The quantization of Planck constant has been the basic theme of TGD since
2005. The basic idea was stimulated by the suggestion of Nottale that
planetary orbits could be seen as Bohr orbits with enormous value of Planck
constant given by $\hbar_{gr}= GM_1M_2/v_0$, where the velocity parameter
v_0 has the approximate value $v_0\simeq 2^{-11}$ for the inner planets.
This inspired the ideas that quantization is due to a condensation of
ordinary matter around dark matter concentrated near Bohr orbits and that
dark matter is in macroscopic quantum phase in astrophysical scales. The
second crucial empirical input were the anomalies associated with living
matter. The recent version of the chapter represents the evolution of ideas
about quantization of Planck constants from a perspective given by seven
years's work with the idea. A very concise summary about the situation is
as follows.

\vm{\it 1. Basic physical ideas}\vm

The basic phenomenological rules are simple.

\begin{enumerate}

\item The phases with non-standard values of effective Planck constant are
identified as dark matter. The motivation comes from the natural assumption
that only the particles with the same value of effective Planck can appear
in the same vertex. One can illustrate the situation in terms of the book
metaphor. Effective imbedding spaces with different values of Planck
constant form a
book like structure and matter can be transferred between different pages
only through the back of the book where the pages are glued together. One
important implication is that light exotic charged particles lighter than
weak bosons are possible if they have non-standard value of Planck
constant. The standard argument excluding them is based on decay widths of
weak bosons and has led to a neglect of large number of particle

physics
anomalies.

\item Large effective or real value of Planck constant scales up
Compton
length — or at least de Broglie wave length — and its geometric
correlate at space-time level identified as size scale of the space-
time
sheet assignable to the particle. This could correspond to the
K\"ahler
magnetic flux tube for the particle forming consisting of two flux
tubes
at parallel space-time sheets and short flux tubes at ends with
length
of order CP_2 size.

This rule has far reaching implications in quantum biology and
neuroscience since macroscopic quantum phases become possible as the
basic criterion stating that macroscopic quantum phase becomes
possible
if the density of particles is so high that particles as Compton
length
sized objects overlap.   Dark matter therefore forms macroscopic
quantum
phases. One implication is the explanation of mysterious looking
quantal
effects of ELF radiation in EEG frequency range on vertebrate brain:
$E=hf$ implies that the energies for the ordinary value of Planck
constant are much below the thermal threshold but large value of
Planck
constant changes the situation. Also the phase transitions
modifying
the value of Planck constant and changing the lengths of flux tubes
(by
quantum classical correspondence) are crucial as also reconnections
of
the flux tubes.

The hierarchy of Planck constants suggests also a new interpretation
for
FQHE (fractional quantum Hall effect) in terms of anyonic phases
with
non-standard value of effective Planck constant realized in terms
of
the effective multi-sheeted covering of imbedding space: multi-
sheeted
space-time is to be distinguished from many-sheeted space-time.

In astrophysics and cosmology the implications are even more
dramatic.
The interpretation of $\hbar_{gr}$ introduced by Nottale in TGD
framework is as an effective Planck constant associated with space-
time

sheets mediating gravitational interaction between masses M and m.
The huge value of $\hbar_{gr}$ means that the integer $\hbar_{gr}/\hbar_0$ interpreted as the number of sheets of covering is
gigantic and that Universe possesses gravitational quantum coherence in
astronomical scales. The gravitational Compton length $GM/v_0=r_S/2v_0$
does not depend on m so that all particles around say Sun say same gravitational Compton length.

By the independence of gravitational acceleration and gravitational Compton length on particle mass, it is enough to assume that only microscopic particles couple to the dark gravitons propagating along flux tubes mediating gravitational interaction. Therefore $h_{gr}=h_{eff}$ could be true in microscopic scales and would predict
that cyclotron energies have no dependence on the mass of the charged
particle meaning that the spectrum ordinary photons resulting in the transformation of dark photons to ordinary photons is universal. An attractive identification of these photons would be as bio-photons with
energies in visible and UV range and thus inducing molecular transitions
making control of biochemistry by dark photons. This changes the view
about gravitons and suggests that gravitational radiation is emitted as
dark gravitons which decay to pulses of ordinary gravitons replacing continuous flow of gravitational radiation. The energy of the graviton
is gigantic unless the emission is assume to take place from a microscopic systems with large but not gigantic h_{gr}.

\item Why Nature would like to have large — maybe even gigantic — value of
effective value of Planck constant? A possible answer relies on the observation that in perturbation theory the expansion takes in powers of
gauge couplings strengths $\alpha=g^2/4\pi\hbar$. If the effective value of
$\hbar$ replaces its real value as one might expect to happen for multi-sheeted particles behaving like single particle, α is scaled
down and perturbative expansion converges for the new particles. One could
say that Mother Nature loves theoreticians and comes in rescue in their
attempts to calculate. In quantum gravitation the problem is especially

acute since the dimensionless parameter $GMm/\hbar$ has gigantic value.
Replacing $\hbar $ with $\hbar_{gr}=GMm/v_0$ the coupling strength becomes
$v_0<1$.

\end{enumerate}

\vm{\it 2. Space-time correlates for the hierarchy of Planck constants}\vm

The hierarchy of Planck constants was introduced to TGD originally as an
additional postulate and formulated as the existence of a hierarchy
of imbedding spaces defined as Cartesian products of singular coverings
of M^4 and CP_2 with numbers of sheets given by integers n_a and
n_b and $\hbar=n\hbar_0$. $n=n_an_b$.

With the advent of zero energy ontology (ZEO), it became clear that the
notion of singular covering space of the imbedding space could be only
a convenient auxiliary notion. Singular means that the sheets fuse
together at the boundary of multi-sheeted region. In ZEO 3-surfaces are
unions of space-like 3-surface at opposite boundaries of CD. The
non-determinism of K\"ahler action due to the huge vacuum degeneracy
would naturally explain the existence of several space-time sheets
connecting the two 3-surfaces at the opposite boundaries of CD. Quantum
criticality suggests strongly conformal invariance and the
identification of n as the number of conformal equivalence classes of
these space-time sheets. Also a connection with the notion of
negentropic entanglement emerges.