

# TOPOLOGICAL GEOMETRODYNAMICS

## More about super-conformal symmetries

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# Closer view about super-conformal symmetries

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- **Almost topological QFT property** allows rich spectrum of super-conformal symmetries. 3-D generalization of stringy symmetries.
- **N=4 super conformal symmetries** in question. Fermions can be arranged to multiplets of N=4 super conformal symmetry: maximal associative super-conformal algebra (F. Englert *et al* (1988), J. Math. Phys. 29, 281). **Two** Super conformal algebras corresponding to **light like coordinate of  $X^3$**  and **lightlike radial coordinate of  $\delta M^4_{+/-}$**  plus the commutators of these algebras.
- **Generalized Super Kac-Moody symmetries** as transformations leaving partonic 3-surface lightlike. Conformal transformations of  $M^4_{+/-}$  and isometries of  $CP_2$  localized with respect to  $X^3$  with a suitable constraints eliminating local translations in time direction as physical degrees of freedom. Extension of Kac-Moody algebra to infinite direct sum of sub-spaces remaining invariant under Kac-Moody and Virasoro associated with lightlike coordinate

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- **Super-canonical symmetry algebra (SCA)** associated with  $\delta H_{+/-} = \delta M^4_{+/-} \times CP_2$ . Analog of Kac-Moody algebra obtained by replacing finite-D Lie group  $G$  with infinite-D group of canonical symmetries of  $\delta H_{+/-}$ . SCA can be localized with respect to partonic 2-surface by taking commutator with partonic SKM algebra and its SV. The commutator algebra assumed to annihilate physical states.
- At parton level all **solutions of modified Dirac equation generate super-Kac Moody and super-conformal gauge symmetries for extremals of C-S action**. Generalized eigen modes define ground states analogous to ground states of N-S representations. Generalized eigenvalues identified as conformal weights. Connection with zeros of Riemann  $\zeta$ .  **$h=1/2$  for N-S replaced with  $h=s=1/2+iy$ ,  $s$  zero of  $\zeta$ .**
- In space-time interior **covariantly constant right handed neutrino** gives rise to an infinite number of conserved and vanishing super charges if absolute extremum property for space-time regions with fixed sign of action density is assumed. These charges annihilate physical states. This supports the hopes that Dirac determinant gives rise to exponent of Kähler function defined as extremum of Kähler action.

# Representations of N=4 Super-conformal algebra

- **N=4 super Virasoro algebra** has  $SU(2)_+ \times SU(2)_- \times U(1)$  algebra as **inherent SKM algebra** acting on second quantized induced spinor fields.  $SU(2)$ 's act as **right and left handed spinor rotations in  $M^4$  degrees of freedom**.  $U(1)$  corresponds to em or Kähler charge.
- **External SKM algebra** corresponding to  $SO(4)$  spinor rotations in  $CP_2$  (contains electroweak symmetries), and to rotations and translations in plane orthogonal to light-like vector. The latter is stringy SKM algebra.
- Representations of N=4 sconformal algebra labelled by **ground state conformal weight  $h$ , and central extension parameters  $k_+$  and  $k_-$  for  $SU(2)$ 's**.  $h$  identifiable as the contribution of  $CP_2$  color partial wave in cm degrees of freedom of parton to  $m^2$ . Breaking of electro-weak symmetries automatic.

- SC generator compensates anomalous color of spinor harmonic.
- **SC generators have negative (tachyonic) conformal weights.** Create tachyonic ground state annihilated by radial Virasoro generators  $L_n$ ,  $n < 0$  of  $\delta M^4_{+/-}$  (Kac determinant=0). Very few of these states. Huge number of super-canonical tachyons eliminated.
- **The commutator [SCA, SKM] annihilates physical states.** Further elimination of exotics.
- **Conformal weight of color partial wave compensates partially the tachyonic SC conformal weight.** The SKM Virasoro excitations of the resulting possibly tachyonic state must have non-negative conformal weight.
- **p-Adic thermodynamics for Virasoro generator  $L_0$  in SKM degrees of freedom.** Mass squared analogous to thermal energy. Also Higgs contribution and contribution depending on genus of parton.
- **Zero energy ontology** modifies state construction somewhat. **Zero energy states** as pairs of positive and negative energy states. Total conformal weights of positive and zero energy conformal states.

## Super-symmetries: TGD contra superstrings

- TGD superconformal symmetries **extend** stringy symmetries
- **Super generators carry quark or lepton number.** Majorana spinors would mix B and L. Fermion number conservation analogous to U(1) charge conservation of N=2 superconformal algebra.
- **Breaking of super-conformal symmetries** since all light-like 3-surfaces and thus also non- extremals of Chern-Simons action allowed.
- **Mass squared thermal expectation of conformal weight in p-adic thermodynamics.** SKMV  $L_n$  do not annihilate physical states. Lorentz invariance means that 4-momentum cannot appear in conformal generators.
- **No tachyon problems.**  $c>0$  ,  $\hbar>0$  does not mean breaking of Lorentz invariance. Reference: **Construction of Quantum Theory: Symmetries.**
- **No super- Poincare symmetry** No particles

- **Critical dimension  $D=8$**  from several arguments.  $N=4$  conformal supersymmetry consistent with it. Number theoretic approach implies (hyper-octonions) it.
- Ordinary integration measure for Grassmann variables requires Majorana type theta parameters and must be generalized. The requirement is that integration measure

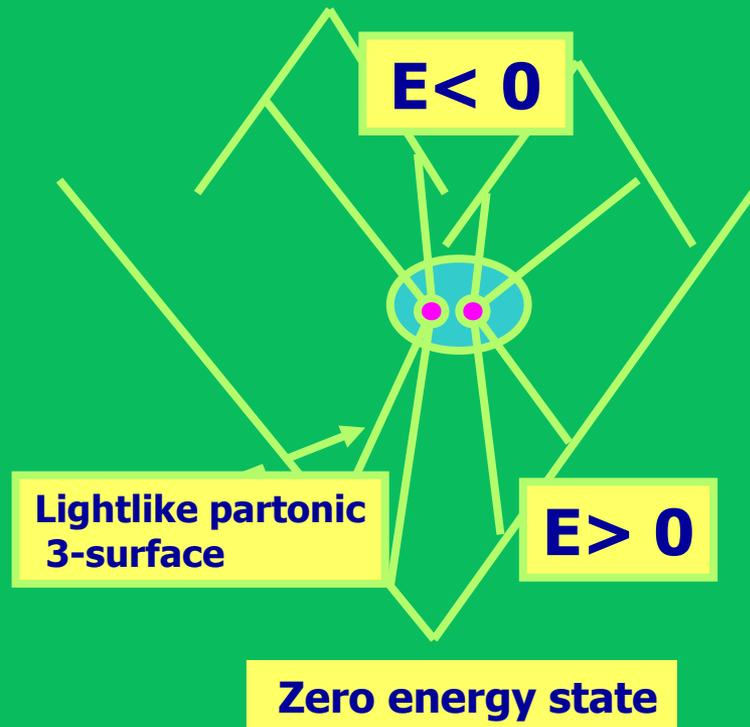
$$\int \bar{\Gamma} d\theta \text{ bar } \Gamma^k d\theta$$

with  $2D$  differentials corresponds to the number of spinor components.

- **$2D = 2^{D/2-1}$  gives  $D=8!$**
- Unclear whether super-space formalism could have application in TGD framework. [Return](#)

# S-matrix in zero energy ontology

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● Partonic 2-surface  $X^2 =$  intersection of incoming lightlike partonic 4-surfaces (!). Note that their interiors do not intersect! Necessary for realizing quantum classical correspondence.

S-matrix unitary entanglement matrix:  $SS^\Sigma = \text{Id}$ ,  $\text{Tr}(\text{Id})=1$ .