TOPOLOGICAL GEOMETRODYNAMICS
Basic Ideas

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Short FAQ about TGD

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Why TGD?

- **Why TGD (1978).** Energy problem of general relativity. Generalization of string models by replacing strings with 3-surfaces. Geometrization of fundamental interactions using sub-manifold geometry.

- **Why TGD (2006):** landscape crisis of M-theory. Failure to reproduce even standard model physics. Super-symmetry might be misunderstood physically. Higgs might not be what it is.

What are the great ideas of TGD?

- **Space-time as 4-D surface in $M^4 \times CP_2$.** Geometrization of classical fields and elementary particle quantum numbers. 3-D light-like surfaces basic dynamical objects.

- **Generalization of Einstein's geometrization program.** Quantum states as classical spinor fields in the world of classical worlds. Do not quantize.

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- **Physics as generalized number theory**. p-Adic mass calculations. p-Adic physics as physics of cognition and intention. Unification of p-adic and real physics by number theoretic universality. Classical number fields and dimensions 8,4,2,0 of imbedding space, space-time, parton, strand of number theoretic braid. Riemann Zeta and physics.

- **Clifford algebra of world of classical worlds and hyper-finite factors of type II_1**. Key to the understanding of quantum TGD and its generalization. Quantum measurement theory with finite measurement resolution in terms of Jones inclusions. Emergence of TGD Universe from number theory. Planck constants dynamical and quantized. Dark matter as macroscopically quantum coherent phases with large value of h.

- **Super-conformal symmetries**. Magic conformal properties of 3-D light-like partonic surfaces and boundary of 4-D light-cone as key aspects of theory.

- **Extension of quantum measurement theory to a theory of consciousness**. New view about relation of geometric and experienced time. Self hierarchy.

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What is common to TGD and standard model?

- TGD predicts standard model (gauge) symmetries and particle spectrum.

What distinguishes TGD and standard physics?

- Reductionistic philosophy given up and replaced with fractality. Various fractal hierarchies. Many-sheeted space-time, p-adic scaling hierarchy, dark matter hierarchy, hierarchy of selves. Scaled up variants of standard model physics. Scaling arguments make theory predictive.
- New view about energy and time. Also negative energies possible. Zero energy ontology.
- Hierarchy of dark matters with nonstandard values of Planck constants. Macroscopic quantum phases in all length scales. Applications in biology especially interesting.

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TGD as solution the energy problem of GRT and as generalization of string models

- Energy not well defined concept in GRT since Poincare invariance is lost in curved space-time. Space-time as 4-surface in $H=M^4\times S$: Poincare symmetries are symmetries of imbedding space.

- Space-time as orbit of particle like object: generalization of string models. String → 3-D surface. Actually light-like 3-surface: parton orbit.

- $S=CP_2$ codes for the symmetries of standard model. Isometries: color group SU(3). Holonomies: ew gauge group U(2). CP2= SU(3)/U(2). Symmetric/constant curvature space.

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- **Geometrization of classical gauge fields. Projections of Killing vector fields of CP_2 as color gauge potentials. Electroweak gauge potentials as projections of CP_2 spinor connection.**

- **Geometrization of standard model quantum numbers. Leptons and quarks correspond to different H-chiralities. Color partial waves. Triality 1 color partial waves for quarks.**
  Conformal symmetries essential for understanding details.

- **Family replication phenomenon topologically.**
  Generation-genus correspondence. 3 fermion families. Hyper-ellipticity key notion.

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Some implications of new notion of classical gauge field

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- **Topological field quantization**. The imbeddability of say constant magnetic field possible for finite space-time region only. Physical objects possess field identity: notion of field (magnetic) body.
- Only the topological half of YM equations satisfied.
- **Classical color and ew fields in all length scales**: hierarchy of fractal copies of standard model highly suggestive. Interpretation in terms of dark matter?!
- **Classical color holonomy Abelian**. Quantum-classical correspondence suggests vanishing of U(2) quantum numbers for physical states. Weak form of confinement. Note: elementary bosons correspond to so called CP_2 type vacuum extremals rather than quantized classical fields.

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Kähler action and vacuum extremals

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- **Kähler action** Maxwell action for induced Kähler form of CP_2.
- **Vacuum degeneracy** of Kähler action key to the understanding of TGD!
- Spin glass degeneracy of Kähler action . Canonical transformations of CP_2 act as U(1) gauge transformations but are dynamical symmetries of **vacuum extremals** only. CP_2 projection **Lagrangian manifold** for vacuum extremal.
- Path integral does not make sense nor does canonical quantization.
- Generalize **Wheeler's superspace**: the world of classical worlds, space CH of 3-surfaces X^3. Realization of **4-D general coordinate invariance** requires that CH geometry assigns to X^3 a unique four-surface $X^4(X^3)$, as preferred extremals of Kähler action, generalized Bohr orbit. Path integral→ functional integral over 3-surfaces using as vacuum functional the exponent of Kähler function K identified as Kähler action for $X^4(X^3)$. Reference:

  TGD: Physics as infinite-dimensional geometry.
- K a **non-local** functional of X^3: local divergences cancel. Ill-defined Gaussian and metric determinants cancel each other.

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- **TGD Universe quantum critical**. Kähler coupling strength corresponds to critical temperature and invariant under renormalization group evolution. Kähler coupling strength turns out to correspond to the value of electroweak U(1) coupling at electron Compton length.

- RW cosmologies vacuum extremals. Poincare/inertial energy density zero in cosmological length scales. The sign of Poincare energy can be also negative. Gravitational mass has definite sign. Reference: TGD and Cosmology.

- Zero energy ontology: all physical states have vanishing conserved quantum numbers. Reference: Construction of Quantum Theory: S-matrix.

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Quantum-classical correspondence

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- Interpretation of classical non-determinism. Space-time provides a symbolic representation of quantum dynamics.
- Maximal deterministic space-time regions as "Bohr orbits" representing quantum states.
- Also a representation of quantum jump sequences (and contents of conscious experience).
- What about quantum measurement theory? Interior of space-time surface represents classical dynamics and defines classical correlates for the parton dynamics at 3-dimensional lightlike surfaces carrying partonic quantum numbers. Interior degrees of freedom zero modes for metric of CH.
- Conformal invariance: light like partonic 3-surfaces are metrically 2-dimensional. Chern Simons action for induced Kähler gauge potential the only possible dynamics at parton level. TGD as almost topological QFT. Only lightlikeness brings in metric implicitly!

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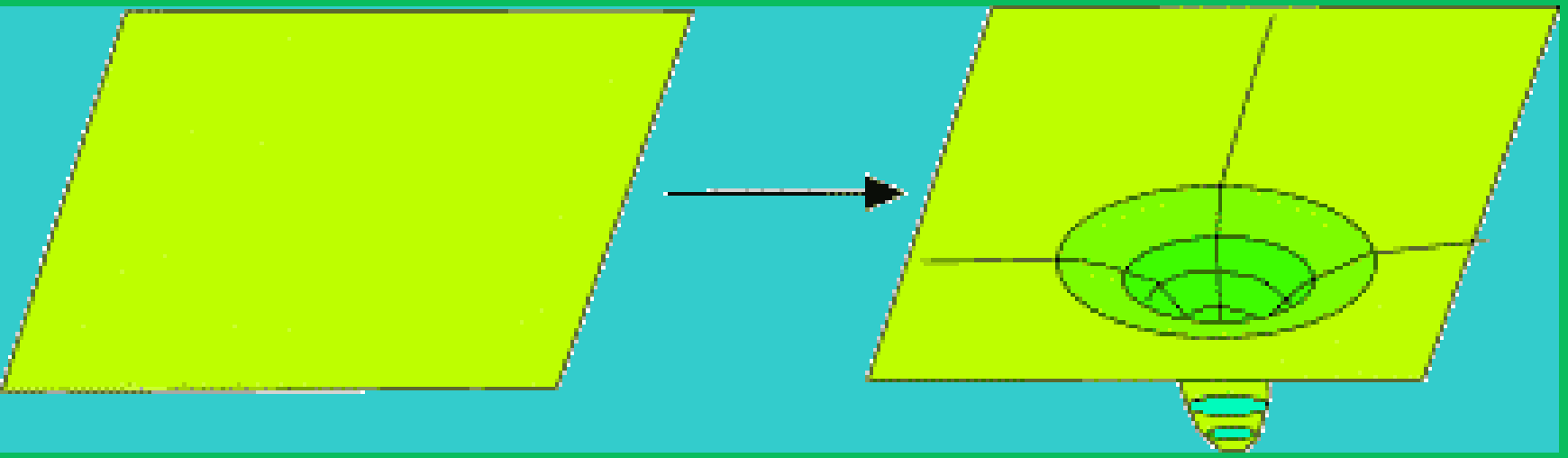
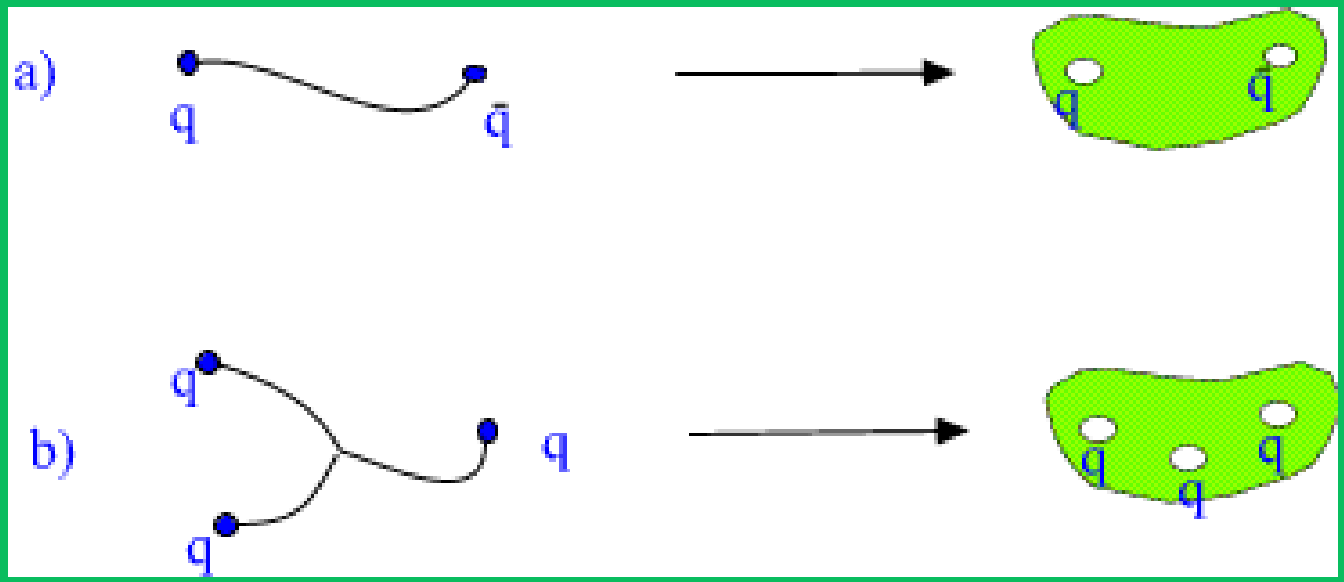
- Reference: Construction of Quantum Theory: Symmetries

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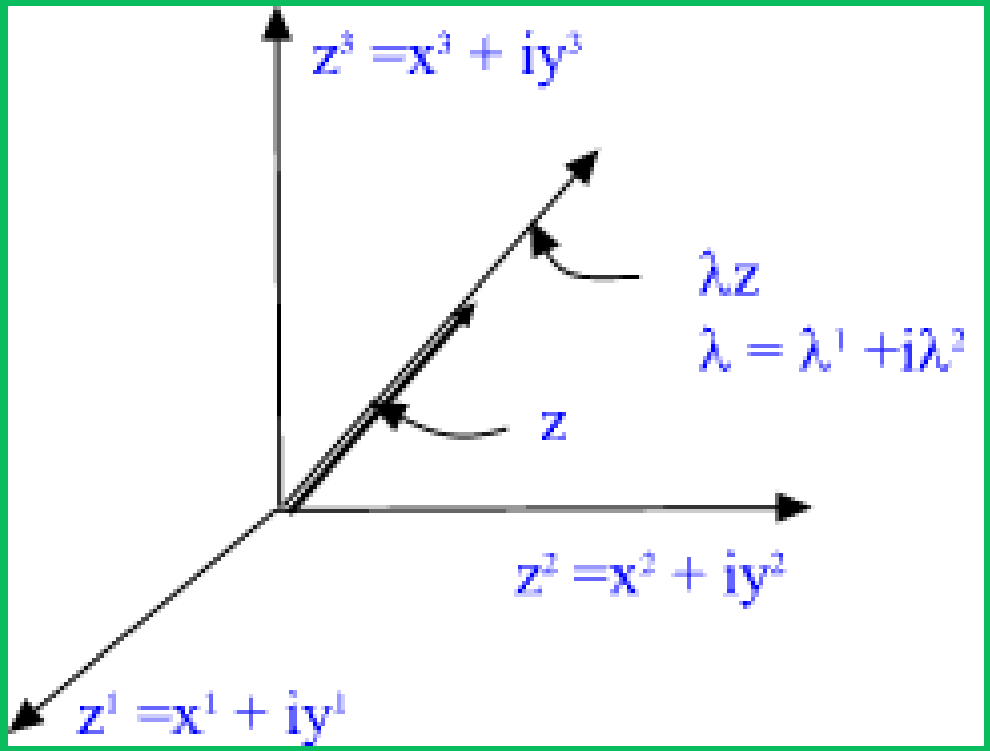
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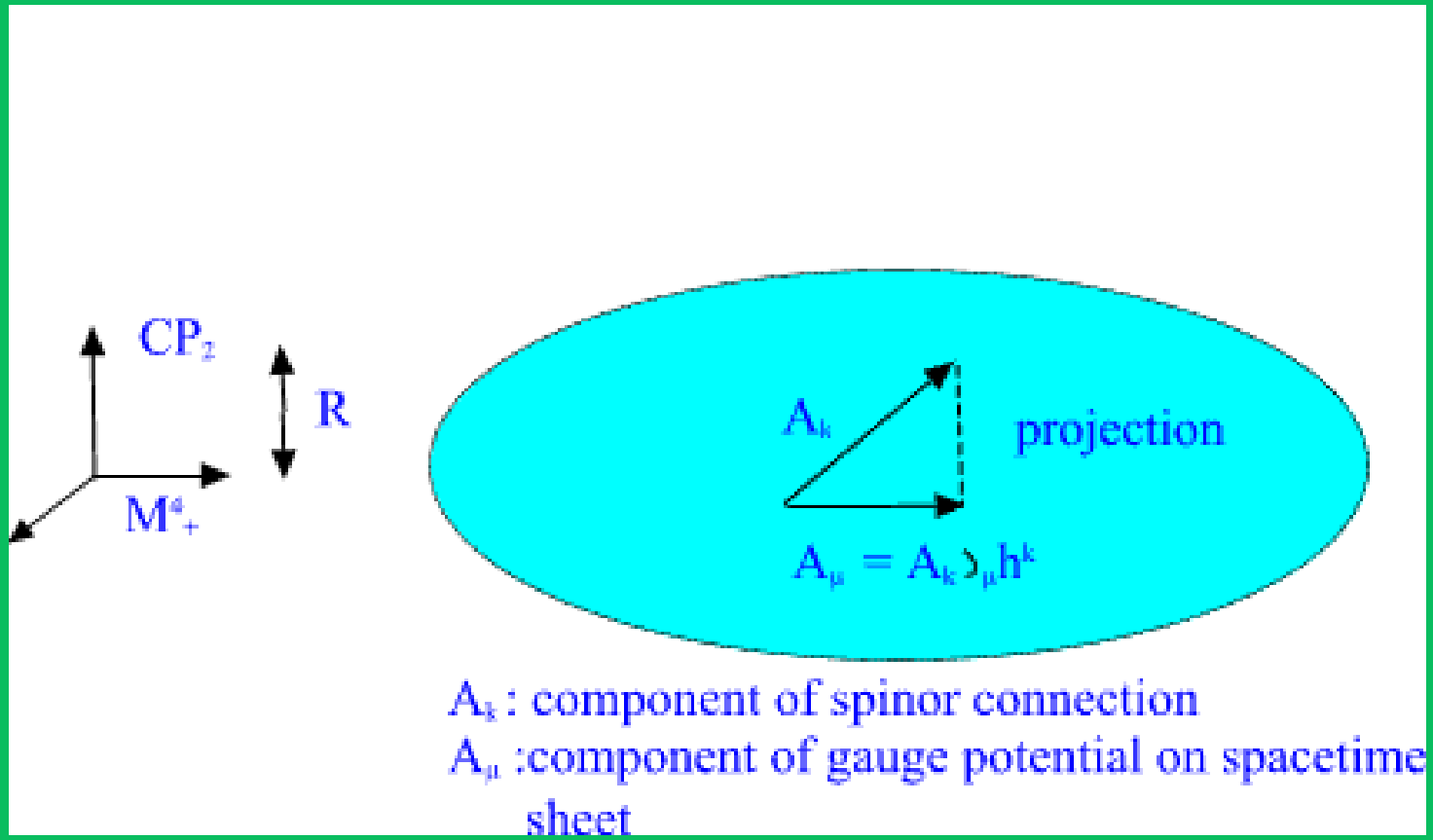
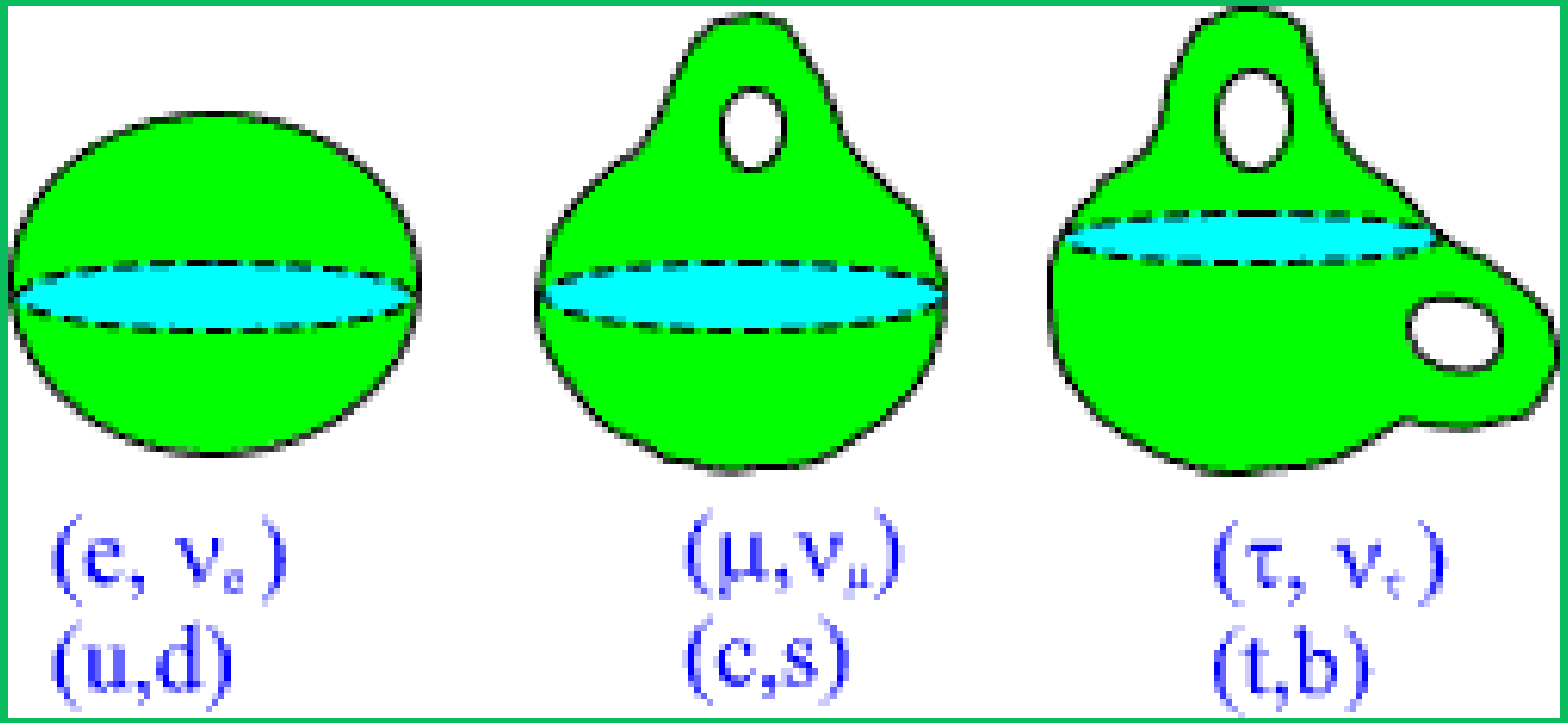


A_k : component of spinor connection

A_μ :component of gauge potential on spacetime sheet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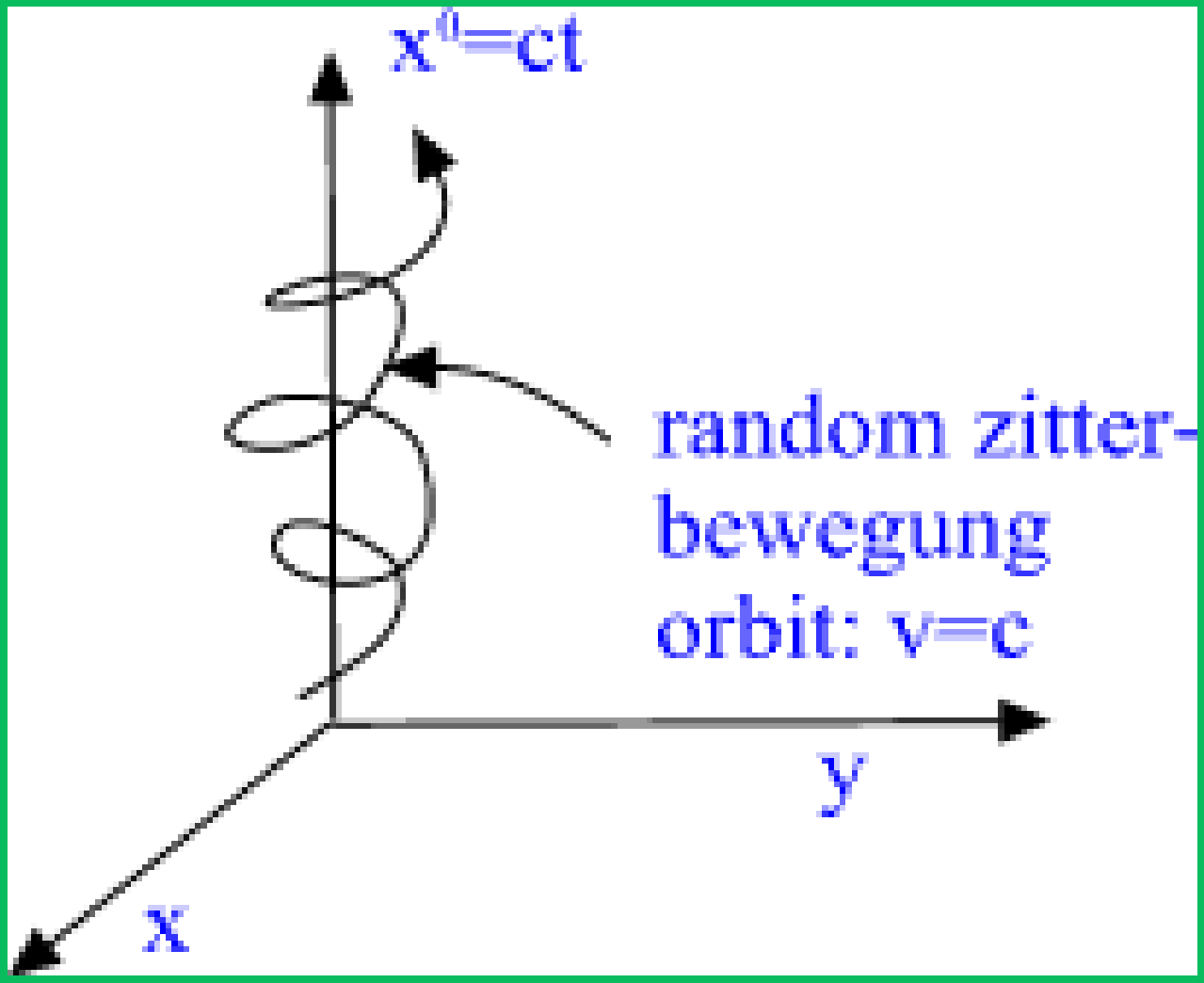
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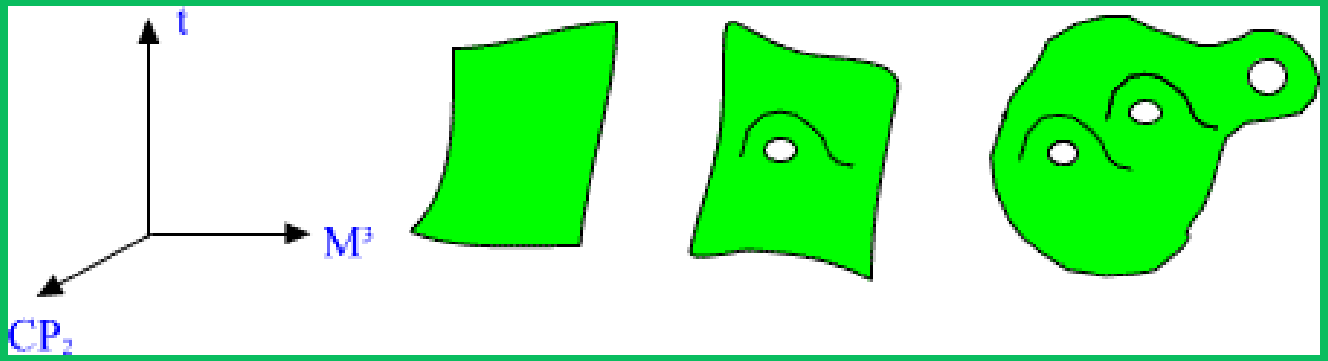
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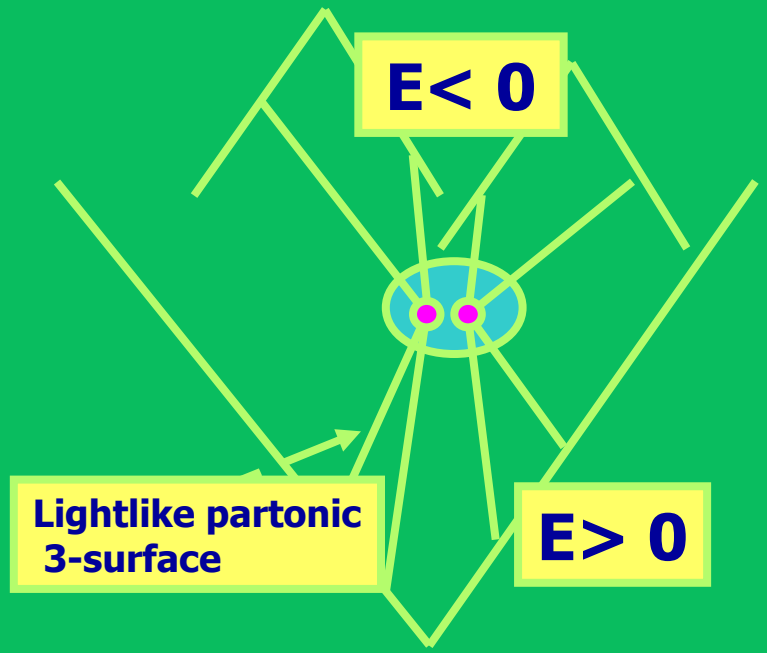
S-matrix in zero energy ontology



Zero energy state

- 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^{Σ} =Id, Tr(Id)=1.