# Towards $M$-matrix

This book is devoted to a detailed representation of quantum TGD.

The first part of the book represents basic vision about preferred extremals of Kähler action and about solutions of the modified Dirac equation defining the quantum dynamics at the level of the spinor geometry of "world of classical worlds" (WCW).

The second part of the book summarizes quantum TGD in its recent form.

1. General coordinate invariance and generalized super-conformal symmetries are the basic symmetries of TGD and Equivalence Principle can be generalized using generalized coset construction.

2. In zero energy ontology $S$-matrix is replaced with $M$-matrix identified as time-like entanglement coefficients between positive and negative energy parts of zero energy states. $M$-matrix is a product of diagonal density matrix and unitary S-matrix. For generalized Feynman diagrams lines correspond to light-like 3-surfaces and vertices to 2-D surfaces.

3. Finite measurement resolution realized using fractal hierarchy of causal diamonds ($CD$s) inside $CD$s implies a stringy formulation of quantum TGD involving replacement of 3-D light-like surfaces with braids representing the ends of strings. Category theoretical formulation leads to a hierarchy of algebras forming an operad.

4. Twistors emerge naturally in TGD framework and several proposal for twistorialization of TGD is discussed in two chapters devoted to the topic. Twistorial approach combined with zero energy ontology, bosonic emergence, and the properties of the Chern-Simons Dirac operator leads to the conjecture that all particles -also string like objects- can be regarded as bound states of massless particles identifiable as wormhole throats. Also virtual particles would consist of massles wormhole throats but bound state property is not assumed anymore and the energies of wormhole throats can have opposite signs so that space-like momentum exchanges become possible. This implies extremely strong constraints on loop momenta and manifest finiteness of loop integrals.

   An essential element of the formulation is exact Yangian symmetry obtained by replacing the loci of multilocal symmetry generators of Yangian algebra with partonic 2-surfaces so that conformal algebra of Minkowski space is extened to infinite-dimensional algebra bringing in also the conformal algebra assigned to the partonic 2-surfaces. Yangian symmetry requires the vanishing of both UV and IR divergences achieved if the physical particles are bound states of massless wormhole throats.

   Quite general arguments suggest the formulation of TGD in terms of holomorphic 6-surfaces in the product $CP_3 \times CP_3$ of twistor spaces leading to a unique partial differential equations determining these surfaces in terms of homogenous polynomials of the projective complex coordinates of the two twistor spaces.