High temperature superconductivity in TGD

1. Ordinary super-conductivity.

   (a) Landau Ginzburg model and BCS theory as models.

   (b) Electron Cooper pairs as carriers of supracurrent. Phonon exchange creates the interaction binding electrons to gether.

   (c) Cooper has vanishing total spin and is in s=0 wave. Statistics favores opposite spins.

   (d) Critical temperature and critical magnetic fields. SCs are of type I and II. SC does not allow the penetration of magnetic field below critical value (Meissner effect). For SC of type I the magnetic field fills the entire super-conductor above critical value. For SC of type II it penetrates as flux quanta and fills it at higher critical value.

   (e) Interpretation: magnetic field destroys Cooper pairs since it tends to turn the spins in same direction.

2. High T_c superconductivity.

   (a) 2-dimensional phenomenon. Supra current flows along preferred lattice planes. Type II super-conductivity in question. Proper sizes of Cooper pairs (coherence lengths) are ξ=1-3 nm. Magnetic length λ is longer than $\xi/\sqrt{2}$.

   (b) Mechanism for the formation of Cooper pairs is same water bed effect as in the case of ordinary SC. Phonons are only replaced with spin-density waves for electrons with periodicity in general not that of the underlying lattice. Spin density waves relate closely to the underlying antiferromagnetic order. Spin density waves appear near phase transition to anti-ferromagnetism.

   (c) The relative orbital angular momentum of Cooper pair is L=2 ($x^2 - y^2$ wave), and wave function vanishes at origin unlike for ordinary s wave SCs. The spin of the Cooper pair vanishes.

3. TGD inspired proposal is roughly following.

   (a) Basic notions: magnetic flux tubes and possibly also dark electrons forming Cooper pairs.

   (b) The appearance of spin waves means sequences of electrons with opposite spins. The magnetic field associated with them can form closed flux tube containing both spins. Assume that spins are orthogonal to the lattice plane in which supra-current flows. Assume that the flux tube branches associated with electron with given spin branches so that it is shared with both neighboring electrons.

   (c) Electrons of opposite spins at the two portions of the closed flux tube have magnetic interaction energy. The total energy is minimal when the spins are in opposite directions. Thus the flux tube tends to favore formation of Cooper pairs.

   (d) Since magnetic interaction energy is proportional to $h_{eff} = n \times h$, it would stabilize the Cooper pairs at high temperatures.

   (e) This does not yet give super-conductivity. The closed flux tubes associated with paired spins can however reconnect so that longer flux closed flux tubes are formed. If this occurs for entire sequences one obtains two flux tubes containing electrons with opposite spins forming Cooper pairs. Thee pairs would form supra-current in long scales.

   (f) The phase phase transitions generating the reconnections could be percolation type phase transition.

   (g) In TGD inspired quantum biology the U-shaped loops carrying opposite magnetic fluxes are the tool of forming connections between two systems. The interpretation is as physical correlate of directed attention or recognition of the presence of second system. The U-shaped loopswould be naturally superconductors with S=0 and L=2 Cooper pairs with electrons at different legs of U-shaped loop which in reconnection process becomes pair of parallel flux tubes connecting the two systems.

4. This picture might apply also in TGD base model of biosuper-conductivity.

   (a) The stability of dark Cooper pairs assume to reside at magnetic flux tubes is a problem also now. Fermi statistics favors opposite spins but this means that magnetic field tends to spit the pairs if the members of the pair are at the same flux tube.

   (b) If the members of the pair are at different flux tubes, the situation changes. One can have L=1 and S=1 with parallel spins (ferromagnetism like situation) or L=2 and S=0 state (antiferromagnetism like situation). L>0 is necessary since electrons must reside at separate flux tubes.