TGD predicts a lot of new physics and it is quite possible that this new physics becomes visible at LHC. Although the calculational formalism is still lacking, p-adic length scale hypothesis allows to make precise quantitative predictions for particle masses by using simple scaling arguments.

The basic elements of quantum TGD responsible for new physics are following.

\begin{enumerate}

\item The new view about particles relies on their identification as partonic 2-surfaces (plus 4-D tangent space data to be precise). This effective metric 2-dimensionality implies generalizaton of the notion of Feynman diagram and holography in strong sense. One implication is the notion of field identity or field body making sense also for elementary particles and the Lamb shift anomaly of muonic hydrogen could be explained in terms of field bodies of quarks.

\item The topological explanation for family replication phenomenon implies genus generation correspondence and predicts in principle infinite number of fermion families. One can however develop a rather general argument based on the notion of conformal symmetry known as hyper-ellipticity stating that only the genera $g=0,1,2$ are light. What \blockquote{light} means is however an open question. If light means something below CP_2 mass there is no hope of observing new fermion families at LHC. If it means weak mass scale situation changes.

For bosons the implications of family replication phenomenon can be understood from the fact that they can be regarded as pairs of fermion and antifermion assignable to the opposite wormhole throats of wormhole throat. This means that bosons formally belong to octet and singlet representations of dynamical SU(3) for which 3 fermion families define 3-D representation. Singlet would correspond to ordinary gauge bosons. Also interacting fermions suffer topological condensation and correspond to wormhole contact. One can either assume that the resulting wormhole throat has the topology of sphere or that the genus is same for both throats.

\item The view about space-time supersymmetry differs from the standard view in many respects. First of all, the super symmetries are not associated with Majorana spinors. Super generators correspond to the fermionic oscillator operators assignable to leptonic and quark-like induced spinors and there is in principle infinite number of them so that formally one would have ${\cal N}=\infty$ SUSY. I have discussed the required modification of the formalism of SUSY theories and it turns out that effectively one obtains just ${\cal N}=1$ SUSY required by experimental constraints. The reason is that the fermion states with higher fermion number define only short range interactions analogous to van der Waals forces. Right handed neutrino generates this super-symmetry broken by the mixing of the M^4 chiralities implied by the mixing of M^4 and CP_2 gamma matrices for induced gamma matrices. The simplest assumption is that particles and their superpartners obey the same mass formula but that the p-adic length scale can be different for them.

\item The new view about particle massivation based on p-adic thermodynamics raises the question about the role of Higgs field. The vacuum expectation value (VEV) of Higgs is not feasible in TGD since CP_2 does not allow covariantly constant holomorphic vector fields. The original too strong conclusion from this was that TGD does not allow Higgs. Higgs VEV is not needed for the selection of preferred electromagnetic direction in electro-weak gauge algebra (unitary gauge) since CP_2 geometry does that. p-Adic thermodynamics explains fermion masses bout the masses of weak bosons cannot be understood on basis of p-adic thermodynamics alone giving extremely small second order contribution only and failing to explain W/Z mass ratio. Weak boson mass can be associated to the string tension of the strings connecting the

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throats of two wormhole contacts associated with elementary particle
(two of them are needed since the monopole magnetic flux must have
closed field lines).



\item One of the basic distinctions between TGD and standard model
is the
new view about color.

\begin{enumerate}

\item The first implication is separate conservation of quark and
lepton
quantum numbers implying the stability of proton against the decay
via the
channels predicted by GUTs.  This does not mean that proton would be
absolutely stable. p-Adic and dark length scale hierarchies indeed
predict
the existence of scale variants of quarks and leptons and proton
could
decay to hadons of some zoomed up copy of hadrons physics. These
decays
should be slow and presumably they would involve phase transition
changing
the value of Planck constant characterizing proton. It might be that
the
simultaneous increase of Planck constant for all quarks occurs with
very
low rate.

\item Also color excitations of leptons and quarks are in principle
possible. Detailed calculations would be required to see whether
their mass
scale is given by $CP_2$ mass scale.  The so called leptohadron
physics
proposed to explain certain anomalies associated with both electron,
muon,
and $\tau$ lepton could be understood in terms of color octet
excitations
of leptons.

\end{enumerate}



\item Fractal hierarchies of weak and hadronic physics labelled by
p-adic
primes and by the levels of dark matter hierarchy are highly
suggestive.
Ordinary hadron physics corresponds to $M_{107}=2^{107}-1$ One
especially
interesting candidate would be scaled up hadronic physics which
would
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correspond to $M_{89}=2^{89}-1$ defining the p-adic prime of weak bosons.
The corresponding string tension is about 512 GeV and it might be possible
to see the first signatures of this physics at LHC. Nuclear string model
in turn predicts that nuclei correspond to nuclear strings of nucleons
connected by colored flux tubes having light quarks at their ends. The
interpretation might be in terms of M_{127} hadron physics. In
biologically most interesting length scale range 10 nm-2.5 μm there are
four Gaussian Mersennes and the conjecture is that these and other Gaussian
Mersennes are associated with zoomed up variants of hadron physics relevant
for living matter. Cosmic rays might also reveal copies of hadron physics
corresponding to M_{61} and M_{31}

The well-definedness of em charge for the modes of induced spinor fields
localizes them at 2-D surfaces with vanishing W fields and also Z^0 field
above weak scale. This allows to avoid undesirable parity breaking effects.
It is quite possible that this localization
is consistent with K\"ahler-Dirac equation only in the Minkowskian regions
where the effective metric defined by K\"ahler-Dirac gamma matrices can be
effectively 2-dimensional and parallel to string world sheet.

\item Weak form of electric magnetic duality implies that the fermions and
antifermions associated with both leptons and bosons are K\"ahler magnetic
monopoles accompanied by monopoles of opposite magnetic charge and with
opposite weak isospin. For quarks K\"ahler magnetic charge need not cancel
and cancellation might occur only in hadronic length scale. The magnetic
flux tubes behave like string like objects and if the string tension is
determined by weak length scale, these string aspects should become visible
at LHC. If the string tension is 512 GeV the situation becomes less
promising. \end{enumerate}

In this chapter some aspects of the predicted new physics and possible
indications for it are discussed. The evolution of the TGD based

view
about possible existing Higgs like particle and about space-time SUSY are
discussed in separate chapters.