

TGD Inspired Theory of Consciousness

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Abstract

The basic ideas of TGD inspired theory of consciousness are briefly summarized.

Why quantum theory of consciousness?

The conflict between the non-determinism of state function reduction and determinism of time evolution of Schrödinger equation is serious enough a problem to motivate the attempt to extend physics to a theory of consciousness by raising the observer from a conceptual outsider to a key notion also at the level of physical theory. Further motivations come from the failure of the materialistic and reductionistic dogmas in attempts to understand consciousness in neuroscience context. There are reasons to doubt that standard quantum physics could be enough to achieve this goal and the new physics predicted by TGD is indeed central in the proposed theory.

Quantum jump as moment of consciousness and the notion of self

If quantum jump occurs between two different time evolutions of Schrödinger equation rather than interfering with single deterministic Schrödinger evolution, the basic problem of quantum measurement theory finds a resolution. The interpretation of quantum jump as a moment of consciousness means that volition and conscious experience are outside space-time and state space and that quantum states and space-time surfaces are "zombies". Quantum jump would have actually a complex anatomy corresponding to unitary process U , state function reduction and state preparation at least.

Intuitively self corresponds to a sequence of quantum jumps which somehow integrates to a larger unit much like many-particle bound state is formed from more elementary building blocks. It also seems natural to assume that self stays conscious as long as it can avoid bound state entanglement with the environment: everything is conscious and consciousness can be only lost. This view predicts infinite self hierarchy with the entire Universe at the top.

If one accepts the hierarchy of Planck constants, it seems unnecessary to distinguish between self and quantum jump. The hierarchy of Planck constants interpreted in terms of dark matter hierarchy predicts a hierarchy of quantum jumps such that the size of space-time region contributing to the contents of conscious experience scales like \hbar . The irreducible component of self (pure awareness) would correspond to the highest level in the "personal" hierarchy of quantum jumps and lower level quantum jumps would give rise to the experience of time flow. Entire life cycle would correspond to single quantum jump at the highest level of personal self hierarchy and the fact that pure awareness prevails during sleep in this case would make it possible to experience directly that I existed yesterday.

Self is assumed to experience sub-selves as mental images identifiable as "averages" of their mental images. This implies the notion of ageing of mental images as being due to the growth of ensemble entropy. Various qualia would basically correspond to increments of quantum numbers which leads to a general classification of qualia in terms of the fundamental symmetries.

Self-referentiality of consciousness

Quantum classical correspondence is the basic guiding principle of quantum TGD. Thanks to the failure of a complete determinism of classical dynamics, space-time surface can provide symbolic representations not only for quantum states (as maximal deterministic regions) but also for quantum jump sequences (sequences of quantum states) and thus for the contents of consciousness. These representations are regenerated in each quantum jump, and make possible the self referentiality of consciousness: self can be conscious of what it *was* conscious of.

Negentropy Maximization Principle

Negentropy Maximization Principle stating that the reduction of entanglement entropy is maximal in quantum jump is the basic variational principle for TGD inspired theory of consciousness. If one accepts the notion of number theoretic entropy making sense for algebraic entanglement probabilities, entanglement entropy can be negative, so that algebraic entanglement can carry information and NMP can force the generation of bound state

entanglement. A possible interpretation is in terms of experience of understanding. Number theoretic entropy has also more concrete applications, for instance it allows to construct a model of genetic code.

Hyperfinite factors of type II_1 provide the basic mathematical framework for quantum TGD and this forces important modifications of the standard measurement theory besides those implied by zero energy ontology. The notion of measurement resolution characterized in terms of Jones inclusions implies that entanglement is defined always modulo some resolution. As a consequence, selves can remain unentangled although sub-selves (mental images) entangle. Fusion and sharing of mental images becomes possible. For instance, in stereo vision right and left visual fields would fuse together. More generally, a pool of shared stereo mental images might be fundamental for evolution of social structures.

Time, memory, and realization of intentional action

The notion of quantum jump implies a new view about time. Experienced time corresponds to a sequence of sub-quantum jumps and cannot be identified with the geometric time identified as a fourth space-time coordinate. This plains various paradoxes related to the notion of time. The fact that the contents of conscious experiences is about 4-D rather than 3-D space-time region motivates the notions of 4-D brain, body, and even society.

One must of course understand why geometric and experienced time correspond to each other so closely that they have been identified. Why geometric future and past are so different is the basic question. If geometric future contains intentional resources (p-adic space-time sheets) transformed to actions in the phase transition propagating to the geometric future and if geometric future is in a quantum critical state transformed to a non-critical state in this process, one could assign the experienced time with the geometric time characterizing the position of the phase transition front (assignable to sub-selves/mental images). Also the almost triviality of U-matrix might be relevant for the stability of the geometric past.

Communications with geometric past using time mirror mechanism in which phase conjugate photons travelling to the geometric past are reflected back as ordinary (possibly dark) photons make possible realization of declarative memories in the brain of the geometric past. This mechanism makes also possible realization of intentional actions explaining Libet's finding that neural activity seems to precede volition, and a mechanism of remote metabolism ("quantum credit card"). Time-like entanglement explains episodal memories as sharing of mental images with the brain of geometric past. An essential element is the notion of magnetic body which serves

as an intentional agent "looking" the brain of geometric past by allowing phase conjugate photons to reflect from it as ordinary photons. The findings of Libet support the view that the part of the magnetic body corresponding to EEG time scale has same size scale as Earth's magnetosphere. The unavoidable conclusion would be that our field bodies have astrophysical size.

p-Adic length scale hierarchy and number theoretically preferred hierarchy of values of Planck constants, when combined with the condition that the frequencies f of photons involved with the communications in time scale T satisfy the condition $f \sim 1/T$ and have energies above thermal energy, lead to rather stringent predictions for the time scales of long term memory.

Fermions and Boolean cognition

Fermionic Fock state basis defines naturally a quantum version of Boolean algebra. In zero energy ontology predicting that physical states have vanishing net quantum numbers, positive and negative energy components of zero energy states with opposite fermion numbers define realizations of Boolean functions via time-like quantum entanglement. This would explain why Boolean and temporal causalities are so closely related. Note that zero energy ontology is consistent with the usual positive energy ontology with certain assumptions about unitary process U associated with the quantum jump.

p-Adic physics as physics of cognition and intentionality

p-Adic physics as physics of cognition and intentionality provides a further element of TGD inspired theory of consciousness. The transformation of p-adic variant of the partonic 3-surface with bosonic quantum numbers to its real counterpart would represent transformation of intention to action. Real fermion and its p-adic counterpart would represent matter and its cognitive representation being analogous to a fermion-hole pair resulting when fermion is kicked out from Dirac sea.

Brain and consciousness

In the proposed vision the role of brain would be basically a builder of symbolic representations assigning meaning to the sensory input by decomposing sensory field to objects and making possible effective motor control. Simplest sensory qualia would be realized at the level of sensory organs so that one could avoid the problematic assignment of sensory qualia to sensory pathways. The new view about time would allow to resolve the objections against this view (say phantom leg phenomenon). For instance, visual col-

ors would correspond to increments of color quantum numbers in quantum jumps at the level of retina.

Also magnetic body can have sensory qualia. The quantum number increments associated with cyclotron phase transitions at magnetic body would correspond to emotional and cognitive content of sensory input and have interpretation as higher level sensory qualia. Right brain sings-left brain talks metaphor would rather concretely correspond to this emotional-cognitive distinction for higher level qualia.

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