

TGD based concept of space-time predicts several new effects.

1. The dark matter associated with rotating macroscopic objects could generate classical  $Z^0$  magnetic fields and this suggests that the behavior of rotating objects could exhibit anomalies. A special signature of effects of this kind is parity breaking caused by the parity breaking couplings of the classical  $Z^0$  field to dark matter. The  $Z^0$  electric fields generated by astrophysical bodies are predicted to be completely negligible as compared to gravitational fields but the topological light rays carrying  $Z^0$  fields could induce interactions over astrophysical distances.  $Z^0$  fields in length scale below cell size are predicted to be quite strong as compared to gravitation.
2. The recent view about fermionic fields [?] leads to the view that the well-definedness of em charge for spinor modes requires that the modes are localized at 2-D surfaces in the generic situation. It is quite possible that this localization is consistent with Kähler-Dirac equation only in the Minkowskian regions where the effective metric defined by Kähler-Dirac gamma matrices can be effectively 2-dimensional and parallel to string world sheet. A natural further assumption is that also classical  $Z^0$  field vanishes at these 2-surfaces above weak scale at least. This would exclude classical  $Z^0$  fields effectively since fermions would not couple to classical electroweak fields above weak scale. If the hierarchy of dark matter is realized, the weak scale could be however arbitrary long and situation would change. The large parity breaking effects in living matter suggest that this might be the case. This gives motivation for this chapter.
3. The mere rotation of a 3-surface carrying magnetic or  $Z^0$  magnetic fields should induce electric or  $Z^0$  electric fields whose divergence gives rise to vacuum charge density. Charge conservation suggests that this gauge flux must flow to a second space-time sheet carrying opposite net charge.
4. In TGD the time orientation of given space-time sheet need not be the standard one and this allows the possibility of negative classical energies. If this kind of space-time sheets are created, energy production with apparent efficiency greater than unity becomes possible. At the space-time sheets with negative time orientations classical fields should propagate from future to past making in principle possible to see to the geometric future of, say, astrophysical objects. Amazingly, the highly science fictive notion of negative energy space-time sheet finds support from the basic classical physics. The total energy associated with the topological field quanta emitted by particle condensed to larger space-time sheets is the natural geometric correlate of potential energy. Potential energy can be negative only if one allows also negative energy space-time sheets.

With the advent of zero energy ontology (ZEO) the notion of negative energy space-time sheet has become more well-defined. For instance, phase conjugate laser beams could have description as negative energy space-time sheets for which the arrow of time would be non-standard at quantum level.

5. A further TGD based element is related to the fact that 3-surface can be regarded as a generalization of point like particle. This means that 3-surface behaves like single coherent whole: in particular, classical fields oscillating coherently in arbitrary long length scales are possible and can give rise to an apparent propagation of effects with infinite velocity. The notion of pair creation from vacuum generalizes. For instance, pairs of space-time sheets with vanishing total classical energy can be created from vacuum.

#### 1. *Some gravitational anomalies*

1. TGD predicts the possibility of anomalously large time dilation effects due to the warping of space-time surfaces, and the experimental findings of Russian physicist Chernobrov about anomalous changes in the rate of flow of time provide indirect support for this prediction.
2. There are quite puzzling observations related to the behavior of rotating stars. These observations are in a dramatic conflict with the standard wisdom about finite propagation velocity

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of signals and with the idea that classical fields propagate in future direction only. The possibility of space-time sheets with negative time orientation and classical fields propagating from geometric future to geometric past plus the possibility that 3-surfaces of even astrophysical size can behave like particle like objects, could explain these mysterious effects.

*2. Anomalies possibly related to  $Z^0$  force in astrophysical length scales*

1. Allais observed that the oscillation plane of Foucault pendulum changes during solar eclipse. NASA performed the same experiment during 1999 eclipse but the processing of the data is still going on. The presence of moon could cause a modification of dark  $Z^0$  laser beams emitted by Sun as synchrotron radiation and modify the contribution of  $Z^0$  electric field to  $Z^0$  force experienced by dark matter component of the pendulum. The effect is predicted to be observed only in the shadow of Moon created by Sun. Allais has observed also 24 and 25 hour periodicities in the oscillation of Foucault pendulum can be understood in terms of Earth's modification and the lengthening of the period associated with the Moon's screening due to the rotational motion of Moon around Earth.
2. Shnoll has shown that the rate distributions for radio active decays and chemical and biochemical processes do not converge to single bell curve but to distributions which have several pronounced peaks. The shapes of the rate curves seem to be similar for widely different reactions (radio-active decays, chemical and biochemical processes) but they fluctuate with time and fluctuation periods correspond to various astrophysical periods: day, month, year,... These anomalies might be understood if astrophysical objects emit  $Z^0$  topological light rays interacting with ordinary matter (recall that already nuclei involve dark matter component).
3. p-Adic fractality predicts that dark  $Z^0$  force could become comparable with the gravitational force in cell length scale. Tests of the Newtonian form of gravitational force are recently carried out in length scales  $100 \mu\text{m}$ . There are anomalously large differences related to the measured values of gravitational constant using Cavendish type experiments or their variants. In the classical Cavendish experiment  $Z^0$  force is effectively eliminated so that most of these discrepancies could be caused by the redistribution of the gravitational flux between space-time sheets.