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Apparent confirmation of Don Borghi's experiment on the laboratory synthesis of neutrons from protons and electrons

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Abstract

We report measurements, necessarily preliminary due to their novelty, toward the laboratory synthesis of the neutron from protons and electrons, in the hope that they are not judged via theoretical conjectures, but subjected instead to independent re-runs for their verification or denial, said process being requested by possible new clean energies so much needed by our increasing environmental problems.

NOTE: This paper was rejected by *Physics Letters, Il Nuovo Cimento* and *Physical Review Letters* with "reviews" solely based on theoretical theologies that can only be qualified as being scientifically pathetic.

1. Introduction.

The synthesis of the neutron inside stars from protons and electrons was proposed by Rutherford [1] in 1920. The existence of the neutron was experimentally confirmed by Chadwick [2] in 1932. The first experiments on attempting the laboratory synthesis of neutrons from protons and electrons were conducted in the late 1960s by C. Borghi, C. Giori C. and A. Dall'Olio at the University of Recife, Brazil [3], and it is known as the Don Borghi's experiment.

The latter tests were ignored for decades because of a number of conflicts between the neutron synthesis and quantum mechanics studied in detail by Santilli (see Ref. [4], Volume IV, Section 6.2), such as:

1) The neutron synthesis requires at least 0.78 MeV over the rest energies of the protons and the electron, in which case the Schrödinger's equation would require a "positive" binding energy (an anathema for quantum mechanics), resulting in unphysical solutions;

2) Quantum mechanics does not allow for a bound state of two particles with spin 1/2, the proton and the electron, to yield the spin 1/2 needed for the neutron;

3) Quantum mechanics does not allow the electron to be bound inside the proton for the 15 m lifetime of an isolated neutron;

4) Assuming that the above anomalies are somehow resolved, quantum mechanics does not allow a representation of the magnetic moment of the neutron from the known magnetic moments of the proton and the electron;

5) Irrespective of all p[receding anomalies, Heisenberg's uncertainty principle does not allow the electron to be permanently bound inside the proton, as it would be the case for the deuteron and other stable nuclei.

Yet, incontrovertible physical evidence establishes that the neutron is indeed synthesized from protons and electrons because stars initiate their life as being solely formed of hydrogen atoms and end their life with the synthesis of all known nuclei, thus including neutrons.

Consequently, physical reality cannot be adapted to a preferred theory such as quantum mechanics, because physics is a discipline that will never admit final theories. No matter how valid and verified a given theory may appear at a given point in time, its surpassing with a broader theory for previously unknown physical conditions is only a matter of time. At any

rate, following a vast effort by hundreds of scholars over three decades, a covering of quantum mechanics under the name of *hadronic mechanics* has already been constructed and shown to have the capability of resolving all the above anomalies 1) to 5), of course, in a preliminary way.

Hence, tests on the laboratory synthesis of neutrons from protons and electron has to be continued, also in view of environmental implications indicated in the concluding remarks. Following decades of lack of interest by various laboratories, in this note we report tests recently done by Santilli at the laboratory of the Institute for Basic Research, in Florida, by apparently confirming Don Borghi's results, thus requiring final independent verifications or denials.

2. Don Borghi's experiment.

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 500 V and 10 mA as well as by microwaves with 10^{10} s^{-1} frequency. In the cylindrical exterior of the chamber the experimentalists placed various materials suitable to be activated when subjected to a neutron flux (such as gold, silver and other substances). Following exposures of the order of weeks, the experimentalists reported nuclear transmutations due to a claimed neutron count of up to 10^4 *cps*, apparently confirmed by beta emissions not present in the original material. Note that experiment [3] makes no claim of direct detection of neutrons, and only claims the detection of clear nuclear transmutations.

3. Santilli's experiment.

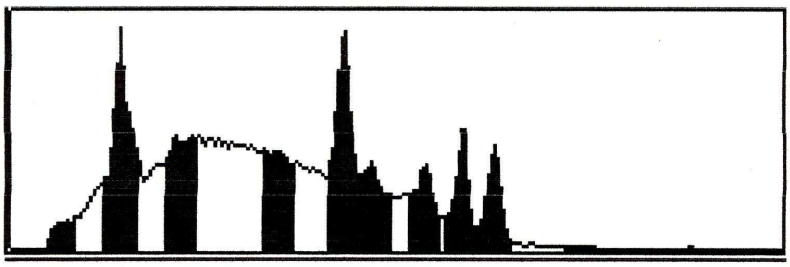
In this note we report various measurements showing that, under certain conditions, *electric arcs within a hydrogen gas generate neutral particles causing nuclear transmutations that seemingly confirm Don Borghi's experiment.* This note is solely intended to report *measurements.* All relevant plots, print-outs of the various scans, pictures and logs are reported in the web site [5] because too numerous for reporting here. Theoretical considerations are reported in the forthcoming volumes [4] jointly with a more extended presentation of the results.

As recalled above, the neutron synthesis *requires* 0.78 MeV over the sum

of the rest energies the proton and of the electron [4]. Consequently, under no scientific ground can the neutron synthesis be confused with the so-called "cold fusion," since the latter aims at the possible *production* of energy via nuclear syntheses. Alternatively, we can say that *the tests under consideration in this note deal specifically and solely with the use of protons and electrons originating from the ionization of a hydrogen gas.* Consequently, possible production of neutrons from nuclear syntheses and/or reactions do not have a direct connection with the tests herein studied and type of neutron production will not be considered at this initial stage of the studies.

Figure 1: A picture of Klystron I and of detector SAM 935. Note the similarity with the klystron used in tests [3], but also the primary differences being given by the use of metal walls for Don Borghi's tests, and transparent polycarbonate walls for Santilli's tests. The latter were selected so as to permit the visual identification of the creation of an interior electric arc with a gap between the electrodes, the latter being necessary to assure the creation of a discharge through the hydrogen gas in which absence all tests are invalid.

All tests here reported were conducted at the laboratory of the Institute for Basic Research (IBR) in Palm Harbor, Florida, with the participation of the IBR technicians Terry Allen, John T. Judy, Michael Rodriguez, Jim Alban and Ray Jones, whose professional assistance has been invaluable for the conduction of tests as well as for their detailed record and documentation [4].



PEAKS FOUND

CHN	ENERGY (keV)	GROSS CPM	AMBIENT CPM	CONTINUUM CPM	NET CPM %	UNC
16	27.0	22122	972	16148	5002 ± 4.25	
37	97.9	132198	8006	65824	58368 ± 0.89	
56	194.8	106786	7284	92488	7014 ± 6.70	U235s
87	424.4	90276	3602	85558	1116 ± 38.5	
110	646.5	128710	2760	68672	57278 ± 0.89	Cs137
118	739.9	67746	2180	60060	5506 ± 6.74	
137	974.9	60834	2026	40820	17988 ± 1.96	U238
149	1143.5	65446	1142	26070	38234 ± 0.95	Co60
160	1305.5	52112	860	16148	35104 ± 0.92	Co60
189	1819.3	4388	122	3498	768 ± 12.3	
210	2246.2	1542	20	1352	170 ± 32.8	
224	2543.3	1706	26	550	1130 ± 5.19	

2 OF 2 LIBRARY LINES FOR Co60 FOUND Correlation = 1.00

LINE	PEAK	INTENSITY	NET CPM
1173.2	1143.5	99.90	38234
1332.5	1305.5	99.98	35104

1 OF 1 LIBRARY LINES FOR Cs137 FOUND Correlation = 0.80

LINE	PEAK	INTENSITY	NET CPM
661.7	646.5	90.00	57278

1 OF 1 LIBRARY LINES FOR U235s FOUND Correlation = 0.80

LINE	PEAK	INTENSITY	NET CPM
185.7	194.8	57.00	7014

1 OF 1 LIBRARY LINES FOR U238 FOUND Correlation = 0.80

LINE	PEAK	INTENSITY	NET CPM
1001.0	974.9	2.00	17988

NUCLIDES NOT PRESENT:

2 OF 3 LIBRARY LINES FOR U233 FOUND Correlation = 0.58
2 OF 3 LIBRARY LINES FOR Ra226 FOUND Correlation = 0.05
0 OF 1 LIBRARY LINES FOR Am241 FOUND Correlation = 0.00
0 OF 7 LIBRARY LINES FOR Eu152 FOUND Correlation = 0.00
0 OF 0 LIBRARY LINES FOR Name FOUND Correlation = 0.00

LINES NOT ASSOCIATED WITH ANY NUCLIDE:

Energy	Net CPM	Eff Corrected	
27.0	5002.0	44976.7	C
97.9	58368.0	224471.0	C

Figure 2: Reproduction of the print out of a typical scan of detector SAM 935 when under neutron alarm (see web site [5] for additional samples of the large number of scans available.

Radiation counts were done via:

1) A photon-neutron detector model $PM1703GN$ manufactured by Polimaster, Inc., with sonic and vibration alarms as well as memory for printouts, with the photon channel activated by CsI and the neutron channel activated by LiI;

2) A photon-neutron detector SAM 935 manufactured by Berkeley Nucleonics, Inc., with the photon channel activated by NaI and the neutron channel activated by $He-3$ also equipped with sonic alarm and memory for printouts of all counts;

3) A BF^3 activated neutron detector model 12-4 manufactured by Ludlum Measurements, Inc., without counts memory for printouts;

4) An alpha, beta, gamma and X-ray detector model 907-palmRAD manufactured by Berkeley Nucleonics, Inc.; and

5) Various material suiotable for nuclear transmutations.

Electric arcs were powered by welders manufactured by Miller Electric, Inc., including a Syncrowave 300, a Dynasty 200, and a Dynasty 700 capable of delivering an arc in DC or AC mode, the latter having frequencies variable from 20 to 400 Hz.

The following three different klystrons were manufactured (see website [5] for pictures and scans not reproduced here for brevity):

I) A sealed cylindrical klystron of about 6" outside diameter (OD) and 12" height made of commercially available, transparent, PolyVinyl Chloride (PVC) housing along its symmetry axis a pair of tungsten electrodes of 0.250" OD and 1" length fastened to the tip of 0.250" OD conducting rods protruding through seals out of the top and bottom of the klystron for electrical connections. The electrodes gap was controllable by sliding the top conducting rod through the seal of the flange. The PVC was selected to be transparent so as to allow a visual detection of the arc.

II) A rectangular, transparent, PVC klystron 3" $\times$ 3" $\times$ 6" filled up with commercial grade hydrogen at atmospheric pressure and temperature traversed by a 2" long electric arc powered by a standard Whimshurst electrostatic generator.

III) A cylindrical metal klystron fabricated in schedule 80 carbon steel pipe with 12" OD, 0.5" wall thickness, 24" length and 3" thick end flanges capable of withstanding hydrogen pressure up to 500 psi with the internal arc between thoriated tungsten electrodes controlled by outside mecha-

nisms.

A first series of measurements were initiated with Klystron I on July 28, 2006, at 2 p.m. Following flushing of air, the klystron was filled up with commercial grade hydrogen at 25 *psi* pressure. We first used detector $PM1703GN$ to verify that the background radiations was 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 [2a]), 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 $10-15$ $\mu R/h$ 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 m (double neutron's lifetime), we were surprised to see detector $PM1703GN$ 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.

Inspection of the laboratory the following morning indicated no neutron detection in the general area, but detector $PM1703GN$ showed clear neutron counts when placed next to the PVC wall. The same detections persisted for two subsequent days until the hydrogen was flushed out of the chamber.

The test was repeated the afternoon of August 4, 2006, with the welder operating in AC mode at 30 V and 30 A plus a transformer that allowed to deliver an arc with 700 V and 1.2 A for 5 s with a gap of about 0.375". We waited again until the incandescence of the tips was extinguished and placed detector $PM1703GN$ near the cylindrical PVC wall, resulting in sonic and vibrational alarms much sooner and definitely bigger than those of the first test with DC arc requiring, again, the evacuation of the laboratory.

Alarm, neutron	9/2/2006/10:50:00 AM	53 Cps
Alarm, neutron	9/2/2006/10:56:00 AM	58 Cps
Alarm, neutron	9/2/2006/10:57:00 AM	34 Cps
The device off	9/2/2006/10:58:00 AM	
The device on	9/3/2006/3:05:00 AM	
Alarm, neutron	9/3/2006/3:05:00 AM	1 Cps
Alarm, neutron	9/3/2006/3:05:00 AM	1 Cps
Calibration	9/3/2006/3:06:00 AM	
Alarm, neutron	9/3/2006/3:07:00 AM	99 Cps
Alarm, neutron	9/3/2006/3:07:00 AM	99 Cps
Alarm, neutron	9/3/2006/3:08:00 AM	99 Cps
Alarm, neutron	9/3/2006/3:09:00 AM	99 Cps
Alarm, neutron	9/3/2006/3:10:00 AM	99 Cps
Alarm, neutron	9/3/2006/3:10:00 AM	99 Cps
Alarm, neutron	9/3/2006/3:11:00 AM	99 Cps
Alarm, neutron	9/3/2006/3:13:00 AM	99 Cps
Alarm, neutron	9/3/2006/3:13:00 AM	99 Cps
Alarm, neutron	9/3/2006/3:17:00 AM	99 Cps
Alarm, neutron	9/3/2006/3:17:00 AM	99 Cps
The device off	9/3/2006/3:17:00 AM	
The device on	9/3/2006/5:53:00 AM	
Alarm, neutron	9/3/2006/5:54:00 AM	1 Cps
Calibration	9/3/2006/5:54:00 AM	
Alarm, neutron	9/3/2006/5:54:00 AM	99 Cps
Alarm, neutron	9/3/2006/5:58:00 AM	99 Cps
Alarm, neutron	9/3/2006/5:59:00 AM	99 Cps
Alarm, neutron	9/3/2006/5:59:00 AM	99 Cps
Alarm, neutron	9/3/2006/5:59:00 AM	99 Cps
Alarm, neutron	9/3/2006/6:00:00 AM	99 Cps
Alarm, neutron	9/3/2006/6:02:00 AM	99 Cps
Alarm, neutron	9/3/2006/6:03:00 AM	99 Cps
Alarm, neutron	9/3/2006/6:04:00 AM	99 Cps
Alarm, neutron	9/3/2006/6:05:00 AM	99 Cps
The device off	9/3/2006/6:05:00 AM	
The device on	9/3/2006/7:45:00 AM	
Alarm, neutron	9/3/2006/7:46:00 AM	1 Cps
Calibration	9/3/2006/7:46:00 AM	
Alarm, neutron	9/3/2006/7:48:00 AM	99 Cps
Alarm, gamma	9/3/2006/7:58:00 AM	18 uR/h
Alarm, gamma	9/3/2006/8:03:00 AM	7 uR/h
Alarm, gamma	9/3/2006/8:03:00 AM	11 uR/h
Alarm, neutron	9/3/2006/8:04:00 AM	37 Cps
The device off	9/3/2006/8:09:00 AM	
The device on	9/3/2006/8:09:00 AM	
Alarm, neutron	9/3/2006/8:09:00 AM	1 Cps
Alarm, neutron	9/3/2006/8:09:00 AM	1 Cps

Figure 3: Reproduction of the print out of a typical scan of detector $PM1703GN$ when under neutron alarm. Note the separation of the background as well as of gamma detections from neutron detections (see, again, web site [5] for numerous additional print-outs).

Most significantly, detector $PM1703GN$ would repeatedly go into sonic and vibrational photon alarms when placed against the cylindrical PVC wall up to three weeks following the last activation of the arc, namely, after a period of time excluding residual atomic excitations, thus confirming nuclear reactions.

During the preceding tests detector SAM 935 was used for a verification of the readings of $PM1703GN$ with rather puzzling results. In fact, detector SAM 935 did show clear detections of apparent neutrons via counts clearly above the background of 0.10 cps, but such counts had no comparison with the continuous neutron alarms of detector $PM1703GN$ (see the scans in [4]).

The settlement of this ambiguity delayed the completion of the tests for a few months due to the need for the proper selection and reception of a third detector. Following various theoretical studies, we selected and secured the BF^3 activated detector 12-4, namely, a neutron detector activated by nuclei *heavier* than the $He-3$ of SAM 935 and the $Li-7$ of detector $PM1703GN$. Following its arrival, confirmation of the background, and placement next to Klystron I operated as in the above reported first tests. detector 12-4 showed no neutron count at all for the entire day of the test. However, the following morning, after manually impacting the klystron, detector 12-4 showed apparent neutron counts at the rate of 50 cps for about one hour duration, namely a count much bigger than that by SAM 935 (as predicted, see below). A second impacting of the klystron produced identical results.

A second series of measurements were initiated with Klystron II on August 8, 2006. Repeated tests produced no neutron detection. To simulate the "trigger" needed for the neutron synthesis [4], the test was repeated the following morning with an implosion due to the contamination of the chamber with air and the resulting $H-O$ combustion triggered by the arc. Despite the rudimentary nature of the equipment, this implosion caused, by far, the biggest neutron alarms in detector $PM1703GN$ due to off-scale *cps* without any appreciable photon detection, as confirmed and documented by the print-outs [5]. The laboratory was evacuated again for the rest of the day, residual counts persisted for days, and the test was not repeated for safety.

A third series of tests was initiated on December 20, 2006, with Klystron III filled up with commercial grade hydrogen at 100 psi, but the tests were

quickly terminated for safety due to an excessive number of counts by the various detectors as well as the virtually instantaneous disintegration of the tips of the thoriated tungsten electrodes. All tests were then systematically re-runs a number of times in 2007 with full confirmation of the results. Independent reruns have been requested elsewhere.

Following completion of the tests, the detectors were returned to their manufacturers for control; they were verified to operate properly; and the printout of all readings stored in their memory was released [5] confirming the measurements reported above.

Systematic reruns of the tests in early 2007 confirmed all the above detections, including in particular their anomalous behavior. However, all tests producing protracted off scale neutron alarms, such as those with implosion or at 100 psi hydrogen gas, were not repeated for safety.

No meaningful counts were detected with the above identified klystrons in using various gases other than hydrogen, although this should not exclude possible similar effects under sufficiently more powerful arcs. No neutron, photon or other radiation was measured from electric arcs submerged within liquids. Hence, the data herein reported appear to be specific for electric arcs within a hydrogen gas under the indicated conditions.

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4. Don Borghis Hypothesis of Neutroids.

The above measurements can be summarized by stating that an electric discharge within a hydrogen gas at a few psi pressure and atmospheric temperature (as above described) produces "entities" that:

1) Are not hydrogen atoms (because in that case no nuclear transmutation would be conceivably possible);

2) Have dimensions of the order of 1 fm as for all hadrons (otherwise the detectors would show no counts);

3) Are neutral (otherwise they would not move through walls);

4) Are stable for hadron standards (more accurate data being grossly premature at this writing);

5) Remain initially confined within the arc chamber under steady conditions, to slowly exit, except for the case of production under implosion causing rapid propagation;

6) Are generally released hours following the tests, with anomalous

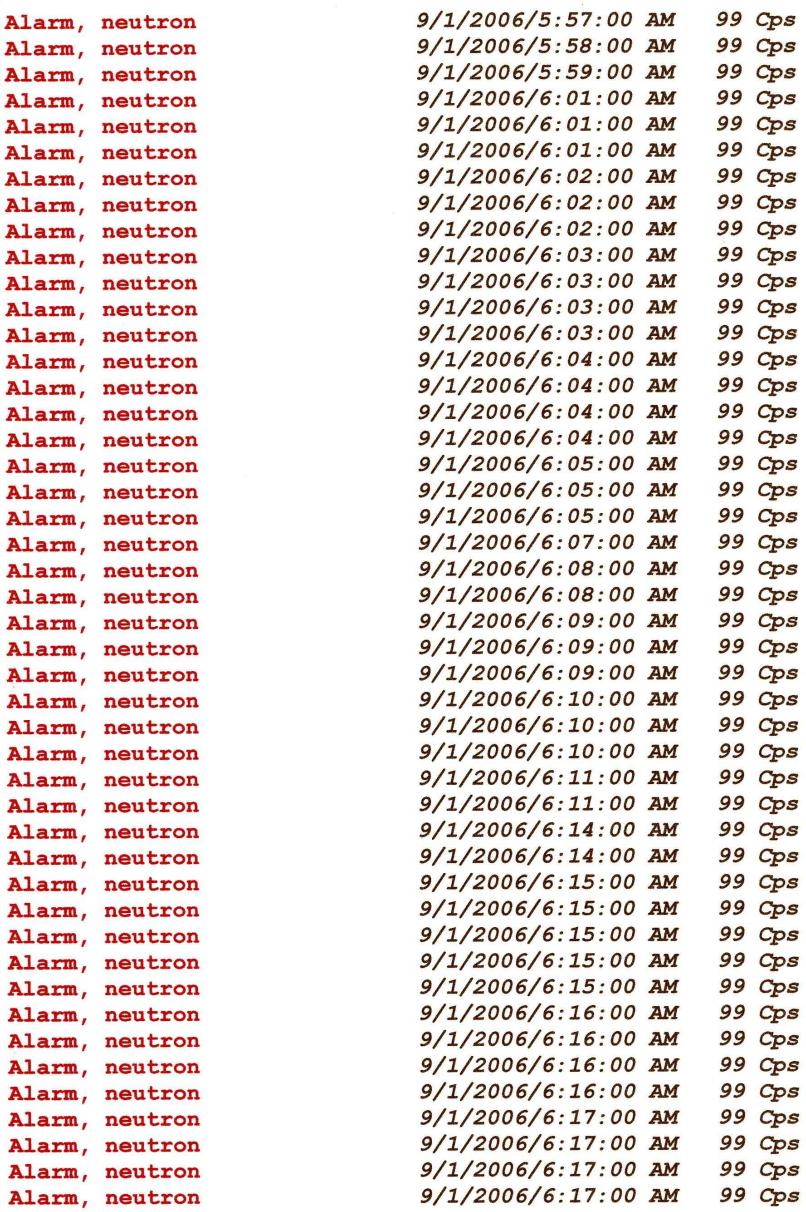

Figure 4: Reproduction of the print-out of a typical scan of detector $PM1703GN$ when under one of the continuous neutron alarms that required evacuation of the laboratory. Note the off-scale and duration of the alarm that dismisses as nonscientific other interpretations.

counts lasting for weeks;

7) Are not necessarily neutrons (otherwise we would have ordinary neutrons detections).

In fact, *all detectors systematically behaved in an anomalous way,* namely, in a way different than that for direct neutron detection as defined by the manufacturers of the equipment. This is clearly illustrated by a kind of "detectors self-activation" since detector $PM1703GN$ entered into neutron alarm with no photon count while driving miles away from the test at about 15 m following exposure to Klystron I. The anomalous behavior was confirmed with reruns in different directions from the lab via the use of detector $PM1703GN$. The other detectors also showed similar anomalous behavior, although with different delay tines.

A plausible interpretation is that the tests produced "entities" other than neutrons that were absorbed by nuclei of the detectors, then causing nuclear transmutations that, following a delay time, produced ordinary neutrons. In different words, the delayed detections here reported for Klystron I do indeed refer to actual neutrons, although originating from nuclear transmutations caused by the original emissions, and not necessarily from the original emission itself.

In view of similar anomalies, Don Borghi and his collaborators [3] introduced the name of *neutroids* for the entities" produced inside the klystron (see Lino Daddi's historical account [6]). We believe that the differentiation between neutrons and neutroids is an appropriate working hypothesis deserving further study. Hence, under steady conditions, thus excluding implosions and other impact events, we assume that an electric arc within a hydrogen gas at a few psi pressure and atmospheric temperature produces new particles called neutroids and denoted with the symbol $\tilde{n}$, having the values (in nuclear units) $A = 1, Z = 0, J = 0, m = 0.008amu$, and we shall write

$$p^+ + e^- \ \rightarrow \ \tilde{n}(1, 0, 0, 1.008). \tag{1}$$

The rest energy of the neutroids is assumed as being that of the hydrogen atom since, in atomic mass units 1 $amu = 931.49MeV$, we have $m_p = 938.27MeV = 1.0078\ amu, m_e = 0.511MeV = 0.0005\ u,\ m_p + m_e \approx 1.008amu$ and the $p - e$ binding energy of Coulomb nature is excessively small for our approximation, being of the order of $10^{-3}MeV$). Note that the value $J = 0$ is assumed for the primary purpose of indicating that the total

angular momentum is assumed as being conventional, thus not excluding integer values requiring separate study not considered at this time.

Our tentative interpretation at this limited level of our knowledge is that, the geometry of the electric arc is quite conducive to processes causing the synthesis of neutron-type particles. By recalling that the magnetic field created by an electric arc is directly proportional to the current and inversely proportional to the distance, in the conditions of Santilli's tests , protons and electrons are exposed to magnetic field with an intensity of the order of 10^8 G when at atomic distances from the arc.

Under so powerful a magnetic field, the geometry of the electric arc first aligns protons and electrons with opposing magnetic moments along the tangent to the local magnetic force. Subsequently, the same geometry is predicted to cause protons and electrons to collapse into a neutral, hadron-size particle due to the very strong Coulomb attractions at short distances of both, opposite charges and opposite magnetic polarities and other reasons (Figure 5).

Quite intriguingly, we cannot exclude the possibility that some of the entities produced by the arc are ordinary neutrons. In fact, the behavior of all detectors for the case of the tests with implosion caused by hydrogen combustion was fully normal and, in particular, without self-activated delayed detection, thus suggesting the production of ordinary neutron.

Similarly, the off-scale neutron alarms with no photon detection were so intense for the tests with klystron III at 100 psi hydrogen gas, that the direct production of neutrons simply cannot be excluded at this writing. The point is that the joint production of a kind of "intermediate" particle between the hydrogen atom and the neutron cannot be excluded either.

Also, at this stage of our quite limited knowledge, we cannot exclude that the addition of high frequency microwaves and related resonances may have caused the production of neutrons in the original experiment by Don Borghi and his collaborators [3]. Note that detectors suitable to identify whether the transmutations originated from the actual production of neutrons, or they originated from neutroids, were not available for tests [116].

Whatever is their interpretation, we can state that *Santilli's experiment herein reported confirms Don Borghi's experiment [3] because the former tests detected nuclear transmutations on various substances placed in the vicinity of the klystrons, which transmutations are the main claim of Ref.*

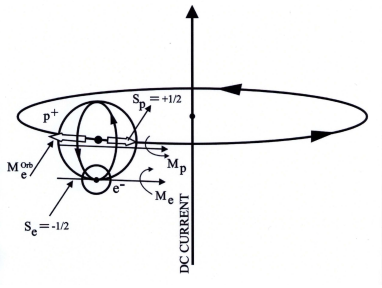

Figure 5: A schematic view of the neutroids expected from the collapse of the electron into the proton structure following the alignment of their magnetic dipoles due to very strong, attractive, electric and magnetic Coulomb forces at $1F$ mutual distances due to opposing charges and magnetic polarities. Note that the coupling is in singlet, as necessary for any bond, and it is of axial character, namely, the spin of the proton and of the electron are initially aligned along a single symmetry axis. Following penetration inside the proton, the electron is expected to acquire conventional integer angular momenta, along the lines of Figure 6.23.

[4]. To be scientific, different views should provide a *quantitative* elaboration of the differences between the two tests, namely, should *prove* that the nuclear transmutations of Santilli's tests are incompatible with those of Don Borghi's tests.

5. Continuous Creation in the Neutron Synthesis?

The incompatibilities of the neutron synthesis with quantum mechanics indicated in Section 1 are studied in Ref. [4]. The issue addressed in this section is: *where is the missing energy of* 0.78 MeV *originating from?* Evidently, there are only three possible answers [7]:

1) The missing 0.78 MeV are provided by the relative kinetic energy of the proton and the electron. However, in this case the $p - e$ cross section is very small (of the order of 10^{-20} $barns$). Consequently, any possible synthesis of the proton and the electron at 0.78 MeV kinetic energy is virtually impossible.

2) The missing 0.78 MeV originate from the environment surrounding the neutron synthesis. This possibility is quite plausible for the synthesis of

the neutron in the core of stars, where all needed energy is indeed available. However, the environment of both Don Borghi's and Santilli's tests cannot provide the missing 0.78 MeV (in ways other than the relative kinetic energy) due to the very low density of the hydrogen gas and other reasons.

3) The missing 0.78 MeV originate from the aether as a universal substratum with very high energy density, as conjectured, apparently for the first time, by santilli [7]. This third alternative essentially identifies in the neutron synthesis a concrete possible realization of the old hypothesis of continuous creation of matter in the universe. For brevity, we refer the study of the latter possibility to Refs. [4,6].

The reader can now understand the scientific caution permitted by the neutroid hypothesis, since the latter avoids the energy, spin and other (but not all) quantum anomalies. In this view, the transition from neutroids to actual neutrons could be performed by ordinary nuclei following their absorption of the neutroids.

6. Interpretation of Don Borghi and Santilli Detections

The idea that the experimentalists of tests [3] (two of whom being Catholic priests) have lied in their claims, is simply ludricous. Hence, in this note we assume that the claims of Ref. [3] are true, namely, that the various substances placed in the exterior of the klystron experienced nuclear transmutations caused by *neutrons.*

Needless to say, it is unknown as to whether said neutrons originated from the interior of the klystron, or from the klystron walls, or from the activated substances themselves.

In the hope (but not the certainly) of achieving an interpretation of measurements [3] by avoiding the continuous creation of matter in the universe, we assume that neutrons are synthesized by nuclear furnaces, namely, *we assume that neutroids are turned into neutrons when absorbed by nuclei,* and we shall write

$$\tilde{n}(1,0,0,1.008) + a \ \rightarrow \ n(1,0,1/2,1.008), \tag{2}$$

where a is the *aetherino* of Ref. [7], namely, the entity representing the transfer of physical quantities from the aether to the neutron synthesis, quantitatively representable via s structural lifting of quantum mechanics [4]. It should be indicated that the aetherino hypothesis does not exclude

the use of neutrinos for reaction (2). However, the alternative of aetherinos vs neutrinos cannot possibly be discussed in this note. Hence, we shall leave the selection to the preference by individual readers since such a selection is inessential for the rest of this note in any case.

It appears that the above assumption is sufficient alone, to represent Don Borghi's data [3], of course, following comprehensive additional experimental studies. To initiate this study, we assume the usual symbol $N(A, Z, J, amu)$ for ordinary nuclides as currently known, and the symbol $\tilde{N}(A, Z, J, amu)$ for possible anomalous nuclides, namely, nuclides following the absorption of a nucloid not existing in available data, here called *nuclidoids*. We also assume that the binding energy of the neutroids is similar to that of an ordinary nucleon (e.g., $BE = 0.0002\ u$ for the deuteron), which assumption is a direct consequence of conversion (2). Then, for the case of gold, we have

$$Au(197, 79, 3/2.196.966) + \tilde{(}1, 0, 0, 1.008) + a \ \rightarrow \ Au(198, 79.2, 197.972), \quad (3)$$

and, similarly, one recovers other conventional activation processes.

By comparison, the application of the above assumption to the steel casing of Don Borghi klystron yields an unknown nuclidoid

$$Fe(57, 26, 1/2, 56.935) + \tilde{n}(1, 0, 0, 1.008) + a \ \rightarrow \ \tilde{Fe}(58, 26, 1, 57.941) \quad (4)$$

since the tabulated nuclide is $Fe(58, 26, 0, 57.933)$.

Needless to say, the anomalous nuclide $\tilde{Fe}(58, 26, 1, 57.941)$ is expected to be highly unstable and decay in a variety of possible modes, although they do not appear to provide the source of neutrons necessary to represent Don Borghi data.

In the preceding section, we have assumed that the neutrons were not synthesized in the interior of the klystron to prevent the direct acceptance of the continuous creation of matter in the universe. Then, reaction (4) excludes that the neutrons in Don Borghi experiment were synthesized in the walls of his klystron and confirms, quite preliminarily of course, that the neutrons were synthesized by the activating substances themselves.

Hypothesis (2) can also interpret some of Santilli detections, with the understanding that the anomalous behavior of the detectors, such as the delayed neutron counts, requires additional experimental studies and perhaps the admission of some additional event not clearly manifest in Don

Borghi's tests. To initiate the study, we have the first possible reaction

$$H(1,1,1/1,1.008) + \tilde{n}(1,0,0,1.008) + a \ \rightarrow \ H(2,1,1,2.014) \qquad (5)$$

namely, we have the prediction that, under transmutation (2), the coupling of a neutroid by a proton creates the ordinary deuteron (see Ref. [4], Vol. IV, Section 6.3, for details). Reaction (5) Indicates that the hydrogen content in the klystron as well as in the polycarbonate walls of Santilli's tests cannot possibly be considered a source of the detected neutrons.

Said polycarbonate contains about 75 % carbon, in which case we have the tentative reaction

$$C(12,6,0,12.000) + \tilde{n}(1,0,0,1.008) + a \ \rightarrow$$

$$\rightarrow \ \tilde{C}(13,6,1/2,13.006) \equiv C(13,6,1/2,13.003) + \gamma, \qquad (6)$$

that excludes said carbon as being a primary source of the detected neutrons.

Finally, said polycarbonate contains about 18.88 % oxygen for which we have the reaction yielding an unknown nuclidoid

$$O(16,8,0,16.000) + \tilde{n}(1,0,0,1.008) + a \ \rightarrow \ \tilde{O}(17,8,1/2,17.006), \qquad (7)$$

because the known nuclide is $O(17,8,5/2,16.999)$. The latter reaction too is not expected to provide the neutron counts detected by Santilli.

In summary, in Santilli's experiment too, it does not appear that the detected neutrons are synthesized in the interior of the klystron or by the klystron walls. This leaves as the only residual possibility that the neutrons are synthesized by the detectors themselves. To study this possibility we consider the reaction for the He_3-activated detector

$$He(3,2,1/2,3.016) + \hat{n}(1,1,0,1.008) + a \ \rightarrow$$

$$\tilde{He}(4,2,1,4.023) + EC \rightarrow He(4,2,0,4.002) + \gamma, \qquad (8)$$

in which, as one can see, the detection of the neutroids is anomalous, if any.

Next, we have the reaction for the Li-activated detectors

$$Li(7,3,3/2,7.016) + \hat{n}(1,1,0,1.008) + a \ \rightarrow Li(8,3,2,8.022) \ \rightarrow$$

$$\rightarrow \ Be(8,4,0,8.005) + e^{-} \ \rightarrow \ 2\alpha, \tag{9}$$

that do indeed behave in a way equivalent as to whether the detection refers to neutroids or neutrons.

Finally, for the base of B-activated detectors we have the reaction

$$B(10,5,3,10.012) + \hat{n}(1,0,0,1.008) + a \ \rightarrow \ \tilde{B}(11,5,5/2,11.018)$$

$$\rightarrow C(11,6,3/2,11.011) + e^{-} + \gamma, \tag{9}$$

that does not appear to behave normally under a flux of neutroids.

From the above reactions we can see a plausible explanation of the reason for the $Li-7$ activated detector as being the best for Santilli's experiment, and that's the reason for mandating the use of Li-activated detector for any reruns of Santilli's experiment. By comparison, the above reactions show a plausible reason for the He_3- as well as B-activated detectors as being the least active of all in Santilli's tests.

In summary, we can say that *the neutrons detected in Don Borghi experiment [3] were apparently synthesized by the nuclei of the activated substances, while the neutrons of Santilli experiment were primarily synthesized by the detectors themselves, either by their activating substance, or by their casing, the latter expected to be the origin of the delayed detection.* Evidently, the explanation of the large, delayed, neutron counts by the BF^3 activated detector requires an experimental study of the absorption by its plastic casing that cannot be possibly done in this initial study.

7. Concluding Remarks

In closing, the reader is warned against superficial conclusions, no matter how appealing or plausible, because we are dealing with a physical event that, despite its most fundamental character, has been vastly ignored by the physics community for over half a century. In fact, we remain with the possibility that *in Santilli's experiment, the neutroids are produced in clusters,* something reminiscent of electron clusters, but deeply connected to the new chemical species of heavy hydrogen presented in Ref. [4], Volume V, Chapter 10 in particular. Regrettably, we cannot study this aspect at this time.

The latter possibility is here indicated because it would provide a clear explanation of the large neutron counts experienced by Santilli, so intense

to force various evacuations of the laboratory. It is easy to see that, if neutroids are absorbed by stable elements in clusters such as $\tilde{n}\times\tilde{n}$, $\tilde{n}\times\tilde{n}\times\tilde{n}$, following their conversion into neutrons by nuclei they would result in an excess of neutrons corrected by nature with neutron emission. In this case, all substances near the experiment, whether the walls of the klystron or the substances composing the detectors, would become a source of the detected neutrons.

A reason for suspecting the creation of neutroids in clusters in Santilli's rather than in Don Borghi's experiment is due to the much bigger power of the electric arc used by Santilli's as compared to that in Don Borghi's tests, as well as by a number of anomalous features of sufficiently powerful electric arcs, one of which is a radial compression of polarized structures, whether atoms or hadrons, toward the arc, thus naturally creating clusters.

The reader should be finally aware that the neutron synthesis studied in this note is an intermediary step toward the complementary topic currently attracting significant industrial investment , the possibility of stimulating the decay of the neutron, since in the latter case we would have the *release* of about 0.78 MeV, with a number of environmental implications, including the possibility of stimulating the decay of nuclear waste [4].

We should recall in the latter respect that all possible forms of energy permitted by quantum mechanics were fully identified by the middle of the past century and they all result to be environmentally unacceptable for one reason or another. Hence, we have a societal need to seek energies and fuels that, to be new and clean, are expected as being beyond quantum doctrines. The industry has already initiated investments in their search. It is hoped that academia does not elect to remain behind just because of attachment to quantum doctrines for conditions they are known to be inapplicable.

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