%\begin{abstract}

The most important p-adic concepts and ideas are p-adic fractality,
4-D
spin glass analogy, p-adic length scale hypothesis, p-adic
realization of
the Slaving Principle, p-adic criticality, and the non-determinism
of the
p-adic differential equations justifying the interpretation of the
p-adic
space-time regions as cognitive representations. These ideas are
discussed
in this chapter in a more concrete level than in previous chapters
in the
hope that this might help the reader to assimilate the material more
easily. Some of the considerations might be a little bit out of date
since
the chapter is written much earlier than the preceding chapters.

\begin{enumerate}

\item 2-D thermodunamical criticality is accompanied by conformal
invariance. The proposed quantum criticality of quantum TGD
motivated the
attempt to generalize conformal invariance to the 4-dimensional
context
providing a motivation of the p-adic approach. After almost two
decades
after the emergence of the idea about extended conformal invariance
the
view about conformal invariance is much more detailed and is indeed
associated with quantum criticality, which reflects the non-
determinism of
K\"ahler action.

\item In TGD as a generalized number theory approach p-adic space-
time
regions emerge completely naturally and have interpretation as
cognitive
representations of the real physics. If this occurs already at the
level
of elementary particles, one can understand p-adic physics as a
model for a
cognitive model about physics provided by Nature itself. The basic
motivation for this assumption is the p-adic non-determinism of the
p-adic
field equations making them ideal for the simulation purposes. The
p-adic--real phase transitions are the second basic concept allowing
to
understand how intention is transformed to action and vice versa:
the
occurrence of this process even at elementary particle level
explains why

p-adic length scale hypothesis works. This picture is consistent with the idea about evolution occurring already at the level of elementary particles and allowing the survival of the systems with largest cognitive resources.

\item Spin glass analogy, which was the original motivation for p-adicization before the discovery that p-adic regions of space-time emerge automatically from TGD as a generalized number theory approach, is discussed at WCW level. The basic idea is that the maximum (several of them are possible) of the exponential of the K\"ahler function with respect to the fiber degrees of freedom as function of zero modes is p-adic fractal. This together with spin glass analogy suggest p-adic ultra-metricity of the reduced WCW CH_{red}, the TGD counterpart of the energy landscape.

\item Slaving Principle states that there exists a hierarchy of dynamics with increasing characteristic length (time) scales and the dynamical variables of a given length scale obey dynamics, where the dynamical variables of the longer length (time) scale serve as \blockquote{masters} that is effectively as external parameters or integration constants. The dynamics of the \blockquote{slave} corresponds to a rapid adaptation to the conditions posed by the \blockquote{master}. p-Adic length scale hypothesis allows a concrete quantification of this principle predicting a hierarchy of preferred length, time, energy and frequency scales.

\item Critical systems are fractals and the natural guess is that p-adic topology serves also as an effective topology of real space-time sheets in some length scale range and that real non-determinism of K\"ahler action mimics p-adic non-determinism for some value of prime p. This motivates some qualitative p-adic ideas about criticality.

\item The properties of the CP_2 type extremals providing TGD based model for elementary particles and topological sum contacts, are discussed in detail. CP_2 type extremals could be for TGD what black holes are for General Relativity. Black hole elementary particle analogy is discussed in detail and the generalization of the Hawking-Bekenstein formula is shown to lead to a prediction for the radius of the elementary particle horizon and to a justification for the p-adic length scale hypothesis. A deeper justification for the p-adic length scale hypothesis comes from the assumption that systems with maximal cognitive resources are winners in the fight for survival even in elementary particle length scales.

\item Quantum criticality in its simplest variants states that states K\"ahler coupling strength α_K is analoggous to critical temperature. In principle allows allows the dependence of the α_K on on zero modes. It would be nice if α_K were RG invariant in strong sense but the expression for gravitational coupling constant implies that it increases rapidly as a function of p-adic length scale in this case. This led to the hypothesis that G is RG invariant. The hypothesis fixes the p-adic evolution of α_K completely and implies logarithmic dependence of α_K on p-adic length scale. It has however turned out that the RG invariance might after all be possible and is actually strongly favored by different physical arguments. The point is that M_{127} is the largest Mersenne prime for which p-adic length scale is non-super-astronomical. If gravitational interaction is mediated by space-time sheets labelled by this Mersenne prime, gravitational constant is effective RG invariant even if α_K is RG invariant in strong sense. This option is also ideal concerning the p-adicization of the theory.

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