Bosonic emergence

1. Background.

   (a) In quantum TGD induced imbedding space spinors are the only quantum fields in the sense that one performs a second quantization for them but nor for imbedding space coordinates. Induced spinors satisfy Kähler-Dirac equation coupling them to the induced metric and spinor connection.

   (b) Bosonic that is WCW ("world of classical worlds") degrees of freedom are also present and correspond to the bosonic parts of super- conformal algebras acting as generators of isometries of WCW.

   (c) Since imbedding space coordinates are not quantized in the usual sense and gauge fields do not appear as primary dynamical variables, one expects bosonic emergence: elementary bosons are bound states of "ur-fermions" as also elementary fermions.

   (d) Indeed, both fermions and bosons correspond to string like objects defining bound states of more elementary fermions.

2. What does bosonic emergence mean?

   (a) Elementary particles correspond to flux tubes at parallel space-time sheets (massless extremals) such that the flux runs to another spatime sheet at the end of flux tube through wormhole contact represented by a deformation of CP_2 type vacuum extremal having Euclidian induced metric. Flux tube carries magnetic flux and throats behave efeffectively like magnetic charges identical to electric charges by weak form of electric magnetic duality.

   (b) The throats of the two wormhole contacts at the ends of the structure carry fermion number at the ends of strings connecting wormhole throats. Particle's electroweak quantum numbers are determined by the fermion content.

   (c) Colored super-conformal generators contribute to color quantum numbers since the color quantum numbers for imbedding space spinors cha- racterizing grounds of the representations of super-conformal algebra do not have correct correlation with electroweak quantum numbers. Quarks/leptons however correspond to triality 1/0 color partial waves.

3. Bosonic emergence and twistor approach.

   (a) The string picture gives good hopes about applicability of twistor approach. For strings one does not face the problem caused by nonplanar diagrams.

   (b) Only algebraic massless M^4 Dirac operator appears at fermionic lines.

   (c) Bosonic emergence means that twistor approach to TGD must be modifed from that applied in $\mathcal{N} = 4$ SUSY where only elementary particles are gauge bosons and their super-partners.

   (d) What is left from Kähler-Dirac for the modes of Dirac operator is the contribution to the action at the space-like ends of spacetime surface and at the light-like partonic orbits. The outcome is just the analog of M^4 Dirac action with Dirac operator replaced with algebraic operator $p^k\gamma_k$ so that one has hopes about well-defined perturbation theory despite the enormous non-linearity of the original situation.

   (e) At space-like ends the sum of Chern-Simons Dirac operator and $p^k\gamma_k$ appears. C-S-D gives rise only to space-like contribution to Dirac operator expressible in terms of CP_2 gamma matrices. A possible interpretation is as an analog of Higgs term.

   (f) The outcome is that only massless Dirac propagators appear in the fermionic part of the action so that the conformal invariance holds true.

   (g) This does not prevent from having a stringy spectrum of massive states: physical states are are many-fermion bound states of in general non-col- linear massless "ur-fermions". Even more the incoming fermions might get mass from Higgs like contribution. An open question is whether it has rep- resentation in terms of p-adic thermodynamics.

(h) The diagrammatics of $\mathcal{N} = 4$ SUSY is replaced with one in which 4-fermion vertex assignable to meeting wormhole contacts is fundamental. One ex- pects that it is possible to talk about virtual bosons identified as wormhole contacts with fermion and antifermion at opposite throats and that this picture leads to a generalization of the recursion formulas of twistor Grassmann approach.