD based quantum model of living matter.

Concerning the modelling of the PLR effect, the basic questions to be answered are following.

1. How could one understand the modulated fractal like spectrum of the radio waves radiation? What is the origin of the frequency scales present in the spectrum and what gives rise to modulatory structure?
2. How does the scattering of coherent light on DNA induce the radio wave emission and how one can understand the correlation between polarizations?
3. How does the spectral memory effect result and what is the mechanism causing the biological effects accompanying the radio waves?

In the following TGD based answers to some of these questions are discussed.

5.3 How to understand the spectrum?

The finding that the width of the basic unit of the spectrum is about $\Delta f = 100$ Hz would suggest that the mechanism involves magnetic transitions in Earth's magnetic field, whose nominal value can taken to be $B_E = .5$ Gauss for definiteness. The corresponding space-time sheet would be $k = 169$ and correspond to p-adic length scale $L(169) \simeq 5$ micrometers.

1. Miracle length scales and the coiling hierarchy of DNA

Above this p-adic length scale are four miracle length scales $k = 151$ (cell membrane thickness of about 10 nm), $k = 157, 163$, and $k = 167$ related by scaling $L(k) = 2^{(k-169)/2} \times L(169)$ to $L(169)$. These p-adic primes correspond to the so called Gaussian Mersennes $G_k = (1 + i)^k - 1$, $|G_k| \simeq 2^k$, which are complex counterparts of ordinary Mersenne primes. Since ordinary and Gaussian Mersennes are fundamental for TGD based elementary particle physics, one expects that the same is true in biological length scales. The coils inside coils inside... structure of the chromosomes could correspond to a quantum control hierarchy of these four space-time sheets, and the transitions of ions between cyclotron (magnetic) states at these space-time sheets would generalize ordinary cyclotron (magnetic) transitions.

If these space-time sheets are also magnetic flux tubes carrying magnetic field satisfying flux quantization condition the corresponding field strengths are obtained by scaling $B(k) = 2^{169-k} B_E$. Cyclotron frequency scales are scaled up in the same manner: $f_c(k) = 2^{169-k} f_c(169)$.

1. For $k = 167$ the cyclotron frequencies are scaled up by a factor 4. What is interesting is that for bosonic Mg_{++} ion cyclotron frequency is $f(169) = 25$ Hz so that for $k = 167$ the cyclotron frequency would be 100 Hz. Mg^{++} is indeed important biological ion, especially so for the functioning of DNA [I6] . Hence the 100 Hz approximate fractal periodicity might relate to the cyclotron harmonics of Mg_{++} ions. There are also other cyclotron frequencies present and for bosonic ions many of these frequencies are in alpha band so that 40 Hz periodicity would also suggest itself. Different frequency scales imply a super-position of the scaled up harmonics spectra.

2. For $k = 163$ the factor is 64 and frequency range 10 – 100 Hz for ionic cyclotron frequencies is scaled up to 640 – 6400 Hz. These transitions could explain the large scale features of the spectrum with characteristic scale of kHz.
3. For $k = 157$ the factor is $2^{12} \simeq 4000$, which means that the frequencies for ions are in MHz range, which corresponds to the upper bound for the frequency range of radio waves.
4. For $k = 151$ the factor is $2^{18} \simeq 10^6/2$ and the cyclotron frequency for proton is about .15 GHz and in microwave range. Microwaves are in a fundamental role in TGD based view about bio-control.

2. *Is the radio-wave spectrum a superposition of many-sheeted magnetic transition spectra?*

The simplest hypothesis is that the radio-wave spectrum is a superposition of relatively simple magnetic spectra for several ions and having the same general shape.

1. The spectrum of a given ion results, when the ion drops from a cyclotron state n_1 at $k > 169$ magnetic flux tubes to cyclotron states n_2 at $k = 169$ magnetic flux tube such that the longitudinal momentum along tube is conserved or is very small. If the magnetic flux tube is of finite length L , the longitudinal energies are given by $E_n = n^2\pi^2/2mL^2$, L the length of the magnetic flux tube. If the length of the magnetic flux tube is considerably longer than the magnetic length, magnetic energy gives only a small contribution to the energy and can be neglected unless Δn is very large.
2. The frequencies of the photons resulting in this manner are given by

$$f(k) = n_1 f_c(k) - n_2 f_c(169) = [2^{169-k} \times n_1 - n_2] \times f_c(169) .$$

Here $f_c(169)$ varies in the region 1-100 Hz for ions other than proton and for proton one has $f_c(169) = 300$ Hz. Quite generally one has $f_c = 300Z/A$ Hz, where A is the mass number of ion and Z its charge. Effectively the harmonics of the ionic cyclotron frequencies at Earth's magnetic field modulate the scaled frequencies at $k < 169$ magnetic flux tubes.

3. A more general model allows the variation of the magnetic field strengths from their nominal values, so that one has the formula

$$f(k) = [a(k)2^{169-k} \times n_1 - a(169)n_2] \times f_c(169) .$$

Here $a(k)$ characterizes the scaling relating the actual value of the magnetic field value to its nominal value.

Under these assumptions it could be possible to understand the basic fractal like characteristics of the spectrum. There is a killer test for the model: one should be able to identify individual lines of the PLR-spectrum as differences $S(k_1, A) - S(k_2, A)$ of the magnetic spectra $S(k_i, A)$ for various ions (A denotes the atomic number). PLR in principle means a possibility to do many-sheeted spectroscopy and might provide the Golden Road to many-sheeted physics.

5.4 Many-sheeted radio-wave laser excited by ordinary laser light

The idea of many-sheeted laser allows to consider several mechanisms explaining the findings.

1. The visible laser light beam could pump the ions from the magnetic flux tubes to cyclotron states at $k < 169$ space-time sheets wherefrom they drop to $k = 169$ space-time sheet and generate coherent photons at radio wave frequencies.
2. Alternatively, laser light might stimulate directly the dropping of pre-existing ions from space-time sheet $k < 169$ to $k = 169$. The emitted light can indeed give rise to stimulated emission just like in the case of the ordinary laser. Entire many-sheeted cascades $k_1 \rightarrow k_2 \rightarrow \dots \rightarrow k = 169$ of emissions analogous to cascades of emissions from the decay of excited atomic states are possible.

3. The analogy with the delayed luminescence forces to ask whether the same basic mechanism is behind both phenomena. If so, the connection between laser irradiation and radio wave generation is less direct involving the reaction of magnetic body. The motor action of the magnetic body would induce gene expression and unwinding of DNA strand and generation of Josephson radiation responsible for the communications to the magnetic body at frequencies $nf_c \pm f_J$: this radiation would give rise to bio-photons as already discussed. The correlation of its polarization with the polarization of laser light is not plausible. If the part of the generalized EEG involving harmonics nf_c of cyclotron frequencies responsible for the control of DNA by magnetic body results as a direct response to the laser irradiation, the correlation between the polarizations of laser light and radio waves is conceivable.
4. The fact that the radio wave radiation is accompanied by biological effects suggests that radio-waves result from dark photons for which energies are above thermal threshold at room temperature. The mechanism would be the decay of r -sheeted ME to r separate MEs with energy determined by frequency in the usual manner. Biological effects would not be produced by the radio-waves but by high energy dark photons with energies in UV range (300 Hz corresponds to ~ 5 eV).

5.4.1 He-Ne laser produces miracle wave length

The wavelength of laser photons corresponds to about 632.48 nm, which is quite near to the p-adic length scale $L(163) = 640$ nm in the approximation $L(151) = 10$ nm. This is one of the p-adic miracle frequencies. This observation suggests that the laser light interacts resonantly with $k = 163$ space-time sheet and somehow generates radio waves in this process. Therefore the general rule of thumb for how to make many-sheeted-ness manifest would be simple. A radiation with wavelength of order p-adic length scale induces resonantly a flow of ions to space-time sheets for which the zero point kinetic energy is of the order of magnitude of the photon energy. This hypothesis is in principle testable by looking whether the laser beams with wavelengths given by p-adic length scales are in a special position.

5.4.2 The energy of photons from He-Ne laser corresponds to the zero point kinetic energy of electron at $k_2 = 73$ space-time sheet

The space-time sheet corresponding to the secondary p-adic length scale $L_2(k = 73) = L(146) \simeq 10/32 \simeq 3.12$ Angstroms, is rather near to the length of single DNA base (10 DNA triplets correspond to the length of 10 nm). In this case electron's zero point kinetic energy is $\simeq 2$ eV and is the same as the energy of photons in the laser beam used in the experiments. This suggests that the kicking of electrons from $k = 163$ space-time sheet to $k = 73$ secondary space-time sheet is the first step of the process. After this step electron drops back to $k = 163$ space-time sheet and emits essentially the original wavelength so that laser action results. The probability for the occurrence of this step is amplified by the presence of coherent laser light (stimulated emission mechanism).

5.4.3 The correlation between the polarizations of radio-waves and laser photons

The polarizations of the radio waves correlate with the polarization of the laser light. This is the case if the radio waves result in a process, which kicks electron from $k = 163$ space-time sheet to $k = 73_2$ space-time sheet. The simplest possibility is that the kicking process involves a coherent interaction with the other ions at $k = 163$ magnetic flux tube inducing the dropping of these ions to $k = 169$ magnetic flux tube accompanied by the radiation at frequency corresponding to the difference of the magnetic energies. One can imagine also a second possibility. Since the electron is kicked to a super-conducting space-time sheet associated with the DNA base, the information about polarization is not lost into a thermal noise, and the electron dropping back to $k \leq 169$ space-time sheet still carries it. Therefore the dropped electron could induce the dropping of ion to $k = 169$ space-time sheet generating still polarized radio waves.

5.4.4 Quantum coherence produces intense radio wave and ELF laser beams

Because of the presence of a large number of Cooper pairs/bosonic ions in the same state at $k \leq 169$ space-time sheet, the process occurs coherently and the rate is proportional to the square N^2 of the

number N of the bosonic ions/Cooper pairs in the system.

The radio waves and ELF radiation produced in ordinary magnetic transitions at $k = 169$ space-time sheet is quantum coherent in the length scale defined by wavelength at least and propagates inside the tubes defined by ELF or VLF MEs. This radiation is obviously ideal for biological communication and control purposes. This suggests that bio-photons propagating inside low frequency MEs with frequencies in kHz range act just like a laser beam and induce emission of radio waves in the proposed manner.

Also $k > 169$ space-time sheets can be involved and produce radiation ULF wave lengths. For instance, maser beam could resonantly interact with structures in the size range of roughly 1 mm-1 m (microwave wavelengths) and kick electrons to $k = 157$ magnetic flux tubes (say) where cyclotron energy scale is of correct order of magnitude. Thus a very complex many-sheeted spectroscopy analogous to atomic and molecular spectroscopies is predicted.

5.4.5 Phantom DNA effect

A further mysterious looking effect involved with the experiments is phantom DNA effect. There is also an elastic scattering of the coherent from irradiated DNA and the simplest mechanism is the kicking of electrons to the $k_2 = 73$ space-time sheet and dropping back so that they regenerate laser photons with essentially the original wave length. When one removes the DNA from the chamber containing it, and irradiates it by laser light, a weak pattern of scattered light is still produced: as if there were a kind of phantom DNA there.

A possible explanation for the effect is that the removal of DNA is not complete but leaves some non-atomic space-time sheets associated with the DNA to the chamber. If $k_2 = 73$. $k = 163$ and $k = 167$ space-time sheets are left besides the $k = 169$ space-time sheets associated with the magnetic field of Earth, the proposed model indeed predicts scattering. Sooner or later however the ionic densities from these space-time sheet should leak from the volume of the chamber and the scattering is not observed anymore. A killer test for the model is whether the removal of the Earth's magnetic field artificially destroys the effect (and also PLR effect).

5.5 Is the radio wave band structure for wheat seed a scaled-up version of the band structure of EEG?

In the model for the hierarchy of EEGs (and generalizations of EEG) based on dark matter hierarchy the band structure of EEG can be understood in terms of resting voltage of cell membrane and cyclotron frequencies in the magnetic field of Earth [K5]. Same ions should contribute to the radio wave spectrum also if it corresponds to a scaled up version of the the cyclotron frequency part of EEG. Therefore it is interesting to look at the band structures of the radio-wave spectrum for wheat seed represented in the figure 3 of [I9] assuming that $k = 163$ magnetic flux tubes are in question.

1. By scaling the frequency bands of figure 3 of [I9] one finds that the lowest band below 250 Hz can be identified as the counterpart of delta band in EEG ($f < 3.9$ Hz).
2. The region 300 – 900 Hz corresponds to the range 4.7 – 14 Hz covering theta and alpha bands. Actually the band extends to about 1300 Hz so that it contains also beta frequencies up to 20 Hz. In the figure 4 representing the spectral memory there is minimum of intensity at about 700 Hz which corresponds to about 11 Hz so that alpha and beta bands separate from each other.
3. The band 1700 – 2100 Hz corresponds to the range 26-32 Hz and also to beta frequencies. 2400 – 2600 Hz band corresponds to 40 Hz thalamo-cortical resonance band 37.5 – 40.6 Hz.
4. 3600 – 3800 Hz band corresponds to the range 56.3 – 59.5 Hz. The DNA spectrum of figure 4 of [I9] contains also a band around 4800 Hz: this frequency corresponds to 75 Hz and to the cyclotron frequency of ${}^4He_+$ ion, which is not bosonic ion unless it is an exotic one. This is somewhat questionable interpretation. For $k = 157$ it could be identified as scaled up variant of delta band around 1 Hz which corresponds to DNA cyclotron frequencies. There are no further peaks visible in the figures of [I9]. Protonic cyclotron peak should be visible at frequency of 19.2 kHz not represented in the figures.

As already noticed, the 100 Hz periodicity visible in the spectrum of apofillit crystal (figure 2b) could be due to the harmonics of the Mg_{++} cyclotron frequency $f_c(167) = 100$ Hz at $k = 167$ space-time sheet. There is also 50 Hz periodicity and a weaker 25 Hz periodicity and these periodicities could correspond to even and odd cyclotron harmonics of Mg_{++} at $k = 169$ space-time sheet. Even harmonics for ordinary cyclotron transitions are suppressed by parity conservation.

6 Conscious hologram and remote mental interactions

The notion of conscious hologram allows also a unified description of remote mental interactions.

6.1 Big vision

The notion of conscious hologram, which is based on the generalization of the notion of Feynman diagram, provides a general view about remote mental interactions.

1. Brain can be seen as a part of a gigantic dynamical and fractal brain consisting actually of the entire universe. The same mechanisms that work at the brain level work also at larger length and time scales. Brains/bodies serve as 'neurons' for the magnetospheric selves receiving information from several brains/bodies. In particular the fusion of the mental images defined by similar structures can give rise to stereo-consciousness, and the notion of species consciousness and even multi-organ consciousness associated with various kinds of organs makes sense.
2. The notions of super-genome and hyper-genome provide a concrete view about how transpersonal levels of self-hierarchy are realized. Super genes are magnetic flux sheets containing sequences of genes like text lines at the page of book. Hyper genes are flux sheets containing sequences of super-genes belonging to different organisms as genetic text lines. This picture conforms nicely with and generalizes Sheldrake's species memory and 'alike likes alike' rule. It also suggest a concrete realization of remote biological mental interaction based on activation of gene expression and nerve pulse activity.

The flux sheets associated with super-genome and hyper-genome have fields strengths of magnetic field of Earth. The correlation of the quality of remote cognition performance with sidereal time [J14] leads to the hypothesis that also the flux quanta of galactic magnetic field couple somehow to living matter.

3. Besides time mirror mechanism charge entanglement realized in terms of W MEs is a basic mechanism of remote mental interaction. The simplest model for the generation of nerve pulse is based on quantum jump leading to a state in which Bose-Einstein condensate of Ca^{++} and/or Mg^{++} becomes exotically ionized and generates charge flow through cell membrane. Quite generally, charge entanglement would be part of the ordinary bio-control realized in terms of Ca^{++} waves. Charged entanglement provides also a mechanism for the sharing of mental images between magnetic body and biological body. There is no reason why this mechanism could not work also at the level of other remote mental interactions than those that we are too familiar with to realize that remote mental interactions are in question. The typical time 13-15 seconds associated with the remote realization of intentions by Qigong masters [J4] could correspond to a typical duration of W entanglement.

The models for bio-photons bio [I5] and Gariaev's findings [I9] suggest a tentative model for how remote mental interactions proceed. Charged entanglement via W MEs makes possible sharing of mental images. After a reduction of entanglement the generation of positive and negative energy MEs occurs and involves time mirror mechanism making possible remote metabolism and communications of declarative memories. In the case of ordinary bio-control magnetic body utilizes the metabolic energy resources of biological body.

4. Association mechanism works also for remote mental interactions and is even in the case of brain based on MEs and magnetic flux tubes with neuronal firing and metabolic activities being side products of the this mechanism.

5. One of the strange findings about remote mental interactions is that remote viewer can receive information about an object for which she knows only coordinates, which as such are meaningless numbers to her. It is also commonly reported that erroneous readings or interpretations of the target tend to propagate to other viewers. These findings suggest that magnetospheric (earthly or galactic magnetosphere could be in question) dynamical multi-brained selves act as kind of relay stations mediating the remote contact between remote viewer and object. If some brain knows the meaning of the coordinates of the target, this is enough to connect remote viewer to the correct target.

Empirical support for the notion of multi-brained collective levels of consciousness comes from the experiments of Mark Germaine [J6] . An operator and a subject person were involved. The stimulation of the subject person consisted of a sequence of identical sounds containing now and then an odd-ball stimulus (now silence). The odd-ball stimulus generated an event related potential (ERP) visible in EEG and reflecting the conscious reaction. The operator was in a second room and by simple toss of coin decided whether to observe the stimuli in the computer monitor or not. The stimuli appeared in the computer monitor one second before they were heard by the subject person.

What was found that when the operator saw the odd ball stimulus from the computer monitor, the ERP was weaker on the average. An 11 Hz periodicity was the major component in the difference profiles.

The simplest explanation is that the brains of both the operator and of the subject person belong to a larger multi-brained self and that the evoked response represented partially the reaction of this self. When this multi-brained self had already seen the stimulus through the operator's eyes, it was not so surprised to hear this stimulus again through the ears of the subject person, and ERP was weaker.

The appearance of the 11 Hz periodicity suggests that this frequency is an important correlate for the entanglement of the subject person's mental images with those of some multi-brained magnetospheric self. The cyclotron frequencies of most bosonic ions in Earth's magnetic field are in alpha band so that the finding is consistent with the vision about a fractal hierarchy of generalized EEGs associated with the dark matter hierarchy [K5] . The notion of hyper-genome provides a detailed model for how transpersonal levels of self hierarchy control the behavior of groups of individuals. The hypothesis could be tested by looking whether the gene expressions of individuals having close personal relationship but not in a direct personal contact correlate.

6.2 Sketch for what could happen in a typical remote viewing experiment

Consider a situation in which a system consists of remote viewer A, person B knowing the position of target T and the coordinates XYZ for it. B gives the coordinates XYZ for person C in turn giving them to the remote viewer A. The following simplified sketch assumes that communication channels are permanent and that the intentions involved with the process are realized as p-adic space-time sheets in the brain of A, and very probably involve p-adic MEs as representations of the intentions.

1. Remote viewer A, person B knowing having target-XYZ association as two mental images in his brain, and target T have permanent bridges to a magnetospheric multi-brained self M. Therefore M knows the target-XYZ association via the brain of B.
2. Remote viewer A is a client of the multi-brained self M using the remote sensory services provided by M. A-M contact is more or less permanent: this is what it means to have the ability to remote view. Minimum requirement is the existence of magnetic flux quanta connecting A to M. The sharing of mental images requires generation of entanglement, say charge entanglement by W MEs. This would correspond the most primitive passive mode of remote viewing. W mode allows to share also mental images of primitive living systems like plants, and even those assignable to system regarded usually as in-animate. The reduction of charge entanglement makes possible remote mental interaction since resulting charge non-equilibrium generates currents: generation of nerve pulse and Ca^{++} waves would represent basic example of this kind.
3. One can imagine also active mode of remote viewing and this could be involved with telepathy: in this case M would not be involved. This mode involves intentional action (p-adic MEs are transformed to their real variants) and classical communications with the geometric past/future

using neutral negative/positive energy MEs could realize declarative memories/"declarative" precognition as well as motor action based on classical communications using symbolic representations. The model for bio-photons suggests that Z^0 and em MEs are generated after the reduction of charge entanglement. The ability to predict reasonable well the personal future could rely on "declarative pre-cognition". The evolution from bicameral mind to modern consciousness [K23] could have proceeded from a mere sharing of mental images by W MEs to complex classical symbolic communications involving also neutral MEs.

4. Since M cannot be assumed to have anything comparable to a nervous system, A-M communications should rely on sharing of mental images. That is, the intention of A (p-adic space-time sheet in brain of A perhaps) to remote view and the questions of A about the target would be shared by M . T-M communications could involve classical communication with light velocity generating magnetospheric sensory representation about the target by self-organization. The 13-17 second delay of remote mental interactions [J4] could correspond to the typical duration of charge entanglement. Target could be also "non-living": it is quite possible that magnetospheric selves form sensory representations also about "non-living" matter. The finding that meteor sounds have frequency spectrum in the 40 Hz band of thalamocortical resonance frequencies, rather than in the predicted 20-20.000 Hz band, supports the view that magnetospheric sensory representations at 40 Hz resonance band are associated also with the non-living matter [K13] , [F1] . Also the vision about dark matter hierarchy conforms with the idea about Earth's magnetosphere as a living organism.
5. Remote viewing by the sharing of mental images means that there are no sensory receptors associated with the passive mode of remote viewing: no such receptors have been identified [J3] . Various physiological correlates (say EEG patterns) of remote viewing should be reactions to the shared mental image rather than direct correlates of it. If primary sensory qualia are at the level of sensory organs, remote viewing differs from hallucinations in that there is no feedback to the retinas from cortex responsible for "qualification": this could provide be a clear-cut test. At least in the case of living targets the laws that govern the ordinary sensory perception should hold true for the remote viewing. For instance, the known correlation of the AC performance with the spatial and temporal entropy gradients of the target should hold true for living targets. Even in the case of a non-living target similar correlation holds true if the sensory perception of magnetospheric selves obeys same laws as that of ours: there is some evidence for the correlation of the entropy of non-living target with the AC performance [J3] .

6.3 Why it is so difficult to take remote mental interactions seriously?

By the fractality of consciousness the anatomy of quantum jump represents the general structure of the life cycle of any self. First totally entangled multi-verse is generated, then state function reduction and preparation by self measurements occur and the end result is a maximally un-entangled state. This is what analysis following the birth of an intuitive idea is. By the fractality of consciousness same process occurs also in longer time scales since the sequences of quantum jumps effectively integrate to single quantum jump and the sequences of these effective quantum jumps have similar structure.

This somewhat pessimistic vision is based on the standard Shannonian notion of entropy. For algebraic entanglement, which is the only possible entanglement between different number fields, number-theoretic entropies can be non-negative and Negentropy Maximization Principle does not force de-entanglement in this case. Thus it might be possible to avoid the unavoidable looking decay, and living systems might apply it routinely.

Dark matter hierarchy provides justification for the hierarchy of moments of consciousness with increasing averaging geometric durations and for the idea of quantum parallel dissipation. The simplest view is that life cycle corresponds at the highest level of the personal dark matter hierarchy single moment of consciousness and lower levels would define the mental images as sequences of quantum jumps. This would explain why we 'know' that we existed also yesterday. Entropy growth would apply only to the sequences of lower level quantum jumps defining sub-selves so that mental images would age but could also reincarnate.

Depending on whether one believes in Shannonian world order or takes seriously the notion of number theoretic entropy, one ends up with two almost diametrically opposite visions: evolution as

an emergence of selfish *resp.* unselfish selves. Both views explain in their own manner why it is so difficult for a modern man to take remote mental interactions seriously.

6.3.1 Pessimistic view: evolution as a gradual de-entanglement?

From the Shannonian view point and assuming no dark matter hierarchy, the evolution of self at any level is also a decay process leading to alienation and loneliness at the level of mental images. What is consoling is that selves can lose consciousness and wake-up into new childhood. One can say that a healing sleep after a hard day is possible at all levels of self hierarchy.

Ancient myths inspire to think that this vision applies to the evolution of modern subjective consciousness from more collective consciousness. Jaynes has proposed a vision about how bicameral consciousness [J8], in which the voices of Gods talking to people were talking to everyone, gradually transformed to the modern subjective consciousness. TGD based articulation of Jaynes's views based on the notion of semi-trance is discussed in the last chapters of this book.

The basic theme of the pessimistic view about evolution would be the gradual de-entanglement. The ancient world has survived in fairy tales. In this world remote mental interactions like telepathy, remote healing, and witchcraft were every-day life. Incredible-to-us physical feats like building of pyramids might have been made possible by the liberation of energy and coherent momentum in the formation of collective bound state entanglement. The rhythmic work songs helping to generate body synchrony are a remnant from this period, but are not sung in modern IT companies. Also the strange intra-terrestrial creatures and spirits of magnetosphere; fairies, trolls, eagle-headed humans, dreadful snakes,...., populated this world. Shamans talk completely seriously to the anthropologists about these creatures without any doubt about their reality. The human sacrifices for Gods, which look extremely cruel to us, were not experienced as such since these people were not individuals with ambitious plans for a lifelong career.

This development has a parallel at the level of personal life. Fairy tales are told to children, who themselves are living the period of oneness. Then these children grow, become more and more rational and analytic. After the days of willpower, intentional resources re depleted and they gradually lose their ability to make choices and there is not much to choose anymore, and become often also lonely and separated. Gradual physical decay adds its own flavor to this process.

The entire evolution could be seen as wake-ups or re-births, bursts of potentialities from which only few are selected during gradual de-entanglement accompanying self-organization, with dissipation serving as the Darwinian selector. Huxley's view about brain as a filter makes sense: our brains would minimize the sharing of mental images, which does not aid controlled behavior and survival, and thus make us modern individuals. For instance, the mysterious ability of birds and fishes to migrate back to their birth places might actually involve quantum entanglement.

Inhibition by various neurotransmitters could be seen as a measure for the degree of de-entanglement. Inhibition would act as the filter, which de-entangles the brain from other brains and the body from the bodies of other life forms. During hallucinatory experiences, generated by say drugs, inhibition would "fail". The degree of inhibition indeed increases, as one climbs along evolutionary tree and in human brain most of the neural activity is inhibition, a rather strange finding difficult to understand in the framework of the ordinary neuroscience.

In accordance with ontogeny recapitulates phylogeny principle, this evolution could be seen as an increasing dominance of inhibition during the development of individual leading from spontaneous children to well-behaved and highly controlled adults. Only in some periods of life inhibition fails: during puberty, in physical death and in great turning points of life. Indeed, puberty and physical death are sometimes accompanied by poltergeist phenomena. Physical death may also be accompanied by telepathic phenomena.

6.3.2 Optimistic view: evolution as an emergence of un-selfish selves?

If the notion of the number-theoretic entropy makes sense and the view that life cycle itself corresponds to a single moment of consciousness at the highest level of personal dark matter hierarchy, the view about the growing role of inhibition as an indication of continual de-entanglement is incorrect.

Rather, the increasing dominance of inhibition would indicate the increasing role of an entanglement during which neuron receives negative energy MEs, and thus provides energy for some another system by buy now and let others pay mechanism. This would mean a gradual emergence of un-selfish

neurons making possible increasing flexibility and co-operativity. This of course applies also at higher levels like family and society. The increasing role of inhibition could also reduce the remote mental interactions having negative effects (witchcraft might involve genuine remote mental interactions). The Jaynesian view about the evolution of subjective consciousness could be seen as a gradual development from a child like selfish self sending negative energy to an adult unselfish self able to receive negative energies and co-operate.

The primitive society as an analog of single muscle becomes a flexible system in which responsibilities are maximally delegated to the individuals and God's voice does not anymore give direct commands and advice. The evolution of social structures and culture is essentially evolution of hyper-genome coding for the transpersonal levels of consciousness. The irony is that the replacement of God's voice with symbolic communications leads to the illusion that there is nothing but the lonely individuals although the emergence of complex social structures suggests just the opposite.

In this picture the loneliness of the post-modern man might be seen as a degeneration, a return to a selfish child like behavior paralleling the disappearance of transpersonal levels of consciousness. In entanglement either party is the one who gives energy, and the refusal of the average market economy self to entangle by receiving negative energy or sending positive energy makes it hard to entangle at all. A society of lonely skeptics is the outcome. In this view, the failure of inhibition is a degeneration phenomenon, a return to childhood, and involves strong fluxes of negative energy to the environment generating irreversible phenomena like poltergeist and inducing telepathic experiences.

6.4 About the physiological correlates of anomalous cognition

In the article "Physiological correlates of Psi cognition" of Charles Tart [J15] some apparently contradictory findings about physiological correlates of anomalous cognition are described besides the experimental findings of Tart. Changes in EEG, galvanic skin response, finger pulse, and basal skin resistance are examples of possible candidates for the physiological correlates of remote mental interactions.

The findings are following.

1. The first class of experiments involves two persons: subject and agent. The agent is subjected to various kinds of stimuli inducing emotional response: sudden sounds, painful stimuli as in the experiments of Targ, etc.. Subject person is typically in a sound proof room and tries to remotely cognize when subject person experiences these stimuli. Various candidates for the physiological correlates are measured. The physiological correlates typically express a heightened arousal. For instance, in the experiments of Tart [J15] galvanic skin response occurred more frequently, and EEG became more complex with more beta waves and fewer alpha, theta, and delta waves.
2. In the second kind of experimental arrangement remote viewing or telepathy is involved but the second person, if present at all, is not subject to any stimuli inducing emotional reaction. Now the physiological correlates tend to be characteristic for a relaxed state of mind. The increase of the basal skin resistance is one such correlate.

At first these findings might seem to be contradictory. The paradox disappears if sharing of mental images is in question and if the mental images induce same emotional response in the subject person as in the agent.

The remotely perceived (possibly sub-conscious) stimulus or remote anticipation of the stimulus induces in the subject person an emotional reaction having as a correlate the reduction of skin resistance. In the experiments of Tart [J15] both the real electrical stimulus experienced by the agent and the electrical stimulus guide by the operator to an electrical resistance instead of the agent, generates the arousal in the subject. This requires that both the operator, agent, and subject belong to the same multi-brained self so that the reaction of the subject can be interpreted as a kind of conditioned reaction of the multi-brained self expressed via the body of the subject.

6.5 Local sidereal time, geomagnetic fluctuations, and remote mental interactions

The article of J. Spottiswoode [J14] discusses two strange findings about remote mental interactions.

1. There is a statistical tendency of the anomalous cognition (AC) performance to concentrate in a 2 hour period around 13.30 of the local sidereal time (ST), which is the time measured using as a reference distant stars and thus running at a slightly different rate than the solar time: the lag is $\Delta T = 24/365$ hours ~ 3.7 minutes during 24 hours.
2. The anticorrelation between the level of geomagnetic fluctuations and AC performance has also a maximum during 2-hour period around ~ 13.30 ST.

The fact that AC performance is associated with the same sidereal hour suggests the identification of the galactic magnetosphere as a conscious involved with remote cognition. For interstellar and galactic magnetic fields cyclotron time scales correspond to the time scales of human consciousness so that also these magnetic flux quanta could receive sensory input from biosphere and control it.

6.5.1 Support for the role of magnetospheric consciousness

The so called ap index measures the intensity of the fluctuations of the Earth's magnetic field. If the magnetosphere is a conscious entity, ap index can be interpreted as a measure for the level of arousal of the magnetospheric mind. The negative correlation between ap and AC performance tells that AC is most probable, when the magnetosphere is in a "calm state of mind". This is natural since only in this kind of situation the noise masks minimally the signals from the galactic magnetosphere.

The local magnetic noise produced by the modern high tech environment is much stronger than the geomagnetic noise but this does not matter. If artificial magnetic fields correspond to $k_d = 0$ level of the dark matter hierarchy, they have no effect on higher levels of dark matter hierarchy.

6.5.2 Is there an ELF signal from the special direction masked usually by the geomagnetic noise?

The obvious question is why the anticorrelation between anomalous cognition effect size and ap index is highest at 13.30 ST? What this finding means that a particular portion of the sky defined by a definite longitude is above the head of a successful anomalous cognizer independently of the time of year. Thus there should be something special in a direction at this longitude.

The simplest explanation for these findings goes as follows.

1. Suppose that there is a higher level conscious entity at the direction 13.30 ST at the galactic magnetic body such that various cyclotron frequencies involved with the communications with this entity correspond to a typical time scale of the anomalous cognition. This conscious entity could have size of galaxy or it could correspond to a flux tube of galactic magnetic body using the cognizer and target as sensory receptors and motor instruments just as our magnetic body might use neurons of our brain or our body parts.
2. Anomalous cognition could involve positive and negative energy signals to this magnetic body and back so that essentially instantaneous AC events would be possible.
3. The information transfer between two kinds of flux tubes is made possible by the topological condensation of the flux tubes of B_E or its dark variant at those of the galactic magnetic field or its dark variant and would be maximal when both are nearly vertical. Also geomagnetic noise would be transferred via wormhole contacts to the flux tubes of the galactic magnetic field and perturb these communications. Both AC and its anticorrelation with geomagnetic noise would be maximal when the flux tubes of of magnetic fields in question are approximately parallel. Since the flux tubes of B_E are approximately vertical, this the case when the galactic center is directly above the head. This would explain the special value of sidereal time. One can say that the magnetic flux tubes of the interstellar magnetic field define kind of cosmic umbilic cord which might serve as a correlate for the tunnel experience associated with NDEs.
4. If signals to geometric past and back are involved the time and length scales would measured using 10^5 years as unit. The signals themselves would be coded using frequencies characterizing time scales of neural consciousness as kinds of ripples to the very slowly oscillating background signal just as perturbations due to nerve pulses interfere with EEG rhythms. Since remote psychokinesis and anomalous cognition should rely on the same mechanism, the first guess for

the time scale involved with these signals is as the time lag of 13 to 17 seconds involved with the remote realization of intentions by Qigong masters [J4] : the interpretation as a typical duration of charge entanglement was already proposed. It would not be surprising if the time scale of entanglement would determine also the scale of cyclotron frequencies. This would mean the importance of the frequencies in the range .06 to .08 Hz for anomalous cognition.

The following scenario suggests a possible manner to understand the time scale of remote PK.

1. If protonic cyclotron transitions generate the low frequency MEs in the range $f_1 = .06$ Hz to $f_2 = .1$ Hz, the strength of magnetic field must be in the range 13 to 17 nT (nanotesla). The magnetic flux tubes of an interstellar magnetic field in a direction with a longitude defined by 13.30 ST should be in question.
2. The ends of the magnetic flux quanta attached to structures within the inner magnetosphere co-rotate with Earth. The resulting twisting presumably tends to induce additional noise to the interstellar magnetic field or Earth's magnetic field or both.
3. The strengths of the typical disturbances of Earth's magnetic field are in the range 50-200 nT [J14] . The average strength for a given frequency component for the fluctuating part of the Earth's magnetic field increases at low frequencies. At the alpha band the strength of the Fourier component of fluctuations is about $\sqrt{B^2(f)} \simeq 1 \text{ pT}/\sqrt{\text{Hz}}$ at alpha frequencies. Interestingly, the magnetic perturbation produced by brain at alpha band has a peak, which is slightly above the fluctuations of the Earth's magnetic field. This is perhaps not an accident in light of the expected role of the alpha band in remote mental interactions. The strength for the Fourier component $B^2(f)$ for the fluctuations of $B^2(t)$ [J1] is roughly $\sqrt{B^2(f)} \simeq .1 \text{ nT}/\sqrt{\text{Hz}}$ at $f_2 = .01$ Hz, and about $\sqrt{B^2(f)} \simeq 10 \text{ nT}/\sqrt{\text{Hz}}$ at frequency $f_1 = .06$ Hz.

What puts bells ringing is that the noise level 50-200 nT is by a factor 4 to 15 higher than the required interstellar static magnetic field at the lower limit corresponding to the 17 second period. These findings suggests that magnetic fluctuations tend to mask the positive effect of the interstellar magnetic field on AC. Only when the strength of the fluctuations of the Earth's magnetic field at the cyclotron frequency of the interstellar magnetic field reduces sufficiently below the strength of the interstellar magnetic field, the masking effect is small enough.

6.5.3 What is the origin of the interstellar magnetic field?

The idea about the magnetic umbilic cord connecting distant astrophysical objects to a single quantum coherent whole is sensible in the many-sheeted space-time. The TGD based model for the galaxy formation assumes that the ordinary matter results from the decay of cosmic strings, which are objects carrying extremely strong magnetic fields (magnetic flux tubes and these objects belong to the same solution family of field equations). These cosmic strings form a complex network. For instance, this model explains gamma ray bursters [K25] .

The huge energy production of gamma ray bursters is consistent with their huge distance only if one assumes that the energy is liberated in jets. In TGD framework the gamma ray bursts can be identified as jets resulting in the decay of split cosmic strings giving rise to the ordinary matter. The bursts are indeed known to originate in the regions, where new stars are born. This picture supports the idea about the existence of a fractal magnetic flux tube network connecting different astrophysical objects, and left as a remnant from cosmic strings, when their magnetic energy transformed to the ordinary matter and gave rise to the birth of stars. This network could give rise to galactic nervous systems in turn combining to the central nervous system of the Universe.

Surprisingly, this picture might be consistent with the constraints on the direction and magnitude of the interstellar magnetic field.

1. According to the online lecture of S. Oliver [E3] , the measured values of the interstellar magnetic fields depend somewhat on the method with which they are measured (this might be a signal of the many-sheetedness). The interstellar magnetic fields vary in the range $B_u = 1 \text{ mGauss}$ – $B_l = .1 \text{ } \mu\text{Gauss}$ [E5] , which means that both electronic and protonic cyclotron time scales for all interstellar magnetic fields correspond to time scales relevant for human consciousness. The minimal values of k_d are $k_d = 53$ for B_u and $k_d = 66$ for B_l from thermal stability: .1 second time scale of alpha band is mapped to 50 s for B_u and to ~ 3 days for B_l .

2. The synchrotron radiation associated with the diffuse emission from the whole sky but concentrated towards galactic plane corresponds to a field strength $\sim .6$ nT. Zeeman splitting for hydrogen 21 cm line from condensing clouds gives fields in 1-2 nT range. In the plane of the galaxy the field is roughly parallel to spiral arms and its strength is .1-1 nT and too weak to correspond to the proposed magnetic umbilic cord. Also the direction of the spiral arm is different from the direction of the required magnetic umbilic cord.
3. The second guess is that the magnetic umbilic cord is orthogonal to the galactic plane. The direction of the galactic North Pole has the right ascension (identifiable as the sidereal time at the meridian of the rotating observer) RA=12.49 $\delta = 27.4$ degrees: RA is not too far from 13.30 so that this guess might make sense. Taking into account that the rotation axis of is tilted by 23.5 degrees towards Sun this would mean that the direction of the magnetic umbilic cord is with accuracy of 3 degrees in the plane defined by the orbit of Earth around Sun. Interestingly, the magnetic field associated with the solar wind varies in the range .2 – 80 nT and average value is 6 nT.

According to [E5] , galactic center carries a dipole like field with a strength of order 100 nT, not too far from 10-30 nT. Also this field has filament like structures (flux tubes), which might extend to long distances [E5] . The flux tubes of this field should intersect the galactic plane orthogonally. If the strength of the magnetic field inside the flux tubes stays constant rather than varying like dipole field strength, these flux tubes could give rise to the magnetic umbilic cords connecting us directly to the center of the galaxy. Galactic center, perhaps the immense black-hole region there, could be an monstrous brain having galaxy sized central nervous system! That the model for magnetospheric consciousness would generalize to the scale of entire galaxy would conform with the fractality of consciousness.

4. According to [E5] , supernova remnants are accompanied by radial filament like structures carrying magnetic field in 1-10 nT and it seems that supernova wind might carry this field around galaxy: very natural if flux tubes carry the field. According to [E3] , for individual sources such as supernova remnants like Cas A Minor, the field strength is 10-30 nT. This corresponds to the interval 5.6 to 17 seconds. That the field strength is of the same order of magnitude as the dipole field at the galactic center conforms with the idea about magnetic nervous system of galaxy connecting the center of the galaxy to the stars. This magnetic field would be easy to observe in case of supernovae because super nova explosion has packed magnetic flux tubes to a very dense bundle.

6.5.4 Connections with other effects?

There might be fascinating connections with other strange findings.

1. In Comorosan effect [K28] , [I3] the irradiation of a bio-matter with a laser irradiation lasting for a multiple of 5 seconds has anomalous effect on a catalyst action. 5 seconds corresponds to $n = 3$ cyclotron transition for proton in a magnetic field of 10 nT. Comorosan effect occurs also in a non-living matter and suggests that the magnetic umbilic cord serves as a kind of cosmic clock.
2. The strength of the Earth's magnetic field in far-away in the plasma sheet is about 10 nT. Could this cosmic magnetic umbilic cord be connected with the plasma sheet and be in a synchrony with what happens there? Plasma sheet is known to be highly self-organizing structure containing in the velocity distributions of charged particles features like "wings" and "eyes" [F2] . In [K14] I have proposed that plasma sheet defines the "self model" of magnetospheric brain and is thus in a role analogous to the insula in the human brain. It would rather natural for the cosmic umbilic cord to couple with that part of the magnetospheric brain which corresponds to the highest level in the self hierarchy associated with the magnetic Mother Gaia.
3. Lungs contain magnetic particles giving rise to magnetic field of about 10 nT. The theory of magnetospheric sensory representations inspires the speculation that the moment of physical death is decided by magnetospheric self sending to lungs stopping signal at proton's cyclotron frequency associated with 10 nT magnetic field.

6.6 DelaWarr camera

One can ask how the information about the body part is coded into the fields associated with the transversal MEs. The most naive guess is that the representation is simply a 4-dimensional photograph about body part, that is dynamical hologram, and that the DNA in the cells which express the formation of a given body part contain this kind of representation. The cells in which the genes are expressed could contain this kind of representation serving as a template and biological control command. Thus body part would contain its own image in each of its cells. The time reversal (phase conjugate) of the 4-D hologram would in turn naturally act as a time reversal of the control command and provide a universal mechanism making possible healing and self repair.

Entire hierarchy of representations in various length scales might be involved providing dynamical photographs about the planned evolution or various bio-molecules, subcellular structures, cells, etc... This sounds utterly simplistic but one can ask what else? The representation for the development body structure must be based on very simple and concrete code since the cells building it during morphogenesis are very simple creatures and see only the light telling where to go and what to do!

This naive guess might have some truth in it as following arguments suggest. In CASYS2001 symposium Peter Marcer [I15] told about the British engineer George DelaWarr built a remote imaging camera in the 1950s. Using only a test object provided from the subject such as a small blood, sputum, or hair sample, this device photographically images the subjects internal conditions at a distance, with a high degree of accuracy.

A unique feature of the DelaWarr system is claimed to be that it is able to detect diseases in the pre-clinical stages prior to detection by conventional techniques such as physical examination, X-ray, CT scan, or Magnetic Resonance Imaging. The photographs taken by DelaWarr camera were treated by Susan Benford by modern image processing techniques and she claims that these photographs contain the information needed to reconstruct three-dimensional holograms. The proposed explanation was that the test object (adjunct) contains a hologrammic representation about the patient.

The functioning DelaWarr camera looks highly mysterious even when one takes seriously the idea that DNA generates holograms of the body parts it codes for. Therefore it is better to introduce the ingredients of the model by making questions.

1. Was the intent of the photographer all that was needed and did other levels levels of the self hierarchy take care of the rest as they do when I make the decision to raise my hand? Could the intent of the photographer have generated a reference wave at some very special frequency acting on the adjunct and activating a hologram giving rise to a photograph about the desired body part or inducing a sequence of events leading eventually to the generation of the photograph?
2. Was the visible light giving rise to the photograph generated in the adjunct? Does the DNA of each cell of body and thus also of the adjunct contain electromagnetic representations for the body parts and are these representations more or less equivalent with holograms? Certainly direct hologrammic images about body parts would provide the simplest manner to realize the field part of the genetic code as proposed.
3. Did the adjunct serve as a relay station (much like thalamus in brain) mediating the information from the patient via magnetic flux tube-ME pairs to the camera projecting it to the camera as a coherent light generating an ordinary photograph? Was the image realized as a coherent light propagating along the MEs connecting adjunct and patient serving as bridges?

7 The experimental work of William Tiller about intentional imprinting of electronic devices

William Tiller in Stanford University has carried out impressive experimental work with what he calls intention imprinted electronic devices (IIED), and his results challenge that standard assumption that the intentions of experimenter do not affect the experimental apparatus [J16, J17, J18] .

7.1 Experimental arrangement

The goal was to try to imprint a specific intention into a simple, low tech electronic device so as to influence the companion, specific, well-designed, target experiment. The intentional imprinting was

attempted in a meditative state. The intentionally imprinted device, IIED, was sent to a laboratory located at distance of about 1500 miles where colleagues had set up the experiment. The device was placed about 6 inches from a continuously running and computer-monitored target experiment and switched on (total electrical power rate was less than 1 microwatt). Over a time period of about 1-4 months the recorded results from the target experiment changed in the directions of the specific intention and the change eventually reached the selected magnitude of the specific intention. Also an identical, but not intention imprinted device was used and the results were compared in order to achieve more objective measurements about the effects of human consciousness on electric devices.

The targets used were purified water, some bio-molecules, and larvae of flies. These targets were either unshielded or shielded from radiation. For the latter purpose they were closed inside a grounded Faraday cage (FC), which screened rather effectively the radiation coming at microwave frequencies whereas for ultra low frequency (ULF) fields the screening is virtually absent (skin depth behaves as $1/\sqrt{\pi\sigma f}$ at low frequencies and $f = 2\pi\sigma$ (in units $\hbar = c = 1$) defines kind of critical frequency above which screening occurs effectively). The targets could be affected by control device (CD) or by identical IIED generating microwave radiation. Radiation was generated either at single frequency (7.3 MHz) or at three frequencies (5.0, 8.0 and 9.3 MHz) [J19] .

In the case of purified water the spatial distributions of physical parameters like pH, temperature, and conductivity were measured as a function time. In the case of bio-molecules the possible effect on thermodynamical activity, which measures the thermodynamical energy of single molecule, was measured. In the case of fly larvae the effect on the larval development time was studied. The results from various arrangements were compared with control targets (no FC, no CD, no IIED).

7.2 Basic experimental findings

The basic experimental results were two-fold. First of all intended effects were achieved. Secondly, the "conditioning" of the laboratory resulted as an unexpected effect and continued even after the removal of the target and IIED.

7.2.1 Direct effects of the intentional action

1. IIED imprinted by intention to increase/decrease the pH of water gradually induced a shift in the pH of purified water to the intended value, increased the in vitro thermodynamic activity of bio-molecules, and a reduction of larval development time.
2. For bio-molecules and larvae four simultaneous side-by-side treatments were tested: i) an unshielded sample, ii) a shielded sample, iii) a shielded sample with an "on" control device, iv) a shielded sample with an "on" IIED. Just the shielding of em radiation affected the thermodynamic activity of the bio-molecules, and just adding less than about 1 microwatt of microwave radiation via control device reduced the thermodynamical activity and lengthened the developmental time. Thus the microwave radiation acted as a stressor having entropic effect. When the control device was replaced with IIED, the degradation caused by microwave radiation was overcome.

7.2.2 "Conditioning" of the laboratory

Quite unexpected phenomena arose from a repeated conduct of IIED in a given laboratory space. By simply continuing to use IIED in the laboratory space, it became "conditioned in some very fundamental way". Three signatures heralded the onset of the "conditioning" process.

1. Oscillations of air and water temperature, and of pH and electrical conductivity of water with large amplitudes with the periods of oscillations in 10-100 minute range developed. The amplitudes of pH- and temperature oscillations was $\sim \Delta pH = .1$ pH-unit and $\Delta T \sim 1 - 3$ K units respectively. Even more remarkably, the oscillations were sustained in the locale even after the removal of the IIED suggesting kind of phantom effect analogous to phantom DNA effect. Oscillation amplitude had peaks at the harmonics of fundamental frequency $f_l = 1/T_l$, $T_l = 36.6$ minutes with three lowest harmonics being very clearly visible [J18] . Also $T_l = 51.2$ minutes appears as fundamental period in some experiments. The ratio of these periods is 1.4 and rather near to $\sqrt{2} = 1.41$, which might relate to p-adic length scale hypothesis.

2. When an pH-increasing IIED with intention to increase pH by one unit was turned on in an almost unconditioned space located several hundred feet away from a strongly conditioned space, a well-defined pattern of pH-oscillations in an unconditioned space emerged. This pattern was accompanied by a highly correlated pattern of oscillations in strongly conditioned space. This kind of highly correlated oscillations were not observed in several unconditioned spaces - also located several hundred feet away.
3. The targets were subject to the action of a vertically aligned magnetic field in the range of $10^{-2} - 5 \times 10^{-2}$ Tesla, such that the direction of the field could be reversed. In an unconditioned space the change of the direction of the magnetic field did not affect the pH. In the strongly conditioned space the effect on pH was different for the opposite directions of the applied field and the difference in pH values was about .6 units. One can say, that the target had become sensitive to the effects of external magnetic fields.

7.3 Explanation of the pH oscillations in terms of the general model of intentional action

The findings described above support the notion of magnetic body as a mediator of the intentional action, and provide a connection with the general TGD based vision about pre-biotic evolution. The following general model for the effects suggests itself.

7.3.1 Intentional action induces magnetic self-organization of the control device and target

The magnetic body of IIED becomes a part of the intentional agent. Also the magnetic body of the target (purified water, etc...) partially fuses with that of IIED. Even more, the general model for the pre-biotic evolution [K8] suggests that the intentional action mediated via the IIED induced a self-organization of a p-adic hierarchy of topological field quanta of magnetic field in the target system. This kind of hierarchy is associated also with DNA in the TGD based model for the effects of laser radiation on DNA observed by Gariaev [I9]. The generation of magnetic structures in shorter length scales is what one expects the intentional action to generate since intentional "growth" proceeds quite generally from long to short length and time scales.

The simplest candidate for the time scale of oscillations varying in 10-100 minute range is as the time scale associated with the cyclotron frequency of magnetic field quanta responsible for the intentional action. The cyclotron period of proton lies in 10-100 minute range for a magnetic field strength varying in the range of 27.8-278 pT. For $T_l = 36.6$ minute period the field strength would be 75.9 pT. The corresponding magnetic length is 4 mm and near to $L(188) = 3.7$ mm. The harmonics of the fundamental f_l could correspond to the quantized values of the magnetic flux coming as integer multiples of the basic flux with the strength of magnetic field quantized to integer multiples. Similar quantization of the Z^0 magnetic field strength is assumed in TGD based model of hearing [K20].

Cyclotron oscillations in the magnetic field could induce by some mechanism a periodic flow of protons between the magnetic flux tubes and the atomic space-time sheets of water and in this manner affect pH. pH-fluctuations would in turn induce temperature and conductivity fluctuations as side effects. Both $T_l = 51.2$ min and $T_l = 36.6$ min appear and have ratio very near to $L(k+1)/L(k) = \sqrt{2}$. If this finding is taken at face value, the magnetic flux quanta must be magnetic sheets for which magnetic flux scales as the inverse of the thickness $d = L(k)$ of the flux sheet having constant size in the second transversal dimension.

7.3.2 Scaling law of homeopathy and frequencies of pH-oscillations and microwaves

The experiment involves two frequencies: the ULF frequencies associated with the pH-oscillations and the frequencies associated with the microwaves generated by the control device. Since intentional action compensates for the entropic effect of microwaves, these frequencies should relate to each other and generalized scaling law is an excellent candidate in this respect.

The TGD based model explains and generalizes the scaling law of homeopathy, which states that low and high frequencies having ratio $f_h/f_l = 2 \times 10^{11}$ accompany each other. Cyclotron oscillations with frequency f_l would result when charged particles drop from smaller space-time sheets and liberate the increment of zero point kinetic energy as a radiation with frequency f_h . Also the reverse of this

process could occur with generation of negative energy photons at frequencies f_h and f_l . The emission of two photons is needed to guarantee momentum conservation since the momenta of charged particles are so small as compared to photon momenta.

The generalized scaling law predicts

$$f_h/f_l = \Delta E_0/E_c(k_2) \ ,$$

where $\Delta E_0 = E_0(k_1) - E_0(k_2)$ is the zero point kinetic energy increment when a charged particle drops from the space-time sheet labelled by k_1 to the sheet labelled by k_2 . $E_c(k_2)$ denotes cyclotron frequency at the magnetic flux tube labelled by k_2 .

The factor f_h/f_l varies but does not depend on the mass of the charged particle and by the quantization of the magnetic flux are apart from a numerical factor proportional to the ratio $p_2/p_1 = 2^{k_2-k_1}$ defined by the p-adic primes $p \simeq 2^k$ for the two space-time sheets in question. The scaling law of homeopathy in its basic form and p-adic length scale hypothesis suggest that f_h/f_l is related by a power of two to $f_h/f_l = 2 \times 10^{11} \sim (200/256) \times 2^{38}$ so that one has

$$f_h/f_l = 2 \times 10^{11} = (200/256) \times 2^n \ ,$$

where the integer n varies.

The generalized scaling law suggests that the frequency of pH oscillations corresponds to f_l . The frequencies of microwaves would correspond to f_h identifiable as the zero point kinetic energy of proton liberated when it drops from space-time sheet generated by the intentionally induced magnetic self-organization.

7.3.3 The mechanism of intentional action

The control device generates microwaves, and the intentional action should compensate the effect of the control device. The model of the intentional action based on the time mirror mechanism supports the view that negative energy MEs and photons are involved. Phase conjugation means essentially time reversal, and it could compensate the entropic effect of the ordinary microwaves generated by IIED and acting as a stressor in case of fly larvae. This also conforms with the fact that phase conjugate microwaves inside MEs can penetrate the Faraday cage.

The longitudinal Fourier expansion of the fields inside ME contains besides high and low frequency Fourier components and also constant component. The constant component represents intentional action and grows quantum jump by quantum jump to a value realizing gradually the desired effect, say change of pH.

The microwave radiation at frequencies f_h could induce a flow of protons between $k = 167$ space-time sheets and larger space-time sheets by providing the needed zero point kinetic energy to kick protons to $k = 167$ space-time sheet. Negative energy (phase conjugate) microwave photons would induce the reverse process. By the basic mechanism of induced emission (now induced dropping) this in turn could induce the flow of protons from atomic space-time sheets to smaller space-time sheets as a kind of domino effect, and lead to a new flow equilibrium would result with different pH. The pre-requisite of this mechanism is that the hierarchy of the magnetic flux tubes characterizing also DNA is present in the target. The IIED affected by the intentional action would give rise to this magnetic hierarchy unless it already exists. IIED would play a role similar to an object received by the person to be healed from the healer (or vice versa) in remote healing.

A more detailed space-time description for what happens might be as follows.

1. Constant field representing intention, ULF and microwave fields are coherently superposed inside MEs (incoherence would mean microwave MEs inside ULF MEs) so that the corresponding transversal magnetic and electric fields are precisely parallel by the highly non-linear properties of MEs. ULF frequencies correspond naturally to the harmonics of cyclotron frequency because of the strong coupling to cyclotron phase transitions of the Cooper pair Bose-Einstein condensate.
2. MEs serve as temporary bridges connecting the boundaries of $k = 169$ and $k = 188$ space-time sheets and the oscillating electric field of ME is orthogonal to the boundaries. By quantum classical correspondence the microwave frequencies associated with ME as well as the voltage along the bridge correspond to integer multiples for the energy of a microwave photon. The same mechanism based on Z^0 MEs underlies the TGD based model of nerve pulse.

3. The superposed ULF and microwave frequency electric fields inside ME induce a periodic flow of the protonic Cooper pairs forth and back between the super-conducting flux tubes of the Earth's magnetic field ($k = 169$) and magnetic flux tubes of the field B_I ($k = 188$). Microwave part induces a rapidly oscillating force superposed to the slowly varying ULF part and constant part of the force. The oscillatory flow of protons from atomic space-time sheets to larger space-time sheets affects the proton density at atomic space-time sheets causing pH oscillations.

7.3.4 Do the three peak frequencies for pH-oscillations correspond directly to three microwave frequencies by scaling law?

Scaling law would suggest that the three peak frequencies coming as harmonics of $f = 1/T_l$, $T_l = 51.2$ min, correspond to three frequencies f_l identifiable as cyclotron frequencies corresponding to the quantized values $n = 1, 2, 3$ for the magnetic flux. The frequencies produced by control device producing microwaves in 1-10 MHz range are non-trivial [J17, J18] and the first bet is that the frequencies given by the generalized scaling law must be in this range to compensate the entropic effects. The generalized scaling law $f_h/f_l = (200/256) \times 2^n$ with $n = 33$ gives the frequencies $f_h = 3.1$ MHz and its two harmonics 6.2 MHz and 9.3 MHz as counterparts of f_l and its harmonics. The frequencies produced by the control device are 5.0, 8.0 and 9.3 MHz and not harmonics of each other. Note however that the highest frequency corresponds exactly to the third harmonic of f_l .

Rather remarkably, $f_h = 3.1$ MHz corresponds to the zero point kinetic energy of a protonic Cooper pair at $k = 169$ space-time sheet associated with the magnetic flux tubes of the Earth's magnetic field. Thus protonic Cooper pairs could drop from the super-conducting flux tubes of the Earth's magnetic field to the magnetic flux tubes of ~ 76 pT magnetic field having $k = 188$. This in turn would generate a cascade like dropping of protons from the atomic space-time sheet so that pH is changed.

7.3.5 Correlation between pH and temperature oscillations and protonic zero point kinetic energy

In the case of water at temperature $T = 300$ K the amplitudes of oscillations are $\Delta T = 3$ K and $\Delta pH \simeq .1$. If the density of protons satisfies $n = n_0 \exp(-\Delta E/T)$, where ΔE is most naturally the zero point kinetic energy .4 – .5 eV of protons at the atomic space-time sheet, one has

$$\Delta pH = \frac{\Delta E}{T} \times \frac{\Delta T}{T} .$$

$\Delta pH = .1$ would require $\Delta E \simeq .3$ eV, which is quite near .4 – .5 eV.

The fact that the exponential $\exp(-\Delta E/T)$ happens to be near to the number $n/n_{H_2O} = 10^{-pH}$, gives further support for the idea that the zero point kinetic energy at $k = 137$ space-time sheet determines pH, or more generally, that the densities of various ions are determined by many-sheeted chemistry and by zero point kinetic energies. If this interpretation is correct, $n(137)$ can be identified as the net density of protons including also protons bound to hydrogen atoms. The net density of protons at a given space-time sheet involves a degeneracy of states factor $g(k)$ so that one would have

$$n(137) = \frac{g(137)}{g(169)} \times n(169) ,$$

where $k = 169$ refers to the super-conducting flux tubes of the Earth's magnetic field. p-Adic fractality and p-adic length scale hypothesis imply that $g(k)$ scales as $1/L^3(k)$. This gives $g(169)/g(137) \sim (L(137)/L(169))^3 = 2^{-48} \simeq 4 \times 10^{-15}$.

7.3.6 Sensitivity to the external magnetic field

The effect of the pH values depends on the direction of the external magnetic field B_{ext} . This could be understood if B_{ext} interferes with the magnetic field at some level of magnetic hierarchy induced by the magnetic fields in .1 nT range which mediate the intentional action. pH is changed if the change of the magnetic field at these space-time sheets in the cellular length scale range affects the flow of protons between atomic space-time sheets and larger space-time sheets when .1 nT flux tubes with thickness around 100 μm are present. This is expected to be the case if the thickness of the flux tubes is affected by the external magnetic field. The flux tubes in a given p-adic length scale could even disappear as a result of destructive or constructive interference.

Concerning the detailed model there are two options.

1. If the magnetic field consists of flux sheets so that one has $B(k) \propto 1/L(k) \propto 2^{-k/2}$. In this case the external field strength corresponds to p-adic length scale $L(k)$ related to the length scale $L(169) \simeq 5 \mu\text{m}$ by a scaling of $.5 \times 10^{-2} - 10^{-3}$ the length scale varies between $L(149) = .5 \text{ nm}$ (thickness of the lipid layer of cell membrane) and 25 nm. This option is supported at the level of DNA magnetic hierarchy by the findings of Gariaev about effects of laser light on DNA, and also by the fact that the ratio of $T_l = 51.2 \text{ min}$ and $T_k = 36.6 \text{ min}$ is very near to $\sqrt{2}$. This situation would result if the flux quanta at various p-adic length scales are quite generally obtained by scaling the flux tubes of the Earth's magnetic field in one direction by keeping the flux as constant.
2. If the magnetic field consists of flux tubes ($B(k) \propto 1/L^2(k) \propto 2^{-k}$) $L(k)$ is related to $L(169)$ by a scaling by a factor $.1 - .03$ so that it is in the range $1.6 - .5 \mu\text{m}$.

7.3.7 Phantom effect

A further strange finding is that the removal of both IIED and target does not eliminate the temperature oscillations of the air although their amplitude is reduced by a factor of about ten. The phantom effect can be understood if the magnetic flux tubes associated with $k = 188$ magnetic field are present also in the air volume, and are not affected by the removal of IIED and target, so that the oscillatory flow of protons between $k = 169$ and $k = 188$ space-time sheets with cyclotron frequency continues and induces the oscillation of the proton density of air.

7.3.8 The effects on random number generators

Also the computers might be affected by the "conditioning". Tiller has tested also this [J19] and found clear evidence that this indeed occurs. In the experiment the computer produced a sequence of pseudo-random numbers in a conditioned environment with a rate of one random number per minute. Both processes produced one random number, call it n , per minute. First of all 200 bits are generated 100 times every minute.

1. The first process computes the sum of these 200 bits and calculates the average of the 100 sums resulting in this manner. One expects the average result to be $\langle n \rangle = 100$ and maximum result to be $n_{max} = 200$.
2. The second process picks the second one of the 200 random numbers and compute the sum of the hundred numbers picked up during minute. In this case the average result should be $\langle n \rangle = 50$ and maximum $n_{max} = 100$.

The Fourier transformation of the distribution of these random numbers taken with respect to real time was found to display peaks at frequency $f = 1/T$, $T = 113.778$ minutes and at its harmonics. The presence of precise harmonics is not easy to explain if random numbers are in question.

The mechanism producing the peaks could be the same as the one producing pH oscillations. The representation of the resulting random numbers involves sequence of bits and the number of bits depends on the accuracy used. Since maximum is 200 in the first case and 100 hundred in the second case, the storage of the integer parts of these numbers requires 8 bits in the first case and 7 bits in the second case. The most significant bit is often zero. Cyclotron oscillations could induce a flow of protons from atomic space-time sheets to larger space-time sheet also in the computer and in this manner affect (say) the voltage representing the zero bit so that it changes from 0 to 1 when the amplitude of oscillation is maximum and from 1 to 0 when the amplitude is minimum since the sign of the electric field is different in these two cases. This effect tends to widen the distribution of the random numbers and is enough to explain the emergence of Fourier components coming as harmonics of the cyclotron frequency.

This model predicts that the mechanism tends to increase the mean from the expected value. Consider the case when the expected mean is 100 and maximum is 200. Let $p(i)$ be the probability of the 8:th bit to be $i = 1, 0$. p_0 is the probability that the integer part of n is in the interval $(0, 127)$ whereas p_1 the probability of the random number to be in the interval $(127, 200)$. Since the probability distribution for the resulting pseudo-random numbers is Gaussian around mean value $\langle n \rangle = 100$, one

has $p_1 > p_0$. Hence the flip $0 \rightarrow 1$ occurs with a higher probability than the reverse process and tends to increase the mean from $\langle n \rangle = 100$.

Of course, the realization of the mechanism depends on the precise representation of the numbers but the general expectation is that mean increases somewhat and harmonics of cyclotron frequency appear in the spectrum.

7.4 The effects caused by the quartz crystal

In some experiments the removal of the target and IED was followed by the addition of quartz crystal [J19]. The quartz crystal was made of natural quartz (in order to avoid undesired intentional imprinting!) and had height $h = 15.24$ cm and minimum diameter $d = h/2 = 7.62$ cm. The crystal was asymmetric in the vertical direction having apex pointing upwards.

The findings were following.

1. When the crystal was in a vertical direction, its presence sharpened the existing spatial phantom profile for temperature oscillations of air and somewhat amplified it.
2. When the crystal was turned to a horizontal direction, its presence immediately increased the temporal frequency of T-oscillations by a factor slightly larger than two. The spatial profile became first almost flat and the amplitude weakened.

The interpretation of the stimulates several ideas and questions.

7.4.1 Does the spatial profile of T-oscillations correspond to a standing wave resulting as an interference pattern of microwaves?

The spatial profile for the temperature oscillations is measured using spatial resolution $D = h = 15.24$ cm, where h is the height of the quartz crystal. The profile is quasi-periodic with a period of $\lambda = 2D = 2h$. Of course, experiments with a better spatial resolution would be required to deduce reliably the profile but the measurements are consistent with a spatial oscillation having period $\lambda = 2D = 2h$. This kind of profile could result as an interference of two classical microwave beams propagating in two opposite directions and generating a standing wave with wave length $2h$. This kind of interference pattern is involved with the four-wave interaction producing phase conjugate waves: the interfering waves correspond to the reference beam and a beam opposite to it. The two additional beams correspond to beam and its phase conjugate, either of them generating the other one.

7.4.2 Does the quartz crystal act as an amplifier?

The orientation of the crystal is obviously important. This encourages to think that the incoming signal enters from a vertical direction and is amplified by the quartz crystal so that the vertical dimension determines the resonantly amplified wave lengths. Perhaps magnetic flux tubes of B_I and the Earth's magnetic field B_E are in this direction. It could be that the light-like vacuum current of ME generates positive or negative energy coherent photons with an intensity distribution having maximum in the directions orthogonal to MEs and that the presence of the quartz crystal amplifies the vacuum current inside ME. Alternatively, it could be enough that quartz crystal amplifies the classical fields associated with MEs.

The height h of the quartz crystal is one half of the microwave wavelength. Hence it could act like an absorbing or emitting half wave antenna. The fundamental frequencies associated with the microwaves would correspond to $f_1 = c/2h \simeq 1$ GHz for the vertical crystal and $f_2 = c/2d = 2f_1 \simeq 2$ GHz for the horizontal crystal. For the vertical crystal $\lambda_1 = 2h = 2D = 30.48$ cm would be the wavelength of the spatial profile which conforms with observations. For the horizontal crystal period would be $\lambda_2 = 2d = 15.4$ cm. The observed spatial profile immediately after the turning of the quartz crystal to horizontal position is flat in consistency with this prediction. It should be easy to check out whether the oscillatory pattern is present by improving the resolution.

7.4.3 Are population inverted many-sheeted masers involved?

The frequencies f_1 resp. $f_2 = 2f_1$ are rather near to the zero point kinetic energies of a protonic Cooper pair for $k = 153$ resp. $k = 152$. In the case of electronic Cooper pairs one has $k = 164$ and 163 (the ratio of proton and electron masses is near to a power of 2: $m_p/m_e \simeq 2^{11}$). Perhaps many-sheeted population inverted micro wave lasers are involved and time mirror mechanism induces dropping of protons to large space-time sheets or the reverse process. $k = 152$ and $k = 153$ correspond to length scales $\sqrt{2} \times L(151)$ and $2 \times L(151)$, where $L(151) = 10$ nm corresponds to the thickness of the cell membrane. The four-wave interaction suggested by the interpretation of the spatial profile would presumably involve many-sheeted laser mechanism at the microscopic level.

7.4.4 Scaling law of homeopathy is satisfied

The approximate doubling of the ULF frequency of T-oscillations when the quartz crystal is turned to a horizontal position is consistent with the generalized scaling law of homeopathy. The ratio f_h/f_l of frequencies of microwave and ULF oscillations occurring at 51.2 min period is 3.1×10^{12} for $f_h = f_1$ and 6.2×10^{12} for $f_h = f_2$. In a good approximation this ratio differs by a factor 2^4 resp. 2^5 from $f_h/f_l = 2 \times 10^{11}$.

7.5 Relating Tiller's hypothesis to TGD framework

Tiller makes the hypothesis that intentional action induces a transition of the system to a new phase in which $U(1)$ gauge group of electromagnetic interactions is extended to $SU(2)$ of electro-weak interactions. In this phase magnetic monopoles would be present besides ordinary charges. Although this proposal sounds rather far-fetched, it has an analog in TGD framework.

7.5.1 Are electro-weak and color symmetries exact for classical gauge fields in living matter?

In TGD $SU(2)_L \times U(1)$ gauge symmetry could be exact at the level of *classical* electro-weak fields above cell length scale since the classical electro-weak fields are indeed long ranged and become important in biological length scales. This predicts exotic phenomena such as charge entanglement made possible by classical W^\pm fields. Also classical color fields unavoidably accompany any classical em field. The color associated with color rotational degrees of the freedom of space-time sheet could be also important and analogous to rigid body angular momentum. TGD based model of color qualia relies on classical color fields.

7.5.2 Classification of phases of matter by the dimension of CP_2 projection

The proposal of Tiller relates interestingly to the classification of the phases of matter according to the dimension D of the CP_2 projection of the space-time sheet. This classification emerges naturally in the study of the general solutions of field equations when one assumes that absolute minimization of Kähler action corresponds to second law so space-time sheets correspond asymptotically to self-organization patterns for which Lorentz four-force representing dissipation vanishes. $D = 2$ is analogous to a ferromagnetic phase consisting of simple magnetic flux tubes. $D = 3$ is analogous to a critical spin glass phase between magnetized and de-magnetized phases, is possible only in a finite temperature range, is highly complex but organized, and corresponds to the living matter. $D = 4$ corresponds to the chaotic demagnetized phase and "dead" matter.

For $D = 2$ the induced gauge fields are Abelian and both electro-weak and color holonomy groups reduce to $U(1) \times U(1)$. For $D = 3$ electro-weak holonomy group is the electro-weak group itself whereas color holonomy group is $U(2)$ or $SU(3)$. Classical color fields would be essential for the colors as qualia (sounds like a joke at first). $D = 3$ is indeed the minimum dimension of CP_2 projection allowing color vision whereas black-white vision is possible for $D = 2$ as has been found already earlier.

7.5.3 Does intentional action generate wormhole magnetic fields and homological monopoles?

TGD allows pseudo-monopoles (having no meaning in single sheeted space-time) as wormhole throats through which magnetic flux flows between space-time sheets. An extremely small dipole of magnetic

charges defined by the wormhole throats at a distance of about CP_2 length is in question. At a given space-time sheet the structure gives rise to a radial magnetic field in the immediate vicinity of the wormhole throat.

The homological magnetic monopoles could be common in condensed matter systems in many-sheeted space-time (note however that also join along boundaries bonds can mediate the magnetic flux between space-time sheets). Magnetic flux tubes in superconductors might well flow to larger space-time sheet via this kind of throats. Also ferromagnets could feed their flux to larger space-time sheets through wormhole contacts. Solar magnetic fields are modelled using this concept in [K24]. The detection of the homological monopoles could be regarded as a direct support for the many-sheeted space-time, for the notion of homological monopole, and thus for the physical reality of the imbedding space $H = M_+^4 \times CP_2$. There is quite recent experimental evidence for magnetic pseudo-monopoles [D3] in condensed matter systems suggested also theoretically in [D4]. These monopoles are however monopoles of the Berry phase connection in momentum space so that they need not have anything to do with homological monopoles.

The magnetic self-organization by intentional action could involve creation of wormhole magnetic field consisting of pairs of positive and negative energy magnetic flux quanta: at least this is energetically an optimal mechanism. The flux between the two sheets flows along wormhole contacts acting as effective magnetic monopoles. In [K22] I have proposed that the changes in the qualitative character of EEG in transitions to altered states of consciousness involving emergence or disappearance of EEG bands might relate to the generation or disappearance of wormhole magnetic fields. New bands would emerge when charged particles dropping to the newly emerge magnetic flux tubes drop to ground state by cyclotron radiation in the EEG band in question.

7.6 A model for the findings based on hierarchy of large Planck constants

The hierarchy of Planck constants suggests an improved and conceptually simpler model for intentional imprinting. Basic ideas are however more or less the same as above.

1. The intentional imprinting means that flux tubes connecting the electronic device with mediators magnetic body are formed. The length of these flux tubes corresponds to the cyclotron time scale, which is between 10-100 minute time scale, which gives could idea about the size scale of the layer of the meditator's magnetic body involved.
2. IIED acts on the target by sending microwave photons part of which travel along the flux tubes to the magnetic body of the meditator as dark photons and are reflected back as negative energy phase conjugate photons and travel now to the target where part of them are transformed to negative energy microwave photons and part induces oscillations in time scale defined by the length of flux tube. This explain pH oscillations and their time scales. Negative energy microwave photons in turn have a syntropic effect compensating for the entropic effect of ordinary positive energy microwave photon generated by the control device. This explains the increase of the thermodynamical activity of bio-molecules and the shortening of the development time of larvae. One can say that the system affecting the target is not IIED but the system IIED + meditator's magnetic body.
3. The values of Planck constant involved correspond to the ratios of times scales 10 – 100 minutes to the time scales of microwave frequencies 5,8, 9.3 MHz. Order of magnitude is in the range $r = 3 \times 10^{10} - 5.4 \times 10^{11}$. The scaling law of homeopathy claims that $r = 2 \times 10^{11}$ is a preferred value of this ratio.
4. The conditioning of the laboratory can be also understood. In the new unconditioned position the IIED sends microwave photons to the magnetic body of meditator and this sends part of them to the previous target so that synchronized oscillations result. The flux tubes from the magnetic body to the target continue to exist also after the removal of IIED. It is not clear to me whether the effect is present also when IIED is not functioning in the new position. One can of course imagine that the flux tube connection continues to carry large \hbar photons even after the removal of the target and the frequency is determined by the length of flux tube. This would mean that the target would possess a primitive analog of EEG.

5. The action of vertically aligned magnetic field with strength in the range $200B_E - 1000 \times B_E$ could be understood in terms of topological condensation of flux tubes of this field to vertical flux tubes of the magnetic field connecting the target and IED to the meditator's magnetic body. The wormhole contacts would affect the value of this magnetic field in a manner depending on the direction of the magnetic field and also transmit the magnetic noise associated with the flux tubes of this field. Situation could resemble that encountered in the explanation of the correlation between anomalous cognition and sidereal time.
6. The effects on number generators would rely on a similar mechanism. The dark cyclotron frequency associated with the magnetic flux tubes connecting computer to the magnetic body of the meditator and corresponding to a period of 113.778 minutes would induce the deviation from the random behavior. Planck constant would be $\hbar/\hbar_0 \simeq 1.3 \times 10^{10}$ for 5 MHz microwave radiation in this case. The mechanism inducing bit flips could rely on low energy dark photons with large Planck constant but energy above thermal threshold. Dark frequencies above 10^2 Hz would correspond to ordinary IR frequencies and define photon energies above thermal threshold. The 1 kHz frequency characterizing synchronous firing of neurons might be involved.

8 Formation of holograms by time mirror mechanism as a key mechanism of intentional action?

The findings of Tiller suggest that four-wave interaction [D6, D7] or its suitable generalization could provide a basic mechanism of intentional action. In this section this proposal is discussed in detail. The basic statement is that probe and conjugate waves are responsible for the remote metabolism allowing to build the hologram which only in a special case reduces to a standing wave formed by reference beams. In general case the hologram corresponds to a synchronously oscillating field pattern, say an "energy eigen state" of a super-conducting order parameter or plasma wave pattern at plasma resonance frequency.

8.1 Four-wave interaction as a mechanism of intentional action

There are however several open questions about four-wave interaction. Could four-wave interaction or its generalization provide a deeper understanding of the scaling law of homeopathy? Could the basic function of probe and conjugate beams be the amplification of the standing wave interference pattern by remote metabolism? Does the standing wave formed by the reference beams serve as a kind of standardized hologram? Is it possible to generalize the notion of hologram in order to get rid of the reference beams?

8.1.1 Are probe and conjugate beams responsible for remote metabolism needed to construct standardized holograms?

The standing wave interference pattern represents a synchronous oscillation of the entire system and would be an excellent physical correlate for the ability of living organisms to act as coherent wholes. The standing wave resulting as the interference pattern of waves propagating in opposite directions would serve kind of a standardized hologram parameterized by the wavelength λ_h . The interference pattern can be also kicked into a motion by Lorentz boost, and the propagation velocity of the interference pattern is an additional characteristic of the pattern.

Probe and phase conjugate beams in four-wave interaction could in turn be interpreted in terms of remote metabolism. System sends negative energy MEs to the geometric past and receives as a response positive energy MEs, and amplification can occur in this process so that negative energy signal serves only a role of control signal. Its generation would utilize the energy provided by the remote metabolism. The emission of negative energy ME would switch on the positive energy laser of the geometric past generating probe beam. The energy source could be system in its geometric past or some system in the environment.

8.1.2 Scaling law and and the role of low frequency MEs as inducers of moving standing wave patterns

The degenerate variant of the four-wave interaction does not require low frequency field components. A more general variant involving also them would allow also moving interference patterns so that pattern could represent parameters: f_h and velocity v . This leads to a new interpretation for the scaling law of homeopathy involving the excitations moving with low velocity.

Suppose that the light-like four-momentum vectors of the opposite reference beams are slightly different, such that the frequencies are $f_1 = f_h + f_l$ and $f_2 = f_h - f_l$. In this situation the interference pattern can be regarded as a Lorentz boost of the pattern at rest and thus moves with a finite velocity $v = x/\sqrt{1+x^2}$, $x = f_l/f_h$. If f_l comes as harmonics of a cyclotron frequency, the velocity is quantized for given f_h and coming as powers of 2 if zero point kinetic energy is utilized as metabolic energy.

The simplest realization of the Lorentz boost would be as quantum jump giving a boost to the entire field pattern representing standing wave and somehow the interaction of low frequency ME with the space-time sheet representing standing wave should realize this boost. The boost would result in the direction of standing wave only if f_l ME has momentum in this direction and the velocity would be $(f_l/f_h)\cos(\theta)$, where θ is the angle between f_h and f_l ME. For the spatial patterns of T-oscillations in air the maximum value of the velocity would be $v = (f_l/f_h)c \simeq 1$ mm/s. For the detected T-oscillations the spatial pattern does not move. The interpretation would be that vertical ULF MEs are in a good approximation orthogonal to the horizontal microwave MEs.

A moving pattern could result also in other manners: in stimulated Brillouin scattering generating also phase conjugate waves, the moving pattern corresponds to classical sound induced in TGD Universe by driving Z^0 ME.

8.1.3 What the interference of reference waves really means?

What the interference of reference beams actually means, is not at all trivial question. TGD allows imbedding of standing wave interference patterns as space-time surfaces [K6] but for these field patterns Lorentz 4-force vanishes only modulo effects caused by the classical gravitation so that in a strict sense they do not correspond to asymptotic self-organization patterns.

A less probable possibility is that the interference pattern is not a field pattern at all but a hologram resulting as a response to the presence of two MEs which are spatial mirror images of each other and represent field patterns moving in opposite directions. The force experienced by particles at material space-time sheets could be mediated by wormhole contacts and in a good approximation superposition of forces generated by MEs, and would thus create same effect as genuine standing wave.

8.2 Plasma oscillation patterns as generalized holograms

Standing wave pattern is the quintessence of a hologram. Probably everyone has childhood memories about swinging a rope. Suddenly it requires hardly no effort to keep the oscillation going on and it is difficult to say whether the rope moves or not.

The interference of two reference waves is only one manner to achieve a standing wave pattern and there is no need to stick to the idea that reference beams are necessary to produce the pattern. What is essential is that there is a synchronous spatial oscillation present. A moving standing wave represents kind of elementary hologram: the information content is coded by the wavelength and velocity of propagation for the interference pattern.

One can go however to other extreme and ask how one might achieve maximal representational power. This obviously requires that the frequency of the Fourier components of the wave does not depend on the wave vector at all:

$$f(k) = f_p = \text{constant} . \quad (8.1)$$

Plasma oscillations, which correspond to density oscillations of the number density associated with a given ion, have this property. The plasma frequency is given by

$$\omega_p \equiv 2\pi f_p = \sqrt{\frac{q^2 e^2 n}{\epsilon_r m}} , \quad (8.2)$$

where n is the number density of ions, q is the charge of the particle using e as a unit, m is its mass, and ϵ_r is the relative permeability. Each ion is characterized by its own plasma frequency.

8.2.1 Examples of plasma oscillations

There is extremely rich palette of plasma oscillations in living matter.

1. Every biologically important ion, such as Ca_{++} , Na_+ , K_+ , Cl_- defines its own plasma frequency. During nerve pulse various plasma frequencies vary but the variation is slow in the time scale defined by the plasma frequency. This would provide a further reason for why ions are so important for the living matter. Also ionosphere and entire magnetosphere contain plasma which supports earlier vision about magnetosphere as a living system.
2. Since atomic nuclei are completely ionized Z^0 ions, every atom and molecule is characterized by a plasma frequency possibly modified by the neutrino screening which can be characterized in terms of Z^0 dielectric constant. Rather remarkably, the Z^0 plasma frequency $f_Z(H_2O)$ of water corresponds to the energy .44 eV, which is the fundamental metabolic energy quantum so that basic metabolism could be related to the formation of holograms defined by Z^0 plasma oscillation patterns of water molecules. Z^0 plasma frequencies are associated also with the electromagnetically neutral matter.
3. Each space-time sheet has its own plasma frequency for every charged particle present at it. Strict p-adic fractality predicts that the densities of the charged particles scale as $n \propto 1/L^3(k) \propto 2^{-3k/2}$ for 3-dimensional structures, which would mean that plasma frequency would scale as

$$\frac{f_p(k)}{f_p(k_0)} = 2^{3(k-k_0)/4} , \quad (8.3)$$

so that plasma frequencies would come as 1/4:th octaves. One can consider also structures which are effectively d=1- or d=2-dimensional (say cell membrane). In this case the plasma frequencies would come as

$$\begin{aligned} \frac{f_p(k)}{f_p(k_0)} &= 2^{(k-k_0)/4} \text{ for } d = 1 , \\ \frac{f_p(k)}{f_p(k_0)} &= 2^{(k-k_0)/2} \text{ for } d = 2 . \end{aligned} \quad (8.4)$$

For 1- and 3-dimensional structures plasma frequencies can correspond to zero point kinetic energies coming as powers 2^k if $k - k_0 = n \times 4$ is satisfied so that the preferred p-adic length scales would come as powers of 4. For $d = 2$ the condition is $k - k_0 = 2$. Both lipid layers of cell membrane and cell membrane itself satisfy this condition.

8.2.2 Metabolic synchrony

The condition that plasma frequencies correspond to zero point kinetic energies, quantizes the values of the ion densities for which time mirror mechanism allows to build plasma oscillation patterns. Ionic system becomes "living" only for quantized values of the ion density. This quantization could play a role in bio-control. The variation of neutrino densities responsible for the screening of the Z^0 charge provides one manner to control particle densities.

Ions with charges q_i and masses m_i can utilize the same metabolic source if the ratio of their number densities satisfies the condition

$$n_i = \frac{m_i}{q_i^2} \times n_0 \quad (8.5)$$

holds true. For instance, Na_+ and Mg_{++} have $A=22$ so that the condition gives $n(Na_+) = 4n(Mg_{++})$. K_+ and Ca_{++} have $A = 39$ and $A = 40$ so that one would have $n(K_+) = 4 \times \frac{39}{40} \times n(Mg_{++})$.

A more general condition for the metabolic synchrony is that the number densities satisfy the condition

$$n_i = 2^{n_i} \times \frac{m_i}{q_i^2} \times n_0 , \quad (8.6)$$

where n_i is an integer. Now the metabolic sources correspond to different space-time sheets.

Since nuclei are completely ionized Z^0 ions and Z^0 charge is in good approximation determined by the neutron number $A - Z$, metabolic synchrony requires in this case

$$n_i \simeq 2^{n_i} \times \frac{A_i}{(A_i - Z_i)^2} \times n_0 , \quad (8.7)$$

The densities would be in a reasonable approximation inversely proportional to neutron number if same metabolic source is used.

8.2.3 Plasmoids as life forms

The idea about plasma oscillation patterns as generalized holograms and symbolic representations provides a further support to the idea that plasmoids consisting of magnetic flux tube structures plus ions define primitive life forms. The original motivation for the idea came from the notions of magnetic body, universal metabolism based on zero point kinetic energies, and some experimental findings which deserve to be discussed in the recent context.

1. The first strange empirical finding that I learned of was the discovery that the velocity distributions of electrons in the plasma sheet at the night side of the Earth's magnetosphere contained features like "wings" and "eyes" [F2] . Note however that velocity distributions are in question, and it is not clear how directly they correlate with plasma waves at plasma frequency.
2. Towards the end of the year 2003 came the finding that plasmoids created in laboratory have basic characteristics usually assigned to living systems [I14] . Plasma oscillation patterns as primitive symbolic representations of external world would be a further characteristic of this kind. Time mirror mechanism would also make possible primitive memory and intentional behavior (also plasmoids have magnetic bodies).
3. The findings of Kozyrev [H4] have natural explanation terms of phase conjugate waves associated with plasma oscillations at magnetic or Z^0 magnetic flux tube structures of astrophysical size. One certainly cannot over-emphasize the importance the possibility of of quantum coherence in astrophysical length scales.
4. The spatial T-oscillation pattern of air discovered by Tiller could correspond to either em plasma oscillations of protonic Cooper pairs or to Z^0 plasma oscillations of water.

Protons are favored for obvious reasons. The scaled down electromagnetic plasma frequency for proton Cooper pairs is $f_p = 2^{-3(k-137)/4} \times x \times f_Z(H_2O)$, $x = (3e/2g_Z)$ and $f_Z(H_2O) = 1.45 \times 10^5$ GHz and should be equal to $f_p \simeq 1$ GHz suggested by the properties of the spatial pattern of T-oscillations. This gives $2^{3\Delta k/4} \simeq 10^5$ implying $\Delta k = k - 137 = 22$ with the error of 8 per cent so that the plasma oscillations of proton Cooper pairs should occur at $k = 159$ space-time sheet.

For the Z^0 plasma frequency $f_Z(H_2O) = 1.45 \times 10^5$ GHz of water the scaling $2^{3\Delta k/4} \sim 1.45 \times 10^5$ is required to get $f_p \simeq 1$ GHz. $\Delta k = 23$ gives a correct result with a 7 per cent error. Since $k = 169$ is the space-time sheet at which the nuclei feed most of their Z^0 electric gauge flux, this would give $k = 169 + 23 = 192$ whereas $k = 188 < 192$ is the space-time sheet of magnetic flux tubes supported by Tiller's findings. This option does not look realistic.

5. Crop circles [K2, K3] might provide the most fascinating example of plasma wave patterns. Symbolic representations of "sacred geometry" based on rational numbers, some simple algebraic numbers, and π could be in question, and identifiable as an attempt to communicate about the fundamental importance of rational numbers and their extensions defining finite extensions of p-adic numbers concerning the understanding of cognitive consciousness [K26] .

There are strong indications that the circles are produced by microwaves, and BOLs ("balls of light") have been repeatedly reported in the vicinity of circles [K2]. Plasmoids would naturally generate the microwaves and the geometry of the crop formation would reflect the geometry of the plasma pattern at some larger space-time sheets. The scale of the smallest microwave patterns is about 15 cm and same as for Tiller's T-oscillation patterns for 2 GHz oscillations. That the same space-time sheets would be responsible for the smallest crop circle structures and T-oscillation patterns provides support for the general vision. The largest crop formations have a size of about 100 m. $\lambda = 75$ m corresponds to $f = 4$ MHz and $k = 171$ assuming that protonic Cooper pairs are responsible for these structures. The magnetic flux tubes of Earth having $k = 169$ would correspond to $\lambda \sim 27$ m.

In the chapters [K26, K2, K3] a rather radical proposal, which could have been inspired by Kozyrev's findings besides Chilbolton and Crabwood crop formations [H1, H2, H3], that crop circles could correspond to the communications of the descendants of human kind or of highly self-organized magnetic or Z^0 Mother Gaia from the geometric future of Earth.

8.3 Nerve pulse generation and holograms

The model for the nerve pulse generation discussed in [K21, K22] assumes that nerve pulse is generated by Z^0 ME connecting the boundaries of space-time sheets and drifting along the axon in such a manner that the effective phase velocity of the Z^0 field pattern is reduced to the nerve pulse velocity. Four-wave mechanism suggest a modification of this mechanism involving interfering Z^0 microwaves acting as reference waves running in opposite axonal directions, and having frequencies differing by twice the frequency characterizing rate of nerve pulses plus transversal probe and conjugate Z^0 MEs containing also the frequencies f_l responsible for remote metabolism.

8.3.1 Is f_l variable or not?

The simplest possibility is that f_l corresponds to a single fundamental frequency and only the angle θ is a variable parameter. The guess $f_l \simeq 1$ kHz promotes itself as the basic frequency of neuronal synchrony and as the time scale for the duration of the nerve pulse. The spatial length per single the nerve pulse in a long axon is about $L = vT_p$, where T_p is the time interval between nerve pulses. Nerve pulses naturally correspond to the maxima of the standing wave so that $\lambda_h = L$ is a natural identification and gives $v = \cos(\theta) \times f_l \lambda_h = \cos(\theta) \times f_l v T_p$ giving $\cos(\theta) = T_l/T_p$ but leaving the value of v free. $v = x \times 10$ m/s and $T = 2$ ms give $f_h = 15/x$ GHz which represents an upper bound for this value of conduction velocity. For this option the angle θ would be the only control parameter and would control both the conduction velocity and frequency of nerve pulses.

It is of course possible that f_l could be varying and expressible as harmonics of some fundamental frequency f_0 . $f_0 = 10$ Hz is the most natural guess since 20 Hz defines the lower bound for audible frequencies and 10 Hz is the alpha frequency beginning to dominate in the absence of sensory input.

8.3.2 Two manners to achieve rate coding

Rate coding could result in two manners.

1. Rate coding could rely on the dependence of the angle $\cos(\theta)$ on the intensity I of the sensory stimulus: the stronger the stimulus the smaller the value of θ . Nerve pulse rate cannot correspond directly to $\Delta f_h = f_l \cos(\theta)$ but would relate to it in a statistical manner like the rate for hopping between the states of bi-stable system relates to the frequency of the driving force in stochastic resonance (for the possible role of the stochastic resonance in nervous system see [K21, K22]).
2. If f_l can have also the harmonics of the fundamental frequency as preferred values, as one might expect if cyclotron frequency is in question, the experienced intensity of the stimulus would be constant and change in a stepwise manner every time when the frequency f_l is replaced by its next harmonic. In this case 1 kHz frequency would represent upper bound for f_l . $f_0 = 10$ Hz could define the value of f_l producing no stimulus and $f_l < 1$ kHz would correspond to maximal alertness. If various frequencies are in one-one correspondence with memetic code words, 64 frequencies are needed and maximum value would correspond to 650 Hz.

8.3.3 Is the pulse rate quantized?

There is some evidence for the quantization of the experienced stimuli [J7]. When over-learning occurs in tasks involving temporal discrimination, the memory images about the intensity of sensation as a function of stimulus deviates from smooth logarithmic form in small scales by becoming a piecewise continuous function [J7] such that the plateaus where response remains constant are octaves of each other. This suggests that the memory image about the sensation depends only on the 2-adic norm of the 2-adic image of the ratio I/I_0 of the intensity of the stimulus to the threshold stimulus under canonical identification. There two two explanations.

1. For fixed value of θ the integer valued function $\log_2(|I/I_0|_2)$ would correspond directly to the harmonics of the frequency f_l/f_0 determining the rate of nerve pulses,
2. $\cos(\theta)/\cos(\theta_0)$ can have only integer values: geometrically this would mean that the x-axis projection of the allowed points of a unit circle would be integer-valued using $x_0 = \cos(\theta_0)$ as a unit. This option makes sense from the point of view of p-adic physics of cognition and intention.

8.3.4 The identification of the standing wave in the case of nerve pulse

There is a considerable freedom concerning the identification of the standing wave representing nerve pulse hologram and there could be (and probably are) several representations since space-time is indeed many-sheeted. The frequencies involved are below $15/x$ GHz for $v = x \times 10$ m/s if one takes the previous estimate seriously.

Z^0 plasma waves are one possible candidate for the standing waves in question. Using value of Z^0 plasma frequency for water, $x = 1$ gives $\Delta k = 17$ giving $k_{min} = 186 < 188$. If Cooper pairs of protons correspond to the plasma waves, one would have $\Delta k = 16$ and $k_{min} = 153$. The variation range for k is $(k_{min}, k_{min} + 7)$ from the assumption that the range for frequencies f_l is $(7, 10^3)$ Hz.

The order parameters characterizing macroscopic quantum phases are good candidates for quantum holograms. In the case of super conductor the stationary states of the complex order parameter characterizing BE condensation to a given quantum state would define holograms since there is a complete synchrony in the spatial degrees of freedom.

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Here qe is the charge of the super-conducting charge carrier, V denotes the membrane potential ($eV \simeq .05$ eV), and m is a parameter with dimensions of mass and determined by the details of the Josephson junction. V corresponds to membrane potential and is slowly varying.

The right hand side represents a very rapidly oscillating source term, which can be neglected in the lowest approximation and treated as a source term giving rapidly oscillation corrections to the basic lowest order approximation. Since the time scale of oscillations is $T = 2\pi/eV \simeq .8 \times 10^{-13}$ s, the variation of the membrane potential during the nerve pulse can be treated as an adiabatic variation. In the adiabatic approximation $\partial_t \Phi_0 = qeV$ the solutions are standing waves

$$\Phi_0 = qe \int V dt + kz . \quad (8.9)$$

Thus the phase factor $\exp(i\Phi) = \exp(i \int eV dt) \exp(ikz)$ represents a standing wave. The wavelength $\lambda = 2\pi/k$ should correspond to the wave length $\lambda = vT$ associated with the nerve pulse.

8.3.5 Intentional action, memory, and holograms

The detailed realization of intentional action at brain level could involve generation of holograms involving synchronous oscillation of the brain region, and gradual quantum jump-by-quantum jump evolution of constant components of electric and magnetic field inside MEs responsible for the control of ion flows between space-time sheets in turn responsible for their concentrations. Standing waves and their moving variants would be one possible manner to realize the holograms.

The negative energy signals to the geometric past would make possible association mechanism in geometric past as a completion of a piece of hologram to a full hologram. Negative energy signal would correspond to only a part of the neural pattern representing the entire memory and would induce in the geometric past the generation of the entire memory mental image communicated back to the geometric future. This would make it unnecessary to do use brain capacity to store associations of past. This could be of utmost importance also for the realization of motor actions: only an incomplete signal to the geometric past would be needed to realize a complex motor action.

8.4 Generalized four-wave interaction in relation to some other anomalies

Four-wave interaction combined with time mirror mechanism might explain many seemingly unrelated anomalies.

1. The standing wave patterns associated with rotating magnetic systems and accompanied by magnetic wall structures [H5] could also be involved with the four-wave interaction and remote metabolism explaining the claimed over unity energy production in these systems.
2. Four-wave interaction could explain Kozyrev's findings about three signals coming from distant astrophysical objects [H4] : one signal from the future, one from the past, and one effective signal travelling with infinite velocity. The negative energy signal from the geometric future would be accompanied by a positive energy signal from Earth to the object and instantaneous "signal" would correspond to the standing wave representing the interference pattern of reference beams.
3. The phantom effects in Tiller's experiments relate to pH, temperature, and conductivity. One can however ask whether there is any evidence for mechanical phantom effects. The Russian physicist N. A. Kozyrev has indeed demonstrated mechanical "after-effects" caused by the presence of what he calls irreversible process, typically an vibrating torsion pendulum [J13, J9] .

The experiments of Kozyrev deserve a more detailed discussion. In the experiments with a vibrating torsion balance, the forces at the support points did not disappear even when the vibration had ceased. The effect did not depend on the mass of the body but was dependent on its density. Most significant effects resulted for porous materials. According to Kozyrev: "Also when a system which had been in the vicinity of a periodic process and then brought to a torsion balance, yielded the same effect on it as the process itself... aluminum showed no memory. The largest memorizing effect for processes of both signs has been shown by sugar".

These findings bring in mind poor Donald Duck who once again has run over the verge of the cliff and defies the force of gravity until he realizes how Newton's laws require him to behave. The second reminiscence is a personal experience. I love swimming and spend long times in sea during summer time. In windy days, completely free floating with empty mind is especially enjoyable. When I return to shore, the experience about being in free floating motion continues for a long time after swimming.

The general model for the formation of conscious holograms could explain also the continuation of oscillatory force response in the support points of the torsion pendulum when the oscillation itself has ceased. Every physical system has magnetic body, also the system consisting of torsion pendulum and the support for it. Brain has tendency to entrain to various kinds of oscillations. The entrainment is based on magnetic homeostasis implying that the values of local magnetic fields at some space-time sheets change so that cyclotron frequencies for some ions become equal to the entraining frequency. Same is expected to happen in the case of support system of the torsion pendulum. Also the well-known tendency of clocks to synchronize could be based on the direct contact of magnetic bodies of these systems and thus be an example of learning in its simplest form.

In the case of Tiller's experiment cyclotron oscillations induce pH-, T-, and σ -oscillations and even oscillations in series of pseudo-random numbers produced by a computer by inducing the flow of protons from magnetic flux tube to larger space-time sheets and back. Forced oscillations for the

support of the pendulum induced by cyclotron oscillations of the magnetic body of the support system would be the desired item representing mechanical phenomenon in this list. In Tiller's experiments the oscillations continue when IIED and water sample are removed: in Kozyrev's experiments force oscillations in the support continue after the removal of the pendulum. The reason would be that magnetic body does not react so rapidly as physical body and can preserve the sensory memory hologram about oscillations by utilizing time mirror mechanism and generalized four-wave interaction.

When an object which has been in the vicinity of the oscillating system is brought near to the support system, the oscillatory force appears. This would be the counterpart for the conditioning induced by IIED in Tiller's experiments. The magnetic body of the support system would fuse with the part of the magnetic body of the "learned" system that has become entrained with the oscillations.

One can apply the model inspired by Tiller's observations at quantitative level.

1. Porosity favors the effect. Therefore the entrainment could occur dominantly with the mediation of the acoustic waves created by the oscillating pendulum. The learning is most effective when sound oscillations spend maximal time in the material. The sound waves are indeed caught in pores of the porous material: this is the reason why porous materials are used to absorb sound.
2. Plasma wave holograms at super-conducting space-time sheets are the best candidates for the symbolic representations of the oscillations associated with the support system. A pair (f_h, f_l) of high and low frequencies is involved. In accordance with the scaling law of homeopathy, the ratio of these frequencies defines the velocity of the moving standing wave pattern via the formula $v/c = f_l/f_h$ resulting when the reference waves with frequencies $f_h + f_l$ and $f_h - f_l$ move in opposite directions have frequencies. f_h is the frequency of the probe and conjugate waves making possible to get the energy needed by the formation of the hologram by utilizing time mirror mechanism.
3. In the recent case f_l is naturally the vibration frequency of torsion pendulums since the pendulum induces acoustic oscillations with the same frequency f_l and its harmonics. v is sound velocity in the air filling the pores of the material. This fixes f_h completely: $f_h = f_l \times (c/v)$.

f_h must be the plasma frequency f_p of protonic Cooper pairs at some non-atomic space-time sheet of air. The magnetic body might be able to vary the protonic Cooper pair density n in order to tune to the plasma frequency $f_p = (e/\pi)\sqrt{n/m}$ so that it coincides with f_h . The simplest manner for the magnetic body to achieve this is to change the local thickness of the flux tube so that charge density and also magnetic field intensity changes.

f_h must also correspond to a zero point kinetic frequency of some particle so that the oscillations can occur by time mirror mechanism using remote metabolism based on the dropping of particles to larger space-time sheets from some space-time sheet in p-adic length scale hierarchy. Since three conditions must be satisfied, the effect favors certain oscillation frequencies f_l of the pendulum.

4. A concrete example helps to get some perspective to the problem. For sound velocity $v = 300$ m/s and $f_l = 1$ Hz, one would have $f_h = 1$ MHz and radio wave with wavelength of $\lambda = 300$ m. The protonic plasma frequency corresponds roughly to p-adic length scale $L(k = 168) \simeq 3.5$ μm , whereas the magnetic flux tubes of the Earth's magnetic field correspond to $k = 169$. It might be that for suitable sizes of pores also the sound resonances inside pores couple to plasma oscillations: this would however require very special conditions to be satisfied. For millimeter sized pores the lowest resonance frequency would be around .3 MHz.

9 Formation of holograms by time mirror mechanism as a key mechanism of intentional action?

The findings of Tiller suggest that four-wave interaction [?]r its suitable generalization could provide a basic mechanism of intentional action. In this section this proposal is discussed in detail. The basic statement is that probe and conjugate waves are responsible for the remote metabolism allowing to build the hologram which only in a special case reduces to a standing wave formed by reference beams. In general case the hologram corresponds to a synchronously oscillating field pattern, say

an "energy eigen state" of a super-conducting order parameter or plasma wave pattern at plasma resonance frequency.

9.1 Four-wave interaction as a mechanism of intentional action

There are however several open questions about four-wave interaction. Could four-wave interaction or its generalization provide a deeper understanding of the scaling law of homeopathy? Could the basic function of probe and conjugate beams be the amplification of the standing wave interference pattern by remote metabolism? Does the standing wave formed by the reference beams serve as a kind of standardized hologram? Is it possible to generalize the notion of hologram in order to get rid of the reference beams?

9.1.1 Are probe and conjugate beams responsible for remote metabolism needed to construct standardized holograms?

The standing wave interference pattern represents a synchronous oscillation of the entire system and would be an excellent physical correlate for the ability of living organisms to act as coherent wholes. The standing wave resulting as the interference pattern of waves propagating in opposite directions would serve kind of a standardized hologram parameterized by the wavelength λ_h . The interference pattern can be also kicked into a motion by Lorentz boost, and the propagation velocity of the interference pattern is an additional characteristic of the pattern.

Probe and phase conjugate beams in four-wave interaction could in turn be interpreted in terms of remote metabolism. System sends negative energy MEs to the geometric past and receives as a response positive energy MEs, and amplification can occur in this process so that negative energy signal serves only a role of control signal. Its generation would utilize the energy provided by the remote metabolism. The emission of negative energy ME would switch on the positive energy laser of the geometric past generating probe beam. The energy source could be system in its geometric past or some system in the environment.

9.1.2 Scaling law and the role of low frequency MEs as inducers of moving standing wave patterns

The degenerate variant of the four-wave interaction does not require low frequency field components. A more general variant involving also them would allow also moving interference patterns so that pattern could represent parameters: f_h and velocity v . This leads to a new interpretation for the scaling law of homeopathy involving the excitations moving with low velocity.

Suppose that the light-like four-momentum vectors of the opposite reference beams are slightly different, such that the frequencies are $f_1 = f_h + f_l$ and $f_2 = f_h - f_l$. In this situation the interference pattern can be regarded as a Lorentz boost of the pattern at rest and thus moves with a finite velocity $v = x/\sqrt{1+x^2}$, $x = f_l/f_h$. If f_l comes as harmonics of a cyclotron frequency, the velocity is quantized for given f_h and coming as powers of 2 if zero point kinetic energy is utilized as metabolic energy.

The simplest realization of the Lorentz boost would be as quantum jump giving a boost to the entire field pattern representing standing wave and somehow the interaction of low frequency ME with the space-time sheet representing standing wave should realize this boost. The boost would result in the direction of standing wave only if f_l ME has momentum in this direction and the velocity would be $(f_l/f_h)\cos(\theta)$, where θ is the angle between f_h and f_l ME. For the spatial patterns of T-oscillations in air the maximum value of the velocity would be $v = (f_l/f_h)c \simeq 1$ mm/s. For the detected T-oscillations the spatial pattern does not move. The interpretation would be that vertical ULF MEs are in a good approximation orthogonal to the horizontal microwave MEs.

A moving pattern could result also in other manners: in stimulated Brillouin scattering generating also phase conjugate waves, the moving pattern corresponds to classical sound induced in TGD Universe by driving Z^0 ME.

9.1.3 What the interference of reference waves really means?

What the interference of reference beams actually means, is not at all trivial question. TGD allows imbedding of standing wave interference patterns as space-time surfaces [?]ut for these field patterns

Lorentz 4-force vanishes only modulo effects caused by the classical gravitation so that in a strict sense they do not correspond to asymptotic self-organization patterns.

A less probable possibility is that the interference pattern is not a field pattern at all but a hologram resulting as a response to the presence of two MEs which are spatial mirror images of each other and represent field patterns moving in opposite directions. The force experienced by particles at material space-time sheets could be mediated by wormhole contacts and in a good approximation superposition of forces generated by MEs, and would thus create same effect as genuine standing wave.

9.2 Plasma oscillation patterns as generalized holograms

Standing wave pattern is the quintessence of a hologram. Probably everyone has childhood memories about swinging a rope. Suddenly it requires hardly no effort to keep the oscillation going on and it is difficult to say whether the rope moves or not.

The interference of two reference waves is only one manner to achieve a standing wave pattern and there is no need to stick to the idea that reference beams are necessary to produce the pattern. What is essential is that there is a synchronous spatial oscillation present. A moving standing wave represents kind of elementary hologram: the information content is coded by the wavelength and velocity of propagation for the interference pattern.

One can go however to other extreme and ask how one might achieve maximal representational power. This obviously requires that the frequency of the Fourier components of the wave does not depend on the wave vector at all:

$$f(k) = f_p = \text{constant} . \quad (9.1)$$

Plasma oscillations, which correspond to density oscillations of the number density associated with a given ion, have this property. The plasma frequency is given by

$$\omega_p \equiv 2\pi f_p = \sqrt{\frac{q^2 e^2 n}{\epsilon_r m}} , \quad (9.2)$$

where n is the number density of ions, q is the charge of the particle using e as a unit, m is its mass, and ϵ_r is the relative permeability. Each ion is characterized by its own plasma frequency.

9.2.1 Examples of plasma oscillations

There is extremely rich palette of plasma oscillations in living matter.

1. Every biologically important ion, such as Ca_{++} , Na_+ , K_+ , Cl_- defines its own plasma frequency. During nerve pulse various plasma frequencies vary but the variation is slow in the time scale defined by the plasma frequency. This would provide a further reason for why ions are so important for the living matter. Also ionosphere and entire magnetosphere contain plasma which supports earlier vision about magnetosphere as a living system.
2. Since atomic nuclei are completely ionized Z^0 ions, every atom and molecule is characterized by a plasma frequency possibly modified by the neutrino screening which can be characterized in terms of Z^0 dielectric constant. Rather remarkably, the Z^0 plasma frequency $f_Z(H_2O)$ of water corresponds to the energy .44 eV, which is the fundamental metabolic energy quantum so that basic metabolism could be related to the formation of holograms defined by Z^0 plasma oscillation patterns of water molecules. Z^0 plasma frequencies are associated also with the electromagnetically neutral matter.
3. Each space-time sheet has its own plasma frequency for every charged particle present at it. Strict p-adic fractality predicts that the densities of the charged particles scale as $n \propto 1/L^3(k) \propto 2^{-3k/2}$ for 3-dimensional structures, which would mean that plasma frequency would scale as

$$\frac{f_p(k)}{f_p(k_0)} = 2^{3(k-k_0)/4} , \quad (9.3)$$

so that plasma frequencies would come as 1/4:th octaves. One can consider also structures which are effectively d=1- or d=2-dimensional (say cell membrane). In this case the plasma frequencies would come as

$$\begin{aligned}\frac{f_p(k)}{f_p(k_0)} &= 2^{(k-k_0)/4} \text{ for } d = 1 , \\ \frac{f_p(k)}{f_p(k_0)} &= 2^{(k-k_0)/2} \text{ for } d = 2 .\end{aligned}\tag{9.4}$$

For 1- and 3-dimensional structures plasma frequencies can correspond to zero point kinetic energies coming as powers 2^k if $k - k_0 = n \times 4$ is satisfied so that the preferred p-adic length scales would come as powers of 4. For $d = 2$ the condition is $k - k_0 = 2$. Both lipid layers of cell membrane and cell membrane itself satisfy this condition.

9.2.2 Metabolic synchrony

The condition that plasma frequencies correspond to zero point kinetic energies, quantizes the values of the ion densities for which time mirror mechanism allows to build plasma oscillation patterns. Ionic system becomes "living" only for quantized values of the ion density. This quantization could play a role in bio-control. The variation of neutrino densities responsible for the screening of the Z^0 charge provides one manner to control particle densities.

Ions with charges q_i and masses m_i can utilize the same metabolic source if the ratio of their number densities satisfies the condition

$$n_i = \frac{m_i}{q_i^2} \times n_0 \tag{9.5}$$

holds true. For instance, Na_+ and Mg_{++} have $A=22$ so that the condition gives $n(Na_+) = 4n(Mg_{++})$. K_+ and Ca_{++} have $A = 39$ and $A = 40$ so that one would have $n(K_+) = 4 \times \frac{39}{40} \times n(Mg_{++})$.

A more general condition for the metabolic synchrony is that the number densities satisfy the condition

$$n_i = 2^{n_i} \times \frac{m_i}{q_i^2} \times n_0 , \tag{9.6}$$

where n_i is an integer. Now the metabolic sources correspond to different space-time sheets.

Since nuclei are completely ionized Z^0 ions and Z^0 charge is in good approximation determined by the neutron number $A - Z$, metabolic synchrony requires in this case

$$n_i \simeq 2^{n_i} \times \frac{A_i}{(A_i - Z_i)^2} \times n_0 , \tag{9.7}$$

The densities would be in a reasonable approximation inversely proportional to neutron number if same metabolic source is used.

9.2.3 Plasmoids as life forms

The idea about plasma oscillation patterns as generalized holograms and symbolic representations provides a further support to the idea that plasmoids consisting of magnetic flux tube structures plus ions define primitive life forms. The original motivation for the idea came from the notions of magnetic body, universal metabolism based on zero point kinetic energies, and some experimental findings which deserve to be discussed in the recent context.

1. The first strange empirical finding that I learned of was the discovery that the velocity distributions of electrons in the plasma sheet at the night side of the Earth's magnetosphere contained features like "wings" and "eyes" [?] Note however that velocity distributions are in question, and it is not clear how directly they correlate with plasma waves at plasma frequency.

2. Towards the end of the year 2003 came the finding that plasmoids created in laboratory have basic characteristics usually assigned to living systems [?] Plasma oscillation patterns as primitive symbolic representations of external world would be a further characteristic of this kind. Time mirror mechanism would also make possible primitive memory and intentional behavior (also plasmoids have magnetic bodies).
3. The findings of Kozyrev [?] have natural explanation terms of phase conjugate waves associated with plasma oscillations at magnetic or Z^0 magnetic flux tube structures of astrophysical size. One certainly cannot over-emphasize the importance the possibility of quantum coherence in astrophysical length scales.
4. The spatial T-oscillation pattern of air discovered by Tiller could correspond to either em plasma oscillations of protonic Cooper pairs or to Z^0 plasma oscillations of water.

Protons are favored for obvious reasons. The scaled down electromagnetic plasma frequency for proton Cooper pairs is $f_p = 2^{-3(k-137)/4} \times x \times f_Z(H_2O)$, $x = (3e/2g_Z)$ and $f_Z(H_2O) = 1.45 \times 10^5$ GHz and should be equal to $f_p \simeq 1$ GHz suggested by the properties of the spatial pattern of T-oscillations. This gives $2^{3\Delta k/4} \simeq 10^5$ implying $\Delta k = k - 137 = 22$ with the error of 8 per cent so that the plasma oscillations of proton Cooper pairs should occur at $k = 159$ space-time sheet. For the Z^0 plasma frequency $f_Z(H_2O) = 1.45 \times 10^5$ GHz of water the scaling $2^{3\Delta k/4} \sim 1.45 \times 10^5$ is required to get $f_p \simeq 1$ GHz. $\Delta k = 23$ gives a correct result with a 7 per cent error. Since $k = 169$ is the space-time sheet at which the nuclei feed most of their Z^0 electric gauge flux, this would give $k = 169 + 23 = 192$ whereas $k = 188 < 192$ is the space-time sheet of magnetic flux tubes supported by Tiller's findings. This option does not look realistic.

5. Crop circles [?] might provide the most fascinating example of plasma wave patterns. Symbolic representations of "sacred geometry" based on rational numbers, some simple algebraic numbers, and π could be in question, and identifiable as an attempt to communicate about the fundamental importance of rational numbers and their extensions defining finite extensions of p-adic numbers concerning the understanding of cognitive consciousness [?]

There are strong indications that the circles are produced by microwaves, and BOLs ("balls of light") have been repeatedly reported in the vicinity of circles [?] Plasmoids would naturally generate the microwaves and the geometry of the crop formation would reflect the geometry of the plasma pattern at some larger space-time sheets. The scale of the smallest microwave patterns is about 15 cm and same as for Tiller's T-oscillation patterns for 2 GHz oscillations. That the same space-time sheets would be responsible for the smallest crop circle structures and T-oscillation patterns provides support for the general vision. The largest crop formations have a size of about 100 m. $\lambda = 75$ m corresponds to $f = 4$ MHz and $k = 171$ assuming that protonic Cooper pairs are responsible for these structures. The magnetic flux tubes of Earth having $k = 169$ would correspond to $\lambda \sim 27$ m.

In the chapters [?] rather radical proposal, which could have been inspired by Kozyrev's findings besides Chilbolton and Crabwood crop formations [?, ?] that crop circles could correspond to the communications of the descendants of human kind or of highly self-organized magnetic or Z^0 Mother Gaia from the geometric future of Earth.

9.3 Nerve pulse generation and holograms

The model for the nerve pulse generation discussed in [?] assumes that nerve pulse is generated by Z^0 ME connecting the boundaries of space-time sheets and drifting along the axon in such a manner that the effective phase velocity of the Z^0 field pattern is reduced to the nerve pulse velocity. Four-wave mechanism suggest a modification of this mechanism involving interfering Z^0 microwaves acting as reference waves running in opposite axonal directions, and having frequencies differing by twice the frequency characterizing rate of nerve pulses plus transversal probe and conjugate Z^0 MEs containing also the frequencies f_i responsible for remote metabolism.

9.3.1 Is f_i variable or not?

The simplest possibility is that f_i corresponds to a single fundamental frequency and only the angle θ is a variable parameter. The guess $f_i \simeq 1$ kHz promotes itself as the basic frequency of neuronal

synchrony and as the time scale for the duration of the nerve pulse. The spatial length per single the nerve pulse in a long axon is about $L = vT_p$, where T_p is the time interval between nerve pulses. Nerve pulses naturally correspond to the maxima of the standing wave so that $\lambda_h = L$ is a natural identification and gives $v = \cos(\theta) \times f_l \lambda_h = \cos(\theta) \times f_l v T_p$ giving $\cos(\theta) = T_l/T_p$ but leaving the value of v free. $v = x \times 10$ m/s and $T = 2$ ms give $f_h = 15/x$ GHz which represents an upper bound for this value of conduction velocity. For this option the angle θ would be the only control parameter and would control both the conduction velocity and frequency of nerve pulses.

It is of course possible that f_l could be varying and expressible as harmonics of some fundamental frequency f_0 . $f_0 = 10$ Hz is the most natural guess since 20 Hz defines the lower bound for audible frequencies and 10 Hz is the alpha frequency beginning to dominate in the absence of sensory input.

9.3.2 Two manners to achieve rate coding

Rate coding could result in two manners.

1. Rate coding could rely on the dependence of the angle $\cos(\theta)$ on the intensity I of the sensory stimulus: the stronger the stimulus the smaller the value of θ . Nerve pulse rate cannot correspond directly to $\Delta f_h = f_l \cos(\theta)$ but would relate to it in a statistical manner like the rate for hopping between the states of bi-stable system relates to the frequency of the driving force in stochastic resonance (for the possible role of the stochastic resonance in nervous system see [?]).
2. If f_l can have also the harmonics of the fundamental frequency as preferred values, as one might expect if cyclotron frequency is in question, the experienced intensity of the stimulus would be constant and change in a stepwise manner every time when the frequency f_l is replaced by its next harmonic. In this case 1 kHz frequency would represent upper bound for f_l . $f_0 = 10$ Hz could define the value of f_l producing no stimulus and $f_l \leq 1$ kHz would correspond to maximal alertness. If various frequencies are in one-one correspondence with memetic code words, 64 frequencies are needed and maximum value would correspond to 650 Hz.

9.3.3 Is the pulse rate quantized?

There is some evidence for the quantization of the experienced stimuli [?] When over-learning occurs in tasks involving temporal discrimination, the memory images about the intensity of sensation as a function of stimulus deviates from smooth logarithmic form in small scales by becoming a piecewise continuous function [?]uch that the plateaus where response remains constant are octaves of each other. This suggests that the memory image about the sensation depends only on the 2-adic norm of the 2-adic image of the ratio I/I_0 of the intensity of the stimulus to the threshold stimulus under canonical identification. There two two explanations.

1. For fixed value of θ the integer valued function $\log_2(|I/I_0|_2)$ would correspond directly to the harmonics of the frequency f_l/f_0 determining the rate of nerve pulses,
2. $\cos(\theta)/\cos(\theta_0)$ can have only integer values: geometrically this would mean that the x-axis projection of the allowed points of a unit circle would be integer-valued using $x_0 = \cos(\theta_0)$ as a unit. This option makes sense from the point of view of p-adic physics of cognition and intention.

9.3.4 The identification of the standing wave in the case of nerve pulse

There is a considerable freedom concerning the identification of the standing wave representing nerve pulse hologram and there could be (and probably are) several representations since space-time is indeed many-sheeted. The frequencies involved are below $15/x$ GHz for $v = x \times 10$ m/s if one takes the previous estimate seriously.

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Here qe is the charge of the super-conducting charge carrier, V denotes the membrane potential ($eV \simeq .05$ eV), and m is a parameter with dimensions of mass and determined by the details of the Josephson junction. V corresponds to membrane potential and is slowly varying.

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$$\Phi_0 = qe \int V dt + kz . \quad (9.9)$$

Thus the phase factor $\exp(i\Phi) = \exp(i \int eV dt) \exp(ikz)$ represents a standing wave. The wavelength $\lambda = 2\pi/k$ should correspond to the wave length $\lambda = vT$ associated with the nerve pulse.

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The detailed realization of intentional action at brain level could involve generation of holograms involving synchronous oscillation of the brain region, and gradual quantum jump-by-quantum jump evolution of constant components of electric and magnetic field inside MEs responsible for the control of ion flows between space-time sheets in turn responsible for their concentrations. Standing waves and there moving variants would be one possible manner to realize the holograms.

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2. Four-wave interaction could explain Kozyrev's findings about three signals coming from distant astrophysical objects [?] one signal from the future, one from the past, and one effective signal travelling with infinite velocity. The negative energy signal from the geometric future would be accompanied by a positive energy signal from Earth to the object and instantaneous "signal" would correspond to the standing wave representing the interference pattern of reference beams.

3. The phantom effects in Tiller's experiments relate to pH, temperature, and conductivity. One can however ask whether there is any evidence for mechanical phantom effects. The Russian physicist N. A. Kozyrev has indeed demonstrated mechanical "after-effects" caused by the presence of what he calls irreversible process, typically an vibrating torsion pendulum [?]

The experiments of Kozyrev deserve a more detailed discussion. In the experiments with a vibrating torsion balance, the forces at the support points did not disappear even when the vibration had ceased. The effect did not depend on the mass of the body but was dependent on its density. Most significant effects resulted for porous materials. According to Kozyrev: "Also when a system which had been in the vicinity of a periodic process and then brought to a torsion balance, yielded the same effect on it as the process itself... aluminum showed no memory. The largest memorizing effect for processes of both signs has been shown by sugar".

These findings bring in mind poor Donald Duck who once again has run over the verge of the cliff and defies the force of gravity until he realizes how Newton's laws require him to behave. The second reminiscence is a personal experience. I love swimming and spend long times in sea during summer time. In windy days, completely free floating with empty mind is especially enjoyable. When I return to shore, the experience about being in free floating motion continues for along time after swimming.

The general model for the formation of conscious holograms could explain also the continuation of oscillatory force response in the support points of the torsion pendulum when the oscillation itself has ceased. Every physical system has magnetic body, also the system consisting of torsion pendulum and the support for it. Brain has tendency to entrain to various kinds of oscillations. The entrainment is based on magnetic homeostasis implying that the values of local magnetic fields at some space-time sheets change so that cyclotron frequencies for some ions become equal to the entraining frequency. Same is expected to happen in the case of support system of the torsion pendulum. Also the well-known tendency of clocks to synchronize could be based on the direct contact of magnetic bodies of these systems and thus be an example of learning in its simplest form.

In the case of Tiller's experiment cyclotron oscillations induce pH-, T-, and σ -oscillations and even oscillations in series of pseudo-random numbers produced by a computer by inducing the flow of protons from magnetic flux tube to larger space-time sheets and back. Forced oscillations for the support of the pendulum induced by cyclotron oscillations of the magnetic body of the support system would be the desired item representing mechanical phenomenon in this list. In Tiller's experiments the oscillations continue when IIED and water sample are removed: in Kozyrev's experiments force oscillations in the support continue after the removal of the pendulum. The reason would be that magnetic body does not react so rapidly as physical body and can preserve the sensory memory hologram about oscillations by utilizing time mirror mechanism and generalized four-wave interaction.

When an object which has been in the vicinity of the oscillating system is brought near to the support system, the oscillatory force appears. This would be the counterpart for the conditioning induced by IIED in Tiller's experiments. The magnetic body of the support system would fuse with the part of the magnetic body of the "learned" system that has become entrained with the oscillations.

One can apply the model inspired by Tiller's observations at quantitative level.

1. Porosity favors the effect. Therefore the entrainment could occur dominantly with the mediation of the acoustic waves created by the oscillating pendulum. The learning is most effective when sound oscillations spend maximal time in the material. The sound waves are indeed caught in pores of the porous material: this is the reason why porous materials are used to absorb sound.
2. Plasma wave holograms at super-conducting space-time sheets are the best candidates for the symbolic representations of the oscillations associated with the support system. A pair (f_h, f_l) of high and low frequencies is involved. In accordance with the scaling law of homeopathy, the ratio of these frequencies defines the velocity of the moving standing wave pattern via the formula $v/c = f_l/f_h$ resulting when the reference waves with frequencies $f_h + f_l$ and $f_h - f_l$ move in opposite directions have frequencies. f_h is the frequency of the probe and conjugate waves making possible to get the energy needed by the formation of the hologram by utilizing time mirror mechanism.
3. In the recent case f_l is naturally the vibration frequency of torsion pendulums since the pendulum induces acoustic oscillations with the same frequency f_l and its harmonics. v is sound velocity in the air filling the pores of the material. This fixes f_h completely: $f_h = f_l \times (c/v)$.

f_h must be the plasma frequency f_p of protonic Cooper pairs at some non-atomic space-time sheet of air. The magnetic body might be able to vary the protonic Cooper pair density n in order to tune to the the plasma frequency $f_p = (e/\pi)\sqrt{n/m}$ so that it coincides with f_h . The simplest manner for the magnetic body to achieve this is to change the local thickness of the flux tube so that charge density and also magnetic field intensity changes.

f_h must also correspond to a zero point kinetic frequency of some particle so that the oscillations can occur by time mirror mechanism using remote metabolism based on the dropping of particles to larger space-time sheets from some space-time sheet in p-adic length scale hierarchy. Since three conditions must be satisfied, the effect favors certain oscillation frequencies f_l of the pendulum.

4. A concrete example helps to get some perspective to the problem. For sound velocity $v = 300$ m/s and $f_l = 1$ Hz, one would have $f_h = 1$ MHz and radio wave with wavelength of $\lambda = 300$ m. The protonic plasma frequency corresponds roughly to p-adic length scale $L(k = 168) \simeq 3.5$ μm , whereas the magnetic flux tubes of the Earth's magnetic field correspond to $k = 169$. It might be that for suitable sizes of pores also the sound resonances inside pores couple to plasma oscillations: this would however require very special conditions to be satisfied. For millimeter sized pores the lowest resonance frequency would be around .3 MHz.

10 How to test the basic vision?

In the following some proposals for testing the basic vision are discussed. Possible tests distinguishing between remote viewing and hallucinatory experiences have been already discussed.

10.1 Leakage of supra currents as basic mechanism

The basic element of the proposed vision is remotely induced leakage of supra currents from magnetic flux tubes to atomic space-time sheets. This same mechanism works for both endogenous biological self-organization and remote mental interactions which would form a routine part of our sensory representations. The most economic experimental strategy would be a direct verification of this basic mechanism.

An especially dramatic effect would be the appearance of ions from magnetic flux tubes to the target of remote mental interaction not present in the target initially. Sue Benford has found evidence for the appearance of S, Mg, and Al in X ray films which were exposed to the radiation coming from so called torsion generator [I2]. Intentional effort was involved with the experiment. What happened was that dots and tracks with typical size scale of one millimeter appeared in the X ray film. The dots and tracks did not allow identification as tracks of charged particles, and the exposed regions contained S, Mg and Al not present elsewhere. The leakage of energetic super-conducting ions to atomic space-time sheets dissipating their energy by emitting electromagnetic radiation and ionizing the atoms is the natural explanation for the effect [I2, I15]. Keith Fredericks has found that similar effect happens in nuclear emulsion when the emulsion is near to finger tips, and interpreted the tracks as tachyons [I11]. Note that both X ray films and nuclear emulsions contain gelatin which is an organic compound and might increase the sensitivity of the system.

10.2 Time reversal for the leakage of supra currents

The time reversal of the mechanism generating the leakage of supra currents could be especially important for healing. This mechanism is consistent with the presence of remote bound state entanglement and anomalous production of metabolic energy when binding energy is liberated.

The mechanism would be accompanied by a mysterious disappearance of marker ions in the tissue, and manifest as time reversed function of various molecular machines certainly detectable. Phase conjugates of (that is time reversed) microwaves at critical frequencies could induce the healing process. For instance, de-differentiation of cells might be induced in this manner.

As explained earlier, geometric time reversal could typically involve generation of anomalous radiation by excitation of atoms or molecules by emission of negative energy photons. Rotating magnetic

systems (Searl machine) would be especially interesting for proving that time reversal indeed occurs. One could try to demonstrate that biological rhythms correspond to dissipation-healing cycles (wake-up sleep period and metabolic cycles being basic examples).

10.3 Controlling metabolism by IR laser beams and DNA functioning by maser beams?

One could also test the 'dropping' of ions to larger space-time sheets. If the dropping ions have dissipated their energy this means that system acts like a maser at wavelength defined by the reduction of the zero point kinetic energy liberated in the dropping of the ion. The pumping process would correspond to the leakage of the supra currents to atomic or some other space-time sheet, and induced emission to the dropping induced by the photons already present.

1. The effectiveness of metabolic energy production in which proton drops and absorbs a negative energy photon of energy about .5 eV could be amplified by a beam of coherent IR light "kicking" protons back to the atomic space-time sheets. The irradiation by phase conjugate beam would "steal" energy from living system by inducing the dropping without locally usable energy. Whether living systems can "steal" energy from other life-forms in this manner could be tested. The "stealing" of the metabolic energy (there is probably a fractal hierarchy of "energy currencies") from cancer cells by phase conjugate laser light might be the first principle explanation for why Priore's machine works.
2. The dropping of ions from say $k = 151$ space-time sheet to larger space-time sheets creates microwaves with frequencies corresponding to zero point kinetic energies about $2^{-15}/A$ eV, A atomic number. For electron the energy is about 1/16 eV. These processes could define exotic forms of metabolism, perhaps at the level of DNA. This process could be amplified by an external microwave beam or its phase conjugate and phase conjugate beam could induce the correction of genetic errors.
3. The scaling law of homeopathy [I22] states that high and low frequencies accompany each other and are in a constant ratio for which TGD predicts several values determined as ratios of zero point kinetic energies and cyclotron energies at magnetic flux tubes. The scaling law can be understood as follows: dropping of ions to cyclotron states generates with the zero point kinetic energy and cyclotron photons. Low frequency photons can interact resonantly with the system for which the internal excitations have same low frequency. This generates internal excitation with wavelength which is of the order of system size and this excitation couples resonantly to photons with wavelength equal to system size: thus high frequency photons result.

Thus one might achieve the above proposed effects using also low frequency irradiation. For instance, irradiation by kHz waves in order to achieve generation of bio-photons and irradiation by ELF waves in order to achieve generation of microwave photons. In fact, I started to develop the vision about living system as a macroscopic quantum system from the finding of Blackman [J2] and other pioneers of bio-electromagnetism that ELF radiation has delicate effects in the functioning of living matter. It seems that the basic mechanism might be the dropping of ions between space-time sheets or its time reversal. This mechanism could be tested also for remote objects.

10.4 How to choose senders and receivers?

An important aspect of testing is optimal choice of targets and the persons acting as sender.

Quite generally, the optimal target system for demonstrating these effects would be a critical system very sensitive to small perturbations. Any critical system would work, and one might even consider that the critical systems used to detect elementary particles might be used. Overcooled vapor or liquid or overheated liquid is one possibility. One could take register what happens in the system using same methods as in particle physics. Organic compounds might be by definition be this kind of systems.

One could also try to identify optimal 'senders'. Persons with strong will power or with firm belief on the effect, or persons with lower level of inhibition (children, actors, artists,...) could be considered as optimal 'senders'. One could find whether some drugs which remove inhibition, could enhance

telepathic and psycho-kinetic abilities. The "blessed are the meek since they quantum entangle" prediction could be also tested. Indeed, one of the most dramatic experiments supporting psychokinesis was done using chicken which imprinted to a robot [J11]. The robot, whose behavior was programmed earlier by random number generator, tended to stay near the chicken, as if chicken had induced a quantum jumps changing the geometric past in macro-temporal time scales.

10.5 How to test the notion of conscious hologram?

The notion of conscious hologram means that practically any part of body can represent any other part of body or even external world. Concerning the notion of conscious hologram at the length scale of body, Kirlian imaging with simultaneous electrical stimulation of other body parts, in particular ear, is very promising manner to test the hypothesis [I12]. It is also known that ear forms kind of fractal miniature of body with respect to acupuncture points so that stimulation of particular part of ear electrically creates sensation that particular part of body is stimulated [J10].

PLR spectroscopy [I9] provides a precise and accurate manner to prove the viability of the notion of conscious hologram empirically. What is needed is the analysis of the frequency spectrum: does it really contain the predicted differences of cyclotron harmonics. If this approach and its variants really work it becomes possible to determine experimentally the densities of super-conducting ions and Cooper pairs at parallel space-time sheets.

At the level of remote mental interactions the stimulation of brain electrically could induce in other brain nerve pulse pattern or even experience correlating with the nerve pulse pattern or even experience in the stimulated brain. Even water near criticality could provide this kind of representations. In Imaging laboratory at Hilversum, Holland the following experiment has been performed with success. The experiment involves water droplet near freezing point. A person with abilities of a healer asks for Universe to express something in the structure of the droplet. What results are beautiful fractal patterns representing say plant leaves, even a picture about the laboratory's architecture has been generated in this manner.

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