TGD BASED VIEW ABOUT QUANTUM BIOLOGY
High Tc superconductivity and living matter

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Some findings about high Tc superconductivity

To the beginning

- Cuprates. Formation of stripes in antiferromagnetic CuO planes. Mott insulators with magnetically "frozen" valence electrons which somehow begin to conduct along striples which are antiferromagnetic defects containing holes added by doping. Critical doping fraction .15.

- In superconducting phase stripes must fluctuate. Coherence lengths short: type II superconductor if h ordinary(!).

- Spin 1 and L=2: J=2 states Cooper pairs present. Evidence also for S=0 BCS type Cooper pairs.

- Simple power law behavior for resistance as function of temperature also above T_c up to another critical temperature T_{c1}. Power law behavior and spin glass character suggests quantum criticality involving competition of two phases. Antiferromagnetic order destroyed by disorder allowing possibly phononic super-conductivity.

- Poorly understood excitation energies. Onset of optical absorption at 50 meV. Second derivative for photon absorption peaked at 68 meV. Resonant neutron scattering at 41 meV. References. See also this.

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Quantum criticality due to presence of 2 kinds of large h Cooper pairs

To the beginning

- Competition of two phases below pseudo gap temperature $T_{c1}>T_c$. Both phases correspond to large Planck constant. Exotic and BCS type Cooper pairs.

- Exotic Cooper pairs due to some new interaction and unstable against decay to ordinary h state at quantum criticality. Reduction of superconductivity to condutivity. Quantum criticality explains scaling laws and fluctuating stripes.

- BCS type Cooper pairs with large h and thus high T_c.

- The value of Planck constant $h= 2^{11}h_0$. Scaled up electron has size $L(149=127+2\times 11=149)=5$ nm. Thickness of lipid layer of cell membrane. Exotic Cooper pair consists of a pair of zoomed up electrons topologically condensed on cylinders of length $L(151)= 10$ nm in different layers.

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- **Coherence lengths scaled up to 1-4 μ m! Ordinary super-conductors have coherence lengths up to 1 μ m.**

- **T_c scaled up too.**

- **Dual of type I superconductor instead of type II superconductor! Stripes analogous to magnetic defects in type I superconductor. Antiferromagnetic quantal counterpart of superconductor of type I in critical magnetic field.**

- **Large size of exotic Cooper pairs solves the problem of integrating the supra phases assigned with stripes to supra phase in longer length scale.**

- **Exotic Cooper pairs formed from neighboring electrons with parallel spins in hole-stripe by a phase transition increasing h. Breakdown of anti-ferromagnetism necessary.**

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Model for exotic and BCS Cooper pairs

To the beginning

- **Exotic Cooper pairs** pairs of cylindrical space-time sheets containing electron per sheet.
- **Wormhole contacts** feed em charge to large space-time sheet. If 2 wormholes per electron then wormholes have quark-antiquark pair at partonic throats.
- **Wormhole contact light Higgs like particle**. Scaled up **dark color force** binds the cylinders to exotic Cooper pair! Exotic Cooper pairs can possess spin.
- **Minimization of energy** using data about transition energies **fixes the size scale of Cooper pair to L(151)** . Thickness of cell membrane and of lipid layer as predictions!
- **Electrons of BCS type Cooper pair inside single cylinder** and **bound by phonon interaction.**
- **Exotic Cooper pair can decay to BCS type pair:** second electron hops to the space-time sheet of its companion. Generates BCS below $T<T$

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Why the doping fraction is in critical range?

To the beginning

- Cusp type (van der Waals) singularity with T and doping fraction p as variables explains the existence of super-conductivity in a finite range for p. How to understand this?

- Assume that stripes are fixed structure with fixed hole concentration. Fractality inspires the notion of superstripe having also fixed hole density. Superstripe has thickness L(151)=10 nm consisting of two layers of thickness L(149) =5 nm and carries supra currents. Superstripe contains stripes of thickness of few atom lengths and average length L(149).

- Lattice of superstripes. Distance between superstripes fixed by doping fraction. The density of super-stripes cannot be too large (Coulomb repulsion) and their distance cannot be longer than coherence length. This gives limits on p.

- Inside super-stripes electrons in quantum critical state below T_{c1} and able to transform to both ordinary and dark electrons.

- Note: super-canonical radial conformal weights of electrons correspond to zeros of Riemann ζ at criticality.

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Excitation energies

To the beginning

- **Excitation energies**. 68 meV binding energy for BCS type Cooper pair with members at same layer. 27 meV binding energy for exotic Cooper pair with members at different layers. 41 meV energy transforms pairs to each other. Criticality: both kinds of pairs co-exist.

- **50 meV critical voltage for nerve pulse generation**!: quantum criticality? 50 meV as the energy of Josephson photon kicking Cooper from interior phase to the boundary phase? **Is cell high Tc superconductor?!**

- **Generalization to bio-superconductivity.** Super-stripes which look locally like flat membranes replaced by cell membranes. Are only cell membranes super-conducting? Cell interior contains a lot endoplasma membranes.

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Arguments and findings challenging notions of ionic pump and channel

To the beginning

- Astronomical number of channels and pumps needed. Further problem: Also cat can walk through the door allowing dog to get in. One could perhaps code various chemicals using a reasonable number binary digits but can this be achieved in the framework of standard chemistry? Could channels and pumps generated by self-organization process when needed?

- Quantal character and universality of cell membrane ionic currents. Cell membrane can be even replaced with a polymer membrane without any essential changes!

- Ionic currents through cell membrane flow even in absence of metabolic energy feed.

- Cellular water does not behave like ordinary water. Does not leak out when cell is rotated, “ordered water” in some sense.

- References. See also this.

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TGD based explanation of anomalies

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- Electron and ionic currents could flow as supra- and dark currents via cell membrane space-time sheet: small dissipation.

- Universality: the purpose of ionic channels and pumps is not what it is believed to be. Magnetic body perceives the state of cell membrane environment. Could channels and pumps act as sensors. Information about ion concentrations by measuring flows through channels and pumps.

- Cell is high Tc super-conductor. Could electron pair in cell membrane transform to a dark electron pair with much larger electron size so that Bose-Einstein condensate is generated. Cell membrane as quantum critical system (electronic super-canonical conformal weights correspond to zeros of ζ). This in a narrow range of temperatures only (around 37 C?).

- Cell membrane as interface between different sectors of imbedding space characterized by different values of Planck constants

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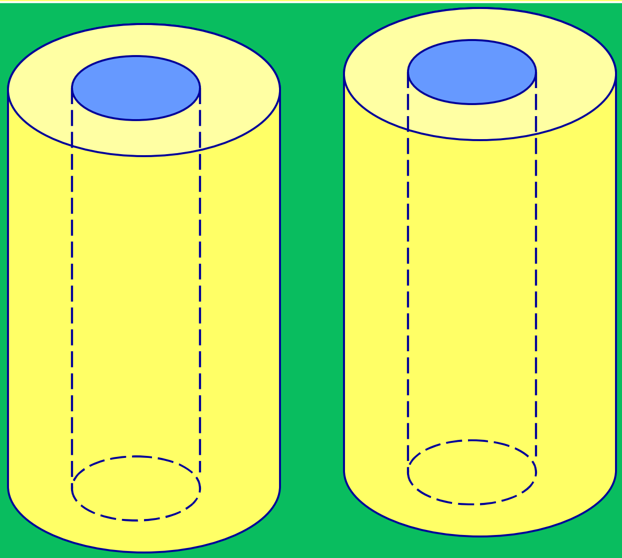
Model for Cooper pairs of high Tc superconductor

Boundary Cooper pair

- Scaled up electron space-time sheets containing electrons as CP_2 type extremals correspond to hollow cylindrical surfaces of outer radius radius L(149) topologically condensed at k=151 space-time sheet (cell membrane thickness).
- Electron space-time sheet feed its electric flux to k=151 sheet via wormhole contacts having u and dbar at the partonic 2-surfaces. Each cylinder has net color charge and cylinders for a color bound state.
- Scaled up variants of electron with scaling factor 2^{11} of Planck constant. Electron corresponds to the p-adic length scale L(127+22)= L(149)=5 nm, thickness of lipid layer of cell membrane.



Interior Cooper pair

Both electrons inside same cylinder
And bound by phonon interaction

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