Neutron production from an arc current in gaseous hydrogen

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Abstract

The anomalous neutron production in hydrogen gas in presence of arc currents is one of the forgotten anomalies of nuclear physics discovered for the first time already 66 years ago. The TGD based model relies on same assumptions as the model for Tesla's findings related to di-electric breakdowns, for cold fusion, and for Pollack effect. Even electrolysis would involve in an essential manner Pollack effect and new physics.

Contents

1 Inroduction

I learned about nuclear physics anomaly new to me (actually the anomaly is 66 years old!) from an article of Norman and Dunning-Davies in Research Gate (see http://tinyurl.com/y7jlhnx8). Neutrons are produced from an arc current in hydrogen gas with a rate exceeding dramatically the rate predicted by the standard model of electroweak interactions, in which the production should occur through $e - + p \to n + \nu$ by weak boson exchange. The low electron energies make the process also kinematically impossible. Additional strange finding due to Borghi and Santilli is that the neutron production can in some cases be delayed by several hours. Furthermore, according to Santilli neutron production occurs only for hydrogen but not for heavier nuclei.

In the following I sum up the history of the anomaly following closely to the representation of Norman and Dunning-Davies [C4] (see http://tinyurl.com/y7jlhnx8): this article gives references and details and is strongly recommended. This includes the pioneering work of Sternglass in 1951, the experiments of Don Carlo Borghi in the late 1960s [C2], and the rather recent experiments of Ruggiero Santilli [C5] (see http://tinyurl.com/y8nsh883).

After that TGD based model for anomalous neutron production is discussed. The model relies on same assumptions as the model for Tesla's findings [K3], for cold fusion [C1, C3] (see http://tinyurl.com/j3csy53), Pollack effect [L1] [L1] and for the anomalous production of neutrons. Even electrolysis would involve in an essential manner Pollack effect and new physics.

1.1 Experimental work

In the following the experimental support for neutron anomaly is summarized.

1.1.1 The pioneering experiment of Sternglass

The initial anomalously large production of neutrons using an current arc in hydrogen gas was performed by Earnest Sternglass in 1951 while completing his Ph.D. thesis at Cornell. He wrote to Einstein about his inexplicable results, which seemed to occur in conditions lacking sufficient energy to synthesize the neutrons that his experiments had indeed somehow apparently created. Although Einstein firmly advised that the results must be published even though they apparently contradicted standard theory, Sternglass refused due to the stultifying preponderance of contrary opinion and so his results were preemptively excluded under orthodox pressure within discipline leaving them unpublished. Edward Trounson, a physicist working at the Naval Ordnance Laboratory repeated the experiment and again gained successful results but they too, were not published.

One cannot avoid the question, what physics would look like today, if Sternglass had published or managed to publish his results. One must however remember that the first indications for cold fusion emerged also surprisingly early but did not receive any attention and that cold fusion researchers were for decades labelled as next to criminals. Maybe the extreme conservatism following the revolution in theoretical physics during the first decades of the previous century would have prevented his work to receive the attention that it would have deserved.

1.1.2 The experiments of Don Carlo Borghi

Italian priest-physicist Don Carlo Borghi in collaboration with experimentalists from the University of Recife, Brazil, claimed in the late 1960s to have achieved the laboratory synthesis of neutrons from protons and electrons. C. Borghi, C. Giori, and A. Dall'Olio published 1993 an article entitled "Experimental evidence of emission of neutrons from cold hydrogen plasma" in Yad. Fiz. 56 and Phys. At. Nucl. 56 (7) [C2].

Don Borghi's experiment was conducted via a cylindrical metallic chamber (called "klystron") filled up with a partially ionized hydrogen gas at a fraction of 1 bar pressure, traversed by an electric arc with about 500V and 10mA as well as by microwaves with 10^{10} Hz frequency. Note that the energies of electrons would be below .5 keV and non-relativistic. In the cylindrical exterior of the chamber the experimentalists placed various materials suitable to become radioactive when subjected to a neutron flux (such as gold, silver and others). Following exposures of the order of weeks, the experimentalists reported nuclear transmutations due to a claimed neutron flux of the order of 10^4 cps, apparently confirmed by beta emissions not present in the original material.

Don Borghi's claim remained un-noticed for decades due to its incompatibility with the prevailing view about weak interactions. The process $e^- + p \to n + \nu$ is also forbidden by conservation of energy unless the total cm energy of proton and the electron have energy larger than $\Delta E = m_n - m_p - m_e = 0.78$ MeV. This requires highly relativistic electrons. Also the cross section for the reaction proceeding by exchange of W boson is extremely small at low energies (about 10^{-20} barn: barn=10^{-28} m^2 represents the natural scale for cross section in nuclear physics). Some new physics must be involved if the effect is real. Situation is strongly reminiscent of cold fusion (or low energy nuclear reactions (LENR), which many main stream nuclear physicists still regard as a pseudoscience.

1.1.3 Santilli's experiments

Ruggero Santilli [C5] (see `http://tinyurl.com/y8nsh883`) replicated the experiments of Don Borghi. Santilli analyzes several alternative proposals explaining the anomalyn and suggests that new spin zero bound state of electron and proton with rest mass below the sum of proton and electron masses and absorbed by nuclei decaying then radioactively could explain the anomaly. The energy needed to overcome the kinematic barrier could come from the energy liberated by electric arc. The problem of the model is that it has no connection with standard model.

Both in the experiments of Don Carlo Borghi and those of Santilli, delayed neutron synthesis was *sometimes* observed. According to Santilli:

> *A first series of measurements was initiated with Klystron I on July 28,2006, at 2 p.m. Following flushing of air, the klystron was filled up with commercial grale hydrogen at 25 psi pressure. We first used detector PM1703GN to verify that the background radiations were solely consisting of photon counts of 5-7 $\mu R/h$ without any neutron*

count; we delivered a DC electric arc at 27 V and 30 A (namely with power much bigger than that of the arc used in Don Borghi's tests...), at about 0.125" gap for about 3 s; we waited for one hour until the electrodes had cooled down, and then placed detector PM1703GN against the PVC cylinder. This resulted in the detection of photons at the rate of 10 - 15 $\mu R/hr$ expected from the residual excitation of the tips of the electrodes, but no neutron count at all.

However, about three hours following the test, detector PM1703GN entered into sonic and vibration alarms, specifically, for neutron detections off the instrument maximum of 99 cps at about 5' distance from the klystron while no anomalous photon emission was measured. The detector was moved outside the laboratory and the neutron counts returned to zero. The detector was then returned to the laboratory and we were surprised to see it entering again into sonic and vibrational alarms at about 5' away from the arc chamber with the neutron count off scale without appreciable detection of photons, at which point the laboratory was evacuated for safety.

After waiting for 30 minutes (double neutron's lifetime), we were surprised to see detector PMl703GN go off scale again in neutron counts at a distance of 10' from the experimental set up, and the laboratory was closed for the day.

1.2 TGD based model for the neutron anomaly

The basic problems to be solved are following.

1. What is the role of current arc and other triggering impulses (such as microwave radiation or pressure surge mentioned by Santilli): do they provide energy or do they have some other role?

2. Neutron production is kinematically impossible if weak interactions mediate it. Even if kinematically possible, weak interaction rates are quite too slow. The creation of intermediate states via other than weak interactions would solve both problems. If weak interactions are involved with the creation of the intermediate states, how there rates can be so high?

3. What causes the strange delays in the production in some cases but now always? Why hydrogen gas is preferred?

The effect brings strongly in mind cold fusion (or LENR) - another process not allowed by standard model - for which TGD proposes a model [L2] in terms of generation of dark nuclei with non-standard value $h_{eff} = n \times h$ of Planck constant formed from dark proton sequences at magnetic flux tubes. The binding energy for these states replacing the scalar particle proposed by Santilli is supposed to be obtained by scaling the nuclear binding energy by $1h/h_{eff}$ and is much lower than for the ordinary nuclei. The proposal is that these nuclei decay to ordinary nuclei as the flux tubes attach to metallic targets with negative surface charge attracting positively charged magnetic flux tubes. The energy liberated would be of the essentially the ordinary nuclear binding energy. Note that the creation of dark proton sequences does not require weak interactions so that the basic objections are circumvented.

TGD explanation for anomalous neutron production could be the same for Tesla's findings [K3], for cold fusion [C1, C3] (see `http://tinyurl.com/j3csy53`), Pollack effect [L1] [L1] and for the anomalous production of neutrons. Even electrolysis would involve in an essential manner Pollack effect and new physics.

Could this model explain the anomalous neutron production and its strange features?

1. Why electric arc, pressure surge, or microwave radiation would be needed? Dark phases are formed at quantum criticality [K4] and give rise to the characteristic long range correlations via quantum entanglement made possible by large $h_{eff} = n \times h$. The presence of electron arc occurring as di-electric breakdown is indeed a critical phenomenon Already Tesla discovered strange phenomena in his studies of arc discharges but his discoveries were forgotten by mainstream.

   Also energy feed might be involved. Quite generally, in TGD inspired quantum biology generation of dark states requires energy feed and the role of metabolic energy is to excite dark

states. For instance, dark atoms have smaller binding energy and the energies of cyclotron states increase with h_{eff}/h. For instance, part of microwave photons could be dark and have much higher energy than otherwise.

Could the production of dark proton sequences at magnetic flux tubes be all that is needed so that the possible dark variant of the reaction $e^- + p \to n + \nu$ would not be needed at all?

2. If also weak bosons appear as dark variants, their Compton length is scaled up accordingly and in scales shorter than the Compton length, they behave effectively like massless particles and weak interactions become as strong as electromagnetic interactions. This would make possible a rapid decay of dark proton sequences at magnetic flux tubes to beta stable dark isotopes via $p \to n + e^+ + \nu$: there is indeed evidence that cold fusion produces only beta stable isotopes. Neutrons would be produced in the decays of the dark nuclei to ordinary nuclei liberating nuclear binding energy. Note however that TGD allows also to consider p-adically scaled variants of weak bosons with much smaller mass scale possible important in biology [K1], and one cannot exclude them from consideration.

3. The reaction $e^- + p \to n + \nu$ is not necessary in the model. One can however ask, whether there could exist a mechanism making the dark reaction $e^- + p \to n + \nu$ kinematically possible. If the scale of dark nuclear binding energy is strongly reduced, also $p \to n + e^+ + \nu$ in dark nuclei would become kinematically impossible (in ordinary nuclei nuclear binding energy makes n effectively lighter than p).

   TGD based model for nuclei as strings of nucleons [K2] [L2] connected by neutral or charged (possibly colored) mesonlike bonds with quark and antiquark at its ends could resolve this problem (if one wants to see it as a problem). One could have exotic nuclei in which proton plus negatively charged bond could effectively behave like neutron. Dark weak interactions would take place for neutral bonds between protons and reduce the charge of the bond from $q = 0$ to $q = -1$ and transform p to effective n. This was assumed also in the model of dark nuclei and also in the model of ordinary nuclei and predicts large number of exotic states. One can of course ask, whether the nuclear neutrons are actually pairs of proton and negatively charged bond.

4. What about the delays in neutron production occurring in some cases? Why not always? In the situations, when there is a delay in neutron production, the dark nuclei could have rotated around magnetic flux tubes of the magnetic body (MB) of the system before entering to the metal target, one would have a delayed production.

5. Why would hydrogen be preferred? Why for instance, deuteron and heavier isotopes containing neutrons would not form dark proton sequences at magnetic flux tubes. Why would be the probability for the transformation of say D=pn to its dark variant be very small?

   If the binding energy of dark nuclei per nucleon is several orders of magnitude smaller than for ordinary nuclei, the explanation is obvious. The ordinary nuclear binding energy is much higher than the dark binding energy so that only the sequences of dark protons can form dark nuclei. The first guess made in [L2] is that the binding energy is analogous to Coulomb energy and thus inversely proportional to the size scale of dark nucleus scaling like h/h_{eff}. One can however ask why D with ordinary size could not serve as sub-unit.

REFERENCES

Particle and Nuclear Physics

[C1] Holmlid L Badiei S, Patrik PU. Laser-driven nuclear fusion D+D in ultra-dense deuterium: MeV particles formed without ignition. *Laser and Particle Beams.* `http://tinyurl.com/pm56kk3`., 28(02):313–317, 2012.

[C2] Giori C Borghi C and Dall'Olio A. Experimental evidence of emission of neutrons from cold hydrogen plasma. *Phys. At. Nucl. AIP*, 56(7), 1993.

[C3] Holmlid L and Kotzias B. Phase transition temperatures of 405-725 K in superfluid ultra-dense hydrogen clusters on metal surfaces. *AIP Advances.* Available at: http://tinyurl.com/hxbvfc7, 6(4), 2016.

[C4] Dunning-Davies J Norman R. Hadronic paradigm reassessed: neutroid and neutron synthesis from an arc of current in hydrogen gas. *Hadronic Journal. http://tinyurl.com/y7jlhnx8*, 40:119–148, 2017.

[C5] Santilli RM. Confirmation of don borghi's experiment on the synthesis of neutrons from protons and electrons. Available at:https://arxiv.org/abs/physics/0608229, 2006.

Biology

[I1] The Fourth Phase of Water : Dr. Gerald Pollack at TEDxGuelphU. Available at: https://www.youtube.com/watch?v=i-T7tCMUDXU, 2014.

Books related to TGD

[K1] Pitkänen M. Magnetic Sensory Canvas Hypothesis. In *TGD and EEG*. In online book. Available at: http://tgdtheory.fi/public_html/tgdeeg/tgdeeg.html#mec, 2006.

[K2] Pitkänen M. Nuclear String Hypothesis. In *Hyper-finite Factors and Dark Matter Hierarchy*. In online book. Available at: http://tgdtheory.fi/public_html/neuplanck/neuplanck.html#nuclstring, 2006.

[K3] Pitkänen M. About Concrete Realization of Remote Metabolism. In *Bio-Systems as Conscious Holograms*. In online book. Available at: http://tgdtheory.fi/public_html/hologram/hologram.html#remotetesla, 2013.

[K4] Pitkänen M. Criticality and dark matter. In *Hyper-finite Factors and Dark Matter Hierarchy*. In online book. Available at: http://tgdtheory.fi/public_html/neuplanck/neuplanck.html#qcritdark, 2014.

Articles about TGD

[L1] Pitkänen M. Pollack's Findings about Fourth phase of Water : TGD View. Available at: http://tgdtheory.fi/public_html/articles/PollackYoutube.pdf, 2014.

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