Some unexpected findings in hadron and nuclear physics from TGD point of view

April 18, 2021

Matti Pitkänen

Email: matpitka6@gmail.com.
http://tgdtheory.com/public_html/.
Recent postal address: Rinnekatu 2-4 A 8, 03620, Karkkila, Finland.

Abstract

This article discusses some recent unexpected findings related to hadron- and nuclear physics.

1. The recent experiments of Dove et al confirm that the antiquark sea is asymmmetric in the sense that the ratio anti-d/anti-u is larger than unity. A model assuming that proton is part of time in a state consisting of neutron and virtual pion seems to fit at qualitative level into the picture.

   The TGD based model relies on the already existing picture developed by taking seriously the so called X boson as 17.5 MeV particle and the empirical evidence for scaled down variants of pion predicted by TGD. Virtual mesons are replaced with real on mass shell mesons but with p-adically scaled down mass, and low energy strong interactions at the hadronic and nuclear level are described topologically in terms of reconnections of flux tubes.

2. That final state nuclei from the fission of heavy nuclei possess a rather high spin has been known since the discovery of nuclear fission 80 years ago but has remained poorly understood. The recent surprising findings by Wilson et al was that the final state angular momenta for the final state nuclei are uncorrelated and must therefore emerge after the decays.

   The TGD proposal is that the generation of angular momentum is a kind of self-organization process. Zero energy ontology (ZEO) and h_{eff} hierarchy indeed predicts self-organization in all scales. Self-organization involves energy feed needed to increase $h_{eff}/h_0 = n$ serving as a measure for algebraic complexity and as a kind of universal IQ in the number theoretical vision about cognition based on adelic physics.

   The final state nuclei have angular momenta $6-7$ $\hbar$. This suggests that self-organization increases the values of h_{eff} to nh, $n \in \{6, 7\}$. Quantization of angular momentum with new unit of spin would force the generation of large spins. Zero energy ontology (ZEO) provides a new element to the description of self-organization and a model for quantum tunnelling phenomenon.

3. Eric Reiter has studied the behavior of gamma-rays emitted by heavy nuclei going through a beam splitter splitting the photon beam to two beams. Quantum theory predicts that only one detector fires. Therefore the pulses in the two detectors occur at different times. This has been verified for photons of visible light. The experiment studied the same situation for gamma-rays and the surprise was that one observes mostly half pulses in both detectors and in some cases also full pulses. Reiter has made analogous experiments also with alpha particles with the same conclusion.

4. Quite recently, empirical support for a particle christened Odderon has emerged. As the name tells, Odderon is not well-understood in QCD framework.

   Odderon is a cousin of Pomeron which emerged already about half century ago in the so called Regge theory to explain the logarithmically rising (rather than decreasing) cross sections in proton-proton and proton-antiproton collisions. Pomeron is part of low energy phenomenology and perturbative QCD cannot say much about it.

These findings pose a challenge for TGD, and in this article a TGD based model for the findings is developed.

Contents

1 Introduction

This chapter discusses some recent unexpected findings related to hadron- and nuclear physics.

1.1 The asymmetry of antimatter in proton from TGD point of view

The recent experiments of Dove et al [C2, C4] confirm that the antiquark sea is asymmmetric in the sense that the ratio anti-d/anti-u is larger than unity. A model assuming that proton is part of time in a state consisting of neutron and virtual pion seems to fit at qualitative level into the picture.

The TGD based model discussed also in [L26] relies on the already existing picture developed by taking seriously the so called X boson as 17.5 MeV particle and the empirical evidence for scaled down variants of pion predicted by TGD. What TGD can give is the replacement of virtual mesons with real on mass shell mesons but with p-adically scaled down mass and a concrete topological description of strong interactions at the hadronic and nuclear level in terms of reconnections of flux tubes.

1.2 The strange fissions of heavy nuclei

That final state nuclei from the fission of heavy nuclei possess a rather high spin has been known since the discovery of nuclear fission 80 years ago but has remained poorly understood.

The recent surprising finding by Wilson et al [L27] was that the final state angular momenta for the final state nuclei are uncorrelated and must therefore emerge after the decays. This represents a challenge for TGD inspired model of nuclei as nuclear strings, and one ends up to a rather detailed model for what happens in the fissions.

The TGD proposal discussed also in [L27] is that the generation of angular momentum is a kind of self-organization process. Zero energy ontology (ZEO) and h_{eff} hierarchy indeed predicts self-organization in all scales. Self-organization involves energy feed needed to increase $h_{eff}/h_0 = n$ serving as a measure for algebraic complexity and as a kind of universal IQ in the number theoretical vision about cognition based on adelic physics.

The observation that the final state nuclei have angular momenta $6 - 7\ \hbar$ suggests that self-organization increase the values of h_{eff} to nh, $n \in \{6, 7\}$. Quantization of angular momentum with new unit of spin forces the generation of large spins. Also zero energy ontology (ZEO) is involved: ZEO provides a new element to the description of self-organization and a model for quantum tunnelling phenomenon.

1.3 The strange findins of Eric Reiner

Eric Reiner [L25] has studied the behavior of gamma-rays emitted by heavy nuclei going through a beam splitter splitting the photon beam to two beams. Quantum theory predicts that only one detector fires. This implies that the pulses in the two detectors tend to occur at different times. This has been verified for photons of visible light. The experiment studied the same situation for gamma-rays and the surprise was that one observes mostly half pulses in both detectors and in some cases also full pulses. Reiner has made analogous experiments also with alpha particles with the same conclusion.

These findings pose a challenge for TGD, and in this chapter a TGD based model for the findings discussed also in [L25] is developed.

1.4 Pomeron and Odderon in TGD framework

Quite recently, empirical support for a particle christened Odderon [C3] emerged. As the name tells, Odderon is not well-understood in QCD framework.

Odderon is a cousin of Pomeron which emerged already about half century ago in the so called Regge theory to explain the logarithmically rising (rather than decreasing) cross sections in proton-proton and proton-antiproton collisions. Pomeron is part of low energy phenomenology and perturbative QCD cannot say much about it.

These four findings pose a challenge for TGD, and in this chapter a TGD based model for the findings discussed also in [L25] is developed.

2 The decays of heavy nuclei as support for nuclear string model

Nuclear string model is more than 20 years ago old applicationof TGD [L1]. The model identifies nuclei as string-like objects i.e. flux tubes carrying nucleons represented as space-time sheets topologically condensed at the larger flux tube. Nucleon space-time sheets are also connected by short flux fube bonds carrying quark and antiquark and having total quantum numbers of a pion or ρ meson. The model has several variants but is surprisingly successful and also the connection with the shell model can be understood. The basic prediction is that nuclear reactions and decays should have a topological description based on reconnection as basic reaction vertex.

2.1 Angular momentum generation in nuclear fission is not understood

I encountered a highly interesting link to a popular article (`https://cutt.ly/XlLnNB5`) to a work of a large international research group studying the fission of heavy nuclei. The article "*Angular momentum generation in nuclear fission*" [L27] (`https://cutt.ly/hlLn86c`) reporting the research findings is published in Nature (February 24). Unfortunately, the article is behind the paywall.

The work involved studying the fragments that resulted from fission of several types of unstable elements, such as uranium-238 and thorium-232. That the final state nuclei from the fission of heavy nuclei possess a rather high spin has been known since the discovery of nuclear fission 80 years ago but has remained poorly understood.

The recent surprising finding was that the final state angular momenta for the final state nuclei are uncorrelated and must therefore emerge after the decays. This represents a challenge for TGD inspired model of nuclei as nuclear strings, and one ends up to a rather detailed model for what happens in the fissions.

2.1.1 Recent findings

The fragments resulting in the scission of heavy nuclei possess relatively high rotational angular momenta, which are typically 6-7 using $\hbar$ as a unit. Why the nuclei should have so large angular momenta looks like a mystery. There are many theories for how this angular momentum is generated. The natural guess is that the angular momentum is possessed by the fragments already before the scission. This predicts that the fragments have opposite angular momenta.

The recent experiments [L27] studying the gamma ray spectrum emitted by the nuclei convincingly demonstrate that the angular momenta for the fragments are independent and therefore must be generated after the scission. This looks very strange from the point of view of angular momentum conservation.

What comes first in mind is that the gamma ray emission takes care of angular momentum conservation. The generation of angular momenta is however analogous to a self-organization process and in standard physics framework it looks strange that this would take place for nuclei.

The classical model proposed by the experimenters relies on an analogy with a rubber band. The nuclei resulting in the splitting of heavy nuclei to two parts are proposed to be highly elongated before the scission.

In the splitting of a rubber band the resulting ends of the rubber band generate opposite torques giving them angular momenta. The energy liberated as the fragment returns from an excited state to an approximately spherical shape would be transferred to rotational energy. Here the proposed analogy is soap bubble with surface tension and pressure difference determining its dynamics: minimal energy corresponds to a spherical shape. The emission of gamma rays would take care of the conservation of the angular momentum.

Elongation makes possible the scission (on could also compare the decay to a decay of water droplet). What could be the mechanism of the elongation?

The TGD based model for scission relies on the model of nuclei as nuclear strings [L1]. Also other other elements of the new physics predicted by TGD are involved. The first element is the identification of dark matter as phases of ordinary matter labelled by effective Planck constant [K2] $h_{eff}/h_0 = n$, ($h = 6h_0$ [L4]), with n identified as the dimension of extension of rationals determined by the degree of a polynomial characterizing a given region of the space-time surface by $M^8 - H$

duality [L16, L17]. Also zero energy ontology (ZEO) [L15] is involved: ZEO provides a new element to the description of self-organization [L13] and a model for quantum tunnelling phenomenon as a pair of BSFRs with the time-reversed period between them identified as tunneling period.

The first guess was that flux tubes, which have much longer length than nuclear size, could explain the mysterious finding that in nuclear decay the fragments manage to generate their angular momenta after the reaction: the flux tubes would make possible the exchange of angular momentum required by angular momentum conservation. The prediction would be that the flux fragments have opposite angular moment but the discovery was that they angular momenta are independent.

A more realistic guess is that the nuclear flux tubes themselves correspond to MB and that the generation of angular momentum is a kind of self-organization process - something usually not expected to be possible at the level of nuclear physics.

1. Zero energy ontology (ZEO) and h_{eff} hierarchy indeed predicts self-organization in all scales [L13] and time reversal plays a key role in this process: dissipation with a reversed arrow of time looks like self-organization for an observer with the standard arrow of time.

2. Self-organization involves energy feed needed to increase $h_{eff}/h_0 = n$ serving as a measure for algebraic complexity and as a kind of universal IQ in the number theoretical vision about cognition based on adelic physics [L8, L9]. The energy feed would be from the vibrational excitations of the flux tube to the rotational degrees of freedom.

3. The observation that the final state nuclei have angular momenta $6-7$ $\hbar$ suggests that self-organization increases the value of h_{eff} to nh, $n \in \{6, 7\}$. The quantization of angular momentum with unit $\hbar_{eff}$ forces the rotation.

2.1.2 The basic ideas of the TGD based model for the scission

In TGD nuclei are modelled as closed nuclear strings [L1]. The counterpart for an elongated nucleus would be a loop looking like a highly flattened square, possibly having helical linking making it a helical knot. This suggests a description of the scission as a reconnection of the flux tube - in the approximation of the flux tube as a closed string this would be basic string vertex.

Also the analogy with DNA is useful. In TGD Universe DNA [L10, L30, L28, L29, L22] and also other basic information molecules are accompanied by flux tubes carrying dark protons (ordinary protons with $h_{eff} = nh_0 > h$) controlling them: dark means that the protons at the flux tubes. The elongation of the nucleus could be analogous to the process of DNA unfolding.

The opening of the helical DNA double strand in transcription forces the rotation of DNA: same would happen for the nuclei. If the value of h_{eff} as a unit of angular momentum increases to say $h_{eff} = 6h$, the torque generating the rotation is necessary to realize minimal non-vanishing value of angular momentum.

2.2 Nuclear string model briefly

TGD based description of nuclei is as nuclear strings containing nucleons along string [L1]. Nucleons from sequences at the magnetic flux tube so that a string like object is in question. Rubber band is indeed analogous to a string.

1. Nucleons correspond to space-time sheets topologically condensed at magnetic flux tube and connected by flux tube bonds representing scaled down pion or ρ meson quantum numbersexcept that the mass is p-adically scaled down to MeV range.

2. There are three options for what nuclear string could mean:

   (a) Neutrons and protons from separate nuclear strings and the flux tube bonds correspond to neutral pionor ρ. Thiswould conform with the treatmentof protons and neutrons in the nuclear shell model.

   (b) Protons and neutrons reside at the same flux tube.

   (c) Neutronlike space-time sheets are not actually ordinary neutrons but correspond to a proton + negatively charged pion-like flux tube bond connecting protons together.

One can also consider the possibility that there are several closed linked and knotted loops present in the nucleus. Reconnections between the loops could generate knotting and linking. For instance, alpha particle could correspond to such a loop.

3. The analogy with strings suggests as the first guess a correlation between masses and angular momenta of the fragments idealized by the mass formula $J = kM^2$. Here k would be determined by the nuclear string tension.

4. Nuclear reactions would proceed by reconnection of flux tubes which for ideal closed strings define the basic vertex. Same applies to nuclear decays. A closed loop representing say alpha particle would be emitted via a reconnection process.

2.3 Scission as reconnection

Consider now the scission of heavy nuclei in this framework.

1. Suppose that in standard configuration nuclear strings are flux tube tangles - kind of flux tube spaghettis. This would correspond to the analogy with a bee nest used in the popular article. The Universe of the TGD is fractal and flux tubes appear in all scales. Galaxies, stars, planets, etc would involve flux tube tangles. Even DNA and other linear bio-molecules would involve flux tubes.

   A flux tube as a volume filling spaghetti is an object analogous to blackhole-like. Since the thickness of the flux tube can vary having values determined by p-adic length scale hypothesis, a hierarchy of blackhole-like entities are predicted [L12]. Ordinary blackholes would have flux tube thickness equal to proton Compton length and consist of nuclear strings. Also stars could be analogous to blackholes. In the csae of Sun the thickness of the flux tube would be of order electron Compton length [**?**, L14].

   Also nuclei would be analogous to mini blackholes. If they are volume filling, the reconnections could occur all the time and the topology would be highly dynamical involving changes of knottedness and decay to disjoint and linked knots.

Consider first the decay of the nucleus in the general case.

1. In the general case, the flux tube spaghetti is knotted. How can the decay to two separate tangles proceed? An arbitrary reconnection does not lead to two separate sub-tangles but changes only the knotting and linking. Even if this happens, the subtangles remain knotted and linked and the decay is not possible without further reconnections.

   If the nucleus manages to evolve by reconnections to two mutually unknotted and unlinked sub-knots, the situation changes. The nucleus would decompose to 2 sub-knots connected by a pair of parallel closely spaced flux tubes for which the reconnection can take place and yield two final state nuclei. A decomposition into a connected sum of two knots would precede the decay in the general case.

2. The hypothesized elongated nucleus could correspond to a more specific situation. A maximally elongated nucleus would correspond to an opened flux loop with a shape of say flattened square. The flux loop could also be helical and stability might favor this. Rubber band analogy would be therefore justified. The scission would correspond to the splitting of this flux loop by reconnection. It is however enough to assume the formation of two separate knots connected by pair of parallel flux tubes close to each other.

The generation of the rotational angular momentum after the decay would correspond to a generation of a rotation of the flux tube as a string-like entity. A helical configuration analogous to DNA double strand is highly suggestive. The elongated nucleus would correspond to this kind of configuration.

The splitting would kick the stringy flux tube to an excited state. The liberated energy would generate the rotational motion. Why the motion would be collective rotation is not at all obvious.

The emission of gamma rays having spin would take care of angular momentum conservation. This however requires that gamma rays tend to have parallel spins. It is not obvious why this should be the case.

2.4 DNA opening as analogue for the scission process

Why the fragments generate angular momenta? Flux tubes appear in all scales in TGD Universe. In particular, the TGD based model for DNA invovles besides ordinary DNA strand also dark DNA strand parallel to it and identifed as a magnetic flux tube carrying dark proton sequence [L10, L30]. Genetic code is realized for dark DNA as dark proton triplets: this realization involves only protons and codons are entangled 3 proton states which do not allow reduction to letters. These dark proton sequences can be regarded as dark nuclei. The nuclear realization of the genetic code would be the fundamental one and the chemical realization would be kind of mimicry.

The model predicts also the dark counterparts of RNA, amino-acids and tRNA as dark proton triplets. One cannot completely exclude the possibility that the genetic code is realized already at the level of ordinary nuclei. This motivates the question whether the opening of the ordinary DNA double strand controlled by dark DNA strand might provide a useful analogy for understanding what happens in the scission.

1. The opening of DNA double strand in the replication or transcription must eliminated the helical linking of strands to give pair of parallel straight strands so that the replication can take place. The opening requires the rotation of strands and generates angular momentum.

2. Could the parallel flux tube portions form an analog of DNA double strand? Amusingly, the spin and isospin states of nucleon give rise to 4 states so that 3 nucleons would form analogs of genetic codons. The "dark" realization as entangled 3-nucleon states is however more plausible.

   DNA/protein unfolding as a self-organiation process is a biological analog for the step leading to an elongated state. The return to the highly tangled state after reaction would be analougs to DNA/protein folding.

2.5 Does non-standard value of h_{eff} explain the values of final state angular momenta?

One should also understand the large angular momenta of the final state nuclei and why these values are around $6\hbar$.

1. The intermediate state in the first BSFR would correspond to a dark nucleus having $h_{eff} = nh_0 > h = 6h_0$. This could be true also after BSFR and the angular momentum could be reduced to its standard value in the final state. This suggests that the angular momentum is quantized with $\hbar_{eff}$ as unit.

2. The observation that the angular momenta are around $6h$ suggests that in the final state one has $\hbar_{eff} = Nh$: $N \in \{6, 7\}$. This would explain why the rotational angular momentum must be generated.

   In standard quantum theory it is very difficult to understand why the emitted ordinary gamma rays could have correlated spins so that the total spin would be N units. If the emitted dark gamma rays are dark they would have angular momentum unit $\hbar_{eff} = N\hbar$ and would decay to ordinary gamma rays.

3. A connection with the notion of dark 3N-protons and 3N-photons of TGD inspired quantum biology [L10, L19, L22] is highly suggestivbe. Dark 3N-protons would be cyclotron condensates analogous to nucleons as color triplets behaving like a single particle. 3N-photons would be analogous to Bose-Einstein condensates of 3N photons [L28, L29]. The mechanism leading to these states would be Galois confinement possible in TGD framework [L6, L21, L23].

4. Since the energies of quantum states quite generally increase with h_{eff}, the increase of h_{eff} would require a "metabolic energy" feed. The excitation of the stringy degrees of freedom could provide this energy and transform to rotational energy. One could think that in the scission the flux tube as string is heated to high temperature and this energy is liberated to collective rotational motion. The minimal value of the angular momentum would be $\hbar_{eff} = N\hbar$ and would force coherent rotation.

2.6 ZEO based view about scission

It is also interesting to consider the description of the scission process could be in zero energy ontology (ZEO) [L15].

1. Quite generally, tunnelling phenomenon in nuclear reactions could correspond to a pair of "big state function reductions" (BSFRs) [L14]. BSFR is the counterpart of the ordinary SFR and changes the arrow of time [L15, L23]. The intermediate period with an opposite arrow of time would correspond to the tunnelling in nuclear reactions.

   This model emerged from a model "cold fusion" as nuclear reactions for dark nuclei with protons and neutrons having nonstandard value of h_{eff} increasing their Compton lengths [L2, L7, L18, ?].

2. When the state of the system is near the threshold for scission, the system is quantum critical and experiences long scale quantum fluctuations with varying balue of h_{eff}. Given fluctuation increases the Compton radius of nucleons by factor $h_{eff}/h = n/6$. Nuclear string would be scaled up in size. This might be true even for ordinary nuclear reactions. Nuclear binding energies would be scaled down like $1/h_{eff}$. After the second BSFR, h_{eff} would return to the original value, perhaps in a stepwise manner.

3. The decay process leading to an elongated nucleus as an intermediate state could emerge in the first BSFR leading instantaneously to the elongated state. In ZEO quantum states are superpositions of classical time evolutions and at the classical level this looks to an observer with a standard arrow of time classically like a deterministic time evolution leading from a roughly spherical initial to a highly elongated state. This interpretation explains the strange looking findings of Minev et al for state function reductions in an atomic system [L11] [L11].

   The state to which the classical time evolutions of the superposition apparently lead would correspond to the elongated nucleus. Actually it would be the initial state of the time reversed time evolution. The classical model of the authors would describe this period.

4. Second BSFR would re-establish the original time direction and correspond to the splitting of the elongated state to fragments in the manner already described.

3 The asymmetry of antimatter in proton from TGD point of view

I encountered a highly interesting popular article *"Decades-Long Experiment Finds Strange Mix of Antimatter in The Heart of Every Proton"* (`https://cutt.ly/BlZtNne`).

The popular article tells about the article "*The asymmetry of antimatter in the proton*" of Dove et al [C2] published in Nature (`https://cutt.ly/BlZt8sV`). This article is behind the paywall but the same issue of Nature has an additional article "*Antimatter in the proton is more down than up*" [C4] (`https://cutt.ly/blZyT4u`) explaining the finding.

What is found is an asymmetry for u and antiquarks in the sense that there are slightly more d-type antiquarks (anti-d) than u type antiquarks (anti-u) in quark sea. This asymmetry does not seem to depend on the longitudinal momentum fraction of the antiquark: the ratio of anti-down and anti-up distribution functions is smaller than one and constant.

A model assuming that proton is part of time in a state consisting of neutron and virtual pion seems to fit at qualitative level into the picture. Unfortunately, the old-fashioned strong interaction theory based on nuclei and pions does not converge by the quite too large value of proton pion coupling constant.

I looked at the situation in more detail and developed a simple TGD based model based on the already existing picture developed by taking seriously the so called X boson as 17.5 MeV particle and the empirical evidence for scaled down variants of pion predicted by TGD [L5]. What TGD can give is the replacement of virtual mesons with real on mass shell mesons but with p-adically scaled down mass and a concrete topological description of strong interactions at the hadronic and nuclear level in terms of reconnections of flux tubes.

3.1 TGD inspired model for the asymmetry

3.1.1 Basic data about quark and nucleon masses

To get a quantitative grasp about the situation, one can first see what is known about masses of u and d quarks.

1. One estimate for u and d quark masses (one must taken the proposals very cautiously) can be found (`https://cutt.ly/dlZukKC`).

   The mass ranges are for u 1.7-3.3 MeV and and for d 4.1-5.8 MeV.

2. In the first approximation n-p mass difference 1.3 MeV would be just d-u mass difference varying in the range 1.2 MeV-4.1 MeV and has a correct sign and a correct order of magnitude. 4.1 MeV for d and 3.3 MeV for u would produce the n-p mass difference correctly.

3. Coulomb interactions give a contribution E_c, which is vanishing por proton and and negative for neutron

$$E_c(p) = 0 \ , \quad E_c(n) = -\alpha \times \hbar/3R_e \ .$$

   R_e is proton's electromagnetic scale.

   This contribution reduces neutron mass. If R_e is taken to be proton Compton radius this gives about $E_c \simeq -3.2$ MeV. This would predict mass n-p difference in the range -1.1-0.9 MeV. This favors maximal n-p mass difference 4.1 MeV and m(u)= 1.7 MeV and md =5.8 MeV: d-u mass difference would be 4.1 MeV roughly 4 times electron mass.

3.1.2 TGD based picture about hadronic an nuclear interactions

Consider first the TGD inspired topological model for hadronic an nuclear interactions implicitly contained in the model of nuclei as nuclear strings [L1] further developed in applications to "cold fusion" [L2, L7, L18] and by using input from the anomaly assignable to the nuclear physics of solar core [L14, L12].

1. The notion of magnetic body (MB) assignable to color and em and electroweak interactions is essential. The interactions are described by virtual particle exchanges in quantum field theory (QFT). In TGD they are described by reconnections of U-shaped flux tubes which are like tentacles.

   In interaction these tentacles reconnect and give rise to a pair of flux tubes connecting the particles. The flux tubes would carry monopole flux so that single flux tube cannot be split. These flux tube pairs serve also as correlates of entanglement replacing wormholes as their correlates in ER-EPR picture.

   This picture looks rather biological and was developed first as a model of bio-catalysis [L30] [K1]: reconnections of U-shaped tentacles would make possible for reactants to find each other and their shortening in phase transitions reducing h_{eff} would bring them near to each other. The picture should apply quite generally to short range interactions at least.

2. The U-shaped flux tubes of color MB replace virtual pion and and ρ meson exchanges in the old fashioned picture about strong interactions. They represent in TGD framework real particles but with p-adically scaled down mass. For instance, pions are predicted to have scaled down variants with masses different by a negative power of 2 from pion mass. Same is true for rho. Now the masses would be below MeV range, which is the energy scale of nuclear strong interactions. Also nuclear strong interactions would occur in this manner [L1] [L14].

3.1.3 A model for the anti-quark asymmetry

Consider now a model anti-quark asymmetry for sea quarks.

1. Quarks and antiquarks would appear at these flux tubes. The natural first guess is that meson like states are in question.

   The generation of u-anti-d type pion or ρ would transform proton to neutron if the valence u transforms to valence d and W boson with scaled down mass.

   Note that the scaling down would make weak interaction stronger since weak boson exchange amplitude is proportional to $1/m_W^2$ and scaled by up by a factor of order 10^{10} if m_W has mass in MeV range.

   This would give the analog of neuron plus charge virtual pion. Taking two sea quarks would lead to trouble with the too large Coulomb interaction energy about -10 MeV of negatively charged sea with positively charged valence part of proton if the sea is of the same size as proton.

2. Does the scaled down W^+ decay to u-anti-d forming a scaled down meson π^+ or ρ^+? Or should one regard u-anti-d as a scaled down W^+ having also the spin zero state analogous to pion since it is massive?

3. Here comes a connection with old-fashioned and long ago forgotten hadron physics. Thepartially conserved axial current hypothesis (PCAC) gives a connection between strong and weak interactions forgotten when QCD emerged as the final theory. PCAC says that the divergence of axial weak currents associated with weak bosons are proportional to pions.

   Are the two pictures more or less equivalent? Virtual pion exchange could be regarded as a weak interaction! Also conserved vector current hypothesis (CVC) is part of this picture. This is not new: I have developed this picture earlier in an attempt to understand what the reported X boson with 17.5 MeV mass is in the TGD framework. Scaled down pion would be in question [L5].

4. What about the masses of quarks and proton? Since the flux loop would have considerably greater size than proton, the mass scale of u-anti-d state would be smaller than say MeV, and the contribution to mass of proton would be small.

5. Why the asymmetry for anti-quarks of sea? The generation u-anti-d loop would increase the charge of the core region by two 2 units and transform it to Δ. This looks neither plausible nor probable. Proton would be a superposition consisting mostly of the proton of good old QCD and neutron plus flux loop with quantum numbers of a scaled down pion.

6. Also the presence of scaled down ρ meson loops can be considered. Their presence would turn the spin of the core part of the proton opposite for some fraction of time. One can wonder whether this could relate to the spin puzzle of proton.

4 Pomeron and Odderon from TGD point of view

The following comments were inspired by a popular article telling about the empirical support for a particle christened Odderon (`https://cutt.ly/2xd7M7Y`). The article about Odderon by Csörgö et al is published in European Physics Journal C [C3]. As the name tells, Odderon is not well-understood in QCD framework.

Odderon is a cousin of Pomeron which emerged already about half century ago in the so called Regge theory to explain the logarithmically rising (rather than decreasing) cross sections in proton-proton and proton-antiproton collisions. Pomeron is part of low energy phenomenology and perturbative QCD cannot say much about it. Since the charge parity (see `https://cutt.ly/ixd78aS`) is $C = 1$ for Pomeron $C = -1$ for Odderon, these states are analogous to pion with spin 0 and ρ meson with spin 1.

Pomeron and Odderon have not been in the interests of the frontier of theoretical physics: they represent for an M-theorist a totally uninteresting and primitive low energy phenomenology - as all that we used to call physics before the first superstring revolution -, and does not therefore deserve the attention of an ambitious superstring theorist more interested in the marvels of brane words, landscape, swampland, and multiverse.

I have written about Pomeron for years ago. The following is something different since the view about low energy strong interactions according to TGD [L20] has developed considerably [L26, L24].

One can go first to Wikipedia to learn about Pomeron [C5, C1] (`https://cutt.ly/Wxd5eFq`).

1. Pomeron exchange appearing in the t-channel in elastic scattering was postulated to explain the slowly (logarithmically) rising scattering cross sections in proton-proton and proton-antiproton collisions. For quarks and gluons the scattering cross sections fall down rather rapidly with energy (by dimensional argument like inverse $1/s$ of cm energy squared) so that something else would be in question.

2. The total cross sections do not depend on the charges of the colliding baryons. The usual shower of Cerenkov radiation was missing from Pomeron exchange events. The absence of pions usually present was interpreted as absence of color charge.

   This suggests that quarks and gluons do not participate the Pomeron events. There is often also a large rapidity gap in which no outgoing particles are observed.

3. In the Regge theory which later was concretized in terms of the hadronic string model. Pomeron would correspond to a Regge trajectory for which the Reggeon would have quantum numbers of vacuum except for mass and angular momentum. Regge trajectory would satisfy the formula $M^2 = M_0^2 = \alpha(s)J$, M mass, J angular momentum. The exchange of the entire Regge trajectory would give rise to approximately constant cross section. Odderon would be Pomeron like state with an odd charge parity $C = -1$ instead of $C = 1$. Pomeron and Odderon could correspond $C = \pm 1$ parts of a Regge trajectory.

4. In the QCD picture Pomeron and Odderon are assumed to be associated with the gluonic exchanges, which should form Regge trajectories: this suggests a stringy picture and non-perturbative QCD. Pomeron *resp.* Odderon would be a many-gluon states with an even *resp.* odd number of gluons.

In the many-sheeted space-time of TGD, hadrons are many-sheeted objects.

1. There is a hadronic space-time sheet and quark and gluon space-time sheets are glued at this. There is a magnetic body (MB) of hadron having a layered structure. In particular, there are em/color/weak MBs consisting of flux tubes and "tentacles", which are U-shaped flux tubes.

   Low energy hadron physics would be described in terms of reconnections of these tentacles. This is a rather new element in the picture. In a reasonable approximation, flux tubes are strings and the reconnection of closed strings appears as a basic reaction vertex for closed strings. This gives a connection with the hadronic string model. TGD indeed emerged as a generalization of the hadronic string model 43 years ago (and also as a solution of the energy problem of GRT).

2. Most of the energy of hadron is assumed to be carried by color MB: quarks and gluons carry only a small part of energy. In QCD space-time dynamics is not present and the analog of hadron as space-time surfaces would be a gluon condensate of some kind.

3. Low energy hadron reactions would consist of reconnections of the U-shaped flux tubes of the colliding color MBs. Besides this there are also the collisions of quarks and gluons having approximate description in terms of QCD. The already mentioned connection with hadronic string model suggests a connection with Regge and string model descriptions of Pomeron/Odderon.

4. Hadrons have U-shaped flux tubes acting like tentacles and reconnect to form a bridge of two flux tubes between colliding hadrons. This topological interaction mechanism would be universal and occur in all scales. In biology the ability of reacting biomolecules to magically find each other in the dense molecular soup would rely on this mechanism. It would be also a mechanism of high Tc - and biological superconductivity.

Could this explain the basic properties of the Pomeron?

1. Charge independence and the absence of pion emission assignable to quark-gluon reactions can be understood. Gluons and quarks of colliding hadrons would not meet each other at all. The two colliding hadrons would just touch each other with their "tentacles" which would transfer some momentum between them in elastic collisions. This would explain the rapidity gap.

2. What about the slow dependence on collision energy? Why the cross section describing the probability of the formation of reconnection would not depend on collision energy?

   (a) One could visualize the cross section in cm frame geometrically as the area of a 2-D surface cylinder parallel to the line connecting the colliding particles. The area of this cylinder would tell the probability for the formations of reconnection. If I try to touch some object in darkness, its area tells how probable the success is.

   (b) In elastic scattering the t-channel momentum exchange would be orthogonal to this cylinder and have vanishing energy component. It would not change in Lorentz boosts increasing the cm collision energy. If the contribution to the cross section depends only on t, it would be independent of collision energy.

5 TGD based interpretation for the strange findings of Eric Reiter

I learned of rather interesting findings claimed by Eric Reiter hosting a public group "*A serious challenge to quantum mechanics*" (`https://cutt.ly/VlBgFk4`). There is a published article [L25, ?] `https://cutt.ly/rlBgOl1`) about the behavior of gammas emitted by heavy nuclei.

Eric Reiter has studied the behavior of gammas emitted by heavy nuclei going through two detectors in tandem. Quantum theory predicts that only one detector fires. It is however found that both detectors fire with the same pulse height and firings are causally related. The pulse height depends on wavelength and distance between the source and detector and also on the chemistry of the source, which does not conform with the assumption that nuclear physics and chemistry decouple from each other. Reiter has made analogous experiments also with alpha particles with the same conclusion. These findings pose a challenge for TGD, and in this article a TGD based model for the findings is developed.

On the basis of these findings, Reiter makes the rather provocative proposal that quantum theory is an illusion, and suggests a semiclassical theory known as loading theory represented originally by Max Planck. The theory states that the detectors fire only after they have loaded a sufficient amount of energy. The theory assumes that quantization of energy holds true only at the moment of emission but after that the energy disperses to the em fields describing the radiation.

In order that loading theory can explain the almost simultaneous and causally related firings, the loaded electromagnetic energy should achieve a critical value at the same time for both detectors. It seems that both detectors must start always as unloaded. It is not obvious how the loading theory can explain the success of quantum theory for visible photons. Reiter claims that this is possible.

Before continuing, let us make clear that I am not a proponent of unquantum theory but trust these observations are real and regard them as an extremely interesting challenge also for TGD.

The basic observations claimed by Reiter [L25, ?] `https://cutt.ly/rlBgOl1`) are the following.

1. Half-pulses and full pulses are detected in both detectors in contrast with the prediction that only one detector should fire if pulses are caused by the absorbtion of the gamma. The pulses are causally related. The probability for half pulse pairs is by factor of 100 higher than by change. The probability for full pulse pairs is 4 times higher than by change. Both observations should correspond to 2 gammas in standard quantum theory. Only full pulses are considered.

   Remark: One can ask whether the secondary gammas associated with the absorption of gamma can propagate to the second detector and cause a pulse in it.

2. In 2-1 cases with full pulse two gammas are observed. This challenges energy conservation and the proposal based on loading theory is that a threshold effect is in question. For half pulses, the energy of pulses would be one half of total gamma energy and thus conserved.

   Remark: One can consider the possibility that the half pulses correspond to Compton scattering and full pulses to absorption of gamma.

5.1 A rough view about the TGD based explanation of the Reiter's effect

I am not an experimentalist and I am not at all sure whether I have understood correctly the description of the experiments and results. With these cautions in mind, consider first a thought experiment forgetting the belief that the incoming particles are ordinary gammas and quantum theory holds true.

1. In 2-1 cases the pulses correspond to separate incoming photons. At least two photons arrive at the first detector.

2. One can understand simultaneous pulses with equal pulse heights, if a considerable number of photons instead of a single gamma arrive the detector simultaneously. The particle from gamma source would not be gamma but a particle decaying to N nearly parallel gammas with the energy of ordinary gamma. These photons for a subset of them would be distributed between the detectors and average pulse heights could be identical.

The challenge is to see whether this picture can be realized in TGD framework. The key questions are the following.

1. What are the particles which would decay to N gammas before the detector or inside it.

2. Why pairs of full pulses and pairs of half pulses are observed?

5.2 Hierarchy of effective Planck constants and the notion of N-photon

The TGD inspired model involves two new physics effects predicted by TGD.

1. In the TGD framework classical physics is an exact part of quantum physics and essential for the interpretation of quantum theory. M^8-H duality which is central element of TGD realizes kind of quantum-classical duality: both M^8 and $H=M^4\times CP_2$ are needed. At the level of M^8 having interpretation as analog of momentum space, everything is quantal: there are no classical fields and space-time is analog of Fermi ball. At the level of $H=M^4\times CP_2$ one has space-time as dynamical entity and classical fields.

2. TGD predicts a hierarchy of Planck constants $h_{eff}=nh_0$, $h=6h_0$ is the value of h_0 suggested by the findings of Randel Mills [D1] [L4]. For a given frequency $E=h_{eff}f$ means that the frequency for a given energy is scaled down by $h/h_{eff}=1/n$ in $h\rightarrow h_{eff}$. $n=2$ would give period doubling.

3. Large values of h_{eff} allow quantum coherence in arbitrarily long scales since quantum coherence lengths increase with h_{eff} [L30]. This makes possible Bose-Einstein (B-E) condensate like N-particle states behaving like single particle: N-protons, N-ions, N-photons... A number theoretical phenomenon that I have christened as Galois confinement would be in question.

   N-photon as analog of BE-condensate-like state of N photons behaving like a single particle. Quantum coherent state can be regarded as superposition of N-photon B-E condensates of this kind.

   N-photons play a central role in TGD inspired quantum biology. For instance, biophotons would be ordinary photons resulting from decay of dark 3N-photons to ordinary photons [L19, L22]. Baryons as 3-quark states provide the analogy: color confinement forces the 3 quarks to behave like a single particle.

Also condensed matter could realize these N-particle states states. Ordinary DNA would be accompanied by dark DNA which would consist of sequence of dark 3-protons realizing genetic code and providing also counterparts for RNA, tRNA, and amino-acids [L10].

The dark 3-protons combine to form similar 3N-proton states representing genes and emitting 3N-photons in collective cyclotron transitions and providing representations of genetic codons and coupling resonantly to corresponding genes. Dark N-particle states might be possible even for nuclei.

These considerations motivate the question whether the gammas could originate from N-gammas, which decay to ordinary gammas possibly having $h_{eff} > h$? Could this guarantee that both detectors receive a signal and average pulse heights are same.

5.3 TGD based model for the findings of Reiter

Reiter has also carried another experiment [?]. In this experiment detectors are in series. The detectors are scintillators in which the incoming gamma can suffer Compton scattering, become absorbed, or transform to an electron-positron pair. Electron can also absorb gamma. It is assumed that full pulses are due to the gamma absorption and that Compton scattering gives rise to what is called half-pulses.

The scintillators are crystals. Compton scattering and gamma absorption by electron lead to secondary processes, which can generate gammas. For instance, after the absorption of gamma the electron dissipates its energy and this effect is amplified in photo-multipliers. Scattered gamma can suffer further scatterings.

The surprising observation is that the responses of the two detectors identical in the measurement resolution used [?].

1. If there is only a single incoming gamma, it should be absorbed in either detector. If the secondary gammas created in the first detector do not enter the second detector, the presence of pulses of same pulse height in both detectors does not conform with the standard physics picture. Even if they enter to the second detector, the pulse heights are not expected to be the same.

2. If the N-gamma decays to N ordinary or dark gammas, it might be easier to understand why the pulse heights are the same.

It is also good to start with an objection. That pulse heights are the same for both detectors, could be simply due to the fact that detectors are ideal yes-no detectors, which are (quantum) critical systems in the sense that incoming gamma rays serve as a control acting producing the same response irrespective of their number and energies. In this case, the secondary gamma rays from the first detector could induce the same response in the second detector.

There are however other observations of Reiter, which strongly suggest that new nuclear physics is involved.

5.3.1 The dependence of the unquantum effect on the chemistry of the gamma source

Unquantum effect depends on the chemistry of the source [?]. This is observed when ^{109}Cd is used as a source. ^{109}Cd appears as salt or metal and salt produces 5 times larger unquantum effect. The proposed interpretation is that gamma waves from salt are more coherent. This behavior suggests that gamma emission is not a single-nucleus effect as standard nuclear physics would predict but involves many nuclei. Hence new nuclear physics would be involved.

Why would the nuclei of ^{109}Cd salt form larger quantum coherent structures? What these structures could be?

1. That several nuclei would be involved with the emission of gammas conforms with the N-gamma model in which N parallel gammas are emitted simultaneously as N-gamma in quantum coherent N-nucleus transition. N-gamma beam is analogous to B-E condensate

of N gammas that is an N-photon state with identical photons. Intensity of N-gamma beam from different nuclei higher.

2. Also coherent states of gammas as superpositions of N-gammas for various values of N can be considered. This state would behave as classically as possible. Intuitively the unquantum effect indeed corresponds to effective classicality.

   Putting it more precisely, coherent state is an eigenstate of the annihilation operator of the photon and has the form $exp(\alpha a^\dagger)|0\rangle$, where α is a complex parameter. The expectation value and variance of photon number N are given by $|N| = |\alpha|^2$ and $|\Delta N^2| = |\alpha|^2$. $|\alpha|^2$ is analogous to field intensity. The larger its value, the more classical the state is.

   The value of $|\alpha|^2$ should be larger for ^{109}Cd salt than for ^{109}Cd metal. The coherence of gammas would directly reflect the quantum coherence of ^{109}Cd as a many-nucleon system: this coherence is impossible in standard physics picture.

The larger the size of quantum coherence length in the gamma source, the larger the value of N if every nucleus emits identical gamma simultaneously. The scale of quantum coherence scales like h_{eff} and N like $(h_{eff}/h)^3(L_n/L_a)^3$ if the coherence region is spherical. Here $L_n \sim 10^{-14}$ m is nuclear scale and $L_a \simeq 10^{-10}$ m is atomic scale. One must $h_{eff}/h >> h_{eff,min}/h = (L_n/L_a)^3 = 10^{12}$ for the spherical option and $h_{eff}/h >> h_{eff,min}/h = (L_n/L_a) = 10^4$ for the linear option.

A couple of remarks are in order.

1. In TGD inspired quantum biology [L30] flux tubes carrying dark protons define linear coherence regions giving $N \propto (h_{eff}/h) \times (L_n/L_a)$.

2. In cold fusion the distance of dark protons at flux tube is about electron Compton length $L_e \simeq 10^{-12}$ m, one has $h_{eff}/h \simeq m_p/m_e \simeq 2000$ [L18, L2].

5.3.2 The dependence of the unquantum effect on the detector-source distance and gamma wave length

The intensity of the unquantum effect depends on the wavelength λ of gamma and distance d between source and detectors [**?**].

1. ^{241}Am has longer wavelength λ. The UQ effect is enhanced as the distance d between source and detector decreases.

2. ^{1}37Cs produces gammas with a shorter wavelength λ. UQ effect is enhanced when d increases.

How to understand this behavior? d is certainly a relevant variable. But is this true for λ? N correlates with the size of the nuclear quantum coherent state. Could N be the relevant variable instead of λ. It is best to build a concrete view for what happens in the decay of N-gamma to N gammas.

1. N-gamma is analogous to B-E condensate of N gammas which have $h_{eff} > h$. B-E condensate is formed from ordinary photons which in general do not have parallel momenta and identical energies. The phase transition however creates this kind of state. The phase transition occurs by addition of photons to the B-E condensate and takes some time.

   The decay of N-gamma is the reversal of this phase transition. Therefore the N-gamma must decay during some time interval to N gammas which do not have exactly parallel momenta. These gammas move inside a cone with some opening angle. The intensity of the gamma beam decreases with distance like $1/r^2$, where r is the distance from the point of phase transition.

   The number of (possibly dark) gammas, which arrive the detector decreases with the distance of the detector from the phase transition region. If more than one gamma contributes to the pulse, one can understand why the height of the peak is reduced with the distance. If only one, the reduction does not occur.

2. On the other hand, the detector must be far enough from the source so that the phase transition to ordinary gammas has already occurred. If the decay of N-gamma to gammas takes place gradually and only the gammas interact with the detector the peak height increases with the distance from the phase transition. This is true if the interaction of the still existing M-gamma state ($1 < M < N$) with the detector is so weak that it goes through the detector without interaction with a high probability.

These two constraints imply that there is some distance at which the pulse height is maximal.For Am having larger gamma wavelength d would be larger than the optimal distance and for Cs with smaller gamma wave d would be smaller than optimal distance. Note that the optimal distance depends on N and therefore the size scale of coherent regions of nuclei. Intuitively it seems clear that the optimal distance increases with N since the decay time of a larger B-E condensate is expected to be longer.

5.3.3 Why the pulse heights in the two detectors are the same?

Pulse heights in the two detectors are the same. This explanation might involve both new physicsand understanding of the functioning of the detector.

It would seem that the conical beam consisting of N gammas is not considerably attenuated in the first detector which is a thin crystal. If the gammas are dark, the interaction with the detector would involve transformation of dark gamma to ordinary gamma and the probability for this process is expected to be low. This alone could explain why the beam is not considerably attenuated in the first detector.

Since the second detector is thicker, also an additional condition must be satisfied. Only the gammas arriving absorbed by electrons (or possibly Compton scattered for half pulses) during some time interval ΔT can contribute to the pulse. The detector would therefore have a time resolution ΔT in the sense that the gammas arriving after this time would not affect the height of the pulse. Detector would be analogous to a neuron which has some dead time after the arrival of the nerve pulse.

Effectively the detector would serve as a yes-no detector telling whether dark N-gamma arrived or not and would be analogous to a quantum critical system whose response does not depend on the strength of control action but only on its existence.

Suppose that a conical beam of N (possibly dark) gammas arrives the first detector.

If only the gammas arriving during ΔT and interacting with electrons of the detector contribute to the pulse, the same pulse height is obtained in both detectors if the number M of interacting gammas is high enough. This suggests that N must be large enough so that the product $M = pN$ is large enough. Here p is the probability of dark-to-ordinary transition. The detector would not react to later gammas. The value of M decreases with the distance of the detector from the phase transition regions by the conical character of the beam. It is however essential that the detectors are not too far from each other. This could be tested.

One cannot exclude the possibility that the secondary gammas, which are ordinary gammas, from the first detector cause a pulse in the second detector. In this case, one cannot expect identical pulse heights.

If $h_{eff} > h$ is true for gammas, one can imagine that one prevents the arrival of the secondary gammas from the first detector to the second one. Dark gammas could however get through and cause detection. This could be used to see whether the primary gammas are dark.

5.3.4 Application to alpha particle decays

The model should also explain similar findings for alpha particles behaving like bosons. The direct generalization of the N-gamma model would require that atoms in the alpha source ^{241}Am (Americium is used as alpha source in smoke detectors) form a quantum coherent state in a scale longer than atomic size scale. This state could be an atomic B-E condensate of N atoms and emit N entangled possibly dark alphas simultaneously. This B-E condensate would decay to dark or ordinary alphas.

Remark: In TGD framework Galois confinement [L30, L28] - also proposed to make possible dark genes as sequences of 3N dark protons - would force the N source nuclei to behave like a single quantum coherent unit.

5.4 Quantum criticality and objection against unquantum effect

The proposed model assumes that the response of the detector is yes-no response. In critical systems the response is almost independent of the stimulus, kind of yes/no response. The incoming stimulus is like a small perturbation generating a phase transition. Therefore thel 3 intuitive idea is that quantum criticality is crucial.

A good metaphor is control knob: the response does not depend on how hard you push the knob. The role of the magnetic body in TGD inspired biology is to control the biological body. The control action pushes a knob generating a phase transition.

How to realize the control action?

1. Quantum criticality is accompanied by long range correlations and fluctuations implied by the quantum coherence in long scales. $h_{eff} = nh_0 > h$ indeed increases the scale of quantum coherence. The natural first guess is that $h_{eff} > h$ is true for the N gamma rays from N-gamma. $h_{eff} > h$ photons behave like dark photons in the sense that they do not interact directly with the ordinary matter.

2. The interaction with ordinary matter requires the transformation of the dark photon to ordinary photon with $h_{eff} = h$ after which the interaction can occur in the usual manner. The Feynman diagrams describing the interaction containing in the incoming photon line a vertex describing this transition.

   A very rough description of the transformation of the dark photon to ordinary photon is in terms of a transition probability p, which does not depend on the detector. A more refined description would be in terms of mixing of ordinary and dark photons. This requires that the mass squared of dark photon is non-vanishing but very small. Nothing happens in the detector unless this transition takes place.

3. Consider now what happens in the detector if the probability p is very small: $p << 1$. The dark photon detection rate $R_{d,1}$ in the first detector is given in the first approximation by $R_{d,1} = pR_1$, where R_1 characterizes the rate for the detection of ordinary gamma.

   In the second detector the "dark" detection rate is $R_{d,2} = p(1-p)R_2 \simeq pR_2$. $1-p$ characterizes the attenuation of the "single photon beam". If the detectors are ideal yes/no detectors then $R_1 = R_2$ and the ratio of the dark rates is $(1-p_1) \simeq 1$. This requires that the detector response is determined only by the first dark photons of the conical dark gamma beam serving in the role of control knob.

To sum up, the prediction is that for ideal detectors the detection rates are the same in both detectors and independent of the values d_i of the detector thickness. This prediction allows the testing of the dark photon hypothesis.

This however also leads to an objection. If both detectors are ideal yes-no detectors, the pulse heights are the same even in the case that the secondary gamma rays leaking from the first detector generate the pulse in the second detector.

There is an interesting connection of quantum criticality with an effect discovered by Podkletnov and Modanese [?] discussed from TGD point of view in [L3]. In Modanese-Podkletnov effect the electric discharges of a capacitor for which the second plate is super-conductor are reported to generate a pulse of unidentified radiation inducing the oscillation of test penduli. What is strange is that the beam of radiation does not seem to be attenuated. This suggests that the effect is caused by a dark photon beam which serves in the role of control knob in a quantum critical system and does not provide energy causing the oscillation of the penduli. Therefore the effect would have obvious resemblance to what is reported to happen in the tandem experiment of Reiter.

5.5 Conclusions

One can divide the findings of Reiter to two categories.

1. The observations that the pulse height depends on the chemistry of the gamma source and on the distance between detector and source strongly suggest the presence of new nuclear physics and nuclear quantum coherence above atomic scale. In the TGD framework, the notion of N-gamma as an analog of B-E condensate and the model for its decay to N gamms explain these findings.

   What is important that these findings can be made without the presence of the second detector.

2. The observation that the pulse heights for detectors in series are the same, could have an explanation in terms of secondary gammas from the first detector generating a pulse in the second detector. If the detectors are ideal yes no detectors the presence of input creates the same responses irrespective of the strength of the input.

One can imagine two experimental arrangements for testing the TGD based explanation.

1. Could one use as a scintillator a network of conducting wires allowing to observe the positions of gammas inducing response and to see whether the input contains several gammas. This could directly provide support for the N-gamma hypothesis.

2. If it is possible to prevent the leakage of the secondary gamma rays from the first detector to the second detector, the observation of causally related pulses in both detectors could be seen as a support for the hypothesis that N-gamma decays to N dark gammas.

Acknowledgements: I want to thank Marko Manninen for the information about Reiter's experiments and for interesting discussions.

REFERENCES

Theoretical Physics

[B1] Minev ZK et al. To catch and reverse a quantum jump mid-flight, 2019. Available at: https://arxiv.org/abs/1803.00545.

Particle and Nuclear Physics

[C1] Pomeron. Available at: http://en.wikipedia.org/wiki/Pomeron.

[C2] [...]Ye Z Dove J, Kerns B. The asymmetry of antimatter in the proton. *Nature*, 590:561–565, 2021. Available at: https://www.nature.com/articles/s41586-021-03282-z.

[C3] Csörgö T et al. Evidence of odderon-exchange from scaling properties of elastic scattering at tev energies. *Eur. Phys. J. C*, 2021. Available at: https://doi.org/10.1140/epjc/s10052-021-08867-6.

[C4] Gao H. Antimatter in the proton is more down than up. *Nature. News and Views*, 2021. February 24. Available at: https://www.nature.com/articles/s41586-021-03282-z.

[C5] Violini G Queen NM. *Dispersion Theory in High Energy Physics.* The Macmillan Press Limited, 1974.

[C6] [...]Ziliani S Wilson JN, Thisse D. Angular momentum generation in nuclear fission. *Nature*, 590:566–570, 2021. Available at: https://www.nature.com/articles/s41586-021-03304-w.

Condensed Matter Physics

[D1] Mills R et al. Spectroscopic and NMR identification of novel hybrid ions in fractional quantum energy states formed by an exothermic reaction of atomic hydrogen with certain catalysts, 2003. Available at: http://www.blacklightpower.com/techpapers.html.

Books related to TGD

[K1] Pitkänen M. Quantum Mind, Magnetic Body, and Biological Body. In *TGD based view about living matter and remote mental interactions*. Available at: http://tgdtheory.fi/pdfpool/lianPB.pdf, 2012.

[K2] Pitkänen M. Criticality and dark matter. In *Hyper-finite Factors and Dark Matter Hierarchy*. Available at: http://tgdtheory.fi/pdfpool/qcritdark.pdf, 2019.

[K3] Pitkänen M. Nuclear String Hypothesis. In *Hyper-finite Factors and Dark Matter Hierarchy: Part II*. Available at: http://tgdtheory.fi/pdfpool/nuclstring.pdf, 2019.

Articles about TGD

[L1] Pitkänen M. Further Progress in Nuclear String Hypothesis. Available at: http://tgdtheory.fi/public_html/articles/nuclstring.pdf., 2007.

[L2] Pitkänen M. Cold Fusion Again . Available at: http://tgdtheory.fi/public_html/articles/cfagain.pdf., 2015.

[L3] Pitkänen M. Could Podkletnov effect be understood using $h_{gr} = h_{eff}$ hypothesis? Available at: http://tgdtheory.fi/public_html/articles/Podkletnovagain.pdf., 2015.

[L4] Pitkänen M. Hydrinos again. Available at: http://tgdtheory.fi/public_html/articles/Millsagain.pdf., 2016.

[L5] Pitkänen M. X boson as evidence for nuclear string model. Available at: http://tgdtheory.fi/public_html/articles/Xboson.pdf., 2016.

[L6] Pitkänen M. About $h_{eff}/h = n$ as the number of sheets of space-time surface as Galois covering. Available at: http://tgdtheory.fi/public_html/articles/Galoisext.pdf., 2017.

[L7] Pitkänen M. Cold fusion, low energy nuclear reactions, or dark nuclear synthesis? Available at: http://tgdtheory.fi/public_html/articles/krivit.pdf., 2017.

[L8] Pitkänen M. Philosophy of Adelic Physics. In *Trends and Mathematical Methods in Interdisciplinary Mathematical Sciences*, pages 241–319. Springer.Available at: https://link.springer.com/chapter/10.1007/978-3-319-55612-3_11, 2017.

[L9] Pitkänen M. Philosophy of Adelic Physics. Available at: http://tgdtheory.fi/public_html/articles/adelephysics.pdf., 2017.

[L10] Pitkänen M. An overall view about models of genetic code and bio-harmony. Available at: http://tgdtheory.fi/public_html/articles/gcharm.pdf., 2019.

[L11] Pitkänen M. Copenhagen interpretation dead: long live ZEO based quantum measurement theory! Available at: http://tgdtheory.fi/public_html/articles/Bohrdead.pdf., 2019.

[L12] Pitkänen M. Cosmic string model for the formation of galaxies and stars. Available at: http://tgdtheory.fi/public_html/articles/galaxystars.pdf., 2019.

[L13] Pitkänen M. Quantum self-organization by h_{eff} changing phase transitions. Available at: http://tgdtheory.fi/public_html/articles/heffselforg.pdf., 2019.

[L14] Pitkänen M. Solar Metallicity Problem from TGD Perspective. Available at: http://tgdtheory.fi/public_html/articles/darkcore.pdf., 2019.

[L15] Pitkänen M. Some comments related to Zero Energy Ontology (ZEO). Available at: http://tgdtheory.fi/public_html/articles/zeoquestions.pdf., 2019.

[L16] Pitkänen M. A critical re-examination of $M^8 - H$ duality hypothesis: part I. Available at: http://tgdtheory.fi/public_html/articles/M8H1.pdf., 2020.

[L17] Pitkänen M. A critical re-examination of $M^8 - H$ duality hypothesis: part II. Available at: http://tgdtheory.fi/public_html/articles/M8H2.pdf., 2020.

[L18] Pitkänen M. Could TGD provide new solutions to the energy problem? Available at: http://tgdtheory.fi/public_html/articles/proposal.pdf., 2020.

[L19] Pitkänen M. How to compose beautiful music of light in bio-harmony? https://tgdtheory.fi/public_html/articles/bioharmony2020.pdf., 2020.

[L20] Pitkänen M. Summary of Topological Geometrodynamics. https://tgdtheory.fi/public_html/articles/tgdarticle.pdf., 2020.

[L21] Pitkänen M. The dynamics of SSFRs as quantum measurement cascades in the group algebra of Galois group. Available at: http://tgdtheory.fi/public_html/articles/SSFRGalois.pdf., 2020.

[L22] Pitkänen M. Is genetic code part of fundamental physics in TGD framework? Available at: https://tgdtheory.fi/public_html/articles/TIH.pdf., 2021.

[L23] Pitkänen M. Negentropy Maximization Principle and Second Law. Available at: https://tgdtheory.fi/public_html/articles/nmpsecondlaw.pdf., 2021.

[L24] Pitkänen M. Some unexpected findings in hadron and nuclear physics from TGD point of view. https://tgdtheory.fi/public_html/articles/3nuclhadroano.pdf., 2021.

[L25] Pitkänen M. TGD based interpretation for the strange findings of Eric Reiner. https://tgdtheory.fi/public_html/articles/unquantum.pdf., 2021.

[L26] Pitkänen M. The asymmetry of antimatter in proton from TGD point of view. https://tgdtheory.fi/public_html/articles/seaasymm.pdf., 2021.

[L27] Pitkänen M. The decays of heavy nuclei as support for nuclear string model. https://tgdtheory.fi/public_html/articles/nuclspinano.pdf., 2021.

[L28] Pitkänen M and Rastmanesh R. New Physics View about Language: part I. Available at: http://tgdtheory.fi/public_html/articles/languageTGD1.pdf., 2020.

[L29] Pitkänen M and Rastmanesh R. New Physics View about Language: part II. Available at: http://tgdtheory.fi/public_html/articles/languageTGD2.pdf., 2020.

[L30] Pitkänen M and Rastmanesh R. The based view about dark matter at the level of molecular biology. Available at: http://tgdtheory.fi/public_html/articles/darkchemi.pdf., 2020.