The model for generalized EEG relates very closely to the general model
of high T_c superconductivity. This motivates a separate discussion of
the vision about bio-super-conductivity in TGD Universe.

\vm{\it 1. General mechanisms of bio-superconductivity}\vm

The many-sheeted space-time concepts suggested a very general mechanism of
superconductivity based on the \blockquote{dropping} of charged particles from atomic
space-time sheets to larger space-time sheets. The first guess was that
larger space-time sheets are very dry, cool and silent so that the
necessary conditions for the formation of high T_c macroscopic quantum
phases are met. The criticism against \blockquote{dropping} is that particle can
topologically condense on several space-time sheets which therefore are not
separate worlds: this is indeed assumed in the recent view about GRT and
QFT limit of TGD. Dropping could therefore occur only at larger space-time
sheet at the boundary of the smaller one. The expansion of the space-time
sheet (flux tube) in p-adic phase transition liberates also zero point
kinetic energy (cyclotron energy).

The possibility of large $\hbar$ quantum coherent phases makes the
assumption about thermal isolation between space-time sheets un-necessary.
The establishment of thermal equilibrium would rely on the phase
transitions transforming ordinary to dark matter and vice versa. Biophotons
could be produced from dark photons in this manner. The flow from a flux
tube portion with larger value of h_{eff} to that with a smaller value
liberates cyclotron energy.

A crucial element is quantum criticality predicting a new kind of
superconductivity explaining the strange features of high T_c
super-conductivity. This led to the proposal that there are two kinds of
Cooper pairs, exotic Cooper pairs with spin $S=1$ and counterparts of
ordinary BCS type Cooper pairs with spin $S=0$. Both correspond to a

large
value of Planck constant. Exotic Cooper pairs are quantum critical meaning
that they can decay to ordinary electrons. Below temperature $T_{c_1}>T_c$
only exotic Cooper pairs with spin are present and their finite lifetime
implies that super-conductivity is broken to ordinary conductivity satisfying scaling laws characteristic for criticality. At T_c spinless
BCS type Cooper pairs become stable and exotic Cooper pairs can decay to
them and vice versa. An open question is whether the BCS type Cooper pairs
can be present also in the interior of cell.

These two superconducting phases would compete in certain narrow interval around
critical temperature for which body temperature of endotherms is a good
candidate in the case of living matter. Also high T_c superfluidity of
bosonic atoms dropped to space-time sheets of electronic Cooper pairs
becomes possible besides ionic super conductivity. Even dark neutrino
superconductivity can be considered below the weak length scale of scaled
down weak bosons.

Magnetic flux tubes would be carriers of dark particles and magnetic fields
would be crucial for super-conductivity. Two parallel flux tubes carrying
magnetic fluxes in opposite directions is the simplest candidate for super-conducting system. This conforms with the observation that antiferromagnetism is somehow crucial for high temperature super-conductivity. The spin interaction energy is proportional to Planck
constant and can be above thermal energy: if the hypothesis that dark
cyclotron energy spectrum is universal is accepted, then the energies would
be in bio-photon range and high temperature super-conductivity is obtained.
If fluxes are parallel spin $S=1$ Cooper pairs are stable. $L=2$ states are
in question since the members of the pair are at different flux tubes.
These two kinds of Cooper pairs could correspond to BCS type and exotic
Cooper pairs.

The fact that the critical magnetic fields can be very weak or large

values of
$\hbar$ is in accordance with the idea that various almost topological
quantum numbers characterizing induced magnetic fields provide a storage
mechanism of bio-information.

This mechanism is extremely general and in principle works for electrons,
protons, ions, charged molecules and even exotic neutrinos and an entire
zoo of high T$_c$ bio-superconductors, super-fluids and Bose-Einstein
condensates is predicted. Of course, there are restrictions due to the
thermal stability it room temperature and it seems that only electron,
neutrino, and proton Cooper pairs are possible at room temperature besides
Bose-Einstein condensates of all bosonic ions and their exotic counterparts
resulting when some nuclear color bonds become charged.

\vm{\it 2. Hierarchies of preferred p-adic length scales and values of
Planck constant}\vm

TGD inspired quantum biology and number theoretical considerations suggest
preferred values for $r=\hbar/\hbar_0$.   For the most general option the
values of $\hbar$ are products and ratios of two integers n_a and n_b.
Ruler and compass integers defined by the products of distinct Fermat
primes and power of two are number theoretically favored values for these
integers because the phases $exp(i2\pi/n_i)$, $i\in\{a,b\}$, in this case
are number theoretically very simple and should have emerged first in the
number theoretical evolution via algebraic extensions of p-adics and of
rationals. p-Adic length scale hypothesis favors powers of two as values
of r.

The hypothesis that Mersenne primes $M_k=2^k-1$, $k\in\{89,107,127\}$, and
Gaussian Mersennes $M_{G,k}=(1+i)k-1$,
$k\in\{113,151,157,163,167,239,241..\}$ (the number theoretical miracle is

that all the four p-adic length scales sith $k\in\{151,157,163,167\}$ are in the biologically highly interesting range 10 nm-2.5 μm) define scaled up copies of electro-weak and QCD type physics with ordinary value of $\hbar$ and that these physics are induced by dark variants of corresponding lower level physics leads to a prediction for the preferred values of $r=2^{k_d}$, $k_d=k_i-k_j$, and the resulting picture finds support from the ensuing models for biological evolution and for EEG.

This hypothesis - to be referred to as Mersenne hypothesis - replaces the earlier rather ad hoc proposal $r=\hbar/\hbar_0=2^{11k}$ for the preferred values of Planck constant.

\vm{\it 3. Fractal hierarchy of magnetic flux sheets and the hierarchy of genomes}\vm

The notion of magnetic body is central in the TGD inspired theory of living matter. Every system possesses magnetic body and there are strong reasons to believe that the magnetic body associated with human body is of order Earth size and that there could be an entire hierarchy of these bodies with even much larger sizes. Therefore the question arises what one can assume about these magnetic bodies. The quantization of magnetic flux suggests an answer to this question.

\begin{enumerate} \item The quantization condition for magnetic flux reads in the most general form as $\oint (p-eA)\cdot dl =n\hbar$. If supra currents flowing at the boundaries of the flux tube are absent one obtains $e\int B\cdot dS =n\hbar$, which requires that the scaling of the Planck constant scales up the flux tube thickness by r^2 and scaling of B by $1/r$. If one assumes that the radii of flux tubes do not depend on the value of r, magnetic flux is compensated by the contribution of the supra current flowing around the flux tube: $\oint (p-eA)\cdot dl =0$. The

supra currents would be present inside living organism but in the faraway region where flux quanta from organism fuse together, the quantization conditions $e\int B\cdot dS =n\hbar$ would be satisfied.

\item From the point of view of EEG especially interesting are the flux sheets which have thickness $L(151)=10$ nm (the thickness of cell membrane) carrying magnetic field having strength of endogenous magnetic field. In absence of supra currents these flux sheets have very large total transversal length proportional to r^2. The condition that the values of cycloctron energies are above thermal energy implies that the value of r is of order 2^{k_d}, $k_d=44$. Strongly folded flux sheets of this thickness might be associated with living matter and connect their DNAs to single coherent structure. One can of course assume the presence of supra currents but outside the organism the flux sheet should fuse to form very long flux sheets.

\item Suppose that the magnetic flux flows in head to tail direction so that the magnetic flux arrives to the human body through a layer of cortical neurons. Assume that the flux sheets traverse through the uppermost layer of neurons and also lower layers and that DNA of each neuronal nuclei define a transversal sections organized along flux sheet like text lines of a book page. The total length of DNA in single human cell is about one meter. It seems that single organism cannot provide the needed total length of DNA if DNA dominates the contribution. This if of course not at all necessarily since supra currents are possible and outside the organism the flux sheets can fuse together. This implies however correlations between genomes of different cells and even different organisms. \end{enumerate}

These observations inspire the notion of super- and hyper genes. As a matter fact, entire hierarchy of genomes is predicted. Super genes consist of genes in different cell nuclei arranged to threads along magnetic flux sheets like text lines on the page of book whereas hyper genes

traverse
through genomes of different organisms. Super and hyper genes
provide an
enormous representative capacity and together with the dark matter
hierarchy allows to resolve the paradox created by the observation
that
human genome does not differ appreciably in size from that of wheat.

%\end{abstract}