

Biosystem as topological quantum computer

1. Background concepts and ideas:

- (a) The notion of magnetic body consisting of flux tubes and sheets and carrying dark matter as phases with large $h_{eff} = n \times h$ making possible macroscopic quantum coherence.
- (b) Knotting, linking and braiding of magnetic flux tubes in 3-space idealizable as strings.
- (c) Dance metaphor. Dancers on 2-D parquette define time-like braiding in 3-D space-time. Each braiding pattern defines a TQC program.
- (d) Imagine that the feet of dancers are fixed to a wall by threads. During dance the threads are geometrically entangled and define a representation of the dance as space-like braiding in 3-space. Fundamental mechanism for memory representations.
- (e) Braiding statistics. The exchange operation for $D > 2$ corresponds to \pm sign (Bose/Fermi statistics). For Abelian anyons possible in $D=2$ because punctured plane has non-trivial first homotopy group, braid statistics can correspond to a more general phase, and for non-Abelian anyons to matrix operation.
- (f) TQC program corresponds to a unitary Smatrix constructed in terms of basic gate characterizing the basic braiding operation exchanging the two braid strands.
- (g) The unitary matrix defining TQC program defines time-like entanglement in ZEO giving rise to density matrix which is proportional to unit matrix. The entanglement in question is negentropic.
- (h) In order to realize unitary Smatrix one must assign particles to the braid ends. Typically fermions belonging to the unitary representations of the group.

2. 2-braids and generalization of TQC.

- (a) Orbits of magnetic flux tubes in 4-D spacetime are idealizable as string world sheets and can get 2-knotted and 2-braided.
- (b) 2-braiding makes possible more general topological quantum computation (TQC).
- (c) For 1-braiding basic gate corresponds to exchange of strands: strand a can go over b or below b. This defines a bit.
- (d) For 2-braiding one has besides this vertex also reconnection: the strands can reconnect or not. This defines second bit so that "crossing" is characterized by 2 bits.
- (e) This allows generalized TQC based on zero energy ontology (ZEO): basic structure is space-time surface, whose ends correspond to 3-surfaces defining braided flux tubes giving rise to 1-braids.

3. DNA-cell membrane system as topological quantum computer.

- (a) Several variants of TGD in question depending on whether the particles are quarks and antiquarks or electrons.
- (b) Magnetic flux tubes representing braid strands connect DNA nucleotides to lipids of cell membrane.
- (c) At the ends electrons or quarks and antiquarks. This could make sense in TGD since scaled variants of ordinary quarks are possible and might be important in living matter.
- (d) Time-like braiding corresponds to the flow of 2-D liquid formed by lipids in liquid-crystal state. This flow could be induced by nerve pulse patterns.
- (e) The space-like braiding is induced by the same flow since the ends of flux tubes at DNA nucleotides are fixed like threads connecting dancers to the wall.

4. DNA-cell membrane TQC represents only one example.

- (a) The proposal that flux tubes connect biomolecules to a kind of "Indra's net" means that the TQC could be automatically occurring at various hierarchy levels of the system.

- (b) It could automatically form memory representations about the motion of system inducing space-like braidings.
- (c) For instance, in the case of microtubules this procedure might be used for computational purposes. Now 2-braiding could define TQC.
- (d) Flux tubes could form kind of 3-D coordinate grid with three tubes meeting at given node. This defines three planes and 2-D grid in each plane define timelike TQC. In each node 3 pairs of bits are needed what happens to the strands. This gives 6 bits: something do with the 6 bits of DNA codon?