Quantum model of sensory receptor

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Abstract

In TGD framework various qualia correspond to the average increments of quantum numbers and of so called zero modes for sequences of quantum jumps. Quantum numbers could be spin, momentum, energy, eletromagnetic charge, color quantum numbers (isospin and hypercharge in a constant proportion), various particle numbers, etc... In the sensory receptors the gradient of some physical quantity is transformed to average increments of appropriate quantum numbers responsible for the quale representing the gradient of the physical quantity. Spatial gradients are transformed first to temporal gradients by a process, which is essentially scanning (say saccadic motion). Temporal gradients are then transformed to non-vanishing average increments of appropriate charges per quantum jump in a long sequence of quantum jumps. The problem is to understand how this process is realized at the level of sensory receptors. In this article a model of visual receptor is constructed in order to clarify the issues involved.

Sensory perception is very active process, much like building of an artwork, and involves a continual selection between alternative percepts. If sensory representations are at the level of magnetic bodies of the sensory organs, this requires the presence of backprojection from magnetic body to brain to sensory organs. Backprojection would be a particular kind of motor action which could be based on classical communications or quantum metabolism by a feed of negative energy to some part of sensory organ which in turn feeds negative energy to higher levels of CNS.

The assumption that sensory qualia are realized at the level of sensory receptors, when combined with the requirement that the average increments of quantum numbers are non-vanishing, and perhaps even remain same for subsequent quantum jumps, poses strong constraints on the model of the sensory receptor. These constraints suggest what might be called the capacitor model of the sensory receptor. There are two reservoirs of quantum charges having total charges of equal magnitude but of opposite sign. The net charges are macroscopic in order to guarantee robustness. These reservoirs are analogous to capacitor plates, and only the

second one corresponds to the sensory experienced quale unless both the quale and its conjugate are experienced simultaneously. Capacitors plates can carry several charges. When the sensory quale is generated, there is a flow of charge quanta between the quantum capacitor plates. The charge quanta are more or less constant. This requirement could be relaxed to the condition that only the average increment is constant.

The capacitor model is applied to develop a model of photoreceptors and retina and a special consideration is given to the problem how back projection might be realized. An argument relying on some simple findings about the early development of embryo leads to the working hypothesis that the backprojection from brain is classical for "skin senses" and quantal for "brain senses". "Skin sense" receptors could however entangle with environment, which could explain why galvanic skin response (GSR) acts as a correlate for subliminal remote mental interactions. This remote mental interaction usually unconscious to us would be the analog of the primary perception exhibited by plants and even by biomolecules. Both the notion of backprojection and the not so fundamental hypothesis about division to skin and brain senses are detailed enough to be testable and several tests are proposed.

1 Introduction

One basic difference between TGD inspired theory of consciousness and standard neuroscience is that TGD supports strongly the view that sensory organs are seats of sensory qualia whereas brain constructs symbolic and cognitive representations. The many objections against this view [C1] will not be discussed in this article: deserve it to say that the notions of many-sheeted space-time and macroscopic quantum coherence allow to circumvent all the objections I am aware of. At the same time it is possible to get rid of the assumption that the neural pathways associated with different sensory modalities and having no obvious neurophysiological differences, manage in some mysterious manner to give rise to different qualia not continuously transformable to each other.

Second fundamental difference from neuroscience is that magnetic body having an astrophysical size serves as a kind of computer screen to which sensory, symbolic and cognitive representations are projected by either classical or quantum communications [5]. In fact, there is a hierarchy of magnetic bodies, even sensory organs are accompanied by magnetic bodies realizing the primary sensory representations. The magnetic body is not only a passive computer screen but also realizes motor actions which proceed from long length scales to shorter length scales in the direction of geometric past. Negative and positive energy topological light rays (MEs) are fundamental element of the model and Libet's classical experiments about time delays of consciousness [6, 7, 8] give support for the identification of "me" as magnetic body.

The third departure from neuroscience framework is that no separate repre-

sentations for memories is needed [5, C2]. Memory recall involves sharing of the mental image representing the desire to remember with the geometric past and memory is either shared quantally or communicated classically to the geometric now. The simplest possibility is that negative energy ME from the magnetic body representing the desire to remember suffers a timelike reflection in brain and transforms to a positive energy ME representing a declarative memory.

The fourth departure from neuroscience is that motor action, sensory perception, and memory are all basically same kind of intentional processes proceeding from long to short length and time scales. This structure involves the generation of a p-adic ME representing intention by a magnetic body at some level of the hierarchy, the transformation of the p-adic ME to negative energy MEs propagating to the geometric past and representing the desire to achieve something communicated to the body and forcing a cascade of similar communications inducing ultimately a generation of classical signals (positive energy MEs and various neural signals) progating towards geometric future and realizing the intention. An idea, which I have given up with frustration and found again with entusiasm several times, is that Z^0 MEs, which do not involve any massless quanta, are specialized to the realization of various aspects of motor action whereas em MEs are specialized to sensory perception. If photons are one universal step in the transformation of the sensory input to sensory qualia, this dichotomy might be understood. The fact that classical Z^0 force seems to be crucial for the understanding of enzyme action (kind of motor action too), supports also this vision.

The fifth basic distinction between TGD approach and neuroscience is that conscious experience is always about changes (quantum jumps) whereas materialism based neuroscience assumes that the state of brain dictates the contents of consciousness. This serves as an invaluable guideline in the construction of the general theory of qualia and sensory receptors.

In the sequel this general picture is applied to build a model of sensory receptor and sensory organ.

a) Various qualia correspond to the average increments of quantum numbers and so called zero modes for quite long sequences of quantum jumps. Quantum numbers could be spin, momentum, energy, eletromagnetic charge, color quantum numbers (isospin and hypercharge in a constant proportion), various particle numbers, etc... What happens in the sensory receptors is that the gradient of some physical quantity is transformed to average increments of appropriate quantum numbers responsible for the quale representing the gradient of the physical quantity. Spatial gradients are transformed first to temporal gradients by a process, which is essentially scanning (say saccadic motion). Temporal gradients are then transformed to non-vanishing average increments of appropriate charges per quantum jump in a long sequence of quantum jumps. The problem is to understand how this process is realized at the level of sensory receptors. In the sequel a model of visual receptor is constructed in order to clarify the issues involved.

b) Sensory perception is very active process, much like building of an artwork, and involves a continual selection between alternative percepts. If sensory representations are at the level of magnetic bodies of the sensory organs, this requires the presence of backprojection from magnetic body to brain to sensory organs. Backprojection would be a particular kind of motor action which could be based on classical communications or quantum metabolism by a feed of negative energy to some part of sensory organ which in turn feeds negative energy to higher levels of CNS.

c) An argument relying on some simple findings about the early development of embryo leads to the working hypothesis that the backprojection from brain is classical for "skin senses" and quantal for "brain senses". "Skin sense" receptors could however entangle with environment, which could explain why galvanic skin response (GSR) acts as a correlate for subliminal remote mental interactions. This remote mental interaction usually unconscious to us would be the analog of the primary perception exhibited by plants and even by biomolecules [9].

d) Both the notion of backprojection and the not so fundamental hypothesis about division to skin and brain senses are detailed enough to be testable and several tests are proposed.

The reader can interested in details of the still developing and far from final theory is encouraged to consult the chapters "Quantum Model for Sensory Representations" of [3] and the chapters "General Theory of Qualia" and "Spectroscopy of Consciousness" of [4]. The articles "Time, Space-time, and Consciousness" and "Quantum model of nervepulse, EEG, and ZEG" in this issue of JNLRMI provide and updated and rather thorough discussion of the basic notions involved.

2 Capacitor model for photoreceptor

In the sequel a general model of sensory receptor is proposed and applied to build a model of photoreceptors in retina. The new physics predicted by TGD is in a key role. The notion of quark color was originally introduced with a tongue in cheek with the motivation coming from the fact that the algebra of color quantum numbers based on the unitary group $SU(3)$ resembles strongly that of visual colors. In TGD framework this joke ceases to be joke: space-time sheets have color rotational degrees of freedom and classical color fields are not only possible but unavoidable in all length scales. One ends up to the identification of primary colors in terms of increments of color quantum numbers, and one can fix the imbedding space $H = M^4_+ \times CP_2$ and thus entire TGD Universe from the fact that there are just 3 primary colors! This perhaps gives a grasp about the amazing predictive power of symmetries in quantum theory.

2.1 Capacitor model for sensory receptor

The assumption that sensory qualia are realized at the level of sensory receptors, when combined with the requirement that the average increments of quantum numbers are non-vanishing, and perhaps even remain same for subsequent quantum jumps, poses strong constraints on the model of the sensory receptor.

These constraints suggest what might be called the capacitor model of the sensory receptor.

a) There are two reservoirs of quantum charges having total charges of equal magnitude but of opposite sign. The net charges are macroscopic in order to guarantee robustness. These reservoirs are analogous to capacitor plates, and only the second one corresponds to the sensory experienced quale unless both the quale and its conjugate are experienced simultaneously. Capacitors plates can carry several charges.

b) When the sensory quale is generated, there is a flow of charge quanta between the quantum capacitor plates. The charge quanta are more or less constant. This requirement could be relaxed to the condition that only the average increment is constant.

Cell membrane, or rather the pair formed by cell interior and exterior, and synaptic junction are excellent candidates for quantum capacitors.

a) During nerve pulse various ions flow between cell interior and exterior, which suggests that sub-neuronal sensory qualia are generated in a time scale of a millisecond. Also membrane oscillations might give rise to some kind of sensory qualia. In particular, superconducting Cooper pairs and bosonic ions enter or leave the Bose-Einstein (BE) condensates at the magnetic flux tubes and this should give rise to a chemical experience defined by the quantum numbers of the carrier particle. Not only the increment of electric charge but increments of magnetic quantum numbers characterize the qualia in question. Various information molecules transferred through the cell membrane could also give rise to sensory qualia.

b) In the synaptic contact the vesicles containing neurotransmitter are transmitted, and the net quantum numbers for the vesicles should determine the neuronal chemical qualia associated with the process.

This model does not apply to all qualia. Qualia can be also associated with the quantum phase transitions at magnetic flux quanta. A typical example is a coherently occurring cyclotron transition for a macroscopic phase of Cooper pairs. It would seem that quantum phase transitions at the magnetic flux quanta and particle flows between the quantum electrodes associated with electret type structures could define two basic types of qualia. Note that electret structures are dual to magnetic flux quanta as solutions of field equations. Vision and hearing would be basic examples of these two types of qualia.

2.2 Capacitor model applied to color vision

Capacitor model allows to attack the problem of how color qualia are generated physically.

a) Color sensation results from a spatial gradient of illumination at a given wavelength transformed first to a subjecto-temporal gradient: presumably by a saccadic motion. This explains color constancy naturally. The subjecto-temporal gradient of illumination in turn induces a quantum jump sequence for which average increments of color isospin and hypercharge per quantum jump are non-vanishing and characterizes the color in question.

b) What is needed are two color capacitor plates with opposite color charges. Since color confinement implies the vanishing total color charges below certain length scale, the notion of color capacitor is very natural. The fact that a region of a given visual color has at its boundaries a narrow stripe with the complementary color could relate closely to color confinement. Also the after images with varying colors could relate to the back-flow of the color charges establishing the equilibrium situation between the plates of color capacitor. The color black experienced when eyes are closed could be interpreted as being due to a background flow occurring even in the absence of the visual stimulus (this sensation disappears and visual consciousness is lost if saccadic motions are not allowed to occur).

c) The temporal gradient of illumination induces a flow of color charges between the plates of the color capacitor. The coding of photon frequencies to colors results if the quanta transferred between the plates are colored (in the sense of QCD color!) particles with the isospin-hypercharge ratio characterizing the visual receptor in question. The simplest and the most natural possibility highly suggested by the general structure of color gauge interactions is that color octet particles are in question so that three primary colors and their conjugates define the basic colors. A BE condensate of colored bosons is the most elegant manner to realize the capacitor. This mechanism requires only that the receptor is frequency sensitive, and that the quantum numbers of the colored particles associated with the capacitor plates depend on the type of the receptor. Depending on the direction of the color charge flow a given receptor contributes color or its conjugate color to the experience, which is an average over some set of receptors and thus a composite color.

There are actually two manners to "mix": the receptors correspond to separate subselves in which kind of statistical mixing results or subselves fuse to single subself representing single mental image representing kind of stereo consciousness. The fact that color receptors are connected by gap junctions supports the latter option.

d) 3+3 primary colors (black and white are counted as conjugate colors) correspond naturally to the charged "gluons" in the octet representation. For higher color representations a more refined color palette results. For white-black vision the increment of the color hypercharge would be vanishing on the average.

It could be also vanishing for the quanta involved (charged "gluons" belonging to $SU(2)$ triplet of gluons). If the classical color gauge field associated with the plates of the color capacitor reduces to $SU(2)$ one could indeed expect that black-white vision results.

2.3 The role of classical color gauge fields and the identification of colored particles

The classical color gauge fields associated with the receptor plates could favour BE condensate with particular color quantum numbers. Classical color gauge fields in general give rise to vacuum color currents, and these could generate coherent states of some gluon like particles giving in turn rise to BE condensates.

Since classical color fields are proportional to the induced Kähler field, one expects that strong color gauge fields are associated to solutions which are far from vacuum extremals. Other sensory receptors might differ from visual receptors in that they correspond to almost vacuum space-time sheets with very weak classical color gauge fields. A weaker condition is that the classical color gauge fields are so random that only weak coherent state and BE condensate results. MEs are excellent candidates for the carriers of colored BE condensates since their CP_2 projections are 2-dimensional and the classical color gauge field is Abelian and thus corresponds to a fixed $U(1)$ sub-group.

The model leaves a lot of room for the identification of the colored particles. The color could be in color rotational degrees of freedom of the space-time sheets; it could be gluonic color for an asymptotically non-free QCD realized in cellular length scale; or it cold correspond superconformal color associated with what might be called configuration space photons, which carry no energy nor momentum and are thus very "mind-like".

Even color magnetic polarization of nuclei at the magnetic flux tubes of the Earth's magnetic field might give rise to some kind of qualia but presumably phase transition type qualia would be in question now. The reason is that the nuclear physics at these space-time sheets differs from the standard one since quarks feed in this case both electromagnetic and Z^0 charges to the same space-time sheet ($k = 169$).

2.3.1 Rigid body color?

The identification of the color as a degree of freedom analogous to rigid body rotational degrees of freedom is rather attractive because of its simplicity.

a) Every space-time sheet has color-rotational rigid body degrees of freedom. For these degrees of freedom the rotation group $SO(3)$ is replaced by the unitary group $SU(3)$. Since the space-time sheet is topologically condensed at a larger space-time sheet and connected by join along boundaries bonds to other space-time sheets, these degrees of freedom are partially frozen. This means breaking of color symmetry to a subgroup of color group. $U(2) = SU(2) \times U(1)$, $U(1) \times$

$U(1)$, and $U(1)$ are the options besides complete breaking of color symmetry. This could explain why color capacitor mechanism is not involved with all cell membranes but requires special receptors.

b) The gluing operation for two space-time sheets occurs along 3-dimensional surface for both wormhole contacts and join along boundaries bonds. The requirement that gluing is possible implies that this portion of surface is a fixed point with respect to the subgroup of color group, which remains unbroken. If the region in question corresponds to a single point of CP_2, the isotropy group is maximal and equal to $U(2)$. This means that quantum states correspond to a rigid body motion in $U(2)$. For $U(1) \times U(1)$ the states are also characterized by isospin and hypercharge. For $U(1)$ only isospin labels the states and this would correspond to black-white vision.

c) The simplest states correspond to the restriction of color representations in $SU(3)$ realized as matrix elements of color representations to $U(2)$. The restriction means that certain states drop off. To get some grasp on the sitution, consider a simple example first. In the case of $SO(3)$ CP_2 is replaced by the sphere S^2 and the restriction to the group $U(1)$ drops away all matrix elements which vanish at the equator. For $J = 1$ triplet only the states having spin $J_z = \pm 1$ remain. Probably also in the case of $SU(3)$ only charged gluons survive in the octet representation restricted to $U(2)$. Since also color neutral states must be possible, the restrictions of higher representations must contain also color neutral states.

d) The freezing of color degrees of freedom means that the remaining degrees of freedom for the space-time sheet are zero mode like degrees of freedom. These degrees of freedom define what is known as a flag manifold. For $U(2)$ these degrees of freedom correspond to $CP_2 = SU(3)/U(2)$, for $U(1) \times U(1)$ the flag manifold is six-dimensional $SU(3)/U(1) \times U(1)$. Since the points of these flag manifold correspond to particular representatives for color rotations, and since color rotations transform pure electromagnetic fields to superpositions of em and Z^0 fields, it is clear that the change of the flag manifold coordinates affects membrane potential and has significant consequences. Flag manifold qualia would correspond to sequences of constant changes for flag manifold coordinates. In the simplest case, sequences of steps along one parameter subgroup of $SU(3)$. The connection between the dance of the honeybee and color group made by Barbara Shipman [10] supports the view that the increments of flag manifold coordinates define fundamental geometric qualia and are responsible, not only for the geometric aspects of vision, but of also other sensory modalities.

2.3.2 Gluons of scaled down versions of QCD?

TGD allows a hierarchy of QCD:s which are not asymptotically free. This property allows to circumvent the experimental bounds on the number of elementary particles. Given QCD would exist only in a certain range of p-adic length scales and thus in a certain range of energy and momentum transfers. This forces to

consider the possibility that QCD:s could exist even in cellular length scales, and that BE condensates of gluons give rise to the opposite color charges of color capacitors. The topological condensation of gluons forces the breaking of the color symmetry for all colored particles, even gluons.

2.3.3 Configuration space photons?

TGD predicts also configuration space color degrees of freedom. Unfortunately, the understanding the relationship of these new physics degrees of freedom to conscious experience is still a virtually unexplored territory. What is however remarkable is that these states do not carry any energy and momentum. Actually infinite-dimensional super canonical representations decomposing into representations of color group are in question. Rigid body color would represent the lowest states of these representations. MEs are especially good candidates for carrying this kind of color.

If MEs with sizes below cell membrane thickness are involved with the transfer of color between the color capacitor plates, the energies of the particles involved must be in ultraviolet range by Uncertainty Principle. If the transfer occurs between cells, the length scale could be of order micrometer and thus visible wavelengths would be in question as is indeed natural. Perhaps the structures formed by cell layers are involved with our color qualia.

3 The structure of the retina and sensory organs as sites of sensory qualia

The assumption that sensory organs are carriers of the sensory representations entangling with symbolic representations realized at the level of cortex [C1, D3] does not mean any revolution of neuroscience, just adding something what is perhaps lacking.

Neuronal/symbolic level would do its best to symbolically represent what occurs naturally at the level of qualia. Color constancy could be understood as a basic characteric of color qualia re-realized at the neuronal level. Center-surround opponency for the conjugate colors is the neural counterpart for the contrast phenomenon in which the boundary for a region of the perceptive field with a given color carries the conjugate color (black-white opponency associated with the luminance is only a special case of this). The contrast phenomenon at the level of visual qualia could derive from the vanishing of the net color quantum numbers for the electrodes of the retinal color capacitors.

The basic prediction is the presence of the back projection at least in the sensory modalities in which hallucinations are possible. MEs with MEs mechanism is the most natural candidate for realizing the back projection, negative/positive energy MEs would realize the back projection based on quantum/classical communications, and the capacitor model of the sensory receptor can be applied to

model photoreceptors and retina. This picture integrates nicely with the various speculations about the role of the ciliary microtubules in vision. The obvious question is how the presence and character of the back projection reflects itself in the structure of the sensory pathways and sensory organs. Basic facts about how gastrulation and neurulation proceed during the development of the embryo, lead to testable predictions about the character of the back projection for various sensory modalities, and one can speak about "brain senses" and "skin senses" according to whether the back projection is based on quantum or classical communications.

3.1 Microtubular structures as photoreceptors/transducers?

There is a definite evidence supporting the idea that microtubuli might be involved with a primitive vision. The information below is from the lecture "Quantum Vitalism" of Stuart Hameroff during an online course about quantum consciousness held in Arizona University 1999.

3.1.1 Findings of Albrecth-Buehler

Albrecht-Buehler [11] has shown that single fibroblast cells move toward red/infrared light (maximum absorption is around .1 eV) by utilizing their microtubule-based centrioles for directional detection and guidance; he also points out that centrioles are ideally designed photodetectors. Photoreception/phototransduction mechanisms at all stages of evolution involve the nine microtubule doublet or triplet structures found in centrioles, cilia, flagella and axonemes. The centriole is a pair of microtubule-based mega-cylinders arrayed in T shape [12]. Albrecht-Buehler has identified centrioles as the photoreceptors/phototransducers in photosensitive eukaryotic cells. Flagellar axonemes are the photosensitive structures in protozoa such as Euglena gracilis. Cilia in rod and cone retinal cells in vertebrate eyes (including humans) bridge two parts of the cells and have length distribution covering visible wavelengths. Photosensitive pigments (rhodopsin) is contained in the outer segment while cell nucleus, mitochondria and synaptic connection are contained in the cell body. Light enters the eye and traverses the cell body and cilium to reach the rhodopsin-containing outer segment.

3.1.2 The role of collective rotational excitations of water

Mari Jibu, Kunio Yasue and colleagues [13] have proposed that super-radiance in a microtubule could be involved with the photo-reception.

a) The energy gain due to the thermal fluctuations of tubulins is assumed to increase the number of water molecules in the first excited rotational energy state.

b) A collective mode of the system of water molecules in rotationally excited states is excited. A long-range coherence is achieved inside a microtubule by

means of spontaneous symmetry breaking. The collective mode of the system of water molecules in rotationally excited states loses its energy collectively, and creates coherent photons in the quantized electromagnetic field inside a microtubule.

c) Water molecules, having lost their first excited rotational energies by super-radiance, start again to gain energy from the thermal fluctuation of tubulins, and the system of water molecules ends up to the initial state.

Jibu and collaborators have predicted that cellular vision depends on a quantum state of ordered water in microtubular inner cores. The authors postulate a nonlinear quantum optical effect termed "super-radiance" conveying evanescent photons by a process of "self-induced transparency" (the optical analogue of superconductivity) involving formation of BE condensate of photons.

Interestingly, the energy scale of the rotational excitations of water is that of microwave photons, and microwave MEs play a key role in the TGD based model of bio-control of living matter discussed in [D1]. The key idea is that the clusters of water molecules can mimick the rotational and vibrational spectra of various molecules. For instance, homepathy might be based on the mimickry of the molecules of the drug. Perhaps the mechanism proposed by Jibu and collaborators could have a variant realized in terms of TGD based physics and involving microwave-, visible-, and very low frequency MEs.

In particular, the collective excitation of the water inside microtubule could be generated by coherent radiation of microwave photons accompanying microwave MEs rather than thermally. On basis of the second law one could indeed argue that thermal excitations cannot lead to the generation of macroscopic quantum coherent states. In light of latest advances in understanding the fractal many-sheeted metabolism [5], it seems however plausible that the quantum phase transitions associated with many-sheeted lasers are involved with the generation of collective excitations. The coherent photons generated by many-sheeted lasers might excite the rotational excitations of water collectively. The test for this hypothesis is that these excitations should occur only for a discrete set of wavelengths corresponding to the differences of zero point kinetic energies for various pairs of space-time sheets. The infared frequency of about .1 eV associated with the maximum absorption of infrared light by cells [11] indeed correspond to this kind of frequency

3.1.3 Evolution of eye

In simple multicellular organisms, eyes and visual systems began with groups of differentiated light-sensitive ciliated cells which formed primitive "eye cups" (up to 100 photoreceptor cells) in many phyla including flatworms, annelid worms, molluscs, crustacea, echinoderms and chordates (our original evolutionary branch). The retinas in human eyes include over 4×10^8 rod and cone photoreceptors each comprised of an inner and outer segment connected by a ciliated stalk. Since each cilium is comprised of about 3×10^5 tubulins, our

retinas contain about 3×10^{13} tubulins per eye. Retinal rods, cones and glia are interconnected by gap junctions [16] and this could be crucial for the generation of the macrotemporal quantum coherence, which quite generally relies on the generation of join along boundaries bonds connecting the boundaries of the space-time sheets forming the bound state in question [D2].

It is usually assumed that the cilium is a purely structural element, but the centriole/cilium/flagella microtubular structure, which Albrecht-Buehler has analyzed as an ideal directional photoreceptor, may detect or guide photons in eye spots of single cells, primitive eye cups in early multicellular organisms, and rods and cones in our retinas. The proposal that retinal macrotemporal quantum coherence leading to a new qualitative level of consciousness with much longer decoherence time could have emerged in sheets of gap junction-connected ciliated cells in eye cups of early Cambrian worms, generalizes the vision of Hameroff and Penrose [14] to TGD context.

3.2 The identification of the color capacitor structure

The organization of retina and visual system is discussed in [15], where also an excellent discussion of the structure of photoreceptor can be found. The first segment of the photoreceptor consists of the cell soma and a part containing mitochondria. This segment is connected by a ciliated stalk to a layered structure containing the photosensitive pigments. The length distribution of the ciliary microtubuli covers visible wavelengths.

The closing of eyes generates so called dark current [17] flowing along the receptor and inducing the hyper-polarization of the receptor membrane. Since visual consciousness is not lost as eyes are closed, the natural TGD inspired conclusion is that dark current is the neural correlate for the quale black as a background color quale which in turn results by the color capacitor mechanism.

The fact that vertebrate retina differs by inversion from the retina of invertebrates [18] inspires the question whether the microtubular vision of invertebrates about external world might have been inverted to produce "inner vision" providing back projection in the case of the vertebrates. If so vertebrate cilia would receive the "inner light" or generate it itself with brain or magnetic body remotely controlling the process. Mitochondria in turn could provide the needed metabolic energy but could also act as amplifiers of the incoming light. Remote control might involve sucking of negative energy or sending of positive energy MEs to mitochondria.

The photosensitive layers consist of endoplasma membranes so that the realization of the capacitor mechanism would be the same as for the ordinary axonal membrane (nerve pulse inducing flows of ions giving rise to the neuronal chemical qualia). The membrane would be at criticality as regards to the occurrence of the spontaneous color discharge and incoming photon would cause the breakdown. Since the color discharge can be assumed to flow from the side determined by the direction of the membrane electric field, each layer generates

same visual qualia although the direction of the color discharge varies. Layered structure would increase the sensitivity of the retina and facilitate the recharging of the capacitors since discharge would make intermediate regions charged and thus unstable.

It would not be surprising if also the endoplasma membranes filling the cell interior might serve the purpose of acting as quantum capacitors providing neuron with sensory receptors of various kinds. Also neuronal vision is quite possible: the difference from our vision would be that our vision involves integration of a very large number of neuronal experiences (more than .1 billion receptors) by quantum entanglement to form our vision. The gap junctions between visual receptors would make possible macrotemporal quantum coherences and the fusion of receptor level visual mental images to our visual mental images.

3.3 Back projection mechanism

The basic mechanism responsible for the back projection would involve curved low frequency MEs. Low frequency MEs could be regarded as topological light rays inside effective wave cavities defined by the magnetic flux tubes parallel to the axons, and leading from the cortex to lateral geniculate nucleus to ganglions to the retina. These magnetic flux tubes would form a part of the magnetic body associated with the retina and have quite large a size, which is predicted by the scaling law [D1] to be about 100 km. Inside low frequency MEs high frequency MEs would propagate as effectively massless particles. In the case of vision high frequency MEs would have lengths in the wavelength range covering that of the visible light.

3.3.1 The inverted structure of retina and back projection hypothesis

Photo receptors consist of rods and cones. Only rods are active at low luminance level (black-white vision). Cones are active at high luminance levels and sensitive to the wavelength of the light. Receptor cells are coupled via bipolar cells to ganglions which in turn feed the sensory input along the inner surface of the retina to the blind spot, and from the blind spot to the lateral geniculate nucleus (LGN) of the thalamus. Below (above) bipolar cells are horizontal (amacrine) cells responsible for the lateral couplings between receptor bipolar synapses.

Back projection hypothesis could allow to understand why the incoming light meets first ganglions and wanders through amacrine, bipolar, and horizontal cells to receptors. The inverted structure is indeed required by the back projection: the inner light (coming along, say curved MEs parallel to magnetic flux tubes parallel to microtubuli to ganglions or even remotely generated in the ciliated stalk), must superpose with the incoming light. If the structure would

be what a naive engineering argument would suggest, the inner light should meet the receptors from an opposite side than the light from the external world, and thus from a wrong side.

3.3.2 Back projection and retinal magnetic body

It is interesting to relate back projection to the retinal magnetic body. The following two arguments lead to the same estimate for the size of the retinal magnetic body.

a) The value of the ratio f_h/f_l of high and low frequencies appearing in the scaling law of homeopathy (see the chapter "Homeopathy in many-sheeted space-time") determines f_l. For the value $f_h/f_l \simeq 2 \times 10^{11}$ identifiable as the ratio of the ionic zero point kinetic energy at atomic space-time sheets and ionic cyclotron energy E_c in the Earth's magnetic field, this would predict that f_l is about $f_l \sim 3$ kHz so that retinal magnetic body would have size of order 100 km.

b) The scaling law relating the sizes L_{CNS} of brain structures to the sizes L_{magn} of the corresponding magnetic bodies would give in case of eye $L_{magn} = (c/v)L_{CNS}$, where v is the conduction velocity of nerve pulses or some other relevant velocity parameter. For $v = 10$ m/s and the size of retina about $L_{CNS} \sim 1/3$ cm, this would give $L_{magn} \sim 300$ kilometers so that the estimates are of same order of magnotude. The ratio c/v could be interpreted as the ratio of the ionic zero point kinetic energy at the cell membrane space-time sheet and of the ionic cyclotron energy E_c.

The thickness of the ionospheric cavity is approximately $d = 100$ km. Could this mean that the size of the retinal magnetic body is determined by the thickness of this cavity believed to also give rise to Schumann resonances? If so, then low frequency retinal MEs could be seen as correlates for a radiation moving between the Earth's surface and ionospheric lower boundary forth and back, somewhat like between two mirrors. For $d = 100$ km the period for a single forth-back reflection would be $\tau = .67$ ms, which is near to the duration .78 ms for a single bit of the memetic codon. For $d = 118$ km the duration $1/1260$ seconds of the memetic bit would result. Of course, retinal magnetic flux tubes could also be loops returning from the surface of the ionosphere which would make τ longer. If this identification is correct, the temporal variations of various perceptive time scales, say the time resolution of visual perception, determined by the duration of memetic bit, could correlate directly with those of d. In particular, during night time, when ionosphere tends to fall to lower heights, the time scales would become shorter making reaction times shorter.

3.3.3 Negative or positive energy MEs or both?

There are reasons to believe that negative energy MEs act as quantum entanglers whereas positive energy MEs, in particular boundary MEs, are dissipative

structures in the sense that the effective phase velocity of the classical fields associated with them is much slower than light velocity. In case of boundary em MEs, the quantum mechanism leading to the drmatic lowering of the effective phase velocity to EEG phase velocity would be basically the stucking of the boundary ME boundary along its boundaries to say cell membrane space-time sheet and to the magnetic flux tube of the Earth's magnetic field.

According to the general model of the motor action [5], motor action propagates from long to short length scales backwards in geometric time. This explains the extreme coherence and synchrony of the motor action extremely difficult to understand in standard neuroscience framework where the motor action is planned and initiated in brain. Now brain only reacts to the desires quantum communicated from magnetic body in the geometric future by sharing of mental images. Desires are communicated using negative energy MEs resulting in p-adic-to-real transitions from p-adic MEs representing intentions. This is true for both motor action, sensory perception, and long term memory recall. The desire would in these cases be "realize a particular motor action"; "direct attention in a particular manner"; "have a memory of a particular kind". This picture explains the strange findings of Libet related to the active passive aspects of consciousness [5].

The hierarchy of negative energy MEs within negative energy MEs could represent the decomposition of the motor action to subroutines and learning the motor skill would gradually lead to a hierarchy of negative energy MEs within ..... realizing the motor action is a precisely targeted manner with minimum amount of conscious attention. It is known that during the initial stages of the development of a motor skill, person tends to perform the motor action with his whole body and that EEG in wide areas of brain is activated. Gradually minimum amount of activity is achieved and also EEG becomes activated only in highly selected areas. Similar findings apply also to sensory perception associated with the motor action. This encourages to think that also a delegation of duties to lower levels of the hierarchy of magnetic bodies is involved and that it is enough to communicate the desire to these levels only.

To sum up, one has two basic options: Classical and Quantum.

Classical option: Positive energy MEs are involved with the back projection. In this case back-projection would be based on classical communications and would not represent intentional action at any level of hierarchy and could only by induced by such an action.

Quantum Option: Negative energy MEs are responsible for the back projection which might be regarded as a generalized motor action with negative energy communicating the desire to modify sensory percept from some level of the hierarchy of magnetic bodies. The phase conjugate of the laser wave would be the standard physics analog. If so then buy now-let other pay mechanism making possible remote metabolism could be involved with the back-projection. This mechanism is the basic mechanism of the metabolism in TGD framework [**?**] and implies extreme flexibility.

There are reasons to believe that both options are realized, and one can classify sensory modalities according to whether the back projection is realized by classical or quantum communications. One can also relate these two options to what happens to the embryo during the gastrulation and neurulation.

3.3.4 Where the control of back projection mechanism is?

One should also understand where the MEs at visible frequencies are generated.

a) If backprojection is just a particular kind of intentional motor action then the picture is following. The magnetic bodies at various levels of fractality realized intentions transformed to desires communicated to various parts of the physical body which reacts by trying to realize the desires. For **Quantum option** the generation of the inner light could mean generation of the quantum entangling negative energy low frequency ME carrying inside it negative energy visible frequency MEs to the appropriate part of the brain. The desire communicated from magnetic body sucks energy from retina which in turn is forced to suck energy from higher levels of CNS by sending negative energy MEs representing lower level desires. In this manner the cascade of desires continues to motor areas where the motor action is usually thought to be initiated. Back projections could generated at magnetic bodies associated with several levels: including magnetic bodies of retinas, ganglions, LGN and various sensory areas. If one believes that going upwards in CNS means going to shorter length scales, this would mean that desires would be always propagated upwards in CNS.

b) Back projection could be partially responsible for the appearance of the conjugate color at the boundary of a region of given color to improve contrast. Neuronal level would mimick this qualia level phenomenon at levels of the hierarchy. Whether back-projection from ganglia could relate the on-off structure of the receptive fields even at ganglion level, is an open question. The appearence of the conjugate color at the boundaries of a region of the visual field of a given color could relate to the vanishing of the net color charge for the "positive" electrodes of the system of parallel color capacitors formed by the photoreceptors coupled by gap junctions to form single macroscopic color neutral system.

c) The chromo-oxidase (CO) blobs associated with the visual areas V1 and V2 [19] are a signature of high metabolic activity. For **Quantum option** this would mean that the mitochondria in the neurons of CO blobs receive negative energy photons from some part of the retina, perhaps from the microtubuli in the ciliated stalk. The interpretation would be that brain area shares the mental image representing the desire of some magnetic body in the hierarchy to modify the sensory image and acts accordingly. For the **Classical option** CO blobs would generate positive energy visual MEs propagating to the sensory receptor along low frequency MEs: this communication would be classical and in case of boundary MEs limited by the effective phase velocity of the positive energy MEs, presumably of order 10 m/s.

3.3.5 Which cellular structures are involved with the generation of the inner light?

The basic question is which cellular structures are involved with the, possibly non-local, generation of the inner light and which are the mechanisms involved. One can imagine several options. Option a) is most plausible in the case of vision and olfaction whereas option b) might be realized when the back projection occurs via classical communications.

a) Mitochondria could act as receivers of the negative energy from the retina. Cytochrome oxidase (CO) [19] is involved with the liberation of the metabolic energy and is associated with mitochondria which are everywhere. The large amount of CO in CO blobs suggest that they are metabolically very active. This could be due to the receival of negative energy photons responsible for the remote metabolism at retina. Note that this mechanism would be essentially lossless and could be said to involve a temporal change of the arrow of the geometric time at the level of MEs.

b) Mitochondrial autofluorescence could generate the inner light actively [20] rather than as a mere by-product of metabolism: in this case however positive energy photons would be generated at CO blobs. The study of fluorescent lifeforms, say fireflies and lifeforms able to change their skin color might provide understanding about the feasiblity of back projection using this mechanism (applying for Classical option). In the case of population inversion negative energy MEs could serve only as a seed of phase transition in which a population inverted many-sheeted laser returns to the ground state (the rate for the transition to the ground state is proportional to the particles in the ground state). Thus autofluorence might be stimulated also by negative energy photons, perhaps even by biophotons.

3.3.6 Do the cilia/mitochondria in photoreceptors serve as pre-amplifiers?

Cilia might act as pre-amplifiers for the light coming the external world, at least in the case that the illumination is very weak. If the inner light comes from brain as positive energy photons (**Quantum option**), it is expected to have extremely weak intensity and pre-amplification mechanism could be at work also now. For **Classical option** the pre-amplification mechanism would be replaced by the sharing of the mental image representing the desired modification of the visual mental image and realized by buy now-pay later mechanism. One can consider at least two different options for the pre-amplification mechanism.

a) Cilia act as pre-amplifiers and the process is triggered by the incoming inner light by a stimulated emission mechanism for which the rate for the generation of photons is proportional to N^2, N the number of photons already existing in the system. For **Quantum option** this mechanism would be at work also for the inner light.

b) The article about reversible excited light induced enhanced fluorescence

(briefly RELIEF [20]) supports the view that mitochondria need not only produce fluorescence as a passive by-product of energy yield but could act as amplifiers of the incoming light [20]. Also now buy now-pay later mechanism could be involved. RELIEF phenomenon allows to consider the possibility that the large number of mitochondria preceiding cilia in the visual receptors could serve as a pre-amplifier for the incoming inner light. The precise information about the mechanism of autofluorescence in case of fireflies and lifeforms able to change their skin color might provide strong constraints on the model.

3.4 Does the back projection emerge in the transition from invertebrates to vertebrates?

Three inversions characterize the transition from invertebrates to vertebrates.

a) The inversion of the retina occurs [18].

b) In vertebrates *resp.* invertebrates incoming color generates hyperpolarization *resp.* polarization of the receptor membrane [18]. Thus it would seem that the roles of white and black are changed in the vision of invertebrates: invertebrates detect the lack of light.

c) During morphogenesis the generation of neural tube giving rise to spinal cord, motor nerve, eyes and other sensory organs in head occurs [22, 23]. Neural tube is formed through a folding process implying that neural tube results essentially from an inside-outside inversion of the outer epithelial sheet of the skin.

The finding that neural tube and skin are related by inversion inspires the following questions.

a) Could one relate the first two inversions to the the third one? The following arguments summarizing the basic facts about gastrulation and neurulation support this guess.

b) What implications the inversion could have for consciousness? Did it change the character of some sensory modalities in a decisive manner so that one see "skin senses" and "brain senses" as inversions of each other in some sense. Could it be that the "skin senses" do not involve the telepathic back projection and that the possible back projection is based on classical communications in this case? Could one understand the emergence of the vertebrates as a step in which the telepathic back projection emerged in vision and perhaps also in some other sensory modalities like olfaction, and made vertebrates dreamers and artists building visual representations as charicatures? Could it be that under appropriate circumstances tactile senses could provide telepathic information from the external world making possible a telepathic remote sensing which in general need however not provide information directly conscious-to-us?

3.4.1 Gastrulation and the differences between vertebrates and invertebrates

Gastrulation [22, 23] during which the growing embryo gets gut, is said to be the most important and vulnerable period in the life cycle of a multi-cellular organism. During this period the embryo begins to express its own genome (mother's genome has taken care of development hitherto). The details of this process differ for invertebrates (sea urchin is standard example), amphibians (say frog), and higher vertebrates (birds, reptiles, mammals).

In the case of vertebrates the process leads to the generation of essentially three kinds of cell populations. Endoderm develops to inner organs like stomach, intestine and lungs. Mesoderm consists of cells originally contained by the surface of the blastula and differentiates to muscles and inner organs like heart. Ectoderm is the outermost cell layer of the embryo consisting two parts which differentiate later to the nervous system and skin.

For invertebrates gastrulation occurs through a process known as invagination, which is essentially the inpocketing of the epithelial sheet. The pocket like structure elongates to gut tube like structure consisting mainly of endoderm. The nervous system develops from the mesoderm.

Gastrulation occurs differently for amphibians and higher vertebrates. In the case of amphibians gastrulation involves so called involution which means that the mesoderm part of the epithelial sheet rolls below the epiderm to form a double-layered structure (the folding of a rug gives idea of what happens). This process occurs for both halves of the embryo and give.

In the case of birds, reptiles, and mammals the gastrulation starts from a situation to which gastrulation leads in the case of amphibians. This in the sense that the outer surface of the blastula is a double layered structure consisting of epiblast and hypoblast below it already in the beginning of the gastrulation. The ingression (detachment) of the cells from the the epiblast *resp.* hypoblast sheet to the interior of the blastula gives rise to mesoderm (muscles, heart,..) *resp.* endoderm (stomach, intestine, lungs,...). The remaining epiblast will later transform to skin and nervous system.

3.4.2 Neurulation and the difference between "skin senses" and "brain senses"

Before neurulation the outer surface of the vertebrate embryo consists of two parts: the future skin and neural plate forming the future nervous system [22, 23]. During neurulation the ectoderm in neural plate invaginates to form neural tube and neural crest between the neural tube and the ectoderm surface forming the future skin. Neural crest is formed by the ingression of cells from the skin and gives rise to sensory and autonomic nerves, Schwann cells, pigment cells, ... Neural tube in turn gives rise to brain, spinal cord, motor nerves, eyes,...

The surface of the neural tube is essentially the outer layer of the skin,

which has suffered inside-outside inversion. The inversion might mean that the external world is replaced effectively by internal world as far as possible sensory experiencing relying on microtubule based sensory organs is considered. This suggests that all "brain" senses such as vision and olfaction involve a telepathy based back projection (sharing of mental images) in an essential manner. "Skin senses", in particular hearing, would in turn involve non-telepathic back projection based on classical communications.

Invertebrate eye is formed from the surface cell layer which has not suffered inversion: this could explain why vertebrage and invertebrate eyes differ by inversion. Invertebrates are "almost-predicted" to have back projection based on the classical signalling, in particular in the case of vision: this prediction is testable.

If hearing is "skin sense", as suggested by the fact that we "hear" low frequencies by skin (besides my fragmentary information on the development of the embryo), one must conclude that the back projection to ears must be classical. This conforms with the fact that geometro-temporal patterns of sound waves are the key element of audition. Oto-acoustic sounds audible even by outsiders are indeed a well-known phenomenon and also tinnitus should be caused by back projection involving classical signalling, perhaps by Z^0 MEs inducing oscillations of nuclei and thus sounds in the inner ear. The hallucinations in "skin senses" and "brain senses" should have a different character. This might explain why dreams are usually either visual or based on internal speech whereas the dreams accompanied by auditory hallucinations are rare and those involving tactile sensations even rarer.

Telepathic "skin senses" (with hearing included) are predicted to be possible and should involve a sharing of remote mental images. The shared mental image need not be directly conscious-to-us. Interestingly, galvanic skin response (GSR) is a well-known physiological correlate of parapsychological effects and skin seems to play an important role quite generally (e.g. healing by touch and the time varying magnetic fields emitted by the hands of some persons with psykokinetic abilities). Blind people can develop tactile vision and also tactile hearing is possible: an interesting question is whether these senses involve quantum entanglement with the object of the perceptive field. The "sense of presence" might also be seen as a remote "skin sense". That car driver experiences the road through the heels of the moving car as if the vehicle were a part of his body, might be understood in terms of the entanglement associated with touch. Furthermore, it is far from trivial how we know that the sounds from the external world really enter from the external world: perhaps quantum entanglement with the sources of the sound waves is part of the explanation.

The notion of bicamerality introduced by Jaynes [24] inspires the hypothesis that bicamerals and also schizophrenics can receive conscious information from collective levels of consciousness as auditory and visual hallucinations (see the last part of [4]). The direct sharing of sensory mental images or of symbolic mental images back projected to sensory mental images would be in question.

In the case of auditory hallucinations this process should involve classical back projection unless a genuine telepathy is in question. This prediction could be perhaps tested by studying the physiological correlates of hallucinogen induced experiences.

3.4.3 Back projection hypothesis and olfaction

Back projection hypothesis could allow to understand also some strange findings about insect olfaction.

a) As Callahan has demonstrated, insects experience odorant molecules through the infrared light that they generate, rather than chemically [25].

b) Olfactory and visual receptors resemble strongly each other.

The fact that olfactory bulb can be seen as part of brain, suggests that the inversion of the receptors occurred also for infrared sensitive microtubular receptors, that the back projection is "telepathic" also in the case of the odour perception, and that for "brain senses" the sensory input is always transformed to photons at some wavelength range before it enters to the quantum capacitor and is transformed to qualia.

The infrared light responsible for the "inner odours" could be generated by the same mechanism as the "inner light" the case of vision and would probably involve microtubular structures. The microtubuli involved with odour receptors should have lengths in the range 5-100 micrometers. Albrecht-Buehler, who has done a lot of experimental work in cellular infared vision, has demonstrated that infrared signals affect the behaviour of cells and that the infrared detector is in the centrosome [26].

3.5 How to test the general model?

The basic assumption of the model are following.
a) Sensory organs are the seats of the sensory qualia and basic sensory representations are realized at the magnetic bodies associated with the sensory organs by entangling sensory mental images with those at the magnetic body.
b) Back projection is based on quantum *resp.* classical communications for "brain senses" *resp.* "skin senses".
There are huge quantities of information about sensory perception so that one can invent tests for these assumptions by just going to Mednet and by loading abstracts.

3.5.1 Phantom sensations, back projection, and the notion of magnetic body

Tactile hallucinations provide interesting tests and challenges for the notion of magnetic body and for the assumption about sensory organs as seats of sensory qualia.

a) It is known that a tactile stimulation of the existing leg can evoke a dual phantom sensation in a symmetric position; that visual input affects the spontaneous but not the evoked phantom sensation; and that sensory-motor input affects the spontaneous phantom leg sensation [27]. The role of the visual input suggests that the evoked phantom leg sensation involves an erraneous localization of the tactile sensation at the level of the sensory map of the geometric now and thus involves cortical information processing. The loss of the leg need not lead to the loss of the magnetic body associated with the leg. The tactile back projection could generate tactile mental image in the stump of the leg, which would be entangled with a point of the magnetic body of the amputated leg at the same position as as the tactile mental image associated with the existing leg. b) The sharing of mental images in principle makes possible to have sensory experiences without any input to cortex, a genuine quantum telepathy in the scale of the human body. Anton's syndrome, in which person is cortically blind but claims to see, could be seen as an example of this. Also various bodily sensations experienced when the afferents to the brain are anesthetized could be seen as sensory telepathy from sensory organ to magnetic body. Typically sensations of swelling, elongation, and shortening as well as of cold, warm, and prickling are involved ("numbness" of hand is familiar to anyone) [28]. The latter sensations could be interpreted as an evidence for the sharing of sensory mental images. The experiences about swelling, elongation and shortening would result from the erraneous estimation of the geometric parameters of the body part in the absence of the sensory input to the cortex implying in turn the distortion of the image of the body part at the magnetic body.

3.5.2 Basic tests for back projection mechanism

Dreams and hallucinations should not involve "skin senses" except in the case that classical back projection is activated. Auditory/tactile hallucinations should involve classical communications from brain to ears/skin unless geometric memories or remote sharing of mental images are involved. Hypnotically induced hallucinations combined with the physiological monitoring of primary sensory organs and sensory pathways allow to test whether the predicted differences between skin and brain senses are indeed there.

The presence of the back projection could be tested by using hypnotic suggestion to experience particular qualia. One can test whether it is possible at all experience hypnotically induced tactile qualia and does this experience involve classical signalling from brain. One could test whether something occurs in color receptors of a person with closed eyes or in a dark room under hypnotic suggestion. One could investigate whether the activity of CO blobs or say P cells in LGN correlates directly with the activity at the retinal level during hallucinations. One could check whether the back projection for invertebrates involves always classical signalling.

3.5.3 Hypnosis and back projection

The findings about hypnosis and color vision [29] suggest more detailed tests for the back projection hypothesis.

a) The study in question was designed to determine whether hypnosis can modulate color perception. Such evidence would provide insight into the nature of hypnosis and its underlying mechanisms.

b) Eight highly hypnotizable subjects were asked to see a color pattern in color, a similar gray-scale pattern in color, the color pattern as gray scale, and the gray-scale pattern as gray scale during positron emission tomography scanning by means of CO_2. The classic color area in the fusiform or lingual region of the brain was first identified by analyzing the results when subjects were asked to perceive color as color versus when they were asked to perceive gray scale as gray scale.

c) When subjects were hypnotized, color areas of the left and right hemispheres were activated when they were asked to perceive color, whether they were actually shown the color or the gray-scale stimulus. These brain regions had decreased activation when subjects were told to see gray scale, whether they were actually shown the color or gray-scale stimuli. These results were obtained only during hypnosis in the left hemisphere, whereas blood flow changes reflected instructions to perceive color versus gray scale in the right hemisphere, whether or not subjects had been hypnotized.

d) The conclusions were that among highly hypnotizable subjects the observed changes in subjective experience achieved during hypnosis were reflected by changes in brain function similar to those that occur in visual perception. These findings support the claim that hypnosis is a psychological state with distinct neural correlates and is not just the result of adopting a role.

The findings of [29] inspire following comments.

a) The occurrence of hypnotically induced changes in brain function similar to those occurring in visual perception supports the view that sensory organs are the seats of the primary sensory experience. If eyes are the seats of color qualia, hypnosis should induce back projection as is also obvious from the fact that hypnosis induces hallucinatory experiences. The occurrence of the back-projection could be tested by using hypnosis in the absence of external light stimulus by testing what happens whether color receptors are active when person is hypnotized to see color.

b) That the left hemisphere is less gullible in ordinary wake-up consciousness supports the role of right hemisphere as the new-ageish entangler and of the left hemisphere as the skeptic loner. Parts of right brain would become more easier extensions for the brains of suggestive persons even without hypnosis. Right brain hemisphere could also be the the sensory artist, and thus the dominating generator of the inner light associated with the back projection. Right brain hemisphere could also generate the inner "voices" of auditory hallucinations as Jaynes proposes [24] or be entanglement with some higher level of self hierarchy

using right brain hemisphere to generate the hallucinations.

3.5.4 Models for sensory organs and back projection

The insights provided by the study of the structure of the retina encourage to think that a detailed data about various sensory receptors and their development during embryo period could provide a lot of insights about the mechanisms generating sensory qualia and about the mechanisms of the back projection and lead to testable predictions. This would however require a lot of professional knowhow. Also the possible role of biophotons in back projection might be amenable to study. Especially interesting is possible role of skin as a sender of negative energy MEs to environment and thus a possible sharer of mental images of other organisms and performer of PK.

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[D1] The chapter *Homeopathy in many-sheeted space-time* of [4].

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[D3] The chapter *General Theory of Qualia* of [4].