This chapter is devoted to further applications of the theory of high
T_c superconductors as quantum critical superconductors involving dark
matter hierarchy and large values of $h_{eff}= n\times h$. A new element is
the model of cell membrane acting as Josephson junction: at microscopic
transmembrane proteins would define Josephson junctions. The theory is
applied to explain the strange findings about ionic currents through cell
membrane, and the possibility that superconductivity and Bose-Einstein
condensates are involved with atmospheric phenomena is considered.

\vm{\it 1. Strange behavior of cellular water and quantal ionic currents
through cell membrane}\vm

The fact that cellular water does not leak out of cell in a centrifugal
force suggests that some fraction of water inside cell is in different
phase. One explanation is that the nuclei of water inside cell are in
doubly dark phase whereas electrons are in singly dark phase (having
Compton length of 5 nm and perhaps directly \blockquote{visible} using day
technology!) as indeed predicted by the model of high Tc superconductivity.
This conceptual framework could explain various findings challenging the
notions of ionic pumps.

The empirical findings challenging the notions of ionic pumps and channels,
nicely summarized by G. Pollack in his book, provide a strong support for
the notions of many-sheeted space-time and ionic super-conductivity.

\begin{enumerate}

\item The selectivity of the cell membrane implies that channels cannot be
simple sieves and there must be complex information processing

involved.

\item The needed number of pumps specialized to particular ions is astronomical and the first question is where to put all these channels and
pumps. On the other hand, if the cell constructs the pump or channel specialized to a given molecule only when needed, how does it know what the
pump looks like if it has never seen the molecule? The needed metabolic
energy to achieve all the pumping and channelling is huge. Strangely enough, pumping does not stop when cell metabolism stops.

\item One can also wonder why the ionic currents through cell membrane
look quantal and are same through cell membrane and silicon rubber membrane. \end{enumerate}

These observations suggest strongly the presence non-dissipative ionic
currents and quantum self-organization. The TGD based explanation would be
in terms of high T_c electronic and possibly even ionic superconductivity associated with cell membrane made possible by the large
h_{eff} phase for nuclei and electrons in the interior of cell. The model
for electronic Cooper pairs as pairs of large h_{eff} electrons at parallel magnetic flux tubes with same (opposite) direction of magnetic
field and in $S=1$ ($S=0$) state generalizes.

The empirical input also supports a view about homeostasis as a many-sheeted ionic flow equilibrium controlled by larger space-time sheets
with the mediation of massless extremals (MEs) serving as space-time correlates for Bose-Einstein condensates of massless bosons (also of scaled
down dark electro-weak bosons and gluons).

In the proposed picture one could understand how extremely low densities
of ions and their supra currents can control much higher ion densities at
the atomic space-time sheets. The liquid crystal nature of the bio-matter
is crucial for the model. This vision allows also much better understanding
of the effects of ELF em fields on bio-matter. Also the effects of homeopathic remedies and acupuncture known to crucially involve electromagnetic frequency signatures of chemicals can be understood if

homeostasis is based on many-sheeted ionic flow equilibrium.

\vm{\it 2. Two models of cell membrane}\vm

TGD inspires two views about cell membrane: the wiews need not be contradictory. For the first model cell is far from vacuum extremal, for
the second model nearly vacuum extremal with classical Z^0 fields in key
role.

\begin{enumerate}

\item There are several constraints on the first model coming from the TGD
based identification of bio-photons as energy conserving decay products of
dark photons and one ends up to a new view about metabolism and gneralization to of the notion of Josephson junction so that Josephson
energy includes besides electrostatic energy also the difference of cyclotron energies at two sides of the membrane. It seem that that the first model might be enough when generalized along lines inspired
by Pollack's findings about the fourth phase of water.

\item It has been clear from the beginning that the nearly vacuum extremals of
K\"ahler action could play key role key role in living systems. The reason
is their criticality making them ideal systems for sensory perception.
These extremals carry classical em and Z^0 fields related to each other
by a constant factor and this could explain the large parity breaking
effects characterizing living matter. The assumption that at least some
cell membranes are nearly vacuum extremals and that nuclei can feed their
Z^0 charges to this kind of space-time sheets (not true for atomic
electrons) in living matter leads to a modification of the model for the
cell membrane as Josephson junction. Also a model of photoreceptors
explaining the frequencies of peak sensitivity as ionic Josephson frequencies and allowing the dual identifications Josephson

radiation as
biophotons (energies) and EEG radiation (frequencies) emerge since the
values of Planck constant can be very large. Contrary to the original
believe, this model does not require non-standard value of Weinberg angle
and this model and first model allow a hybrid.
\end{enumerate}

\vm{\it 3. Bose-Einstein condensates at magnetic flux quanta in astrophysical length scales}\vm

The model for the topological condensation at magnetic flux quanta of
endogenous magnetic field $B_{end}=.2$ Gauss is based on the dark matter
hierarchy with levels characterized by the values of Planck constant. The
hypothesis for the preferred values of Planck constans allows to build
quantitative model for the Bose-Einstein condensation at magnetic flux
quanta assuming that the value of B_{end} scales like $1/h_{eff}$. A
justification for this hypothesis comes form flux quantization conditions
and from the similar scaling of Josephson frequencies.

\begin{enumerate}

\item There are several levels of dynamics. In topological
condensation the internal dynamics of ions is unaffected and h_{eff} has
the ordinary value. For instance, the formation of Cooper pairs involves
dynamics at $k_d=24=151-127$ level of dark matter hierarchy if one assumes
that electrons and Cooper pairs have size given by the cell membrane
thickess $L(151)$. Also the dynamics of ionic Cooper pairs remains
unaffected in the topological condensation to magnetic flux quanta obeying
$k_d>24$ dynamics.

\item Cyclotron energies scale as as h_{eff} so that for a sufficiently
high value of k_d thermal stability of cyclotron states at room
temperature is achieved for a fixed value of B. Same applies to spin
flip transitions in the recent scenario. The model for EEG based on dark

matter hierarchy involves the hypothesis that EEG quanta correspond to Josephson radiation with energies in the visible and UV range and that they produce in the decay to ordinary photons either bunches of EEG photons or visible/UV photons. This identification allows to deduce the value of k_d when the frequency of the dark photon is fixed. The Mersenne hypothesis for the preferred p-adic length scales and values of Planck constants leads to very precise predictions.

\item Cyclotron energies $E= (h_{eff}/2\pi) \times ZeB/Am_p$ are scaled up by a factor $r=2^{k_d}$ from their ordinary values and for 10 Hz cyclotron frequency are in the range of energies of visible light for $k_d=46$.

\item These B-E condensates might be favored by the large negative spin interaction energies of spins with the magnetic field (proportional to h_{eff}) so that spontaneous magnetization of the magnetic body becomes possible. This kind or process would make possible for the system to gain energy and angular momentum by feeding charged particles to its magnetic body.

\end{enumerate}

\vm{\it 4. The model of ionic superconductivity}

The model of ionic superconductivity is based on same mechanism as the electron one.

The general idea is that magnetic flux tubes are carriers of dark charged particles including ions and electrons. Usually magnetic field tends to destroy Cooper pairs since it tends to flip the spins of electrons of pair to same direction. In TGD flux quantization comes in rescue and magnetic fields favor the formation of Cooper pairs. If one has two parallel flux tubes with opposite directions of magnetic fluxes with large value of $h_{eff}=n\times h$, $S=0$ Cooper pairs with even $L\geq 2$ are

favored. This situation is encountered in systems near antiferromagnetic
phase transition in small scales leading to formation of sequences of flux
loops carrying Cooper pairs. Macroscopic super-conductivity results when
the loops are reconnected to two long flux tubes with opposite fluxes. If
the magnetic fluxes have same sign, $S=1$ Cooper pairs with odd $L\geq 1$
are favored.

This model applies to both electrons and fermionic ions and if the
proposal that h_{eff} is proportional to the mass of ion, it predicts
same binding energies for all Cooper pairs as their spin-spin interaction
energy. This hypothesis predicts universal spectrum of bio-photons energies
if they result from dark photons and is motivated by the identification of
gravitational Planck constant with h_{eff}. In this
case binding energies would be in eV range and much above thermal energy
at room temperature.

\vm{\it 5. Atmospheric phenomena and superconductivity}\vm

There is a considerable evidence that various electromagnetic time scales
associated with the atmospheric phenomena correspond to those associated
with brain functioning. If magnetic sensory canvas hypothesis holds true,
this is just what is expected. In this section these phenomena are
considered in more detail with the aim being to build as concrete as
possible vision about the dynamics involving the dark matter Bose-Einstein
condensates at super-conducting magnetic magnetic flux quanta. A new
element is the assumed presence of cell membrane like structures near
vacuum extremals. If the potentials differences involved are same order of
magnitude as in the case of cell membrane, the luminous phenomena can be
understood in terms of effects caused by Josephson radiation at visible and
UV frequencies.

Tornadoes and hurricanes provide the first example of self-organizing
systems for which Bose-Einstein condensates of dark matter at

magnetic and
Z^0 magnetic flux quanta might be of relevance. Auroras represent a
second phenomenon possibly involving supra currents of Cooper pairs and of
exotic ions. Lightnings, sprites and elves might also involve higher levels
of dark matter hierarchy. p-Adic length scale hypothesis and the hierarchy
of Planck constants provide a strong grasp to these far from
well-understood phenomena and allow to build rather detailed models for
them as well as to gain concrete understanding about how dark matter
hierarchy manifests itself in the electromagnetic phenomena at the level
of atmosphere.

%\end{abstract}