Does the flow of time correspond to the increase of the average value of effective Planck constant?

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June 20, 2019

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Abstract

This article was inspired by blog questions relating to non-determinism of Kähler action. How this non-determinism relates to quantum non-determinism? How the non-determinism in elementary particle scales relates to that in biology? The unexpected fruit was a little discovery: the mechanism generating the arrow of geometric time in zero energy ontology might rely in crucial manner to a sequence of phase transitions tending to increase the value of Planck constant $h_{eff}/h = n$ for CDs the superposition of CDs and hence the size of the causal diamond (CD) characterized by quantum average temporal distance. Since the second boundary of CD is fixed, the second one moves to future in average sense: hence the flow of experienced time and its arrow. Conscious entities become more intelligent as they age! It became also clear that large h_{eff} characterizes many-particle system rather than single particle. This leads to view in which intelligent consciousness involving the experienced about the flow of time emerges as the complexity of the systems measured by the number of fundamental particles increases.

1   Introduction

I like answering questions. It gives a lot of meaning to the life of a theoretician who is not allowed to enjoy the pleasures of academic existence. Career builder would of course argue that writing again and again similar answers is a waste of time: I should be building social networks to important people instead. This activity however allows to make important observations and little discoveries. This time I answered to the questions relating to non-determinism of Kähler action. How this non-determinism relates to quantum non-determinism? How the non-determinism in elementary particle scales relates to that in biology?

The unexpected fruit was a little discovery: the mechanism generating the arrow of geometric time in zero energy ontology might rely in crucial manner to a sequence of phase transitions increasing the value of Planck constant $h_{eff}/h = n$ and hence the size of the causal diamond (CD) characterized by quantum average temporal distance. Since the second boundary of CD is fixed, the second one moves to future in average sense: hence the flow of experienced time and its arrow. Conscious entities become more intelligent as they age! It became also clear that large h_{eff}/h characterizes many-particle system rather than single particle. This leads to view in which intelligent consciousness involving the experienced about the flow of time emerges as the complexity of the systems measured by the number of fundamental particles increases.

2   Background

Quantum classical correspondence suggests that the non-determinism of Kähler action could be correlated for quantum non-determinism. An alternative but not exclusive interpretation is as a correlate for quantum criticality.

2.1   The non-determinism of Kähler action and quantum non-determinism

The first question was about the relationship between non-determinism of preferred extremals and quantum non-determinism. As a matter of fact, I like to use the phrase "partial failure of determinism for Kähler action" rather than "non-determinism of Kähler action".

A possible interpretation could be as a correlate for quantum non-determinism. Second interpretation would be in terms of quantum criticality implying non-determinism. I do not know whether the interpretations are actually equivalent.

I certainly do not believe that one could get rid of quantum non-determinism and there is no need for it. The generalisation of quantum-classical correspondence is however natural in ZEO, where basic objects are 4-D surfaces- classical time evolutions serving as space-time correlates for quantal evolutions.

The origin of the failure of classical determinism is following.

1. Kähler action has a huge vacuum degeneracy. For instance, for space-time surfaces, which are maps from M^4 to at most 2-D Lagrangian manifold of CP_2 having by definition vanishing induced Kähler form (configuration space

and momentum space are Lagrangian manifolds in the context of classical mechanics) induced Kähler form of course vanishes. These vacuum extremals define an analog of gauge degeneracy of Maxwell action for vacuum extremals. For non-vacuum externals it is expected to be lifted at least partially. Hence 4-dimensional spin glass degeneracy is more appropriate analogy. One could say that classical gravitation breaks the analog of gauge invariance for non-vacuum extremals.

2. For CP_2 type vacuum externals one has also non-determinism, which corresponds directly to Virasoro conditions expressing the light-likeness of 1-D M^4 projection of the CP_2 type vacuum extremal. Now induced Kähler form does not vanish.

3. Zero energy ontology (ZEO) and causal diamond (CD) are essential notions concerning the interpretation but leave these notions as an exercise for the reader. The ends of the vacuum extremal at light-like boundaries of CD are connected by infinite number of vacuum extremals.

   One expects that some of the vacuum degeneracy is present also non-vacuum externals. Part of this degeneracy must be analogous to gauge degeneracy since by strong form of general coordinate invariance implying strong form of holography, only the partonic 2-surfaces and their 4-D tangent space data fix the physics since WCW metric depends only on this data. Hence the interiors of 3-surfaces carry very little information about quantum states.

2.2 Identification of gauge degeneracy as hierarchy of broken conformal gauge invariances

The conjecture is that conformal symmetries acting as partially broken gauge symmetries realize this vision. TGD allows several kinds of conformal symmetries, and a huge generalisation of string model conformal symmetries (including Kac-Moody) [K1] but I will not go to this here. Suffice it to say that the generalization of conformal symmetries means replacement of AdS/CFT correspondence with a correspondence which looks intuitively much more realistic [K4], [L1].

Classical conformal charges would vanish for sub-algebra for which the conformal weights are multiples of some integer n, $n = 1, 2,$. These conditions would give the long-sought-for precise content to the notion of preferred extremal. These conditions would be the classical counterparts of corresponding quantum conditions and define a Bohr orbitology. This hierarchy would correspond to the hierarchy of Planck constants $h_{eff} = n \times h$ and to the hierarchy of dark matters [K2]. There would be infinite number of hierarchies $(1, n_1, n_2, ...n_i, ...)$ such that n_i would divide n_{i+1}. They would correspond to the hierarchies of inclusions of hyper-finite factors of type II_1 (HFFs) [K5]. Included algebra defines measurement resolution, which would thus realized as generalized conformal gauge symmetries. Evolution would correspond to a sequence of symmetry breakings: this is not a new idea but emerges naturally if n serves as a quantum "IQ".

The proposal is that that there is a finite number $n = h_{eff}/h$ of conformal equivalence classes of four-surfaces with fizxed 3-D ends at the opposite boundaries of

CD so that the non-determinism with gauge fixing would be finite and would correspond to the hierarchy of Planck constants and hierarchy of conformal symmetry breaking defined by the hierarchy of sub-algebras of various conformal algebras with weights comings as integer multiples of integer $n = 1, 2, ,$. These n surfaces would be analogous to Gribov copies for gauge conditions in non-Abelian gauge theories.

3 The non-determinisms of particle physics and biology

There was also a question about the non-determinism of partcle physics contra that of biology, where it manifests itself as partially free will.

3.1 NMP

Before continuing it is good make clear that a new principle is involved: Negentropy Maximization Principle (NMP) [K3]. Also a new kind of entanglement entropy based p-padic norm is involved. This entanglement entropy is negative unlike ordinary entanglement entropy and characterizes two-particle system rather than single particle system. By consistency with quantum measurement theory it corresponds to identical entanglement probabilities $p_i = 1/n$.

Negentropic entanglement is assumed to be associated with pairs of n-sheeted coverings (at least these) defined by the space-time surfaces in n conformal equivalence classes associated with $n = h_{eff}/h$ and connecting same 3-surfaces at the ends of space-time surface. Two systems of this kind can entangle negentropically. Unitary entanglement matrix associated with quantum computation gives rise to negentropic entanglement. Also n-partite negentropic entanglement makes sense.

3.2 What could be common for particle physics and biology?

Basically the non-determinism of particle physics and of biology could be essentially the same thing but for living matter whose behave is dictated by dark matter the value of $h_{eff}/h = n$ would be large and make possible macroscopic quantum coherence in spatio-temporal scales, which are longer by factor n. Note that n could characterize macroscopic quantum phase rather than single particle system: this distinction is important as will be found.

The hierarchy of CDs brings additional spatio-temporal scale identified as secondary p-adic scale characterising the minimal size of CD. This size scales like $h_{eff}/h = n$ and one can think of a superposition of CDs with different values of n and that the average value of n measuring the age of self increases during the sequence of quantum jumps. Since n is kind of IQ, NMP says that conscious entities should become wiser as they get older: maybe this is too optimistic hypothesis in the case of human kind but maybe electrons are different!;-) I swear that this interpretation is not due to the fact that I have passed the magic threshold of 60 years when one begins to feel that the ageing means growing wisdom;-). I must confess that the interpretation of experience time flow in terms of increasing h_{eff}/h

charactering CD scaling has not come into my mind earlier. One could even consider the possibility that there is no superposition - just a sequence of h_{eff}/h increasing (in average sense) phase transitions, kind of spiritual growth even at the level of elementary particles - or rather, the macroscopic quantum phases.

For instance, for electron characterised by Mersenne prime $M_{127} = 2^{127} - 1$ the minimal CD time scale is .1 seconds (note that it defines a fundamental biorhythm of 10 Hz) and thus macrotemporal. Corresponding size scale is of the order of Earth circumference. This size scale could characterize quite generally the magnetic body of the elementary particle or the magnetic body at which macroscopic quantum phase of particles resides. In both cases there would be a direct connection between elementary particle physics and macroscopic physics becoming manifest in living matter via alpha rhythm for instance.

3.3   What distinguishes between particle physics and biology?

There are essential differences between elementary particle physics and biology. The first differences comes from quantum measurement theory in ZEO.

1. The repeated state function reduction does nothing for the state in standard ontology. In TGD the state is invariant only at the second boundary at which the reduction occurs. For second boundary of CD the average value if n increases. This gives rise to the experienced flow of geometric time and the arrow of time. Self exists as long as reductions take place on same boundary of CD and dies as the first reduction to opposite boundary is forced by NMP.

2. In particle physics context one expects that the duration of self identified as a sequence of state function reductions at the same boundary of CD is much shorter than in living matter. Otherwise one would have too strong breaking of reversibility in elementary particle time scales.

Objections usually help to make the formulations more precise. Now the objection is that the increase of average h_{eff}/h so that particles darken gradually, should have been observed long time ago since reaction rates are independent of Planck constant only the lowest order in h_{eff} that is in classical approximation. The attempt to circumvent this objection leads to two crucial questions?

1. Does h_{eff} characterize elementary particle (or fundamental fermion) or a magnetic/field body of physical system which could be also many-particle system.

   If $h_{eff}/h = n$ corresponds to n-sheeted covering which becomes singular at the ends of space-time surface so that sheets co-incide at partonic 2-surfaces representing particles, it seems that large h_{eff} is a phenomenon assignable to the field/magnetic body inside CD rather than particle identified as partonic 2-surface or 3-surface at the end of CD. If so large h_{eff} effects would relate to the dynamics associated with the magnetic/field bodies carrying dark matter.

2. Is darkness single particle phenomenon or many-particle phenomenon? For the latter option elementary particle physics would not be any challenge so that

it looks the reasonable option. Note that negentropic entanglement requires at least one pair of (say) electrons and suggests macroscopic quantum phase - say high-T_c super-conductivity or super-fluidity.

The idea about evolution of many-electron systems at dark magnetic body generating increasing value of h_{eff} makes sense, and would conform with the observation that electrons secondary p-adic time scale defines fundamental bio-rhythm. Dark magnetic bodies carrying dark particles are indeed in key role TGD inspired quantum biology. Bose-Einstein condensates and spontaneously magnetized dark phases at magnetic bodies would conform with the idea that dark matter is many-particle phenomenon.

Large h_{eff} would not be seen in elementary particle physics. This does not seem to support the idea that sparticles in TGD SUSY might have same p-adic mass scale as particles but be more stable in dark phase (this would be due to the scaling up of the size of CD) [K6]. Note however that in TGD already elementary particles are many-fermion systems so that it might be possible to circumvent this objection.

3. The original formulation for darkness was at single particle level so that h_{eff} characterizes elementary particles rather than many-particle systems. In elementary particle reactions the particles in the same vertex would always have the same value of h_{eff}/h. It was assumed that h_{eff} can change only in 2-vertex analogous to mass insertion vertex.

   The previous arguments suggest that darkness makes sense only for many-particle systems so that mass insertion vertex becomes phase transition. These phase transitions would occur routinely in living matter but as phase transitions involving large number of particles. For instance, bio-photons would result from dark photons in this manner. This picture seems to make sense at least at the level of many-particle systems but not necessary for Feynman graphs.

   This many-particle aspect would explain at very general level why the search for dark particles has been fruitless.

3.4   Could one regard elementary particle as a conscious entity?

The previous considerations support the view that it is macroscopic quantum phases of particles at magnetic flux tubes which can be seen as conscious and intelligent evolving entities experience the flow of time. In the case of single elementary particle previous arguments would suggest that only single state function reduction occurs at given boundary of CD so that the lifetime of elementary particle self would have zero duration! This in accordance with the absence of the arrow of time at elementary particle level. Strictly speaking this does not exclude consciousness but excludes intelligence and experience of time flow.

Could already systems with small particle number, be conscious entities and develop - not necessarily large - $h_{eff}/h > 1$. Hadrons consist of quarks and I have considered the possibility that valence quarks and gluons at the color magnetic

body are dark. Also nuclei as many-nucleon systems could be dark. In TGD even elementary particles consist of fundamental fermions so that one can ask whether elementary particles possess some elementary aspects of consciousness identified as the possibility of non-vanishing "biological" life-time. This kind of picture would conform with the idea about consciousness as something emerging as the complexity of the system increases.

The average lifetime of elementary particle as a conscious entity cannot be longer than the life-time of particle in the sense of particle physics. In the case of electron having infinite lifetime as elementary particle the "biological" lifetime must be finite since otherwise the irreversibility would manifest itself as a breaking of time reversal invariance in electron scale. The temporal time scale of CD characterising the dimensions of the magnetic body of the elementary particle is the first order of magnitude estimate for the lifetime of elementary particle self. The "biological death" of electron means state function reduction in the sense of ordinary quantum measurement theory implying for instance localization of electron or giving eigenstate of spin in given quantization direction and these quantum jumps meaning re-incarnations of electron certainly occur.

This time scale could give an idea about the geometric duration of elementary particle self (the growth of the temporal distance between tips of CD during the sequence of reductions or equivalently the increase of n). One expects that Δn is by NMP rather small for single particle systems.

3.5 Could thermodynamical breaking of time reversal symmetry relate to the CP/T breaking in particles physics?

Could the "thermodynamical" breaking of time reflection symmetry (T) correspond to the breaking of T as it is observed for elementary particles such as neutral kaon? I think that most colleagues tend to be skeptic about this kind of identification, and so do I.

The point is that particle physicist's T breaking could be purely geometric whereas thermodynamical breaking of T involves the notion of subjective time, state function reduction, and consciousness. One could however ask whether the particle physicist's T could serve as space-time correlate for thermodynamicist's T and whether systems showing CP breaking could be seen as conscious entities in very primitive sense of the word ($n_f/n_i > 1$ but small). An important point is that the time evolution for CDs corresponds to scaling so that usually exponential decay laws are replaced with their hyperbolic variants. Hyperbolic decay laws become an important signature of consciousness. For instance, bio-photon intensity decays in hyperbolic manner.

Consider neutral kaon as example.

1. The mean lifetimes are of long-lived and short lived neutral kaon are $\tau_L = 1.2 \times 10^{-8}$ seconds and $\tau_S = 8.9 \times 10^{-11}$ seconds: the ratio of the time scales is roughly 2^7. This does not conform with the naivest guess that the size of CD gives estimate for the duration of elementary particle self (increase of the temporal distance between tips of CD): the estimate would be $_L = 10^{-7}$

seconds from the fact that the mass of neutral kaon is roughly 10^3 times electron mass.

2. This is not too far from the lifetime of K_L^0 but is about 2^7 times longer than the life-time of short-lived kaon. Why K_S would be so short-lived? Could the lifetime be dictated by quark level: the longer time scale could be assigned as secondary p-adic time scale with the p-adic prime $p \simeq 2^k$, $k = 104$, characterising b quark. Could the short life-time be understood in terms of loops involving heavier quarks with shorter lifetimes as conscious entities: they indeed appear in the description of CP/T breaking?

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Articles about TGD

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The value of any investment is found by computing the. A) present value of all future sales. B) present value of all future liabilities. C) future value of all future expenses. D) present value of all future cash flows. Answer: D. 5. In the one-period valuation model, the value of a share of stock today depends upon. A) the present value of both the dividends and the expected sales price. B) only the present value of the future dividends. C) the actual value of the dividends and expected sales price received in one year. D) the future value of dividends and the actual sales price. Answer: A. 6...Â In the generalized dividend model, a future sales price far in the future does not affect the current stock price because. A) the present value cannot be computed. B) the present value is almost zero. Free cash flow measures profitability. It includes spending on assets but does not include non-cash expenses on the income statement. This figure is available to all investors, who can use it to determine the overall health and financial well-being of a company. It can also be used by future shareholders or potential lenders to see how a company would be able to pay dividends or its debt and interest payments. Operating Free Cash Flow. Operating free cash flow (OFCF) is the cash generated by operations, which is attributed to all providers of capital in the firm's capital structure. This ...Â To calculate the value, take the OFCF of next period and discount it at WACC minus the long-term constant growth rate of the OFCF. ï»¿ Value of the firm. =OFCF1Ã·(kâˆ'g). where In general, the higher values of the production and sale of products and services and lower their cost, the higher profitability of the company, which will positively affect its financial condition. Nerytmichnist manufacturing processes, product quality deterioration, difficulty with its implementation result in the decrease of funds to the enterprise, resulting in worsening its solvency. There is a feedback, because of lack of funds could lead to disruptions in the provision of material resources, hence the manufacturing process. Financial activity should be aimed at ensuring regular revenue