Comments about Ben Goertzel's Eurycosm approach to consciousness

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Abstract

Ben Goertzel considers a highly interesting proposal for a theory of consciousness relying on what he calls euryphysics. Goertzel formulates euryphysics by listing 23 principles. The notions involved are certainly central to consciousness and in the following I will comment this approach from TGD point of view trying suggesting TGD counterparts for the notions introduced (this is the only manner that I can learn!). I restrict my attention to the basic principles and make only brief comments about the proposed applications involving peaked distribution and morphic resonance as key notions. Most of these notions have natural TGD counterparts. My basic criticism concerns the relational interpretation of quantum mechanics.

1 Basic notions and postulates of Eurycosm theory

Ben Goertzel considers a highly interesting proposal for a theory of consciousness relying on what he calls euryphysics. Goertzel formulates euryphysics by listing 23 principles. The notions involved are certainly central to consciousness and in the following I will comment this approach from TGD point of view trying suggesting TGD counterparts for the notions introduced (this is the only manner that I can learn!). I restrict my attention to the basic principles and make only brief comments about the proposed applications involving peaked distribution and morphic resonance as key notions. Most of these notions have natural TGD counterparts. My basic criticism concerns the relational interpretation of quantum mechanics.

I have discussed non-locality in TGD framework [K1] (see http://tinyurl.com/gwaal5l), and the IIT of Tononi and Koch [J4, J2, J1, J3] at [K2] (see http://tinyurl.com/zk3efhs).

1.1 Relational interpretation of quantum mechanics

Goertzel adopts so called relational interpretation of quantum mechanics (see http://tinyurl.com/mo25186).

1. The motivation comes from the fact that in special relativity time perception depend on the state of motion of O relative to S (time dilation, Lorentz contraction). Also the Unruh effect suggests that the an observer O in accelerated motion relative to S sees thermal spectrum of photons emerging from S. To my opinion this does not however serve as justification for the assumption that entanglement or lack of it is observer dependent notion.

2. Relational interpretation postulates that state function reduction is not real and that quantum state is observer dependent concept characterizing the relationship of observer O and measured system S. This interpretation is encouraged by conflict between the non-determinism of state function reduction and unitary time evolution emerging in the Copenhagen interpretation and forcing to give up ontology altogether so that wave function describes only the knowledge about the system. In this framework relational interpretation would be natural. One can however argue that this makes the notion of quantum state rather complex.

3. Since an interpretation of quantum theory is in question, consistency suggests that entire Universe obeys unitary time evolution although it is not observed at the level of O+S pairs. State function reduction effectively occurs for sub-system pairs in the sense that second member - observer - perceives itself and second system un-entangled although the external observer perceives them as unentangled system. The density matrix for entangled system pair defines a natural observable in the sense that its eigenstates define preferred state basis for O (or by symmetry for S).

4. A third system not entangled with O+S perceives it as entangled system. One can therefore ask whether the entangled pair gives rise to a superposition of several conscious entities formed by observer-system state pairs. It is difficult to see why this would not be the case. If so, then any entangled system pair would represent superposition of parallel conscious sub-universes and there would be a close connection with Everett's interpretation.

What objections can one invent against relational interpretation?

1. Suppose that observer and system (O+S) are maximally entangled spin 1/2 systems in spin singlet state so that the density matrix is 2×2 unit matrix. By the rotational symmetry any choice of quantization axis for spin is equally good. There is no obvious criterion making possible to choose a unique quantization axis and to decide what is the state of S perceived by O or vice versa. One can of course ask that exact rotational symmetry is impossible in practice and there is always a small mixing with spin 1 state with same spin projection implying that the density matrix deviates from identity matrix. One cannot however demand internal consistency in statistical sense only.

2. If one assumes separate unitary evolution for all O-S pairs one ends up with infinite number of consistency conditions: my guess is that they cannot be satisfied. If one that only the state of the entire universe obeying unitary evolution, one can ask whether this notion has any operational meaning. This makes the application of the theory rather difficult.

1.2 The notion of eurycosm

Eurycosm is introduced as a key notion. Its precise meaning is however left open. Eurycosm would contain space-time as we understand it as a subset. Eurycosm would be a structure possessing topology, geometry, and various order relations. One the other hand, it is noted that it probably has no dimensional structure characterizing manifolds. If I have understood correctly, the ordering relations for eurycosm would characterize various key aspects of consciousness rather than serving as mere correlates.

In TGD framework one analog of eurycosm would be the 8-D imbedding space containing space-time as 4-surface, and more generally would adelic space-time as surface in adelic imbedding space. "World of Classical Worlds" (WCW) and its adelic analog would also serve as TGD analogy for eurycosm. They would however be zombies and provide only classical correlates for various aspects of conscious experience associated with state function reductions not assumed in Goertzel's approach.

Adelic Universe means that instead of reals as basic number field one consideres adeles, which are Cartesian product of reals, and finite-dimensional extensions of various p-adic number fields induced by an extension of rationals. Rationals allow both algebraic and non-algebraic extensions and there is infinite hierarchy of them so that adelic worlds at various levels (space-time, imbedding space, WCW) form a hierarchy interpreted in terms of evolution.

p-Adic sectors of the adelic world correspond to space-time correlates for cognition and imagination. One can speak of p-adic space-time surfaces and they correspond rather closely to real space-time surfaces but the one can also have p-adic space-time surfaces with no real counterparts: imaginations are not always realizable. The reason is that due to the occurrence of p-adic pseudo constants p-adic partial differential equations are non-deterministic and allow much more solutions than their real counterparts. Strong form of holography (SH) allows to construct real and p-adic space-time surfaces from string world sheets and partonic 2-surfaces by algebraic continuation as preferred extremals for the basic action principle. There is strong analogy with analytic continuation in complex analysis: real function at real axis can be continued to analytic function in the entire complex plane.

1.3 Definition of consciousness

"Raw" consciousness is regarded as a property of any physical system and even of space-time and eurycosm rather than assigning it somehow to state function reduction or Zeno effect as in TGD. The identification of consciousness as a property of eurycosm identified as topological object leads to "boundary problem": where the mind begins and where the body ends?

Consciousness is identified as a property of system, even that of eurycosm as topological object. The basic objections against the identification of consciousness as a property are same as in materialistic approach: there is no manner to distinguish between consciousness and any other physical property. Also free will suggesting that state function reduction is real would be an illusion.

Some comments are in order.

1. Relational interpretation would strongly suggest that "raw" consciousness corresponds to elementary observation identifiable in this interpretation as effective state function reduction. If one assumes that state function reduction is real, one ends up with conflict between determinism of unitary evolution and non-determinism of state function reduction if the causality of free will is assumed to be same as that for laws of physics. One could call this problem "causality paradox". This in turn relates to the identification of experienced time as geometric time: an assumption which cen be only approximately true (second law).

2. To me quantum parallel conscious observers defined by entangled quantum state would look like a feasible notion in the framework of relational interpretation: conscious entity could correspond to this kind of system having no entanglement with environment. This interpretation would not be plagued by the "boundary problem". This would also mean panpsychism: any entangled system could be in role of conscious observer unless one poses some additional conditions to what it is to be an observer. I however understood that this interpretation is ot adopted.

In TGD framework ZEO and generalization of quantum measurement theory to a theory of observer as conscious entity leads to a resolution of "causality paradox". Consciousness is an (only) effectively a property of systems, which are negentropically entangled to entities stable under NMP and un-entangled from the environment. Actually the self is changing in every state function reduction and only the passive boundary of CD and the states associated with it remain unaffected. Regarding consciousness as a property is strictly speaking impossible albeit very practical. This delicacy does not have great practical significance but is of fundamental since it allows to solve a bundle of difficulties plaguing consciousness theories.

1.4 The notion of observation

Observation is taken as a key notion.

1. It is noticed that observation has directedness. This is certainly true in macro scales. The first guess inspired by quantum measurement theory is that state function reduction corresponds to observation in its simplest form. This does not however conform with the complete symmetry between O and S implied by the relational interpretation. The directedness would naturally follow if O is capable of intentional actions, in particular measuring the state of S by inducing genuine state function reduction. Now this is not possible now. Note that this relates also to the directedness of attention: there is the system with directs attention and the system which is attended.

   My understanding is that the perception of O+S by O as un-entangled system although it is entangled from the point of view of outside does not represent primitive observation.

2. Observations are proposed to have a hierarchical structure: observations within observations. Also the notion of complex observer is also introduced. The composition of entities is introduced as a basic principle.

3. The notions of simplicity (equivalently complexity), surprisingness, intensity, and notability as characterizers of the observations are introduced. Observations can be ordered by the degree for these attributes and allow to characterize basic notions related to consciousness. Also gradient of surprisingness is introduced as a key notion. Local time axis would be defined in terms of gradient of surprisingness.

4. Also the notions of representation and pattern are introduced. If A is intense when B is intense, A represents B. P is pattern if P represents S and is simpler than S. Pattern could be seen in terms of of inclusion of hyperfinite factors with included factor defining pattern which is simpler due to the lower measurement resolution. The notions of emergence and intelligence are mentioned.

5. Goertzel introduces the notion of persistent entity and speaks of causal arrows and network of them defining space.

6. Understanding the essence of intelligence is a fascinating challenge. For instance, what problem solving could mean at quantum level? Intelligent systems certainly form "stories" as symbolic representations/simulation of the external world in various spatial and time scales so that fractality seems to be an essential element of intelligence. The emergence of symbolic dynamics seems to be an essential element of intelligence: one can predict the behavior of person for years just by knowing his role in society. Trying to compute it from all available data at molecular level would be completely hopeless task - even in principle.

What about the situation in TGD?

1. Also in TGD this the case - strictly speaking only observations exist and observer is only a useful idealization.

2. In TGD framework state function reduction represents the core element of observation and also now the challenge is to understand the directness of observation. U-shaped magnetic flux tube loops of the magnetic body (MB) of system define a concrete realization of directed attention using "magnetic tentacles". Directing attention to another system would mean reconnection of the U-shaped loops of the two systems to a pair of flux tubes connecting the systems so that they quantum entangled or can do so. The asymmetry would be due to the fact that the more complex system - observer - can perform intentional motor actions of MB that is control flux tube thickness and therefore magnetic fields and corresponding cyclotron frequencies so that for suitable frequency resonant reconnection can occur (magnetic field strengths are same for the two reconnecting U-shaped flux loops). Directedness would basically come from self hierarchy. The self directing attention would perform intentional action forcing its sub-self to reconnect with the MB of the attended system.

3. Self hierarchy is analogous to the hierarchy of observations. At the level of space-time surface the counterpart is hierarchy of space-time sheets glued to larger space-time sheets by wormhole contacts glued to.... The geometric counterparts are hierarchy of CDs at the level

of imbedding space. Self has sub-selves which it experiences as mental images. Sub-subselves are experienced as kind of average. State function reductions take place as top-down cascades. A reduction of system decomposes it to two unentangled subsystems and for this NMP can force a further state function reduction and cascade stops when all resulting sub-systems are negentropically entangled.

4. In TGD framework measure of complexity for representations could be defined in terms of measurement resolution allowing definition in terms of inclusions of hyperfinite factors: included factor would have lower resolution and would be simpler. For p-adic cognition measurement resolution is unavoidable and increases as the complexity of the algebraic extension of rationals behind adeles increases.

   In TGD the hierarchies of Planck constants, p-adic length scales defines, algebraic extensions of rationals define evolutionary hierarchies with increasing complexity measured also by the entanglement negentropy. NMP states that negentropy gain is maximized in state function reduction and intensity of conscious experience could be measured as negentropy gain. To my view surprisingness demands ability to predict the time evolution so that the deviation from prediction would characterize surprisingness. In ZEO zero energy states have indeed 4-D space-time surfaces as correlates and these would define the predictions. Notability would perhaps might be characterized in terms of the value of negentropy gain in state function reduction.

5. Subjective time as sequence of repeated reductions at the same boundary of CD corresponds to the experienced time in TGD framework but the negentropy associated with passive boundary of CD is not changing. The drift of the active boundary of CD farther away from the passive one defines clock time giving rise to experienced flow of time. One can say that the sequence of state function reductions defining subjective time is mapped to a sequence of increasing temporal distance between the tips of CD. Same is true for subselves/sub-CDs.

   During the period of reductions defining self subselves (sub-CDs) defining mental images are generated and the increase of negentropy assignable to them accompanies this flow of time (usually thermodynamical entropy defines arrow of time). In TGD p-adic entanglement negentropies correlate very closely with real entanglement entropy and the randomness assignable to reductions at opposite boundary of CD meaning death and reincarnation of self generate thermodynamical ensemble entropy.

6. Persistent entity corresponds in TGD naturally to the negentropic subsystems at passive boundary of CD defining the unchanging part of self responsible for self identity. These can be also seen as negentropy resources of the Universe, kind of Akashic records. The network of magnetic flux tubes carrying dark matter as large h_{eff} phase define a kind of neural network giving rise to experience about space and body as something distinguishable from environment. The flux tubes would meet at nodes and there would be NE between the nodes. One must clearly distinguish between space in purely geometric sense and system able to create the experience about space as 3-D structure, biological body (BB).

7. What about understanding of emergence and intelligence? The number theoretic evolution realized in terms of algebraic extensions of rationals suggests first principle definition of emergence of intelligence as phase transitions making the extension more complex, increasing the value of h_{eff} and thus scale of quantum coherent, increasing the p-adic length scale, etc... Negentropy Maximization Principle would be the driving force and state that state function reductions tend to increase negentropic recources of the Universe: strong form states that the negentropy gain is maximal (see `http://tinyurl.com/gwaal5l`). One one identify several ingredients of intelligence (see `http://tinyurl.com/zcwa5jj`). What seems essential is that intelligent system is able to build "stories" as p-adically scaled variants of real event sequences so that simulations can be carried out in much shorter or also longer time scale than that for the real events.

2 Further notions and ideas

Goertzel introduces also the notions of peaked distribution and morphic resonance and the idea about space-time as metaphorical knot.

2.1 The notions of peaked distribution and morphic resonance

Many other notions are introduced and the theory is applied to Psi phenomena, morphic resonance, and other candidates for anomalous phenomena. In the following I discuss the notions of peaked distribution and morphic resonance from TGD point of view.

1. The notion of peaked distribution is introduced. In TGD framework the notion of preferred extremal of Kähler action is an analogous notion. In ordinary quantum field theory one would have path integral over all 4-surfaces connecting initial and final states. By holography one does not have path integral now. Already ordinary holography produces effectively 3-D dynamics and SH produces effectively 2-D dynamics: the data about space-time geometry is carried by 2-D surfaces (apart additional discrete degrees of freedom very probably present.

   Preferred extremals satisfy powerful conditions stating that infinite number of Noether charges assignable to the symmetries of WCW vanish and guarantee that space-time sheets can be constructed from essentially 2-D data - space-time genes. These conditions leave extremely restricted set of space-time surfaces as preferred extremals representing kind of archetypal dynamical patterns. The actual space-time engineered from these and standard model + GRT limit of TGD lacks therefore this simplicity although it is topologically simple. These preferred extremals would be natural counterparts for the peaks of distribution. One might say that the space-time surface represent kind of dynamical archetypes possessing huge symmetries. EEG pattern would be a typical example.

   Brain is mentioded as a key example of system in which this kind of peaking occurs. In TGD brain would be a system building standardized mental images by virtual sensory input to sensory organs as feedback and 4-D self-organization would replace zero-energy state reduction by reduction with a new one approaching asymptotic pattern defining standardized mental image.

2. Morphic resonance as mechanism for the formation of habits is emphasized. In TGD context ZEO implies that MBs define 4-D temporal patterns connecting initial and final states at the opposite boundaries of CD serving as correlates for behaviors, functions, habits, etc... The replication of 4-D MBs analogous to what occurs for the elementary particle in the decay A$\rightarrow$ B+C could lead to the morphic resonance and establishment of a new skill. Ordinary DNA and cell replication would be 3-D shadow of morphic resonance in this sense. The reconnection would be also basic mechanism in various remote mental interactions such as telepathy and psychokinesis. To understand precognition also ZEO (signals propagating also in non-standard time direction) is needed.

   Resonance aspect is actually very concrete. Dark photons at magnetic flux tubes are characterized by cyclotron frequencies and reconnection of two flux tubes requires that the magnetic field strengths and therefore also cyclotron frequencies are identical, which means resonance in concrete sense. The establishment of a habit would be based on reconnection of the flux tubes of the MBs associated with the members of the community. Since MBs can have size of order Earth size scale or even larger, the habit could be established at different sides of globe almost instantaneously.

2.2 Space-time as a metaphorical knot

Could problem solving have space-time correlate? Goertzel talks about space-time as a metaphorical knot. Opening a knot could serves as an attractive metaphor problem solving. I am not however quite sure whether Goertzel has exactly this in mind.

1. In TGD framework knottedness of space-time is much more than metaphor. Effectively one-dimensional (from the point of view of homology) magnetic flux tubes as basic space-time

structures can get knotted in 3-space as also 1-D fermionic strings inside them. Braiding is another name for this process and defines classical counterparts of quantum computer programs. The special role of knots is solely due to the dimension D=4 of space-time. Even more: also the (effectively) 2-D orbits of fermionic strings (flux tubes) can form 2-knots in 4-D space-time. This brings additional topological reactions.

2. The idea about opening a knot without cutting it temporarily as a space-time correlate for problem solving in civilized manner is very attractive. 2-knots correspond to processes in which this is carried out in Alexandrian manner by cutting the knot temporarily: the portions of knots go through each other or are split and reconnected in a new manner. Reconnection processes for MB in living matter would be rebuilding of communication network based on flux tubes.

3. The vision about scattering diagrams as space-time surfaces defining geometric and topological representations for algebraic computations is central in quantum TGD. Particle reaction can be seen as an algebraic computation connecting initial and final collections of algebraic objects (particles) with vertices defining algebraic operations $A + B \to C = A \circ B$. There is infinite number of equivalent manners to perform the computation and the simplest computation correspond to a diagram containing no loops. This gives infinite number of dualities between different but equivalent computations very much analogous to mirror symmetry in M-theory. Could the problem solving be understood as a process in which one finds the simplest possible representation of algebraic computation in terms of space-time correlates? There is an objection: if these dualities are complete symmetries, it should not be possible to speak about solving problem in this manner. Symmetry breaking is needed to make a difference. Maybe one must give up this very nice metaphor.

4. SH suggests however an alternative view about problem solving. Problem solving involves imagination in an essential manner and means finding an imagination, which is realizable. By SH both real and p-adic space-time surfaces are constructible from 2-D space-time genes in the intersection of reality and various p-adicities (string world sheets and partonic 2-surfaces) by algebraic continuation. Due to the inherent non-determinism of p-adic partial differential equations much larger set of continuations is possible in p-adic sectors than in real sector. p-Adic imagination need not therefore be realizalbe. Could the solution of the problem mean finding a p-adic imagination having also real counterpart.

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