

The three non-determinisms of TGD

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1. The non-determinism for preferred extremals of Kähler action.
2. (a) The huge vacuum degeneracy of Kähler action means that any space-time surface with CP_2 projection belonging to Lagrange manifold of CP_2 is vacuum extremals since by definition the induced Kähler form is pure gauge. Lagrange sub-manifolds are at most 2-D and analogous to momentum of position space in phase space of classical mechanics.
 - (b) Vacuum extremals are analogous to pure gauge configurations in gauge theory but now one does not have genuine gauge symmetry since the degeneracy is in general lost for non-vacuum extremals.
 - (c) One expects that the vacuum degeneracy gives rise to non-determinism for small deformations of vacuum extremals in the sense that two space-like 3-surfaces at the upper and lower boundaries of causal diamond (CD) are connected by several preferred extremals with the same Kähler action defining Kähler function/Morse function at Euclidian/Minkowskian regions of space-time surface.
3. The proposed hierarchy $h_{eff} = n \times h$ of Planck constants would define dark matter as hierarchy of phases of ordinary matter and would follow from the non-determinism of Kähler action.
 - (a) n would correspond to the number of preferred extremals connecting given 3-surfaces at boundaries of CD and having same Kähler action. One might wonder whether also conserved charges should be identical. This would reduce the degeneracy.
 - (b) Mathematical description could be in terms of covering space of imbedding space with n giving the number of sheets. Multi-sheeted would be the term to be not confused with many-sheeted used about 3-surfaces. A singular local covering would be in question and singularities would be at the ends of CD.
 - (c) One could consider also stronger condition $n = n_1 \times n_2$, where n_1 and n_2 can be assigned to M^4 and CP_2 degrees of freedom.
 - (d) The assumption is that this degeneracy brings in genuine dynamical degeneracy so that one can perform the analog of second quantization at the sheets of resulting surface. This would give rise to discrete degrees of freedom.
 - (e) What the $h_{eff} = n \times h$ really means? Kähler action is proportional to $1/\alpha_K$, $\alpha_K = g_K^2/2h$. One obtains the sum of identical Kähler actions over n sheets so that one effectively single sheet but with $h_{eff} = n \times h$.
 - (f) The original vision was that the failure of perturbative description means multisheetedness and the increase of Planck constant allows to achieve reducing α_K allows to achieve perturbative description. Mother Nature would be merciful for theoreticians.
4. Non-determinism of Kähler action could yield space-time correlate for quantal non-determinism.
 - (a) The preferred extremal connecting space-like 3-surface A at first end of CD CD to B at second end of CD can be modified if there is multifurcation associated with its time evolution. As a consequence, one has new preferred extremal, which is same as before near A but is changed later so that B is replaced with C.
 - (b) This non-determinism could also define spacetime correlate for the nondeterminism of state function reduction making possible kind of symbolic representations for sequences of quantum jumps giving rise to conscious experiences.
 - (c) Summation over loops that is path integral is central in QFT. In TGD one sums only over 3-surfaces at the ends of CD. Could the summation over loops correspond to the non-determinism at space-time level.
5. p-Adic non-determinism is inherent to p-adic differential equations.

- (a) The initial values of ordinary differential equations are constants. For p-adic differential equations they are replaced by pseudo-constants, which by definition depend on finite number of positive pinary digits of the coordinate variable.
- (b) p-Adic non-determinism is independent of non-determinism of Kähler action and the proposal is that it could relate to the non-determinism of imagination and cognition. p-Adic spatime sheets would serve as correlates of intentions and thoughts.
- (c) It seems that there are connections with the p-adic non-terminism and non-determinism of Kähler action.