Identification of preferred extremals of Kähler action

The first question is what preferred extremal could mean.

1. In positive energy ontology preferred extremal would be a space-time surface assignable to given 3-surface and unique in the ideal situation: since one cannot pose conditions to the normal derivatives of imbedding space coordinates at 3-surface, there is infinity of extremals. Some additional conditions are required and space-time surface would be analogous to Bohr orbit : hence the attribute "preferred". The problem would be to understand what "preferred" could mean. The non-determinism of Kähler action however destroyed this dream in its original form and led to zero energy ontology (ZEO).

2. In ZEO one considers extremals as space-time surfaces connecting two space-like 3-surfaces at the boundaries. One might hope that these 4-surfaces are unique. The non-determinism of Kähler action suggests that this is not the case. At least there is conformal invariance respecting the light-likeness of the 3-D parton orbits at which the signature of the induced metric changes: the conformal transformations would leave the space-like 3-D ends or at least partonic 2-surfaces invariant. This non-determinism would correspond to quantum criticality.

3. Effective 2-dimensionality follows strong of general coordinate invariance (GCI) stating that light-like partonic orbits and space-like 3-surfaces at the ends of space-time surface are equivalent physically: partonic 2-surfaces and their 4-D tangent space data would determine everything. One can however worry about how effective 2-dimensionality relates to the the fact that the modes of the induced spinor field are localized at string world sheets and partonic 2-surface. Are the tangent space data equivalent with the data characterizing string world sheets as surfaces carrying vanishing electroweak fields?

   There is however a problem: the hierarchy of Planck constants (dark matter) requires that the conformal equivalence classes of light-like surfaces must be counted as physical degrees of freedom so that either space-like or light-like surfaces do not seem to be quite enough.

   Should one then include also the light-like partonic orbits to the what one calls 3-surface? The resulting connected 3-surfaces would define analogs of Wilson loops. Could the conformal equivalence class of the preferred extremal be unique without any additional conditions? If so, one could get rid of the attribute "preferred". The fractal character of the many-sheeted space-time however suggests that one can have this kind of uniqueness only in given length scale resolution and that "radiative corrections" due to the non-determinism are always present.

The identification of (possibly preferred) extremals of Kähler action remains one of the basic challenges of TGD although

1. there are several educated guesses consistent with what is known about extremals of Kaehler action such as

   (a) preferred extremals as space-time surfaces which are associative or co-associative.

   (b) space-time surfaces possessing so called Hamilton-Jacobi structure providing rather detailed physical picture about the structure of preferred extremals and generalizing complex structure.

2. TGD as almost topological QFT hypothesis

   (a) favors the Hamilton-Jacobi structure.

   (b) Kaehler action to 3-D Chern-Simons terms weak form of electric-magnetic duality implying enormous calculational simplification $j^\alpha A_\alpha$ term in the expression of Kaehler action vanishes. is satisfied and

3. the vacuum degeneracy of Kaehler action provides a lot of qualitative information about preferred extremals (4-D spin glass degeneracy) and motivates Zero Energy Ontology (ZEO).

4. very large classes of extremals are known such as

(a) CP_2 type vacuum extremals.
(b) massless extremals (MEs) or topological light rays.
(c) cosmic strings.