Life and Death and Consciousness

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June 20, 2019

Abstract

Life and death belong to the greatest mysteries of science. The development of quantum theories of consciousness has made possible to say something non-trivial also about life and death. In this article I describe TGD inspired theory of consciousness and the view that it provides about life and death. There are several notions which are new from the point of view of standard physics. From the point of view of TGD inspired theory of consciousness the most important ones are Zero Energy Ontology (ZEO), Causal Diamond (CD), Negentropy Maximization Principle (NMP). One can say that self as conscious entity is a sequence of repeated state function reductions at the same boundary of CD and not affecting or states at it - Zeno effect- and that self dies as the first reduction to the opposite boundary of CD is forced by NMP and means reincarnation of self as time-reversed self.

Contents

1 Introduction

Life and death have remained the deepest mysteries of science. The development of quantum theories of consciousness has however encouraged scientist to make also questions about the essence of life and death. In this article TGD based view about consciousness, about about life and death is discussed.

To begin with, it is good to represent the basic ideas of TGD inspired theory of consciousness.

1. Living system bring in mind elementary particle like coherent unit. This suggests that macroscopic quantum coherence is an essential aspect of life and consciousness. Non-predictability, which does not mean randomness, is second essential aspect of living systems and we experience it as free will. The description of this aspect however leads to problems in the materialistic approach originally inspired by physicalism and the idea that physicist can predict everything given the initial values.

   State function reduction seems to be however a genuine non-deterministic physical phenomenon and leads to severe problems in quantum measurement theory: it is very difficult to combine the non-determinism of state function reduction with determinism of unitary time evolution (causality problem): this has led to a multitude of interpretations trying to avoid the paradox. The obvious first guess is that it might hold key to the understanding of consciousness.

2. TGD inspired quantum theory of consciousness can be seen as a generalization of quantum measurement theory replacing the notion of observer as kind of black box with the notion of self as conscious entity. In TGD framework causality problem is solved by assuming that there are two times: subjective time defined by sequence of state function reductions following the analog of unitary time evolution lasting for finite time and geometric time of physicist. Corresponding causalities are independent and quantum jump replaces entire time evolution with a new one so that the conflict between the causalities is resolved.

   This picture leads to what I call Zero Energy Ontology (ZEO). In ZEO physical states are zero energy states, which are superpositions of pairs of positive and negative energy states serving as analogs of what might called classical event. They respect basic conservation laws and solution of field equations connects the members of state pair: this realizes holography. The members of pair are localized at boundaries of causal diamond (CD) obtained by taking the intersection of future and past directed light-cones of Minkowski space and replacing its points by CP_2.

   State function reduction occurs in cascade like matter proceeding to shorter scales and from system to the sub-system if system decomposes to a product of unentangled sub-systems in the reduction. The outcome at passive boundary of CD is a set of inherently negentropically entangled subsystems having no entanglement between themselves. These systems can be seen as sub-selves of self experiencing these subsystems as mental images.

For given CD state function reduction occurs repeatedly to what I call passive (light-like) boundary of CD and leaves members of state pairs at it invariant. Also the passive boundary itself remains unchanged. The members of state pairs at opposite, *active* boundary of CD experiences the analog of unitary time evolution followed by a reduction passive boundary: this occurs repeatedly as in Zeno effect. Active boundary also drifts further away from the passive boundary whereas nothing happens at the passive boundary.

3. The basic variational principle of consciousness theory identified as quantum measurement theory is Negentropy Maximization Principle (NMP), which demands that entanglement negentropy associated with entanglement is not reduced. In real number based theory entanglement negentropy would be non-positive and genuine information would not be possible. The requirement that the theory describes also cognition, however leads to the generalization of real number based physics to what I call adelic physics. p-Adic number fields allow only algebraic number valued entanglement and assign to it negentropy, which can be positive. One has negentropic entanglement (NE) NMP allows several variants but the mildest form requiring that NE is not reduced seems to be the realistic one.

4. Self as conscious entity can be regarded as generalized Zeno effect identified as a sequence of state function reductions to the same (passive) boundary of CD not changing the part of state at it. Eventually the first reduction to opposite boundary takes place and self dies and re-incarnates as time reversed self at the opposite boundary of CD - obviously a highly non-trivial prediction of ZEO. The flow of subjective time can be interpreted as the increase of temporal distance between the tips of CD.

To help the reader to build a context it helps to summarize what TGD inspired consciousness is and what it is not. In particular, I try to make explicit those key assumptions of TGD, which are in conflict with the existing belief system. The basic assumptions of TGD as a theory can be certainly be blamed of being speculative but the basic predictions of TGD follow from these assumes and are not speculations in the framework of TGD.

1. The approach is that of physicist but not of physicalist. TGD tries to extend physics as a theory of regularities of conscious experience to a theory of consciousness. TGD does not try to reduce consciousness to a property of some system as physicalist would do, and therefore also avoids the hard problem plaguing monistic and dualistic approaches. For physicist the idea that consciousness would be assignable only to brain, human brain, or even male brain is extremely non-feasible and bring in mind the view about Earth as the center of Universe.

   One could blame TGD for panpsychism. This kind of view is adopted also by Tononi and Koch in IIT approach [J4] (for TGD based criticism of IIT see [L5]). Self hierarchy is the key prediction challenging the standard neuroscience based view, and combined with the identification of sub-selves as mental images gives rise to a rather powerful and predictive approach. Hence in the following life

and death are seen as universal notions expected to make sense in much wider framework than biological systems.

2. The experience from discussions is that the relationship between geometric and subjective times is difficult notion. In particular, understanding of how subjective time as a sequence of state function reductions (to the same boundary of causal diamond (CD)) corresponds to clock time has been one of the main challenges of TGD inspired theory of consciousness during the last two decades.

   Existence is often thought to be just single type of existence but now conscious existence is assigned with state function reductions, something between two quantum worlds (objective existences in the sense of physics), which represent mathematical existence and are zombies. For a non-mathematician this notion is not easy to grasp. It is however extremely economical ontologically since it allows to get rid of the assumption that there is something "behind" the quantum worlds as mathematical realities. Conscious existence means continual re-creation of the quantum universe and together with NMP it implies evolution.

3. In ZEO physical states are replaced with something analogous to events, pairs of positive and negative energy states with opposite total quantum numbers. This is also new and difficult to comprehend. For people thinking in terms eastern philosophies ZEO might be easier notion but for a "westener" the idea that there are only observations of events and that physical world as something absolute and given is only a narrative, looks weird. ZEO is of course consistent with the laws of physics, in particular conservation laws, but implies their scale dependence accepted already in quantum field theories.

   ZEO can be also defended by its extreme flexibility allowing to avoid the usual problems causing grey hairs for theoretician. In classical physics initial values fix the entire time evolution and only single solution of field equations is realized: in strict sense theories are untestable and obsolete. One can also wonder what metaphysical principle selects the initial values. Also in quantum physics conservation laws restrict strongly the set of allow time evolutions and the idea about theory for entire Universe becomes somewhat obsolete.

4. The assumption about fixed arrow of time is not usually questioned and thermodynamics is assumed to imply arrow of time. ZEO forces to give up this belief, and predicts the notions of time-reversed self and re-incarnation. These can be argued to be very weird predictions, and they might be of course wrong. This can be tested. TGD inspired theory of consciousness is indeed a theory and good theories usually predict something not consistent with naive everyday intuitions. For instance, Libet's strange findings about active aspect of consciousness [J1] could be understood if the arrow of time changes in motor actions.

5. The notion of macroscopic quantum coherence is central and represents new physics relevant for quantum biology. The new quantum biology comes from several sources: the hierarchy of Planck constants $h_{eff} = n \times h$ making possible

macroscopic quantum coherence for large enough values of n assignable to dark matter as phases of ordinary matter so that dark matter would become key player in the drama of living matter.

Second new notion is what I call many-sheeted space-time. In field theory and general relativity limit of TGD the effects of many-sheeted space-time show as small anomalies [K3] but in biology this notion becomes central.

The third new notion is that of magnetic body (MB) deriving from the new view about classical fields implied by the postulate that space-times are 4-D surfaces in $M^4 \times CP_2$. Systems have field identity, field body, in particular magnetic body serving as intentional agent receiving sensory data from biological body and controlling it by using analog of EEG realized in terms of dark photons. Also this notion raises strong emotional reactions. I can only defend TGD by telling that this is what TGD naturally predicts, and I have done quite impressive work in finding anomalies where magnetic body raises its head.

One can compress the general vision to following mnenomics: ZEO, CD, NMP, NE, and Zeno effect. In the sequel I describe TGD more precisely. In this article the focus is in consciousness theory and neither quantum TGD nor quantum biology are discussed. Also the p-adic physics and adelic physics playing essential role in the understanding of NMP are not discussed in detail. The article [L4] gives a more detailed view about TGD, TGD inspired theory of consciousness, and TGD inspired quantum biology.

2 ZEO and generalization of quantum measurement theory to a theory of consciousness

TGD inspired theory of consciousness can be seen as a generalization of the quantum measurement theory by making observer part of physical system as conscious entity subject to laws of quantum physics. I will talk about this conscious entity as self and pose no a priori restrictions what self can be. The basic vision is that quantum measurement theory must be generalized so that observer ceases to be an outsider and is described by the quantum physics. ZEO plays a key role in this generalization and makes highly non-trivial predictions. Raising quantum measurement to a universal physical phenomenon requires the identification of the density matrix of subsystem as a universal observable and introduction of Negentropy Maximization Principle (NMP) [K2] as the fundamental variational principle of consciousness.

2.1 ZEO

One must generalize ontology in order to solve the contradiction between deterministic time evolution and the evolution by state function reductions. This requires understanding the notion of subjective time and its relationship to the geometric time. The new ontology must allow to see selves as something unchanged in some aspects and continually changing in some other aspects. Also the experience about the flow of subjective time must be explained.

1. In TGD framework the answer is ZEO [K2]. The concept of quantum state is generalized. States are now analogs for physical events characterized by initial and final quantum state that is pairs of positive and negative energy states. The conserved quantum numbers of the members are opposite so that zero energy states can be created from vacuum. This is a radical generalization of the physicalist world of view but entirely consistent with conservation laws: there is no need to give laws of physics in order to have free will. Positive and negative energy parts of the zero energy states can be assigned to opposite light-like boundaries of CDs, which are intersections of future and past directed light-cones multiplied by CP_2. CDs form a fractal scale hierarchy. They can be seen as imbedding space correlates for the 4-D perceptive fields of selves.

2. CD is a central notion in ZEO and serves as imbedding space correlate for self. State function reduction can occur to either boundary of CD ("upper" or "lower"). Self can be seen as a generalized Zeno effect - a sequence of state function reductions to either boundary of CD. These two kinds of selves can be said to be time reversals of each other. The period of non-boiling pot corresponds to the passive boundary of CD not changing in the reductions: also the parts of zero energy states at this boundary remain unaffected. The opposite - active - boundary is shifted towards future reduction by reduction and states at it are changed. The shifting the geometric future gives rise to the experienced time flow. This is the analog of unitary time evolution.

2.2 NMP as variational principle of consciousness

One must generalize standard quantum measurement theory to a theory of consciousness. The notions of NMP, entanglement negentropy and negentropic entanglement (NE) are the key notions.

1. Negentropy Maximization Principle (NMP) [K2] is the variational principle of consciousness in TGD framework reducing to quantum measurement theory in Zero Energy Ontology assuming adelic physics. Negentropy Maximization Principle or something akin to it should be consistent with the standard rules of quantum measurement theory and possibly generalize them. In particular, NMP should tell which observables are measured in given entangled situation. The density matrix defined by the entanglement is the unique candidate for the universal observable. All systems could be said to give rise to quantum measurements. NMP must decide how long the self "lives": self lives as long as repeated state function reductions at the same boundary give the maximal negentropy gain.

2. One must have a mathematical definition of negentropy [K2]. When NE is possible and what is the measure for the negentropy? Shannon entropy is the natural starting point but it cannot have negative values in real context. One could define information as a reduction of entropy as conscious observer learns the state of the system under consideration: the IIT approach of Tononi [J4], [L5, L4] relies on this notion and leads to a circular definition of conscious information. Now however the conscious entity would be this

system and this definition of information does not apply. One must fined a genuine measure of information assignable to entanglement as entanglement negentropy rather than lack of information about the state of either entangled member of entangled by identifiable as entanglement entropy (ordinary Shannon entropy).

Here one cannot avoid number theory and I can only apologize. The p-adic generalization of Shannon entropy by replacing the logarithms of probabilities with the logarithms of their p-adic norms provides a possible solution of the problem [K2, K1]. It is well defined for algebraic entanglement probabilities belonging to the algebraic extension of rationals defining also the extensions of varius various p-adic number fields) [L3].

Adelicity (roughly: adeles correspond to Cartesian product of positive real numbers and all p-adic number fields) holds true in the sense that the sum of real and p-adic information measures (finite number of primes contribute) over all primes vanishes for rational entanglement probabilities. This is not the case for the algebraic extensions of adeles induced by those of rationals [L3].

It is not quite clear whether NMP applies to the sum of p-adic entropies or to the sum of real and p-adic entropies providing alternative definitions of information. Both options conform with the fact that large entropy seems to be prerequisite for life as proposed Jeremy England [**?**] [K4] [L1].

3. NE (negentropic entanglement) is a further key notion and entanglement negentropy identified as number theoretic entanglement entropy, which can be negative. NE can only increase in state function reductions and this brings in evolution forced by NMP.

In the formulation of NMP in terms of maximal negentropy gain one considers divisions of the system into subsystem and complement and finds the pair for which the reduction of entanglement would give maximum reduction of entropy. If the system is irreducible this kind of pair characterized by entropic entanglement cannot be found. The eigenstates of density matrix for negentropically entangled subsystems are in 1-1 correspondence. An interesting question is whether associations in the sense of neuro science corresponds to NE between the states of associated systems.

State function reduction cascade is a key notion. State function reduction sequences is a top down cascade propagating downwards to smaller system sized. First the reduction in CD scale occurs. The resulting two subsystems decompose to to two parts and so on untile decomposition is not possible anymore because it would not generate negentropy.

There is an obvious analogy with the Integrated Information Theory (IIT) of Tononi and Koch. The quantity Φ postulated by Tononi and Koch [J4] resembles negentropy in TGD [L5]. The basic objection against IIT is that the notion of conscious information is circular being based on entropy as fundamental notion. Information is defined as reduction of entropy when conscious entity learns what the state of system is. The notion of conscious information cannot involve this kind of dependence. The outcome is a paradox: printer printer text is conscious if no-one knows about the contents of the file, not if some-one already knows since the definition of conscious information reduces it to conscious information gained by the

outsider. This is not surprising, since entropy as a notion belongs to the physics of outsider about object rather than subject.

In TGD framework negentropy for entanglement does not involve this kind of assumption since conscious information represents abstraction or rule with the superposed state pairs (a_i, b_i) representing the instances of a rule (A, B) and A and B representing concepts.

2.3 The notion of self

Self is identified as a generalized Zeno effect and corresponds to a sequence of state function reductions to a fixed (passive) boundary of CD remaining unaffected in the sequence of reductions: also the members of state pairs defining zero energy states at it are unaffected. Active boundary drifts farther away state function reduction by state function reduction and the state at it also changes. The analogy of unitary time evolution is in question and the experienced time corresponds to the increase of the temporal distance between the tips of CD.

1. One possibility is that sensory input and mental images ("Maya") generated by it can be assigned with the active boundary of CD. A more elegant assumption suggested by quantum measurement theory is that the passive boundaries for sub-CDs give rise to mental images as outcomes of repeated quantum measurements. The unchanging part of self ("Self") is associated with the passive boundary. It corresponds to negentropically entangled subsystem having no entanglement with environment. In ordinary ontology it would not be possible keep self un-entangled from the environment.

2. State function reductions occur at either boundary of CD as long as they produce maximal negentropy gain. If the reduction at opposite boundary produces larger negentropy gain, it occurs. Self dies and re-incarnates as time reversed self. During repeated state function reductions at same boundary the part of state at that boundary and boundary itself remains unaffected (this corresponds to unchanging part of self) whereas the state at opposite boundary changes and the bounary also shifts outwards. The increase of the distance between the tips of CD corresponds to the flow of geometric time and gives precise meaning for the ageing of self. For instance, sensory-motor rhythm could correspond to the sequence of repeated state function reductions to opposite boundaries of CD. Motor action would correspond to reversed arrow of time: this conforms with the finding of Libet that conscious decision is preceded by neural activity used to argue that there is no free will.

   Time reversed self evolves as reductions shifting the opposite boundary of CD to opposite time direction so that the size of CD continues to increase and defines a measure for the duration of the entire sequence of re-incarnations. This implies quantum physical realization for the idea about transmigration of souls!

3. Repeated state function reductions form a sequence for analogs of unitary time evolutions lasting time Δt, which corresponds to the increase of the temporal distance between tips of initial and final CD. Ordinary Hamiltonian clock time

evolution does not make sense except as idealization. Is Δt constant or is it determined by the reduction statistically? The most general and the only non adhoc assumption is that a superposition of CDs with different values of $\Delta t > 0$ is formed and that each repeated state function reductions perform a position measurement - that is localization of the active boundary of CD - so that one Δt is selected and $\Delta t$is thus varying. One can speak about average Δ as a kind of chronon of clock-time.

4. Suppose that self dies and thus re-incarnates as time reversed self S_1, and S_1 in turn dies and reincarnates as S_2 having the same arrow of time as S. Does S_2 re-incarnate at the time when S died? This does not make sense. Also the first reduction to opposite boundary of CD must involve non-vanishing Δt. This conforms with what is known about claimed re-incarnations and might allow to test re-incarnation hypothesis.

5. The totally unexpected prediction is therefore that life is not just a brief spark in cosmic darkness. This particular life is only one in a sequence of lives: the next life will be lived at the opposite boundary of personal CD to opposite direction of geometric time. The negentropy gained during his life will be usable as possibly unconscious knowledge during the next life. What our next life will be depends how much we gather negentropic resources for the next life.

6. Self can also make moral choices since NMP in its weak form leaves us freedom to make also bad choices or especially negentropic choices (for details see [K2]). Possible are also choices, which do not yield optimal negentropy gain. By allowing sin NMP also makes possible really big negentropy gains: NMP would be like venture capitalist in this sense. In statistical sense there is however an evolution as increase of the negentropic sources of the Universe. Crime is part of being alive: living creatures are fighting desperately for NE and a clever but inmoral manner to gain it is to eat other living beings.

7. One big news is that selves form a hierarchy (CDs within CDs) and sub-selves are identified as mental images. In TGD framework it is also possible for sub-selves of two unentangled selves to entangle negentropically. This corresponds to sharing of mental images and means that our conscious experience is not completely private. The pool of shared mental images might in fact make possible communication and social structures. Sharing of mental images is possible only in many-sheeted space-time forcing to generalize the standard view about subsystem.

3 Questions related to the notion of self and time

The notion of self and the relation between subjective and geometric time involves unclear aspects. In the following I try to articulate the problematic issues as clearly as possible.

1. The precise nature of the hierarchy of causal diamonds (CDs) as correlate of self hierarchy should be characterized. The basic prediction that sub-selves have also time reversed variants should be interpreted and one can ask whether sensory-motor dichotomy is a sensible interpretation.

2. Are sub-selves always experienced as mental images and whether after images really represent re-incarnations of sub-selves.

3. Can the rather dramatic prediction of re-incarnations be transformed to an experimentally testable predictions. If one takes seriously the notion of self hierarchy and identifies the EEG correlates of self in a manner proposed by Fingelkurts brothers [J2], this kind of prediction is possible.

3.1 Hierarchies of causal diamonds and space-time surfaces as geometric correlates for self hierarchy

CDs are obtained from the intersections of future and past directed light-ones by replacing their points with CP_2: as a matter fact, CP_2 plays no active role in the definition. I have not been able to nail down the precise definition for the hierarchy of causal diamonds. Self hierarchy demands that CDs serving as imbedding space correlates for selves have sub-CDs identifiable as mental images of self. The basic question is whether CDs can also overlap. If so then finite unions of CDs could be allowed.

Selves as conscious entities are assumed to have space-time surfaces within CDs as space-time correlates. These CDs are dynamical: the other boundary remains unaffected during sequence of repeated state function reductions as also the states at it. Second boundary shifts so that that the distance between the tips of CD increases and defines the experienced flow of time. These space-time surfaces form also a hierarchy. One could consider also a more precise identification of self. By SH string world sheets and/or partonic 2-surfaces or their light-like orbits could serve as space-time correlates of selves. The orbit of partonic 2-surface is indeed analogous to nervous system residing at the boundary between internal (Euclidian) and external (Minkowskian) worlds.

Given space-time surface has both Minkowskian and Euclidian regions - wormhole contacts - separated by wormhole throats at which the signature of the induced metric changes. Minkowskian space-time sheets are connected by extremely short CP_2 sized Euclidian wormhole contacts and in GRT-standard model approximation are approximated by single GRT space-time. If the magnetic flux through wormhole contact is monopole flux, the wormhole contact connecting two Minkowskian space-time sheets has interpretation as a building brick of elementary particles. Minkowskian space-time sheets at different levels of hierarchy are disjoint and separated by Euclidian wormhole contacts. This forces to modify the notion of quantum mechanical subsystem as a tensor factor of the state space.

What is new that two Minkowskian space-time sheets glued to larger disjoint Minkowskian space-time sheets can be connected by magnetic flux tube serving as a correlate for (negentropic) entanglement just as wormholes in ER-EPR proposal of Maldacena and Susskind [**?**, **?**] (see `http://tinyurl.com/y7za98cn`) serve as correlates for maximal entanglement between blackholes. Two unentangled systems can

therefore have subsystems, which are entangled and correspond to two space-time sheets connected by magnetic flux tubes! This is possible only in many-sheeted space-time and the hypothesis has been that two selves, which have no entanglement at their own level of self-hierarchy, can have entangled subselves and that this negentropic entanglement (NE) means sharing of mental images giving rise to a kind of stereo consciousness. The fusion of right and left visual fields would be example of stereo consciousness. Stereo consciousness would make also possible to communicate besides bits also their meaning: during conscious communication the mental images of two selves would fuse temporarily to single mental image by the reconnection of magnetic flux tubes. This reconnection would make possible also directed attention.

What does this situation mean at the level of CDs? It would seem that the CDs associated with selves sharing mental images overlap and that the space-time surfaces assignable to fused mental images/subselves belong to the intersection of CDs. Thus it seems that one must allow unions of also overlapping CDs.

3.2 Are time reversed sub-selves always experienced as mental images?

In the proposed vision about self as generalized Zeno effect self dies as the first state function reduction to the opposite boundary of CD takes place. This implies the re-incarnation of self with the property that the geometric time flows in opposite direction since the opposite boundary of CD shifts such that the temporal distance between it and the opposite static boundary increases in repeated state function reductions leaving the states at static boundary un-affected.

Subselves correspond to mental images. The question is whether self really experiences the time reversed sub-selves as a mental image and if this is the case, what can one conclude about this. For sub-sub...-selves this problem is not acute if sub-sub-selves are experienced as kind of statistical averages.

A possible interpretation for self and its time reversal is in terms of sensory input and motor action. I have indeed proposed that motor action is essentially sensory experience in reversed time direction and Libet's discovery [J1] that conscious decision is preceded by neural activity (with respect to geometric time) provides a support for this interpretation. The time reversal of sensory mental image would represent motor action and at the level next below our level of hierarchy would be directly experienced as volitional act.

I have considered also other interpretations. One is suggested by visual illusion in which the picture of dancer is experienced to make either right or left pirouette. The direction of rotation would distinguish between mental images and its time reversal. It however seems that the sensory-motor dichotomy provides the most plausible and economical interpretation.

One can also wonder what happens, when mental the image is associated with a boundary of CD_1, which overlaps with CD in such a manner that the opposite boundary is outside of CD. Does self experience the mental image associated with CD but not its time reversal?

3.3 Re-incarnation and EEG

It is amusing how fast the attitudes change as ideas evolve and experimental data emerge. Only few years ago I could not say anything definite about reincarnation in the framework of TGD inspired theory of consciousness. Now it has become an unavoidable prediction of ZEO, which itself is a "must" in TGD framework.

The prediction related to re-incarnation is however not quite what one might have expected. In death of self a reincarnation as time reversed conscious entity takes place. For time reversed self subjective time evolution corresponds to evolution in a reverse direction of geometric time. The next death/reincarnation after this re-incarnation gives rise to a self for which the arrow of geometric time is the original one.

Can one test this prediction? If one accepts the predicted fractal self hierarchy in which sub-selves correspond to mental images of self, this is possible. I am too lazy to retype basics about ZEO, CDs, and about how self as generalized Zeno effect emerges and just assume that reader knows the basic concepts or sees to trouble to refresh her knowledge about them.

1. Self hierarchy predicts that also our mental images are conscious entities. Motor-sensory dichotomy naturally corresponds to sub-self and time reversed sub-self. That is sensory mental image and that associated with motor action induced by sensory input. Motor action initiated in the geometric past at the opposite boundary of CD (this explains Libet's finding that conscious decision is preceded by neural activity in geometric time). Note that motor action does not proceed from brain to muscles but in reversed time direction from muscles to brain! This conforms with the vision in which magnetic body is intentional agent.

2. To proceed one must identify EEG correlates for the sub-selves (mental images) and their time reversed re-incarnates. Here the work of Fingelkurts brothers (see `http://tinyurl.com/jpszfpy`) working in Finland helps [J2]. They postulate what they call operational architecture of brain (OA) having operations (O) and operational modules (OM) as building bricks. Quasi-stationary EEG segments are assumed to serve as correlates for operations and synchrony of these segments associated with various locations in brain tells that they belong to the same OM.

   Synchrony means spatio-temporal coherence - not only spatial - and is very natural concept in ZEO, where 4-D CDs and space-time surfaces inside them serve as geometric correlates of selves. Synchrony implies that these EEG segments at different spatial locations begin and end at the same time. Between EEG segments there is rapid transition period (RTP) allowing to distinguish segments from each other. Quasi-stationary segments of EEG have average duration is about .3 seconds.

   The translation of this picture to TGD framework is rather straighforward. Operations correspond to sub-selves and OMs to collections of them forming sub-selves of self. CDs (sub-CDs) in turn serve as geometric correlates for selves (sub-selves). The quasi-stationary segments of EEG become correlates

for sub-selves/mental images. Operational module corresponds to a self/CD having sub-selves/sub-CDs with synchronous EEG segments. The average duration of mental image would be about .3 seconds.

Two sub-sequent quasi-stationary segments separated by RTP would correspond to sub-self and its re-incarnation in the original time direction. Note that a very brief period of geometric time defined by the duration of RTP identifiable as the duration of a unitary time evolution between two sub-sequent state function reductions at the same boundary of CD corresponds to a finite duration of experienced time - the lifetime of the time reversed mental image!

The testable prediction is that the segment corresponding to time-reversed sub-self is located in geometric past and runs in opposite direction of geometric time. This EEG segment should be assignable to motor response accompanying sensory mental image. This is a highly non-trivial prediction testing the new view about time.

3. One can check whether these EEG segments appear as pairs with first member assignable to sensory mental image and second one to motor mental image. Time reversal implies that second law is obeyed in "wrong" time direction for EEG segment assignable to the motor output and this can be tested. Already Fantappie [J3] discovered that both directions of (geometric) time appear in living matter and introduced the notion of syntropy as time reversal of entropy. Spontaneous molecular self-assembly is a basic example of a syntropic process and identifiable as a decay process in reverse direction of geometric time. Phase conjugation is known to occur for phase conjugate laser light and sound. Does a process analogous to self-assembly occur for segments of EEG associated with motor actions: is the motor part of EEG time reversed? To answer this question one needs phase information about EEG besides power spectrum. In principle this information is contained in EEG.

3.4 After images as reincarnations of mental images?

After images (see `http://tinyurl.com/kevnzgq`) appear periodically as one can easily find by looking and lamp and closing eyes. They also change colors. Could these after images be interpreted as re-incarnations? This sounds attractive but one must be very careful. A sub-self S, which dies and transforms to its time reversal S_1 reincarnates eventually as sub-self S_2 with the original arrow of time. According to the assumption about first reduction to opposite boundary made S_2 emerges at time later than S died and this conforms with what is known. The time interval between two subsequence after images would give information about the average value of Δt. The after images need not be identical copies of the original and their color indeed changes.

An alternative interpretation is that after images are not re-incarnations but belong to a 4-D population of sub-selves. Our geometric past is alive and changes all the subjective time. This is not so confusing when one realize that ZEO means that conscious existence is essentially 4-dimensional. Also our memories are dynamical and change all the subjective time. Negative energy signals to geometric past which correspond to time reversed sub-selves indeed affect the geometric past and memory

representations. In principle this kind of signalling could be carried out artificially to manipulate geometric past.

3.5 Re-incarnation and time reversed selves as basic predictions of TGD inspired theory of consciousness

Life has been hard for skeptics during last two decades. A typical skeptic has as building bricks of his ego the items in the list of notions that they regard as pseudoscientific. This allows to attack the people who have the gift of imagination and passion for genuine understanding, which skeptics unfortunately do not possess. What makes attacks easy that no arguments based on contents are needed and the skeptic need not waste his time by trying to understand the arguments of the person to be labelled as pseudoscientist or crackpot.

The typical rhetoric tricks used begin from replacement of Dr X with Mr X and end up with the "conclusion" that the work of Mr X is totally incomprehensible. I have learned that rather often skeptic of this kind is an academic dropout who never managed to do his MsC. Obviously, the role of skeptic became a manner to survive socially and retain the illusion "I am a scientist". During last decades the list of pseudoscientific notions has shortened item by item as quantum biology and quantum consciousness have emerged as respected branches of science. The notion of re-incarnation (see `http://tinyurl.com/jfpowqg`) has been certainly regarded as one of safest pillars supporting the ego of skeptic but even this pillar is in danger to fall down. Poor skeptics.

It is indeed amusing how fast the attitudes change as ideas evolve and experimental data emerge. Only few years ago I could not say anything definite about reincarnation in the framework of TGD inspired theory of consciousness. Now it has become an unavoidable prediction of zero energy ontology (ZEO), which itself is a "must" in TGD framework.

3.5.1 Reincarnation: a testable prediction?

The prediction related to re-incarnation is however not quite what one might have expected. In death of self a reincarnation as time reversed conscious entity takes place. For time reversed self subjective time evolution corresponds to evolution in a reverse direction of geometric time. The next death/reincarnation after this reincarnation gives rise a mental image for which the arrow of geometric time is the original one.

Can one test this prediction? If one accepts the predicted fractal self hierarchy in which sub-selves correspond to mental images of self, this is possible. I am too lazy to retype basics about ZEO, CDs, and about how self as generalized Zeno effect emerges and just assume that reader knows the basic concepts or sees to trouble to refresh her knowledge about them.

1. Self hierarchy predicts that also our mental images are conscious entities. Motor-sensory dichotomy naturally corresponds to sub-self and time reversed sub-self. That is sensory mental image and that associated with motor action induced by sensory input. Motor action initiated in the geometric past at the

opposite boundary of causal diamond (CD) (this explains Libet's finding that conscious decision is preceded by neural activity in geometric time). Note that motor action does not proceed from brain to muscles but in reversed time direction from muscles to brain! This conforms with the vision in which magnetic body is intentional agent.

2. To proceed one must identify EEG correlates for the sub-selves (mental images) and their time reversed re-incarnates. Here the work of Fingelkurts brothers (see `http://tinyurl.com/jpszfpy`) working in Finland helps [J2]. They postulate what they call operational architecture of brain (OA) having operations (O) and operational modules (OM) as building bricks. Quasi-stationary EEG segments are assumed to serve as correlates for operations and synchrony of these segments associated with various locations in brain tells that they belong to the same OM.

   Synchrony means spatio-temporal coherence - not only spatial - and is very natural concept in ZEO, where 4-D CDs and space-time surfaces inside them serve as geometric correlates of selves. Synchrony implies that these EEG segments at different spatial locations begin and end at the same time. Between EEG segments there is rapid transition period (RTP) allowing to distinguish segments from each other. Quasi-stationary segments of EEG have average duration is about .3 seconds.

   The translation of this picture to TGD framework is rather straighforward. Operations correspond to sub-selves and OMs to collections of them forming sub-selves of self. CDs (sub-CDs) in turn serve as geometric correlates for selves (sub-selves). The quasi-stationary segments of EEG become correlates for sub-selves/mental images. Operational module corresponds to a self/CD having sub-selves/sub-CDs with synchronous EEG segments. The average duration of mental image would be about .3 seconds.

   Two sub-sequent quasi-stationary segments separated by RTP would correspond to sub-self and its re-incarnation in the original time direction. Note that a very brief period of geometric time defined by the duration of RTP identifiable as the duration of a unitary time evolution between two sub-sequent state function reductions at the same boundary of CD corresponds to a finite duration of experienced time - the lifetime of the time reversed mental image!

   The testable prediction is that the segment corresponding to time-reversed subself is located in geometric past and runs in opposite direction of geometric time. This EEG segment should be assignable to motor response accompanying sensory mental image. This is a highly non-trivial prediction testing the new view about time.

3. One can check whether these EEG segments appear as pairs with first member assignable to sensory mental image and second one to motor mental image. Time reversal implies that second law is obeyed in "wrong" time direction for EEG segment assignable to the motor output and this can be tested. Already Fantappie [J3] discovered that both directions of (geometric) time appear in living matter and introduced the notion of syntropy as time reversal of entropy.

Spontaneous molecular self-assembly is a basic example of a syntropic process and identifiable as a decay process in reverse direction of geometric time. Phase conjugation is known to occur for phase conjugate laser light and sound. Does a process analogous to self-assembly occur for segments of EEG associated with motor actions: is the motor part of EEG time reversed? To answer this question one needs phase information about EEG besides power spectrum. In principle this information is contained in EEG.

3.5.2 Do conscious entities with different time arrows interact?

Zero Energy Ontology (ZEO) predicts conscious entities with both arrows of geometric time. I find that forcing myself to think and write about this is difficult. The fear is that the whole nice scenario falls down by predicting something totally absurd. The questions that I try to avoid are following. What could these ghostly time-reversed entities be? Do they interact with those with standard time orientation? How could they do so?

Let us first briefly recall what ZEO based theory of consciousness says.

1. In ZEO self corresponds to a generalized Zeno effect that is sequence of state function reductions leaving the passive boundary of CD unaffected as also the members of state pairs associated with 3-surfaces at it. At active boundary the members of state pairs change and the active boundary drifts reduction by reduction farther away from passive boundary. The temporal distance between the tips of CD increases gradually and corresponds to the experience about flow of time.

2. Negentropy Maximization Principle (NMP) [K2] forces eventually self to die by making the first reduction to the passive boundary of its causal diamond (CD), which now becomes the active boundary: a new time reversed self is born. This option is forced because it produces more negentropy. For this self the arrow of geometric time would be opposite since now the formerly passive boundary would be active and shift in opposite direction of time: in this manner CD would steadily increase in size.

   Also the time-reversed self would eventually die and make the first reduction to the opposite - the original - boundary of CD. The position of the boundary of active boundary in first reduction would be shifted to the geometric future from the original position. The first and - as will be found - probably wrong guess for the size of shift towards geometric future from the position at the moment of previous death would be as the average increase of the temporal distance between tips of CD during Zeno period. This increment could be rather small as compared to the size of CD itself.

This picture raises questions.

1. Do we make this kind jump to time-reverse life at some level of our personal self hierarchy as we fall sleep? If wake-up period corresponds to re-incarnation in the original time direction, time increment of CD from its previous value would be the duration of sleeping period as seen by a larger conscious system.

This is much longer than the subjective chronon for sensory mental images about .1 seconds.

Remark: Note that EEG splits to pieces of duration about 300 ms and it might be possible to identify in EEG periods, which correspond to mental images and their time reversals. These periods could differ by a phase conjugation although the power spectrum would have the same typical behavior (sound wave and its phase conjugate have same power spectrum but we can distinguish sound and its time-reversal from each other).

Could the first big reduction correspond to a time increment, which is of the same order of magnitude as the total time duration of life-cycle of the time-reversed self? The size of 3-surfaces at the boundary of time-reversed CD has increased by about life-time. Could the first reduction to the opposite boundary increase the size of the 3-surface at this boundary by the same amount? If so, the re-incarnations for human life cycles would take roughly life-time after the death.

Could one identify negative energy time reversed signal as time-reversed self at some level of hierarchy? If so then the selves associated with CDs could gradually increase their energy by dying and re-incarnating repeatedly since the opposite boundary would increase also the magnitude of the negative energy at the opposite boundary. This is in principle possible since conservation laws hold true by the very definition of zero energy states as well as for classical time evolutions appearing in their quantum superposition. The average energy for a given member of pair defining zero energy state would increase gradually. The size of the CD associated with re-incarnating self could become arbitrary large and gain an arbitrary high total energy: the wildest speculation is that cosmologies correspond to very large selves [L2].

2. Could selves/systems living in opposite directions of time have direct interactions? If the vision that motor actions are realized as negative energy signals travelling to brain of the geometric past and induce neural activity fraction of second earlier than the conscious decision was made (Libet's finding), this could be the case. Motor action could correspond to a death of sensory self, reincarnation as time-reversed motor-self, and a re-incarnation as sensory self in time scale of .1 seconds. Sensory-motor cycle would correspond to a sequence of re-incarnations as time reversed sub-self.

3. How the time reversed selves could reveal themselves? If their presence can be indeed detected, a key signature would be the opposite direction of the thermodynamical arrow of time for them. Heat would be apparently transferred in wrong direction: from cold to hot. This kind of apparent breakings of second law have been observed: phase conjugate laser waves and acoustic signals represent examples of this. Fantappie suggested that they occur routinely in living matter and introduce the notion of syntropy as time reverse counterpart of entropy [J3]. The strange cooling of the air at magnetic walls associated with the rotating magnetic systems [L6] provides second example.

4. Good music is claimed to send cold shivers in spine and sensations of cold are

assigned also with the perception of ghosts. Could the claims about encounters of ghosts be due to a perception of time reversed selves? I remember that in my personal great experience for three decades ago the entire body went into a state analogous to that created by a good music. Did I interact with a time reversed conscious entity? My experience indeed was that I was in contact with what I called Great Mind. This is of course just a subjective experience and the skeptic scientist knows that I was in a psychotic state since it is completely obvious from my scientific work even without reading it that I am a madman.

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