

# Holography

## 1. Background:

- (a) t'Hooft proposed that planar gauge theory diagrams sum up to something assignable to string world sheet. Strong and weak coupling related by holography.
- (b) Susskind proposed holography in quantum gravity. Somehow blackhole horizon codes for the physics inside blackhole.
- (c) Maldacena proposed AdS/CFT duality relating conformally invariant QFT in conformally compactified Minkowski space to string model in higher dimensional space-time AdS.

## 2. Holography in TGD:

- (a) Implied by General Coordinate Invariance (GCI) assigning to space-like 3-surfaces at the ends of causal diamond (C
- (b) more or less unique space-time surface as preferred extremal of Kähler action whose value defines Kähler function. 3-surfaces related by general coordinate transformation equivalent physically.
- (c) Alternative form of GCI: 3-surfaces identified as lightlike orbits of wormhole throats connecting the ends of CD define preferred 3-surfaces in WCW. Which identification is correct?

Both interpretations of GCI are correct:

- (a) Strong form of GCI: the identifications are equivalent. The partonic 2-surfaces at the ends of CD defined by the intersections of these 3-surfaces plus their 4-D tangent space data code for quantum physics.
- (b) Strong form of GCI implies strong form of holography. Effective 2-dimensionality.

## 3. This inspires questions

- (a) Could effective 2-dimensionality allow to express conserved quantities as integrals over partonic 2-surfaces at one end of CD.
- (b) Or could they even reduce to integrals of fermionic charge densities over strings at the ends of CD as quantum classical correspondence suggests.
- (c) String tension in string models essentially  $1/\hbar G$ . In TGD  $n/R^2$ , where  $R$  is  $CP_2$  scale.  $\hbar$  dependence disappears and  $n$  is dimensionless constant which TGD in principle predicts.

## 4. Holography inspires some conjectures.

- (a) For preferred extremals of Kähler action the  $j_A$  contribution to the action vanishes so that the action reduces to 3-D boundary terms at the ends of CD and at the light-like orbits of wormhole throats (3-surfaces at which the signature of induced metric changes from Euclidian to Minkowskian).
- (b) If weak form of electric magnetic duality holds true then Kähler action reduces to Chern-Simons terms and the idea about TGD as almost topological QFT would be realized.
- (c) Could effective 2-dimensionality allow to express conserved quantities as integrals over partonic 2-surfaces or could they even reduce to integrals of fermionic charge densities over strings at the ends of CD as quantum classical correspondence suggests.

## 5. What about string world sheets at which the solutions of Kahler-Dirac equation with well-defined em charge are localized?

- (a) Are both partonic 2-surfaces with tangent space data and string world sheets needed?
- (b) Could string world sheets characterize the tangent space data at partonic 2-surfaces?
- (c) Could string world sheets and partonic 2-surfaces with appropriate tangent spaced data provide dual descriptions. In other words: do these data fix the space-time surface apart from possible gauge degeneracy.