Vacuum functional in TGD

1. In Zero Energy Ontology (ZEO) vacuum functional is analogous to a complex square root of exponent of free energy.

   (a) Vacuum functional decomposes to a product of real exponent of Kähler function exponent of imaginary term analogous to action in quantum field theories. In topological picture the exponent of imaginary term is analogous to exponent of Morse function and its extrema have topological interpretation in terms of topology change at the level of WCW.

   (b) Simplest example about Morse function is height function for torus having maximum, minimum and two saddle points where the signature of the quadratic form associated with height function changes. They all correspond to topology change for h=constant section.

   (c) Kähler resp. Morse function is expressible as Kähler action for Euclidian resp. Minkowkian regions of space-time surface. Square root for the determinant of the induced metric is indeed imaginary in Minkowskian regions.

   (d) Kähler function should not have saddle points since this is signature for metric, which is not positive definite. Kähler function $log(1+r^2)$ for CP_2 is good example in this respect. Same should hold true also in Euclidian regions. The properties of Kähler action in Euclidian signature guarantee that it is non-negative. This alone does not yet guarantee Euclidian signature of WCW metric.

2. Some properties of Kähler action and Kähler function.

   (a) Kähler action is inversely proportional to Kähler coupling strength a_K . Thermodynamical analogy motivates the postulate is that α_K is analogous to critical temperature so that TGD Universe would be quantum critical and vacuum function unique (if several critical points exist, then the minimum of a_K is a natural choice, assuming that it exists).

   (b) Kähler function depends on zero modes which do not contribute to the line element and appear as parameters in the Kähler metric defined in terms of Kähler function using standard formula. The quantum fluctuating degrees of freedom contributing to the line element can be expressed in terms of complex coordinates whereas zero modes are real parameters. Various fluxes associated with induced Kähler form define symplectic invariants and also zero modes if symplectic transformations of $\delta CD \times CP_2$ are isometries of WCW metric. The space of quantum fluctuating degrees of freedom corresponds to symplectic group or its coset space.

   (c) The notion of finite measurement resolution suggets strongly a hierarchy of coset spaces related to the hierarchy of inclusions of hyperfinite factors of type II_1. Also the hierarchy of Planck constants $h_{eff} = n \times h$ possibly realized in terms of of inclusion hierarchy of subalgebras of conformal algebra isomorphic with the algebra itself suggests this.

3. Kähler action involves also 3-D "boundary" terms.

   (a) These terms are analogous to the Lagrangian multiplier terms appearing in the definition of thermodynamical partition function (for instance, fixing the values of energy and particle number). These terms are proportional to Lagrangian multipliers (for instance, temperature and chemical potential).

   (b) Quantum classical correspondence suggests that the charges in the Car- tan algebra of isometries are identical to the eigenvalues of corresponding fermionic charges. This contraint selects specific spinor modes and implies that spacetime geometry codes information about quantum numbers.

   (c) Weak form of electric magnetic duality is realized as boundary terms assignable to the light-like orbits of partonic 2-surfaces and reducing the Kähler acaction for preferred extremals to Chern-Simons terms if j.A term in the action vanishes identically as it does for the know extremals. This reduction means enormous calculational simplification since it is not necessary to know all the details of the preferred extremal. It is correlate for holography and gives hopes about the calculability of the theory. It also supports the idea that TGD is almost topological QFT.

4. The maxima of Kähler function have special physical importance.

   (a) In ZEO they these maxima correspond to especially favoured 4-D field patterns since they connect 3-D surfaces at the boundaries of CD.

   (b) This interpretation is especially relevant in quantum biology where temporal patterns for many-sheeted space-time surfaces (in particular, for topologically quantized classical fields) serve as templates for the time evolution of living system. The idea that temporal evolution of magnetic body carrying dark matter realized as large h_{eff} phases serves as template for the development of organism, is natural in this framework.