%\begin{abstract}

There are two basic approaches to quantum TGD. The first approach, which is
discussed in this chapter, is a generalization of Einstein's
geometrization program of physics to an infinite-dimensional context.
Second approach is based on the identification of physics as a
generalized number theory. The first approach relies on the vision of
quantum physics as infinite-dimensional K\"ahler geometry for the \blockquote{world of
classical worlds} (WCW) identified as the space of 3-surfaces in in
certain 8-dimensional space.

There are three separate manners to meet the challenge of constructing WCW
K\"ahler geometry and spinor structure. The first approach relies on direct
guess of K\"ahler function. Second approach relies on the construction of
K\"ahler form and metric utilizing the huge symmetries of the geometry
needed to guarantee the mathematical existence of Riemann connection. The
third approach relies on the construction of spinor structure based on the
hypothesis that complexified WCW gamma matrices are representable as linear
combinations of fermionic oscillator operator for second quantized free
spinor fields at space-time surface and on the geometrization of
super-conformal symmetries in terms of WCW spinor structure.

In this chapter the proposal for K\"ahler function based on the requirement
of 4-dimensional General Coordinate Invariance implying that its definition
must assign to a given 3-surface a unique space-time surface. Quantum
classical correspondence requires that this surface is a preferred extremal
of some some general coordinate invariant action, and so called K\"ahler
action is a unique candidate in this respect. The preferred extremal has
in positive energy ontology interpretation as an analog of Bohr orbit so
that classical physics becomes and exact part of WCW geometry and
therefore also quantum physics. In zero energy ontology (ZEO) it is
not clear whether this interpretation can be preserved except for

maxima
of K\"ahler function.

The basic challenge is the explicit identification of WCW K\"ahler function
K. Two assumptions lead to the identification of K as a sum of
Chern-Simons type terms associated with the ends of causal diamond and with
the light-like wormhole throats at which the signature of the induced
metric changes. The first assumption is the weak form of electric
magnetic duality. Second assumption is that the K\"ahler current for
preferred extremals satisfies the condition $j_K\wedge dj_K=0$ implying
that the flow parameter of the flow lines of j_K defines a global
space-time coordinate. This would mean that the vision about reduction
to almost topological QFT would be realized.

Second challenge is the understanding of the space-time correlates of
quantum criticality. Electric-magnetic duality helps considerably here.
The realization that the hierarchy of Planck constant realized in terms of
coverings of the imbedding space follows from basic quantum TGD leads to a
further understanding. The extreme non-linearity of canonical momentum
densities as functions of time derivatives of the imbedding space
coordinates implies that the correspondence between these two variables is
not 1-1 so that it is natural to introduce coverings of $CD\times CP_2$.
This leads also to a precise geometric characterization of the criticality
of the preferred extremals. Sub-algebra of conformal symmetries consisting
of generators for which conformal weight is integer multiple of given integer n
is conjectured to act as critical deformations, that there are n
conformal equivalence classes of extremals and that n defines the effective
value of Planck constant $h_{eff}=n\times h$.

%\end{abstract}