Hydrinos again

M. Pitkänen
Email: matpitka6@gmail.com.
`http://tgdtheory.com/`.

June 20, 2019

Contents

Abstract

Randell Mills has proposed his notion of hydrino atom to explain anomalous energy production and EUV radiation in 10-20 nm range taking place in certain electrolytic system and having no chemical explanation. The proposal of Mills is that hydrogen atom can make in presence of a catalyst a transition to a lower energy state with a reduced size. I have already earlier considered some TGD inspired models for hydrino. The resemblance with the claimed cold fusion suggests that the energy production involved in the two cases might involve the same mechanism. I will consider two models. The first model would be a variant of cold fusion model that might explain the energy production and the observed radiation at EUV energy range. Second model is a variant of hydrino atom assuming that ordinary hydrogen atom corresponds to $h_{eff}/h = n_H > 1$ and that catalyst containing hydrogen atoms with lower value of $n_h < n_H$ could induce a phase transition transforming hydrogen atoms to hydrinos with binding energy spectrum scaled up by scaling factor $(n_H/n_h)^2$ and radii scaled down by $(n_h/n_H)^2$. The findings of Mills favour the value $n_H = 6$.

1 Introduction

I have a habit of returning to TGD explanation of various anomalies to see whether progress in TGD could allow new insights. At this time the question about whether hydrinos might be real, served as an inspiration. This led a to consider a possible connection with cold fusion and a new TGD inspired model for hydrinos. I have discussed this topic earlier at [K2, K1].

Randell Mills as written a book and numerous articles about hydrino concept and many of them are published in respected journals [D1]. The company of Mills has a homepage containing besides commercial side also list of the abstracts with links to the corresponding articles related to the experimental aspects of the hydrino concept giving a brief summary about what is known about hydrinos (see `http://tinyurl.com/hajyqo6`). What has been observed are anomalous energy production and EUV radiation in 10-20 nm range taking place in certain electrolytic system and having no chemical explanation.

The proposal is that hydrogen atoms allows besides the states labelled by integer n also states labelled by inverse integer $1/n$. Ordinary states would have size proportional to n^2 and binding energy proportional to $1/n^2$. Hydrino would have sizes proportional to $1/n^2$ and binding energies proportional to n^2. There would be strange duality between binding energy and size of the orbit and it is difficult to imagine a modification of hydrogen atom making this possible. Not surprisingly, mainstream physicists do not accept the notion since it challenges the existing atomic model.

The most straightforward proof of the concept would be observation of a radiation emitted as ordinary hydrogen atom goes from ground state to hydrino state and emits radiation with energy

$E_n \simeq n^2 E_1$, where E_1 is the ground state energy $E_1 \simeq 13.6$ eV. The natural limit for binding energies corresponds to $n = 137$: in this case binding energy becomes larger than electron mass. Also more general transitions $1/n_1 \rightarrow 1/n_2$ are predicted. (see for the table of transition energies `http://tinyurl.com/zmfma79`).

These transitions are not however observed. The explanation is that they are non-radiative transitions occurring as the catalyst molecule having energy level with same energy absorbs the emitted UV photon. The proposal is that the energy from the transition $1/n \rightarrow 1/(n+1)$ and given by $(2n+1)E_1$ goes to a many-particle state formed by n hydrogen atoms and is eventually liberated as a continuum EUV radiation (see `http://tinyurl.com/glf975u`).

Skeptic can argue that if these transitions are possible, they should occur even spontaneously, and that if catalyst is indeed necessary there must be some good explanation for why this is the case. Hence the experimental support for the hypothesis is indirect and one can consider also alternative explanations.

In any case, the articles are published in refereed journals such as European Physics Journal and the claim is that energy is produced and the technology is claimed to already exist. The energy production is explained in terms of hydrino atom.

The article *Mechanism of Soft X-ray Continuum Radiation from Low-Energy Pinch Discharges of Hydrogen and Ultra-low Field Ignition of Solid Fuels* (see `http://tinyurl.com/hdzu9np`) gives an idea about the experimental side.

The article reports EUV radiation in the wavelength range 10-20 nm (62 eV-124 eV) assigned with the transition $1/n = 1/3 \rightarrow 1/4$ of hydrino atom for which the energy of the emitted quantum would be 94.2 eV. Emission in this wavelength range was observed for electrodes containing metal oxides favorable to undergo reduction to HOH (water) catalysts so that HOH catalyst would play a significant role. A low voltage high current was passed through a solid fuel comprising a source of H and HOH catalyst to produce explosive plasma and similar EUV radiation was detected. This kind EUV radiation cannot be explained in terms of any chemical reaction.

2   Is there a connection with TGD based model for cold fusion?

The experiment brings in mind the experiments of the group led by Prof. Holmlid (see the popular article at `http://tinyurl.com/nbephxb`) and the slides of the talk by Sweinn Olaffsson at `http://tinyurl.com/j3csy53`) related to cold fusion (or low energy nuclear reactions (LENR). This work is taken rather seriously by the community and the status of cold fusion has changed. Also in this case one considers electrolyte and water is in key role. Also Coulomb explosion producing plasma is involved and claimed to produce what is interpreted asa very dense phase of condensed matter consisting of string like structure with distance between hydrogen atoms given essentially by the Compton wavelength of electron.

1. In TGD framework the atomic strings of Holmlid are replaced by nuclear strings [L1] and interpreted as dark nuclei with large value of h_{eff} meaning that the Compton length of proton is scaled up to that of electron by a factor about $h_{eff}/h = 2^{11}$.

   Could the findings of Mills et al relate to the same phenomenon as the findings of Holmlid? The effective radius of the dark nucleus is 2.4×10^{-12} meters. The radius of $n = 4$ hydrino would be 3.3×10^{-12} m so that the two phenomena might have common origin.

2. Dark nuclear binding energy is liberated as dark photons as dark protons fuse to a dark nuclear string. The naive scaling of the nuclear binding energy per nucleon would mean that it is proportional to the Compton length of nucleus and thus to $h/h_{eff} = 2^{-11}$. If nuclear binding energy is taken to be of order 1 MeV one has binding energy scale 500 eV, which is about 5-10 times higher than the energies in the energy range of EUV radiation. This would suggests that hydrino does not reduce to same physical effect as cold fusion. One must be however cautious and ready to challenge both the idea about low energy nuclear reactions and about hydrino atom as such.

3. One could however consider also other values of h_{eff}/h. Assume that they come as powers of 2. If one has $h/h_{eff} = 2^{-14}$ the Compton length is 2.84×10^{-11} m to be compared with

Bohr radius 5.3×10^{-11} m. For $h/h_{eff} = 2^{-13}$ the binding energy would be about 63 eV which corresponds to the lower boundary of the energy interval. In this case the size of dark nucleus would be 4 times longer than electron Compton length. Could the phase transition take in two steps or could one have quantum criticality in TGD sense meaning that phases with several values of h_{eff} are present? Or could the experiments of Mills and Holmlid differ in that Mills detects $h_{eff}/h = 2^{13}$ case and Holmlid $h_{eff}/h = 2^{11}$ case.

4. The formation of dark proton string would give rise to emission of dark photons with nucleon binding energies of the nuclear string and its excited states formed in this manner. These dark photons are observed only if they transform to ordinary photons in the measurement volume. Their wavelength would be anomalously long - by a factor of order 2^{13} longer than the wavelength of ordinary EUV photon in wavelength range 10-20 nm and therefore in the length scale range 80 - 160 μm assignable to living cells. The transformation to ordinary photons could be by the transition $h_{eff}/h \to 1$ and absorbtion by a complex of n hydrogen atoms transforming it to continuum radiation.

5. The dark nuclei would decay eventually to ordinary nuclei and liberate ordinary nuclear binding energy. There is experimental evidence for the occurrence of this process. It is however quite possible that most of the dark nuclei leak out of the system and that the energy could be liberated in metal targets.

This if of course only a one possible model for the effect observed by Mills and TGD allows to consider also a model of hydrino based on the TGD based view about dark matter.

3 Hydrino as dark atom?

I have considered several models for hydrino in TGD context. One of them corresponds to a quantum group analog of Laguerre equation giving fractional spectrum for the principal quantum number n [K2, K1]. The spectrum would be more general than that proposed by Mills since one would have $n \to n/m$ rather than $n \to 1/n$.

The following considerations are inspired by the heretic proposal that hydrogen atom might not actually correspond to the smallest possible value of $h_{eff}/h = n$. This idea has popped into my mind repeatedly but I have dismissed it since I have felt that $h_{eff}/h = n$ hypothesis is already enough to irritate colleagues beyond the border. The phase transition $n \to n_1 < n$ scales up the binding energy spectrum by factor n/n_1 and is the simplest proposal found hitherto.

The model should explain why hydrino states are generated spontaneously but require the presence of catalyst and why the photons associated to the hydrino transitions are not detected directly but only as a continuum radiation.

1. The first guess would be that hydrino corresponds to hydrogen atom with non-standard value of Planck constant $h_{eff}/h = n_h$ assuming that ordinary hydrogen atom corresponds to the smallest value of $h_{eff}/h = 1$. The problem is that the formal substitution $h \to h_{eff} = n_h \times h$ in hydrogen atom scales down the energies by $E_n \to E_n/n_h^2$ so that they decrease instead of increasing.

   One can however make a heretic question. Does ordinary hydrogen atom really correspond to the smallest possible value of $h_{eff}/h = n_{eff}$ with $n_{eff} = 1$ and thus of $\alpha_{eff} = e^2/4\pi\hbar_{eff}$? Should one take this as a purely experimental question and remember also that in perturbative approach Planck constant does not appear in the scattering rates except in loop corrections. Therefore in the lowest order the value of h_{eff} could vary. In TGD loop corrections vanish by quantum criticality and coupling constant evolution is discretized and it could be difficult to detect the variation of h_{eff}.

2. Could the ordinary hydrogen atom actually correspond to $h_{eff}/h = n_H > 1$ and therefore to $\alpha_{eff} = \alpha_R/n_H = e_R^2/4\pi\hbar n_H$ ("R" for "real") so that one would have $\alpha_R = n_H\alpha$? The convergence of the perturbation theory would dictate the value of n_H and in only special situations smaller values of n_H would be possible. This would explain why hydrogen atom does not make a spontaneous transition to the hydrino state.

The maximal value of n_H would be $n_{H,max} = 137$ (the binding energy becomes larger than the electron mass) implying $\alpha_R \simeq 1$ for $h_{eff,R} = h/137$. For hydrino atom made possible by the presence of catalyst, the value of h_{eff} would be reduced so that the energy would be scaled up by a factor x^2: $x = h_{eff,H}/h_{eff,h} = n_H/n_h$: here "$h$" is for "hydrino". The energy spectrum would transform as $E_n/E_1 \to (n_H/n_h) \times (E_n/E_1)$ rather than $E_n/E_1 = 1/n^2 \to n^2$ as in the model of Mills. The scaling would be fractional.

3. Could this model explain why the transition to hydrino state is non-radiative? Dark photon with $h_{eff}/h = n_h < n_H$ it would have shorter wave length by factor $1/n_h$ in the range λ/n_H, $\lambda \in [10, 20]$ nm and would be observed only when transformed to ordinary photon. If the photon emitted in the transition is dark it could leak out of the system, or could be absorbed by the catalyst if the catalyst has also dark hydrogen atoms with the same value of $h_{eff}/h = n_h$. The catalyst would serve as a seed of $n_H \to n_h$ phase transitions.

4. How to understand the observed spectrum in the EUV range [10,20] nm? The transition energies for the transitions from the ground state of hydrogen atom to hydrino state would be of form

$$\frac{\Delta E}{E_1} = (\frac{n_H}{n_h})^2 - 1 \ . \tag{3.1}$$

For the transitions between hydrino states with principal quantum numbers n_1 and n_2 one would have

$$\frac{\Delta E}{E_1} = \left[(\frac{n_H}{n_{h_2}})^2 \frac{1}{n_2^2} - (\frac{n_H}{n_{h_1}})^2 \frac{1}{n_1^2} \right] = n_H^2 \left[(\frac{1}{n_{h_2}})^2 \frac{1}{n_2^2} - (\frac{1}{n_{h_1}})^2 \frac{1}{n_1^2} \right] \ . \tag{3.2}$$

If one allows fractional values n_H/n_h, it is rather easy to explain the effective continuum spectrum. One can also consider the option that the transitions are such that n_h is a divisor of n_H and more generally n_{h_2} divides n_{h_1} in the transitions of hydrinos. I have considered earlier some arguments in favor of the divisibility hypothesis but one must take them with a grain of salt. If only the range of EUV energies spanning one octave is assumed, additional conditions follow.

Here one must notice that single photon transition between ground states $n = 1$ with different values of h_{eff} is not possible without spin flip for electron so that the minimum change of n for ground state transitions without spin flip is $n = 1 \to 2$. Spin flip allows also transitions $n = 1 \to 1$. The photon emitted in $n_H \to n_h$ transition would define the EUV analog of hydrogen 21 cm line.

The simplest option corresponds to $n_H = 6$.

(a) This option satisfies also the natural constraint that Bohr radius for $n_h = 2$ hydrino is larger than electron Compton length. There are also more complex options to consider (such as $n_H = 12$ and $n_H = 2^4 = 16$) but this option seems rather unique.

(b) Spin-non-flip transition $n = 1 \to 2$ has the energy $\Delta E/E_1 = 5E_1/4$ with $\Delta E/eV = 17.0$. Primary spin-flip transitions $n = 1 \to 1$ have energies $\Delta E/E_1 \in [8, 3]$ with $E/eV \in [108.8, 40.8]$. Secondary spin-flip transition has energy $\Delta E/E_1 = 5$ giving $\Delta E/eV = 60.0$. Only 17 eV transition is outside the EUV energy range considered by Mills.

(c) This would however force to modify the conjecture that the imaginary parts for the zeros of Riemann Zeta correspond to the values of $1/\alpha_K$ assigned with electroweak U(1) hypercharge at p-adic length scales correspond to p-adic primes near prime powers of two [K3]. The prediction for α_R would be $1/\alpha_R = 22.8$. The minimal critical values of $1/\alpha_K$ would become 6-ples of the imaginary parts. Hydrino would correspond to a phase with an anomalously large value of $1/\alpha_K$ with the existence of perturbation theory possible only in special situations.

The model suggests a universal catalyst action. Among other things catalyst action requires that the reacting molecule gets energy to overcome the potential barrier making reaction very slow. If an atom - say (dark) hydrogen - in catalyst suffers a phase transition to hydrino (hydrogen with smaller value of h_{eff}/h), it liberates binding energy, and if one of the reactant molecules receives it it can overcome the barrier. After the reaction the energy can be sent back and catalyst hydrino returns to the ordinary hydrogen state. The condition that the dark binding energy is above the thermal energy gives a condition on the value of $h_{eff}/h = n$ as $n \leq 32$. The size scale of the dark largest allowed dark atom would be about 100 nm, 10 times the thickness of the cell membrane.

The notion of high energy phosphate bond is somewhat mysterious concept and manifests as the ability provide energy in ATP to ADP transition. There are claims that there is no such bond. I have spent considerable amount of time to ponder this problem. Could phosphate contain (dark) hydrogen atom able to go to the hydrino state (state with smaller value of h_{eff}/h) and liberate the binding energy? Could the decay ATP to ADP produce the original possibly dark hydrogen? Metabolic energy would be needed to kick it back to ordinary bond in ATP.

One could turn the situation upside down and ask whether the cold fusion effects could correspond to the formation of hydrino atoms in the proposed sense.

(a) h_{eff} would be reduced rather than increase in the presence of a catalyst inducing a phase transition reducing $h_{eff,H}$. In particular, could the formation of string of dark nuclei with size of electron be replaced with the formation of strings of dark hydrinos with the same size but with smaller Planck constant as for ordinary hydrogen atom? This picture would be more in spirit with that proposed by Holmlid but forces to challenge the hypothesis that cold fusion followed by the decay of dark nuclei to ordinary nuclei is responsible for the anomalous energy production.

(b) Holmlid however reports evidence for superconductivity. The reduction of the value of Planck constant and thus of Compton scale of electron does not support superconductivity.

(c) Of course, both phenomena could be involved. Hydrogen with $n_H = 6$ and hydrinos with $h_{eff}/h = n_h \in \{2,3\}]$ for electrons would have dark nuclei with $h_{eff}/h = 2^{11}$. The scaled down Bohr radius for $n_h = 2$ would be 5.9×10^{-12} m and dark proton size would be electron Compton length 2.4×10^{-12} m. For other options the Bohr radius could be smaller than the size of dark proton so that $n_H = 6$ option would be unique.

REFERENCES

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. Available at: `http://www.blacklightpower.com/techpapers.html`, 2003.

Books related to TGD

[K1] Pitkänen M. Dark Nuclear Physics and Condensed Matter. In *Hyper-finite Factors and Dark Matter Hierarchy*. Online book. Available at: `http://www.tgdtheory.fi/tgdhtml/neuplanck.html#exonuclear`, 2006.

[K2] Pitkänen M. The Notion of Free Energy and Many-Sheeted Space-Time Concept. In *TGD and Fringe Physics*. Online book. Available at: `http://www.tgdtheory.fi/tgdhtml/freenergy.html#freenergy`, 2006.

[K3] Pitkänen M. Does Riemann Zeta Code for Generic Coupling Constant Evolution? In *Towards M-Matrix*. Online book. Available at: `http://www.tgdtheory.fi/tgdhtml/tgdquantum.html#fermizeta`, 2015.

Articles about TGD

[L1] Pitkänen M. Cold Fusion Again . Available at: `http://tgdtheory.fi/public_html/articles/cfagain.pdf`, 2015.