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.

4-D tangent space data must relate to the presence of strings connecting partonic 2-surfaces and defining the ends of string world sheets at which the modes of induced spinor fields are localized in the generic case in order to achieve conservation of em charge. The integer characterizing the spinor mode should charactize the tangent space data. Quantum criticality suggests strongly and super-conformal invariance acting as a gauge symmetry at the light-like partonic orbits and leaving the partonic 2-surfaces at their ends invariant. Without the fermionic strings effective 2-dmensionality would degenerate to genuine 2-dimensionality.

\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 involves besides p-adic
thermodynamics also Higgs particle but there is no need to assume

that Higgs vacuum expectation plays any role. All particles could be seen as pairs of wormhole contacts whose throats at the two space-time sheets are connected by flux tubes carrying monopole flux: closed monopole flux tube involving two space-time sheets would be ion question. The contribution of the flux tube to particle mass would dominate for weak bosons whereas for fermions second wormhole contact would dominate.

\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 τ 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 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}

\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 the predicted new physics and possible indications for it are discussed.