

# Brief Summary of TGD

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June 20, 2019

Topological Geometroynamics (TGD) is an attempt to unify fundamental interactions by assuming that physical space-times can be regarded as sub-manifolds of certain 8-dimensional space  $H$ , which is product  $H = M^4 \times CP_2$  of Minkowski space and 4-dimensional complex projective space  $CP_2$ . One could end up with TGD as a generalization of string model obtained by replacing 1-dimensional strings with 3-dimensional light-like surfaces, or as an attempt to construct Poincare invariant theory of gravitation (Poincare group acts in imbedding space rather than on space-time surface). One outcome is the notion of many-sheeted space-time involving notions like topological field quantization and field body. The huge conformal symmetries of the theory are essentially due to the light-likeness of 3-surfaces. The empirically motivated generalization of quantum theory by introducing hierarchy of Planck constants forces a generalization of imbedding space to a book like structure and different pages of the book corresponds to macroscopic quantum phases which behave relative to each other like dark matter.

Quantum TGD realies on two parallel approaches.

1. The first approach starts from a generalization of Einstein's program proposing geometrization of classical physics so that entire quantum physics is geometrized in terms of the Kähler geometry of "World of Classical Worlds" (WCW) consisting of space-time surfaces which are preferred extremals of the action principle involved. Classical physics becomes exact part of quantum theory. The Kähler geometry of infinite-D WCW and thus physics is unique from its mere existence (this was shown for loop spaces by Dan Freed).

Generalization of 4-D twistor approach to its 8-D variant based on on lift of Kähler action exists only for  $H = M^4 \times CP_2$  forced also by standard model symmetries so that TGD become completely unique.

2. Second approach is number theoretic. The starting point was the amazing success of p-adic mass calculations. The interpretation is that p-adic number fields and p-adic physics provide the physical (in generalized sense) correlates of cognition and imagination. This leads to what I call adelic physics fusing real number based "ordinary" physics for matter and various p-adic physics for cognition to single coherent whole. Extensions of rationals induce an infinite hierarchy of extensions of p-adic number fields and therefore of also adeles.

This hierarchy can be seen as evolutionary hierarchy for cognition. The higher the dimension of extension, the higher the complexity and the higher the "IQ". Cognitive representation is the basic notion. At space-time level it consists of points common to real space-time surfaces and various p-adic space-time surfaces: common points have preferred imbedding space coordinates in the extension of rationals so that they make sense in all number fields. This extensions generalizes to the level of WCW: the discrete set of points serves as coordinates of WCW point.

This also leads to a hierarchy of cognitive representations of scattering amplitudes. Cognitive representation serves as an approximation of the actual scattng amplitude and there is hierarchy of improving approximation. One concrete prediction is hierarchy  $h_{eff}/h_0 = n$  of effective values of Planck constant assumed to label phases of ordinary matter behaving like dark matter. The number theoretic interpretation of  $n$  is as the dimension of extension of rationals.

Also quaternions and octonions play a key role in TGD. So called  $M^8 - H$  duality mapping algebraic associative surfaces in complexified octonionic  $M^8$  to space-time surfaces in  $H$  appearing as preferred extremals of the action principle. The identification of preferred extremals as minimal surfaces apart from discrete set of points is very promising since minimal surface property extremizes also Kähler action and the dynamics involves no couplings as quantum criticality requires. This would reduce TGD to octonionic algebraic geometry at the level of  $M^8$  allowing to understand the hierarchy of Planck constants geometrically.

TGD forces to give up the naive length scale reductionism characterizing competing theories, in particular string models, and to replace it with fractality: this has far reach implications such as predicted existence of scaled variants of electroweak and hadronic physics. The notion of many-sheeted space-time, p-adic length scale hypothesis, and the identification of dark matter as  $h_{eff} = n \times h$  phases of ordinary matter are corner stones of this picture.

TGD inspired theory of consciousness and quantum biology are also essential parts of TGD.

1. Around 1995 I started to work with what I call TGD inspired theory of consciousness. It can be seen as a generalization of quantum measurement theory so that the observer become part of physical system rather than remaining an outsider as in the usual approaches.

A generalization of the standard ontology to what I call zero energy ontology (ZEO) solves the basic problem of quantum measurement theory due to the conflict between determinism of unitary evolution and non-determinism of state function reduction, and leads to a new view about the relationship between subjective time and geometric time: there are two causalities, the causality of free will and that of field equations and they are consistent with each other in ZEO.

2. Also quantum biology as seen from TGD perspective became application of TGD. An essential role is played by the the notions of many-sheeted space-time and the notion of field body emerging naturally from the identification of space-time as 4-surface. The effects due to many-sheetedness are not seen at QFT limit but play a pivotal role in living matter. One can assign to any system field identity - field body, in particular magnetic body. This completes the pair bio-system–environment to a triplet field-body–bio-system–environment. Magnetic body can be said to act as intentional agent using biological body as a sensory receptor and motor instrument. For instance, EEG would serve this purpose.

## 0.1 Material about TGD

The articles at following address give summary about basic ideas of TGD and TGD inspired theory of consciousness and quantum biology.

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- "Why TGD and What TGD is?": see <http://tinyurl.com/yd8bnc4k>.
- "Can one apply Occams razor as a general purpose debunking argument to TGD?": see <http://tinyurl.com/ybw47zns>.
- "Getting philosophical: some comments about the problems of physics, neuroscience, and biology": see <http://tinyurl.com/y9qc451e>.
- "TGD": <http://tinyurl.com/y7s95utf>.

There are several sources about TGD.

- Besides thesis there are three published books about TGD: see <http://tinyurl.com/y9p683qe>, <http://tinyurl.com/zn98vka>, and <http://tinyurl.com/h26hqul>.
- Homepage contains both online books (17) and articles related to TGD: see <http://www.tgdtheory.fi>.

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- I have published most of the articles as versions in the journals published by Huping Hu. See <http://prespacetime.com>, <http://jcer.com>, and <http://dnadecipher.com>.  
The links up-to-date versions of articles can be found at my homepage at <http://tinyurl.com/yaa4ec45l>.
  - TGD can be found also in Research Gate: see <http://tinyurl.com/yark4rdm>.
  - "TGD diary" is a blog telling about progress in TGD: <https://matpitka.blogspot.com/>.  
For a list of blog postings arranged according to topic see "The latest progress in TGD": see <http://tinyurl.com/ycyhja5r>.
  - My FB timeline contains (mostly) links to a progress in TGD: see <http://tinyurl.com/y78et2uy>.