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Experimental confirmation of the synthesis of neutrons and neutroids from a hydrogen gas

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Abstract

In this paper, we outline preceding mathematical, theoretical and experimental studies on the synthesis of neutrons from a hydrogen gas, and present additional systematic experimental confirmations via the use of three different neutron detectors. We also present experimental evidence of the existence of an intermediate bound state of a proton and an electron with spin zero known as the neutroid. A number of industrial applications currently under development by Thunder Energies Corporation are pointed out.

1. THE SYNTHESIS OF THE NEUTRON

H. Rutherford [1] suggested in 1920 that the hydrogen atom in the core of stars is “compressed” into a new neutral particle which he called the *neutron*

$$p^+ + e^- \rightarrow n. \tag{1.1}$$

The existence of the neutron was experimentally confirmed by J. Chadwick in 1932 [2]. E. Fermi [3] suggested the addition in the neutron synthesis of a massless and chargeless particle which he called *neutrino* (meaning “little neutron” in Italian), in order to conserve the angular momentum

$$p^+ + e^- \rightarrow n + \nu, \tag{1.2}$$

with spontaneous decay (when the neutron is isolated) of 15 minutes

$$n \rightarrow p^+ + e^- + {}^-\nu, \tag{1.3}$$

where ν^- is the *antineutrino.*

R. Norman [4] has conducted a historical search in the field by identifying an original letter in which W. Pauli suggested the addition of a new particle with spin ½ later named as the “neutrino” by Fermi, at the suggestion of Amaldi. Additionally, Ref. [4] outlines three experimental, tests on the synthesis of neutrons from a hydrogen gas, the first by Ernest J. Sternglass in 1951 (including his interesting letter to A. Einstein), the second tests were done by E. Trounson in 1952, and the third tests were done by Don Carlo Borghi and his associates in the 1960’s.

None of the above tests were conducted with neutron detectors, evidently because they were not available at the time and as will become clear the reported synthesis of neutrons was in fact indirect evidence, those neutrons being secondarily created and detected via nuclear transmutations within natural elements placed around the reactors. None of the initial three tests were published because they all implied that the neutron is in fact a conventional quantum mechanical bound state of a proton and an electron, a theoretical stance view which is known to be inconsistent with accepted theory.

Beginning with the late 1970’s, R. M. Santilli has conducted systematic, mathematical, theoretical, and experimental studies on the synthesis of neutrons from a hydrogen gas [6-30]. As a result of these studies, the U. S. publicly traded company *Thunder Energies Corporation* (thunder-energies.com) is now offering production and sale of a *Thermal Neutron Source* (TEC-TNS) providing the controlled production of neutrons when desired from a commercially available hydrogen gas.

To briefly outline the latter developments, Santilli first identified the mathematical methods needed for the representation of the neutron synthesis known as *isomathematics* [5-9] (see also independent studies [10-15]). He then constructed the corresponding physical methods known as *isomechanics* as a branch of *hadronic mechanics* and showed its validity for the representation of the class of systems under the conditions considered [14-16]; then reached the representation of ”all” characteristics of the neutron in its synthesis from the hydrogen at the non-relativistic [17,18] and relativistic [19.20] levels; and then conducting systematic experiments on the synthesis of neutrons from a hydrogen gas by achieving the first known direct detection of synthesized neutrons via neutron detectors [21-26]. (See the reviews [27-30]).

The main difficulty addressed in these studies stemmed from the fact that *the rest energy of the neutron is “bigger” than the sum of the rest energies of the proton and the electron,*

$$E_p = 938.272\ MeV,\ E_e = 0.511\ MeV,\ E_n = 939.565\ MeV, \tag{1.4}$$

resulting in the *neutron mass excess*

$$E_n - (E_p + E_e) = 0.782\ MeV > 0. \tag{1.5}$$

Under the above conditions, the Schrödinger equation remains exactly valid for an electron orbiting in a vacuum at large distances around the proton (exterior dynamical problem), but it does not yield physically consistent results for the same electron when “compressed” within the hyperdense medium inside the proton (interior dynamical problem)

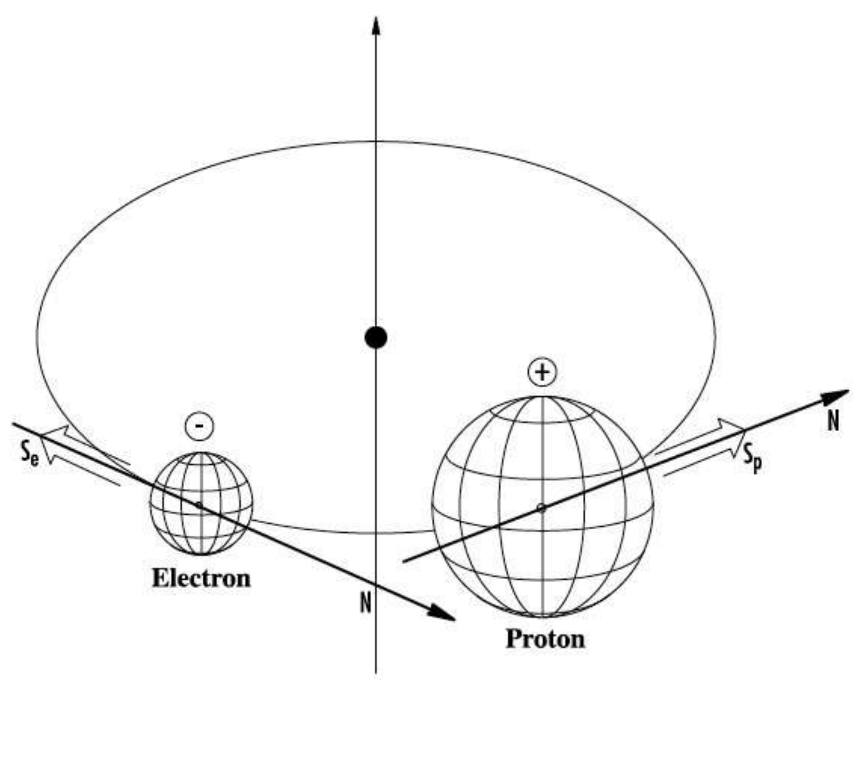


Figure 1:

due to numerous reasons, such as: quantum mechanics requires the necessary approximation of the proton as a massive point, in which case the electron cannot be “compressed” within its interior; the neutron synthesis would require a “positive binding energy” with ensuing “mass excess” there is due to the emergence of the electron within the proton a set of new interior dynamical problems of non-linear, non-local and contact types, hence necessitating non-Hamiltonian interactions; and other reasons beyond any descriptive capacity of quantum mechanics.

Similarly, special relativity at large, and Dirac’s equation in particular, remains exactly valid for the structure of the hydrogen atom, although they become inapplicable (and certainly not violated) for the ”compression” of the same atom into the neutron, not only because of the need to achieve an ”excess mass,” but also due to the inevitable emergence of non-linear, non-local and non-Hamiltonian interactions beyond any hope of consistent representation by the *mathematics* underlying relativistic quantum mechanics.

Due to the above insufficiencies, Santilli had no other choice than that of first constructing the foundations of new mathematics [5-9], consisting of a broadening of 20th century applied mathematics for the representation of *extended* particles in interior conditions. The ensuing hadronic mechanics is essentially a non-unitary “completion” of quantum mechanics much along the celebrated argument by Einstein, Podolsky and Rosen whose non-unitary transformation represents the actual shape of particles as well as contact interactions. The image of the Schrödinger equation under said “transformation” shows a strongly attractive Hulten potential, plus a new renormalization of the intrinsic

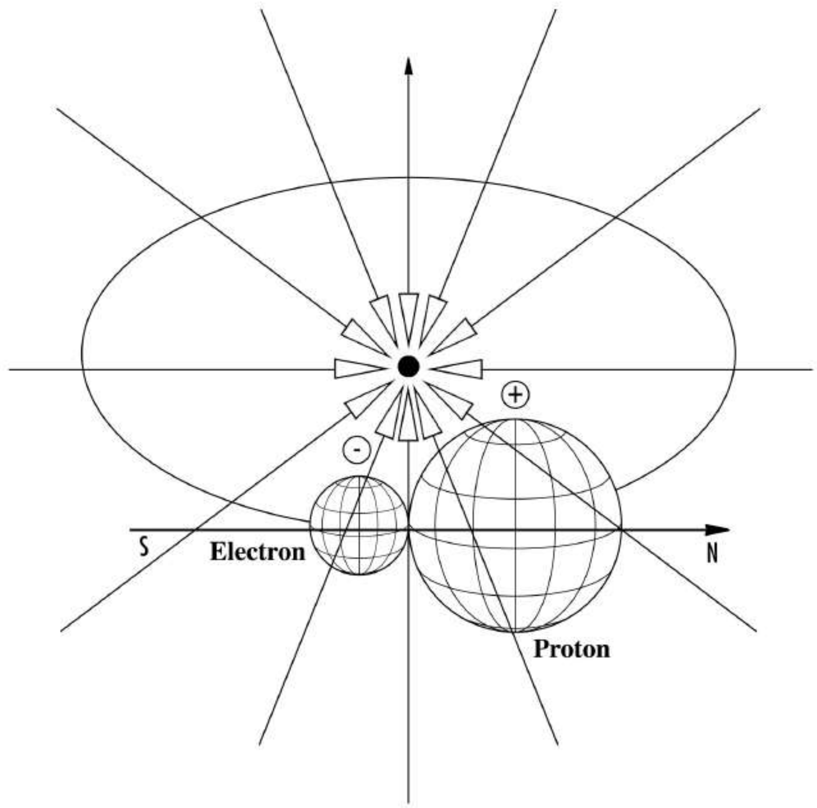


Figure 2:

characteristics of particles in interior conditions achieving the crucial representation of the "mass excess" (1.5). The representation of "all" characteristics of the neutron in synthesis (1.2) is then consequential. It should be finally kept in mind that isomathematics and isomechanics, as well as hadronic mechanics at large, are solely applicable under conditions which imply the overlapping of wavepackets of particles or of their charge distributions making it necessary to consider non-linear, non-local and non-Hamiltonian interactions, essentially at $10^{-13}\,cm$ mutual distances. For mutual distances of particles imputing no appreciable wave overlapping, hadronic mechanics recovers quantum mechanics uniquely and identically.

On experimental grounds, refs. [21-26] have shown that the most effective way to synthesize neutrons from a hydrogen gas is the use of a gaseously submerged rapid DC discharge between a pair of tungsten electrodes with at least $3\ kV$ and $1\ J$ or, alternatively, with at least the power $3\ kW$ (data hereon referred to as $threshold\ values$), below which neutrons are not systematically synthesized due to insufficient arc energy needed to supply the missing $0.782\ MeV$. By recalling that, when inspected in an oscilloscope in the millisecond range, DC arcs are continuously disconnected and reconnected, properly selected steady DC arcs can also synthesize neutrons from a hydrogen gas, although in

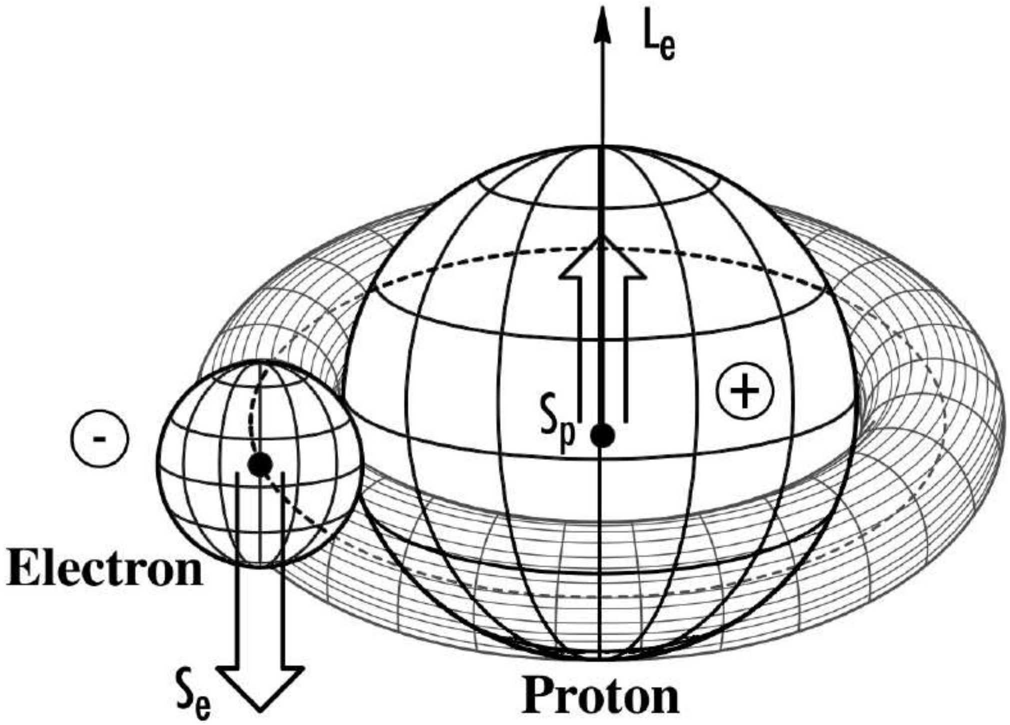


Figure 3:

a less efficient way. Below said threshold values of $3\ kV$ and $1\ J$, Refs. [21-26] reported the lack of directly detectable neutrons, but confirmed the existence of delayed nuclear transmutations as reported in the initial tests [4].

In this paper, we report recent systematic *experimental* confirmations of *industrial* synthesis of neutrons from a commercially available hydrogen gas which can be controlled via the control of the arc voltage, the arc energy, pressure of the hydrogen gas, electrode gap, and other engineering means. The non-initiated reader should know that the appraisal of the experimental results via the use of conventional doctrines is afflicted by a number of insidious inconsistencies that generally remain undetected by non-experts in the field, thus suggesting a knowledge of isomathematics and isomechanics for a technical understanding of the field.

2. THE SYNTHESIS OF NEUTROIDS

Isomathematics and isomechanics predict the existence of an intermediate state prior to the neutron synthesis called by the name *neutroid* [4,13-15], and indicated with the symbol $\tilde{n}$, which is itself the singlet coupling of a proton and an electron at $10^{-13}\ cm$ caused by the strong Coulomb attraction (which is of the order of $10^{22}\ N$ at the indicated mutual distance) as well as by the strong attraction caused by the deep mutual penetration of the wavepackets [6,17-20]

$$p^{+}_{\uparrow} + e^{-}_{\downarrow} \rightarrow \tilde{n}. \qquad (2.1)$$

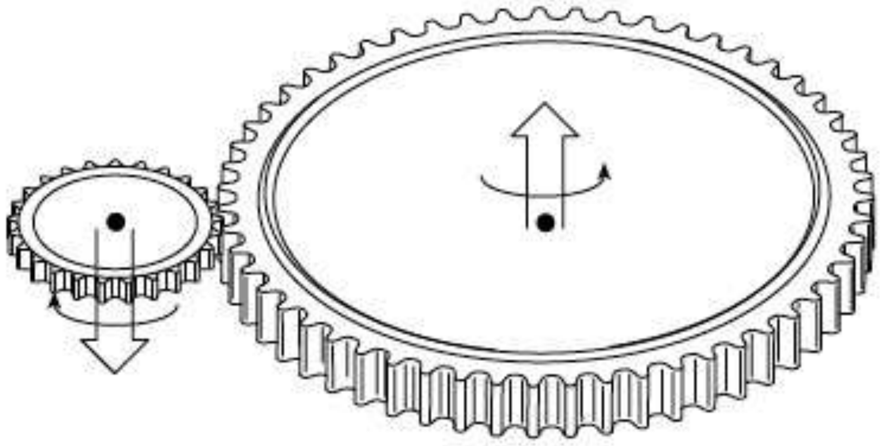


Figure 4:

The neutroid is a new particle with; null charge; null spin; null magnetic moment (in first approximation); estimated mean life of 9 s; rest energy (estimated via the sole use of conventional electromagnetic interactions)

$$E_{\tilde{n}} = m_p + m_e - BE = 938.2721 + 0.511 - 0.009\ MeV =$$

$$= 938.7741\ MeV = 1.008091\ \text{am}u; \quad (2,2)$$

charge radius $R_{\tilde{n}}$ and mean life $\tau_{\tilde{n}}$

$$R_{\tilde{n}} =\approx 10^{-13} cm,\ \tau_{\tilde{n}} \approx 9s; \quad (2.3)$$

"completion" into a neutron (under the availability of the needed $0.782\ MeV$ energy)

$$\tilde{n} \rightarrow n + \nu, \quad (2,4)$$

and decay (in the absence of said missing energy)

$$\tilde{n} \rightarrow p^+ + e^-. \quad (2.5)$$

It appears that all original tests by E. J. Sternglass, E. Trounson, Don Borghi, as well as the initial tests by R. M. Santilli below the indicated threshold values of voltage and energy [4], synthesized neutroids, rather than neutrons due to the energy of the DC arc being insufficient to supply the missing $0.782\ MeV$ and other reasons identified later on. The above view implies that the nuclear transmutations detected by the original tests were caused by the absorption of neutroids by natural elements, their consequential instability and subsequent delayed transmutations into new elements.

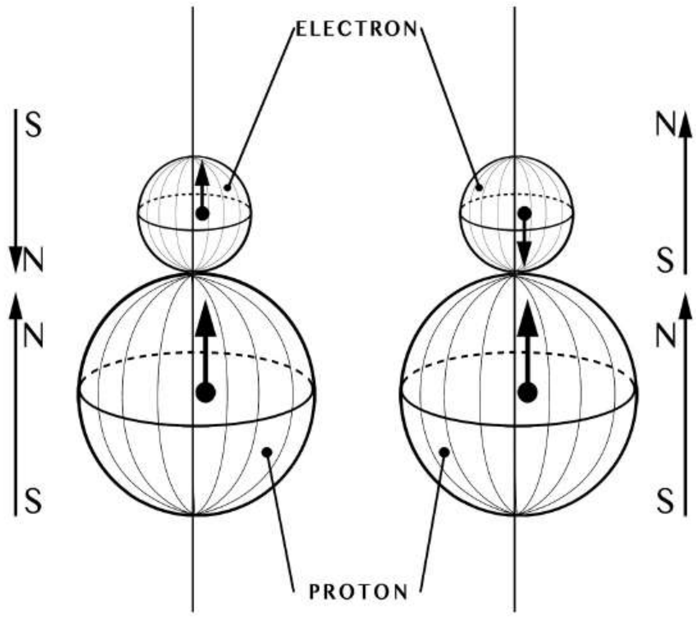


Figure 5:

Note that, even though neutrons and the neutroids are both neutral and have essentially the same size, *neutroids cannot be detected by available neutron detectors* because they have different spins, different rest energies, different magnetic moments, and different mean lives. Therefore, neutroids can be solely detected via the analysis of the transmutations, such as via the delayed detection of neutrons, electrons, gammas and other radiations, as detected in Refs. [4, 21-26].

For a better understanding of the experiments reported in this paper, it is necessary to have a conceptual, semi-classical illustration of the various processes occurring in the synthesis of neutroids and neutrons in mind, while understanding that a technical grasp of the matter is solely possible assuming a detailed knowledge of isomathematics, isomechanics and their quantitative treatment of the synthesis.

Figure 1 depicts well known effects caused by a DC arc between tungsten electrodes submerged in a hydrogen gas, namely: the separation of the hydrogen molecule into H-atoms; the ionization of the H-atoms; the consequential creation of a plasma composed by protons and electrons; and their alignment along the tangent to a local magnetic line with opposite charges, opposing magnetic polarities and opposing spins.

Figure 2 depicts the realization of Rutherford's "compression" [1] of protons and electrons, one against the other, caused by the disconnection of a rapid DC discharge, its activation essentially creating the indicated plasma of protons and electrons. Note that, when inspected in an oscilloscope at the millisecond scale, DC discharges with constant voltage (CV) and constant current (CC) are continuously disconnected and reconnected.

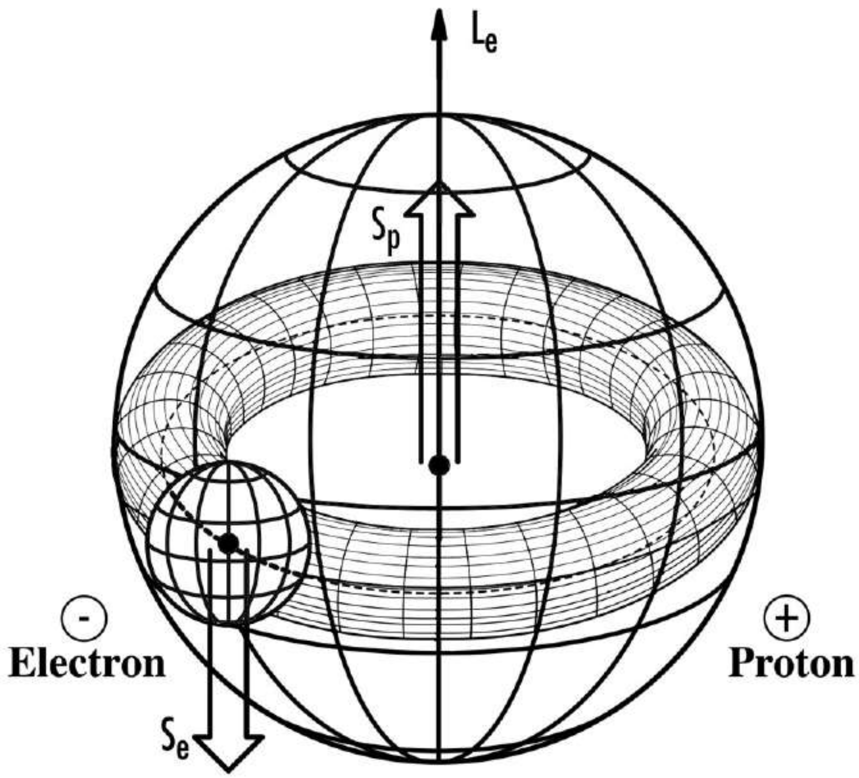


Figure 6:

Therefore, CV, CC and DC arcs submerged in hydrogen with voltage and energy values beyond their threshold do synthesize neutrons, although in a way less effective than that of a rapid DC discharge.

Figure 3 provides a conceptual illustration of the neutroid as a single bound state of a proton and an electron under partial penetration of their wavepackets, with null total charge, null spin and null magnetic moment (the latter in first approximation) since the value of the angular momentum L_e of the electron is null in the ground state. Figure 4 illustrates a novel analogy revealed by isomathematics and isomechanics, namely, the similarity between the coupling of particles with the coupling of gears [6], both requiring antiparallel angular momenta for stability due to their extended character.

It should be indicated that the structure of neutroids according to Figure 3 is impossible within conventional quantum mechanics since the sole bound states between a proton and an electron are those of the H-atoms. This is due to the point-like abstraction of the proton and the electron which is inherent in quantum mechanics without any consideration of the non-linear, non-local and non-Hamiltonian effects due to wave overlapping. When the proton is represented with its actual dimension as occurring in physical reality, said non-linear, non-local and non-Hamiltonian effects are inevitable and play a crucial role in the augmentation of basic scientific advances and knowledge founded over the past century.

To achieve a quantitative understanding of the predicted $9\ s$ mean life of the neutroid,

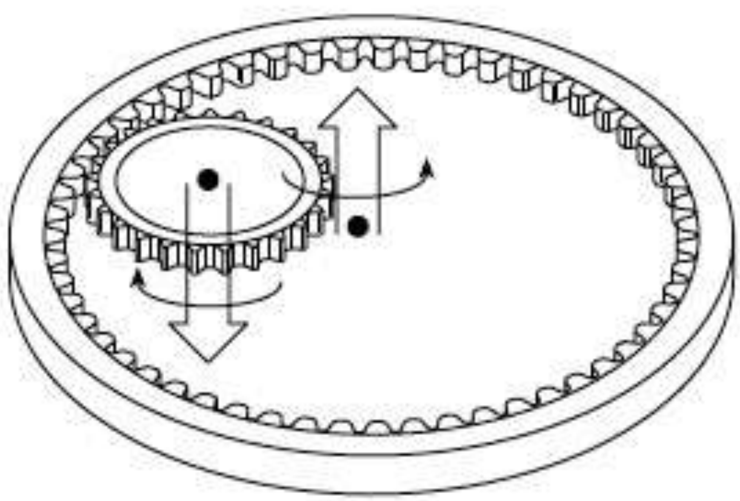


Figure 7:

one should note that: the neutroid is an intermediate state prior to the full neutron synthesis; the neutron has a 15 "minute" mean life; and that isomathematics and isomechanics require the new isorenormalization of all characteristics of particles beginning with their rest mass, as known since 1978 (see Section 5 of Ref. [6]). Note that the neutroid has *no excited states* because following any such excitations, mutual wave overlapping of particles ceases to be appreciable, quantum mechanics returns to be exactly valid and the sole possible bound states of a proton and an electron are those of the H-atom.

Figure 5 depicts conceivable "axial couplings" of one proton and one electron, at times called *neutroids of the second (third) kind when the total angular momentum is* 1 *(*0*).* These couplings are ignored in this paper because they are predicted to have such short mean lives as to prevent industrial applications. This occurrence illustrates again the differences between quantum mechanics and isomechanics because in the former abstract particles are conceived as dimensionless points, in which case both singlet and triplet couplings are possible. By contract, the latter mechanics represents particles with their actual size, in which case a triplet coupling would be the same as coupling gears in Figure 5 with parallel spins [5].

Figure 6 depicts the synthesis of the neutron from a proton and an electron achieved via rapid DC discharges through tungsten electrodes submerged in a commercially available hydrogen gas with values of the voltage sufficiently bigger than $3\ kV$ and energy sufficiently bigger than $1\ J$ [5-30]. Figure 7 illustrates that the conceptual rendering via the coupling of gears requires, this time, that the smaller gear has to rotate "inside" the bigger one, besides having antiparallel angular momenta. By remembering that the electron is about 2000 times lighter than the proton, the synthesis of the neutron is essentially based on Rutherford's total "compression" of an electron within the hyperdense medium inside the proton, in which case the electron is constrained by said medium to rotate with an angular momentum equal to the proton spin. The total angular momentum of the electron is null and the spin of the neutron is equal to that of the proton.

Figure 8:

Note half-values of the angular momentum are prohibited in a vacuum, but are fully admitted within physical media due the isotopies of Lie's theory [10]. In any case, values of the angular momentum different than $1/2$ would imply that the electron moves inside the proton in a direction against its hyperdense medium, which is a physical impossibility. Note also that the above synthesis is impossible for quantum mechanics, again because the proton is dimensionless. Note finally that, the above view has permitted a numerically exact and time invariant representation of "all" characteristics of the neutron, including a representation of its anomalous magnetic moment achieved thanks to the new contribution of the rotation of the electron inside the proton different than that conceived during the time of Pauli and Fermi.

A technical understanding of this paper requires a knowledge of the connection between the quantitative representation of the synthesis of the neutron, and the resolution of problems in nuclear physics and chemistry that have remained fixed for one century. In fact, the resolution of all problems here referred to, is based on the use of the same methods, the novel isomathematics and isomechanics.

Recall that quantum mechanics has been unable to achieve a representation of the magnetic moment of the simplest nucleus, the deuteron (because 1% is still missing following all possible corrections) with embarrassing deviations from theoretical predictions for large nuclei such as that of plutonium. A similar situation has occurred for nuclear spins that have remained unresolved for nuclei at large. The representation permitted by isomathematics and isomechanics of protons and neutrons as *extended, and therefore, deformable charge distributions under contact non-Hamiltonian interactions when members of a nuclear structure* has permitted the achievement of the first known *numerically exact and time invariant representation of nuclear magnetic moments [31,32] and spins [33].*

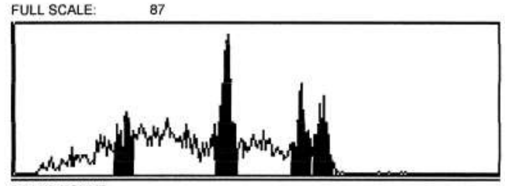
Alarm, gamma	5/8/2006/01:34	15 uR/h
Alarm, gamma	5/8/2006/01:34	14 uR/h
Alarm, gamma	5/8/2006/01:35	14 uR/h
Alarm, gamma	5/8/2006/01:35	14 uR/h
Alarm, gamma	5/8/2006/01:35	14 uR/h
Alarm, gamma	5/8/2006/01:35	13 uR/h
Alarm, neutron	5/8/2006/01:40	15 Cps
Calibration	5/8/2006/01:45	0 Cps
Alarm, gamma	5/8/2006/01:50	17 uR/h
Alarm, neutron	5/8/2006/01:50	89 Cps
Alarm, neutron	5/8/2006/01:53	99 Cps
Alarm, neutron	5/8/2006/01:56	60 Cps
Alarm, neutron	5/8/2006/01:57	99 Cps
Alarm, neutron	5/8/2006/01:58	56 Cps
Alarm, neutron	5/8/2006/01:58	52 Cps
Alarm, neutron	5/8/2006/01:59	62 Cps
Background, gamma	5/8/2006/02:12	4 uR/h
, neutron		0 Cps
Alarm, neutron	5/8/2006/02:37	0 Cps
Alarm, neutron	5/8/2006/02:49	0 Cps
Alarm, neutron	5/8/2006/02:51	0 Cps
Alarm, neutron	5/8/2006/02:52	0 Cps
Alarm, neutron	5/8/2006/03:08	0 Cps
Alarm, neutron	5/8/2006/03:09	0 Cps
Background, gamma	5/8/2006/03:12	3 uR/h
, neutron		84 Cps
Background, gamma	5/8/2006/04:12	3 uR/h
, neutron		0 Cps
Background, gamma	5/8/2006/05:12	3 uR/h
, neutron		0 Cps
Background, gamma	5/8/2006/06:12	3 uR/h
, neutron		0 Cps
Background, gamma	5/8/2006/07:12	3 uR/h
, neutron		0 Cps
The device off	5/8/2006/07:51	
The device on	5/8/2006/19:22	
Calibration	5/8/2006/19:22	0 Cps
Alarm, gamma	5/8/2006/19:26	18 uR/h
Alarm, neutron	5/8/2006/19:39	1 Cps
Alarm, gamma	5/8/2006/19:42	16 uR/h
Background, gamma	5/8/2006/20:11	4 uR/h
, neutron		0 Cps
Background, gamma	5/8/2006/21:11	4 uR/h
, neutron		0 Cps
Background, gamma	5/8/2006/22:11	4 uR/h
, neutron		0 Cps
Alarm, gamma	5/8/2006/22:15	4 uR/h

MCA REPORT

SAVED AS: Spectrum # 1

DATE:	19-Jul-2006 07:16	BIAS:	746
EN CAL DATE:	18-Jul-2006 09:06	COARSE GAIN:	1
		FINE GAIN:	1.87
BKG DATE:	18-Jul-2006 09:07	LOW DISC:	1.00%
GROSS CPS:	2741	HIGH DISC:	100.05%
NET CPS:	2449	ELAPSED LT:	1.29
GROSS INTEGRAL:	3536	ELAPSED RT:	1.33
NET INTEGRAL:	3160	DEAD TIME:	3.01%

FULL SCALE: 87



PEAKS FOUND

CHN	ENERGY (keV)	GROSS CPM	AMBIENT CPM	CONTINUUM CPM	NET %	UNC
57	204.9	16046	2790	8697	4558 ± 19.0	
111	660.0	24744	1162	11255	12325 ± 8.71	Cs137
151	1165.6	15906	232	6883	8790 ± 9.79	Co60
162	1335.1	13488	186	3813	9488 ± 8.35	Co60

2 OF 2 LIBRARY LINES FOR Co60 FOUND Correlation = 0.99

LINE	PEAK	INTENSITY	NET CPM
1173.2	1165.6	99.90	8790
1332.5	1335.1	99.98	9488

1 OF 1 LIBRARY LINES FOR Cs137 FOUND Correlation = 0.80

LINE	PEAK	INTENSITY	NET CPM
661.7	660.0	90.00	12325

NUCLIDES NOT PRESENT:

1 OF 3 LIBRARY LINES FOR U233 FOUND Correlation = 0.04
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
0 OF 3 LIBRARY LINES FOR Ra226 FOUND Correlation = 0.00
0 OF 1 LIBRARY LINES FOR U235s FOUND Correlation = 0.00
0 OF 1 LIBRARY LINES FOR U238 FOUND Correlation = 0.00

LINES NOT ASSOCIATED WITH ANY NUCLIDE:

Energy	Net CPM	Eff Corrected
204.9	4558.1	21321.7 C

MCA REPORT

Figure 9:

Recall that the so-called "hot fusions" have not achieved to date any industrially valuable results due to known extreme instabilities ultimately due to the use of excessive energies. The so-called "cold fusions" have established the existence of nuclear fusions in our Earthly environment, but they have not achieved industrially valuable results due to, at this time, energy insufficient for all necessary engineering needs. The representation of protons and neutrons as extended and deformable particle under contact non-Hamiltonian interactions when members of a nuclear structure have permitted the formulation and experimental verification of Intermediate Controlled Nuclear Fusion (CNF, also called "warm fusions") without the emission of harmful radiation and without the release of radioactive waste, which fusions occur at energies intermediate between those of the hot and cold fusions, and are controlled via a number of engineering means [34-38].

Finally, recall that, according to quantum mechanics and chemistry, identical electrons in valence couplings should *repel* each other, and certainly cannot attract each other contrary to the evidence that molecular structures are due to strongly attractive valence bonds between identical electrons. It should be indicated that non-linear, non-local and non-Hamiltonian interactions due to deep overlapping of the wavepackets of particles have been crucial for the first known articulation of an *attractive force between identical valence electrons in singlet couplings* as occurring in the reality of molecular structures [39]. Consequently, the new bond of Figures 3 and 5 are fully aligned with the bond of identical valence electrons in singlet coupling as occurring in molecular structures.

3. THEORETICAL PREDICTIONS

3.1. Basic assumptions

In this section, we review the conventional activation of tabulated nuclide [40] via a neutron flux and present the corresponding activation via a flux of neutroids as is necessary for their experimental verification.

We shall represent nuclides with the known symbols (Z,A,J), where Z represents the atomic number, A represents the atomic mass, and J represents the angular momentum. The mass of nuclides are ignored since we shall be dealing with tabulated decays emitting energy [33]. Under the assumed notation, nuclides N shall be written $N(Z,A,J)$ and the related data assumed from Table [41].

For convenience, we shall assume the same notation for neutrons and neutroids

$$n = n(0,1,1/2),\ \tilde{n} = \tilde{n}(0,1,0), \tag{3.1}$$

as well as for other particles participating in nuclear transmutations, such as

$$\beta^-(1,0,1/2),\ \nu(0,0,1/2),\ \gamma(0,0,1),$$

Figure 10:

$$EC = EC(-1,0,1/2), \quad (3.2)$$

where EC denotes Electric Capture, for which the value $Z = -1$ for the electron stands to recall that its absorption implies the decrease of the atomic number by one unity due to the neutron synthesis while the value $J = +1/2$ denotes the increase of the nuclear spin by $1/2$.

In regard to emission of particles, atomic numbers, atomic masses and spins should be subtracted from the original values.

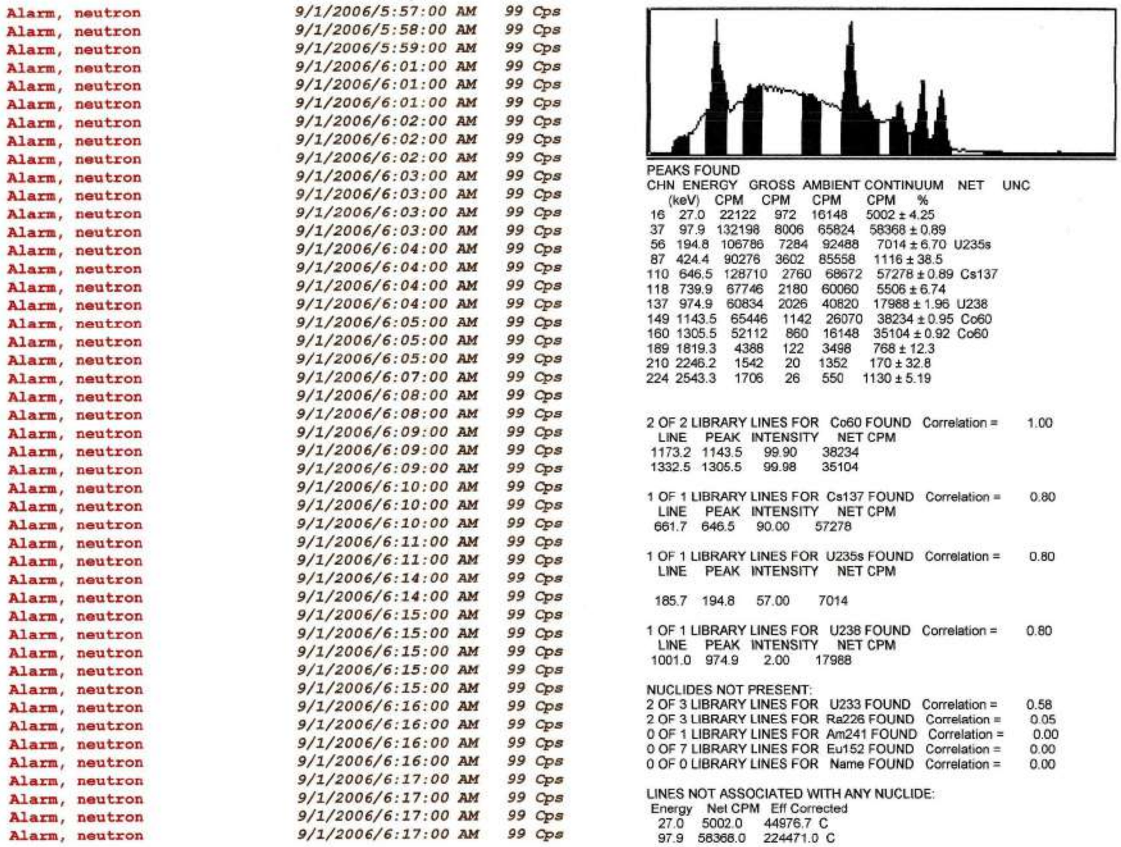


Figure 11:

3.2. Nuclides and nucleoids

Neutron activations of tabulated nuclides N [31] follow the well-known rules (see e.g., tabulated data [41])

$$N(Z,A,J) + n(0,1,1/2) \rightarrow$$

$$\rightarrow N^0(Z, A + 1, J + 1/2), \tag{3.3}$$

where N^0 is a known, generally unstable nuclide [31] and the possible chains of decays into a final stable isotope are equally well known [41].

Neutroid activations of a tabulated nuclide N are predicted to follow the new rules

$$N(Z,A,J) + \tilde{n}(0,1,0) \rightarrow$$

$$\rightarrow \tilde{N}(Z,A + 1,J), \tag{3.4}$$

where $\tilde{N}$ denotes generally unstable and untabulated nuclides first introduced in Ref. [17] under the name of *nucleoids.*

When $\tilde{N}$ is sufficiently excited to release the missing energy of $0.782\ MeV$ for synthesis (2.4), the nucleoid is predicted to have the nuclear transmutation

$$\tilde{N}(Z,A+1,J) \rightarrow N^0(Z,A+1,J+1/2) + \nu(0,0,1/2), \quad (3.5)$$

where $N^0(Z,A+1,J+1/2)$ is a tabulated nuclide with known decay.

When nucleoid $\tilde{N}$ does not have the needed missing energy, it decays according to Eq. (2.5) with ensuing transmutation

$$\tilde{N}(Z,A+1,J) \rightarrow N^0(Z+1,A+1,J+1/2) + \beta^-(1,0,1/2), \quad (3.6)$$

where $N^0(Z+1,A+1,J+1/2)$ is a tabulated nuclide with known decay of the type

$$N^0(Z+1,A+1,J+1/2) \rightarrow N''(Z+1,A+1,J) + \nu(0,0,1/2). \quad (3.7)$$

The study of a number of additional possible transmutations and decay is left to the interested reader.

Due to the lack of existence at this writing of detectors capable of directly detecting neutroids, the sole way known to detect neutroids is given by: 1) Setting up TEC-TNS *below* the threshold values of $3\ kV$ and $1\ J$; 2) Assuring via conventional detectors the *lack* of neutron emission; and 3) Seeking nuclear transmutations of type (3.4)-(3.7) via neutron, electron, gamma delayed emission or spectroscopical analysis of the original and of the irradiated sample.

3.3. Activations of $\mathbf{Ag(47,107,1/2)}$

The conventional neutron activation of $Ag(47,107,1/2)$ is given by [41]

$$Ag(47,107,1/2) + n(0,1,1/2) \rightarrow Ag(47,108,1) \rightarrow$$
$$\rightarrow Cd(48,108,0)[stable\ isotope] + e^-(-1,0,1/2) + \nu(0,0,1/2), \quad (3.8)$$

resulting in the stable nuclide $Cd(48,108,0)$, as well known.

The predicted neutroid activation of $Ag(47,107,1/2)$ is given by

$$Ag(47,107,1/2) + \tilde{n}(0,1,0) \rightarrow \tilde{Ag}(47,108,1/2), \quad (3.9)$$

where $\tilde{Ag}(47,108,1/2)$ is a nucleoid because it is untabulated (due to the spin 1/2).

In the event the nucleoid $\tilde{Ag}(47,108,1/2)$ is sufficiently excited to trigger synthesis (2.4), we have the decay

$$\tilde{Ag}(47,108,1/2) \rightarrow Ag(47,108,1) + \nu(0,0,1/2) + \gamma(0,0,1), \quad (3.10)$$

where $Ag(47{,}108{,}1)$ is a stable nuclide and we have used our assumption on the sign of emitted particles.

Figure 12:

Figure 13:

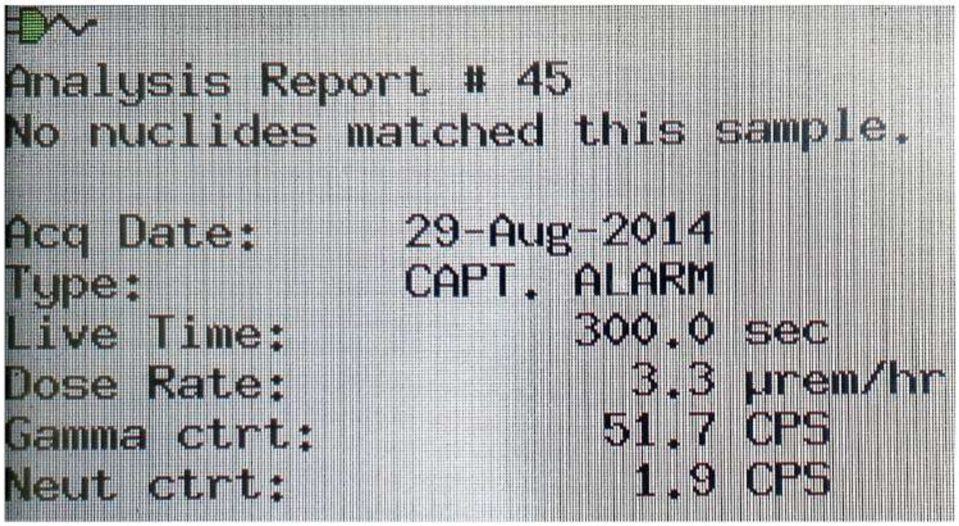
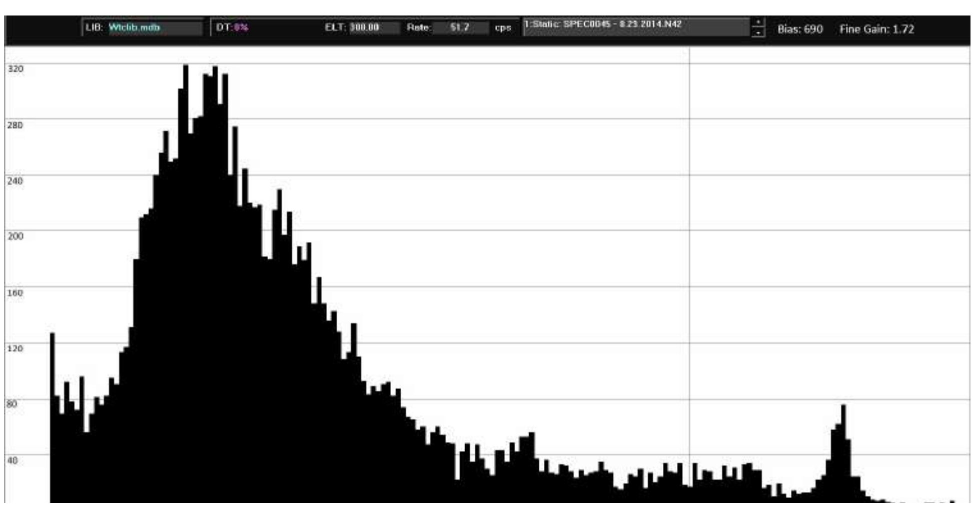


Figure 14:

Figure 15:



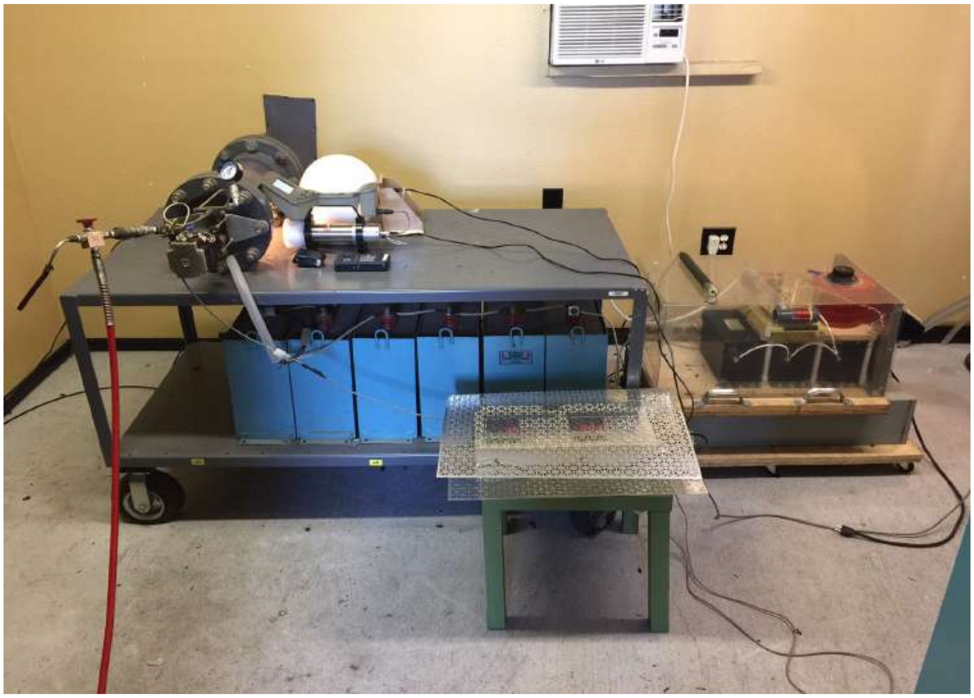



Figure 16:

Figure 17:

Figure 18:

Intriguingly, J. Sternglass suggested the apparent synthesis of neutrons from the detection of β emitted from his reactor [4]. Since his equipment did not have sufficient energy to supply the missing energy of $0.782\ MeV$ for the neutron synthesis, it appears that J. Sternglass detected a transmutation of type (3.8) caused by neutroid activation.

Under the assumption that the nucleoid is not in such an excited state to trigger synthesis (2.4), $Ag^{\sim}(47,108,1/2)$ is predicted to decay along Eq. (2.5)

$$Ag^{\sim}(47,108,1/2) \rightarrow Cd(48,108,0) + \beta^{-}(1,0,1/2), \tag{3.11}$$

where the resulting stable nuclide $Cd(48,108,0)$ is the same as for the conventional neutron irradiation, Eq. (3.8).

Intriguingly, E. J. Sternglass reported in his letter to A. Einstein the emission of electrons that appear to be fully in line with decay (3.11), while his experimental set up did not have sufficient energy to synthesize neutrons, thus confirming that he synthesized neutroids.

A third possible decay is given by

$$Ag^{\sim}(47,108,1/2) + EC(-1,0,+1/2) \rightarrow Pd(46,108,0) + \gamma(0,0,1), \tag{3.12}$$

where $Pd(46,108,0)$ is a stable, hence tabulated isotope.

3.4. Activations of Ag(47,109,1/2).

Readout from Polimaster PM1704GN

12:19:20 AM	Gamma background	4 μR/h
12:19:20 AM	Neutron background	0.02 cps
1:19:20 AM	Gamma background	4 μR/h
1:19:20 AM	Neutron background	0.02 cps
2:19:20 AM	Gamma background	4 μR/h
2:19:20 AM	Neutron background	0.02 cps
3:19:20 AM	Gamma background	4 μR/h
3:19:20 AM	Neutron background	0.02 cps
4:19:20 AM	Gamma background	4 μR/h
4:19:20 AM	Neutron background	0.02 cps
5:19:20 AM	Gamma background	4 μR/h
5:19:20 AM	Neutron background	0.02 cps
6:19:20 AM	Gamma background	4 μR/h
6:19:20 AM	Neutron background	0.02 cps
7:19:20 AM	Gamma background	5 μR/h
7:19:20 AM	Neutron background	0.02 cps
7:46:20 AM	**Neutron alarm**	**0.02 cps**
8:19:20 AM	Gamma background	4 μR/h
8:19:20 AM	Neutron background	0.02 cps
9:19:20 AM	Gamma background	4 μR/h
9:19:20 AM	Neutron background	0.02 cps
10:17:58 AM	**Neutron alarm**	**0.02 cps**
10:19:20 AM	Gamma background	5 μR/h
10:19:20 AM	Neutron background	0.02 cps
11:19:20 AM	Gamma background	4 μR/h
11:19:20 AM	Neutron background	0.02 cps
11:47:20 AM	**Neutron alarm**	**0.02 cps**
12:19:20 PM	Gamma background	3 μR/h
12:19:20 PM	Neutron background	0.02 cps
1:19:20 PM	Gamma background	3 μR/h
1:19:20 PM	Neutron background	0.01 cps

Figure 19:

The conventional neutron activation is given by

$$Ag(47,109,1/2) + n(0,1,1/2) \rightarrow Ag(47,110,1) \rightarrow$$
$$\rightarrow Cd(48,110,0) + \beta^-(1,0,1/2) + \nu(0,0,1/2), \qquad (3.13)$$

resulting in the stable nuclide $Cd(48,110,0)$, as well known. The predicted neutroid activation is given by

$$Ag(47,109,1/2) + \tilde{n}(0,1,0) \rightarrow \tilde{Ag}(47,110,1/2), \qquad (3.14)$$

where $\tilde{Ag}(47,110,1/2)$ is an untabulated nucleoid with: first possible decay under synthesis (2.4)

$$Ag\tilde{}\ (47,108,1/2) + EC(-1,0,+1/2) \rightarrow Pd(46,110,0) + \gamma(0,0,1), \tag{3.15}$$

or alternative decay according to neutroid decay (2.5)

$$Ag\tilde{}\ (47,110,1/2) \rightarrow Cd(48,110,0) + \beta^-(-1,0,1/2), \tag{3.16}$$

and other decays whose study is left to the interested reader.

3.5. Activations of Au(79,197,3/2)

The conventional neutron activation is given by

$$Au(79,197,3/2) + n(0,1,1/2) \rightarrow Au(79,198,2) \rightarrow$$

$$\rightarrow Hg(80,198,0) + \beta^-(1,0,1/2) + \nu(0,0,1/2) + \gamma(0,0,1), \tag{3.17}$$

resulting in the stable nuclide $Hg(80,198,0)$, as well known. The predicted neutroid activation is given by

$$Au(79,197,3/2) + n\tilde{}(0,1,0) \rightarrow Au\tilde{}\ (79,198,3/2), \tag{3.18}$$

where $Au\tilde{}\ (79,198,3/2)$ is a nucleoid with decay predicted along synthesis (2.4) although without the emission of a neutrino

$$Au\tilde{}\ (79,198,3/2) \rightarrow Pt(78,198,0) + \beta^-(1,0,1/2) + \gamma(0,0,1), \tag{3.19}$$

because the emission of a neutrino as requested by synthesis (2.4) would yield the inconsistent decay

$$Au\tilde{}\ (79,198,3/2) \rightarrow Hg(80,198,0) + \nu(0,0,1/2) + \beta^-(1,0,1/2) + \nu(0,0,1/2) + \gamma(0,0,1).$$

An alternative decay is given by

$$Au\tilde{}\ (79,198,3/2) \rightarrow Hg(80,198,0) + \beta^-(1,0,1/2) + \gamma(0,0,1), \tag{3.20}$$

resulting again in the same stable nuclide $Hg(80,198,0)$ as that released by neutron activation, although without the possibility of consistently admitting the emission of a neutrino, thus casting doubts on basic syntheses (1.2) and (2.4)

The study of additional, virtually endless neutroid activations is left to the interested reader.

4. EXPERIMENTAL VERIFICATIONS

4.1. Basic information

The first direct detection of the synthesis of neutrons from a hydrogen gas was achieved by R. M. Santilli in 2006 [21,22] the complete documentation being available in Ref. [23] also of 2006.

Tests [21-23] were first done with the experimental set up of Figure 8 comprising: a vertical reactor fabricated from a translucent PVC pipe of 3" diameter and 12" length filled up with a commercially available hydrogen gas at a maximum of $10\ psi$; a $5\ kW$ DC welder produced by Miller Electric delivering an electric arc between submerged tungsten electrodes of $1/3$" diameter with $20\ V$ and $200\ A$; and various neutron and gamma detectors, by Ludlum, Berkeley Nucleonics and Polimaster with internal recording of data. This first experimental set up $did\ not$ produce neutrons, but produced neutroids due to the steady character of the DC arc. In fact, tests [21,22] essentially produced transmutations of natural elements surrounding the reactors, at times delayed up to 15 minutes.

Tests [21-23] were also done with the equipment of Figure 10 comprising: a high-pressure metal reactor of 1^0 diameter and 2^0 length containing hydrogen gas up to $100\ psi$; a DC welder produced by Miller Electric with up to $50\ kW$ used to deliver an arc between carbon electrodes (because tungsten electrodes would instantly melt at the power here considered) of about $30\ V$ and $1{,}000\ A$ corresponding to $30\ KV A$; and the same neutron detectors of the preceding tests. The tests produced such neutron alarms, particularly at the activation and disconnection of the arc, to mandate the rapid evacuation of the laboratory, as illustrated by the data of Figure 11 (see Ref. [23] for comprehensive data). In view of this occurrence, no additional tests have been done since 2006 with the hydrogen gas at $100\ psi$ for obvious reasons connected to operator safety.

The third tests were done in 2014 [24,25] with the setup of Figure 12 comprising: a reactor fabricated from a translucent PVC pipe of 6": diameter and 24" length containing a commercially available hydrogen gas at a maximum of $30\ psi$; a high voltage $3\ kW$ power source supplied by Information Unlimited of New Hampshire, depicted in Figure 13, delivering a sequence of rapid DC arcs between submerged, 1" diameter carbon electrodes with up to $15\ kV$ and up to $2{,}500\ J$ when connected to a $20\ \mu F$ capacitor; and various neutron-gamma detectors with internal recording of all detections, including a SAM 935 by Berkeley Nucleonics, a PM1703 by Polimaster, and other detectors. The reactor was fabricated in translucent PVC so as to allow visual inspection of the working setup filled with air, then filling up of the reactor with hydrogen, activating and disconnecting the reactor at a distance, and downloading data on neutrons and gamma CPS from the memory banks of the detectors. Tests [24,25] established the controlled synthesis of neutrons from a hydrogen gas with an industrially valuable flux with up to 1.9 neutron CPS corresponding to about $4{,}500$ CPS when pro-rated to the sphere centered in the arc. Tests [24,25] also established the thermal character of the synthesized neutrons due to lack of energy from the plasma surrounding the arc which was insufficient to create high energy motion perpendicular to the arc. In this paper, we report the following tests:

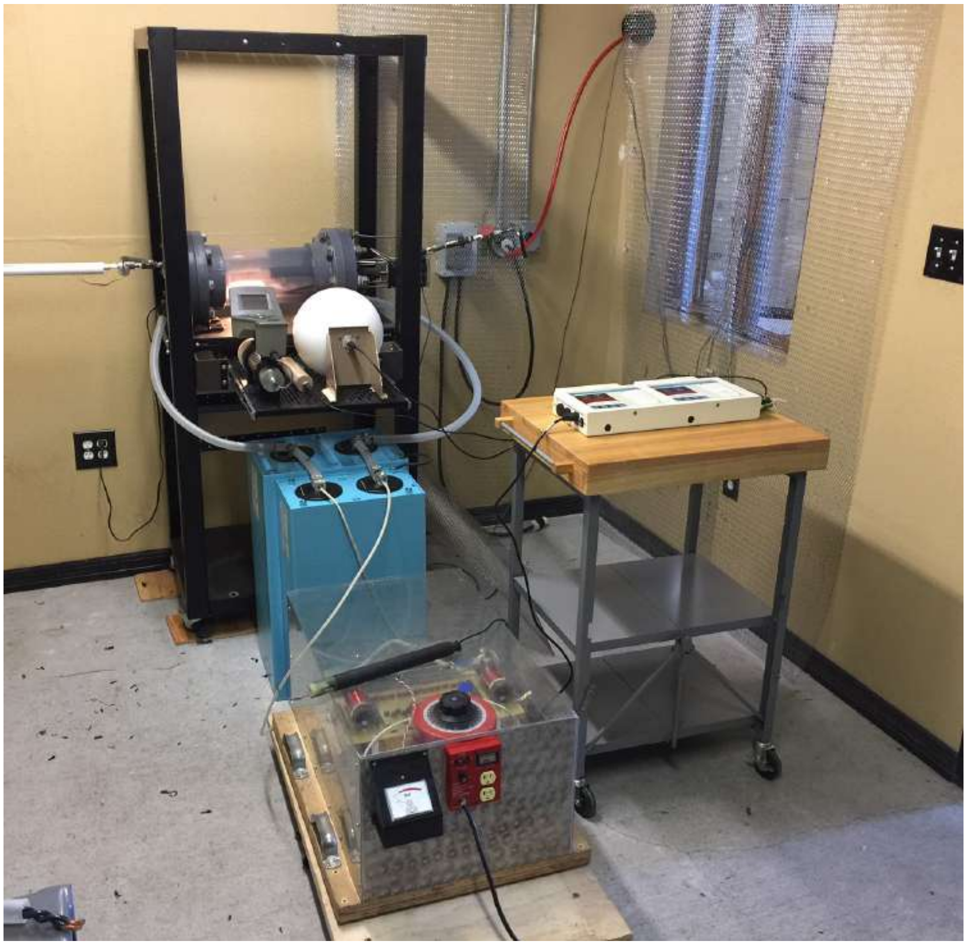


Figure 20:

TESTS 1: Done with the experimental set up of Figure 16 comprising: the same power source as that of tests [24,25] (Figure 13) charging six capacitors for a total of $10\ \mu F$; the Ludlum 375 and SAM 940 neutron and gamma detector; the reactor depicted in Figure 17 showing the remote controlled stepper motor (on the left), the internal electrodes and various valves; and the remote control station depicted in Figure 18 comprising from the right, the control of the gap between the electrodes, the main switch to activate the power source the neutron and gamma remote Ludlum sensors and the Polimaster PM1703 to verify the lack of harmful radiation at the remote control station for the safety of the operator. Some of the neutron CPS detected by the Ludlum 375 are depicted in the left of Figure 19, and the confirmation of neutron detected by the SAM 940 is depicted in the right (see also Ref. [42] for a short movie on these tests).

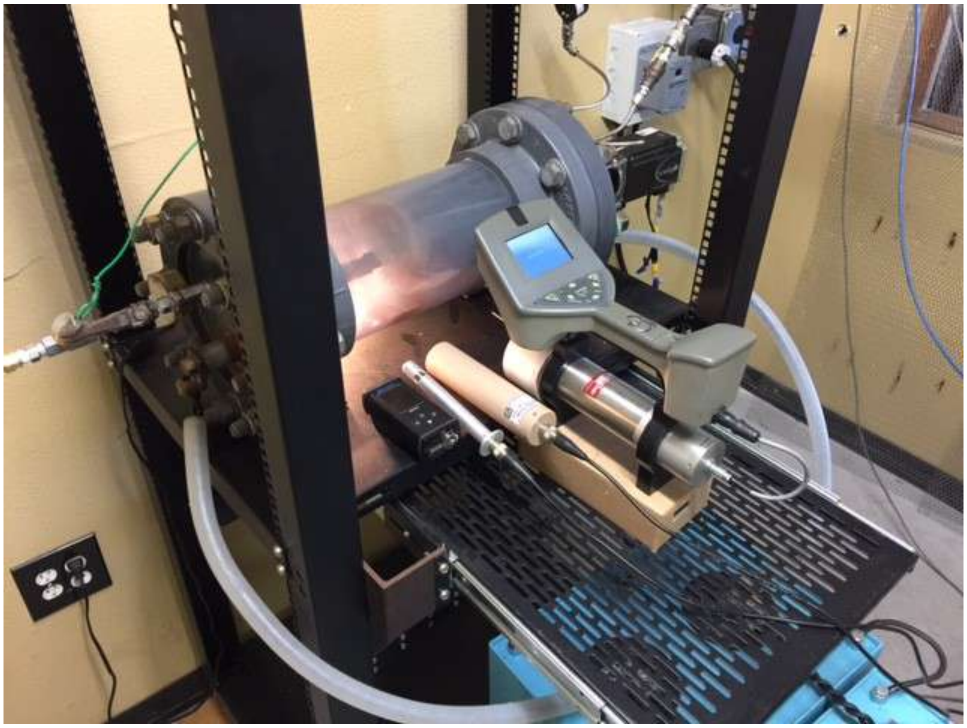


Figure 21:

Figure 22:

TESTS 2: Done with the experimental set up of Figure 20 known as the Thermal Neutron Source (TNS) 20 comprising: the same reactor of Figure 17 and the same high voltage power source of Figure 13 used in preceding tests, the latter being connected of rapid discharge capacitors with $20\ \mu F$ supplied by General Atomic of San Diego, California; the Ludlum 375, SAM 940 and Polimaster PM1704 neutron and gamma detectors with position of their sensors illustrated in Figure 21; the remote control station illustrated in Figure 22 comprising from the right and the remote control of the stepper motor to achieve the desired gap between the carbon electrodes, the main switch to activate the power source; the Ludlum remote sensors for neutron and gamma CPS; and the remote control of the power used in the power source. A number of neutron CPS detected during these tests are presented in Section 4.2 and 4.3.

TESTS 3: The same experimental set up as that of Tests 2 with the high voltage power source of up to $20\ kV$ and $5\ kW$ delivering a rapid DC discharge between the submerged electrodes of up to $3{,}000\ J$ following the charge of capacitors with $20\ \mu F$ (see Picture 23 showing in front-right the $5\ kW$ high voltage power source).

TESTS 4 The same experimental set up of Tests 3 with the Magna-Power source, model XR10000-0.80/480POS+LXI with 8 kW, 10 kV and 0.8 A. During the tests, the source was set at 8 kV and 0.5 A, but operated with voltage oscillating between 2.5 kV and 0.5 A, with a rapid rate of charging the capacitors at about 3 discharges per second, that resulted in an essentially steady production of 4 to 6 neutron CPS (see Picture 23 showing in front-left the 8 kW high voltage Magna-Power source).

TESTS 5: The same experimental set up of Tests 3 but with the power source supplied by Information Unlimited directly connected to the arc without capacitors (the MagnaPower source could not be used because of its automatic disconnect when used to deliver DC arcs).

The various tests were done according to the following written routine: verification that all switches are off and the capacitors are discharged; flushing the reactor with air from a compressor to remove hydrogen residues; selection of the desired power; consequential selection of the gap between the electrodes; remote activation of the power unit; verification of the existence of acceptable arc in air; disconnection of all switches and verification that the capacitors are discharged; flushing the reactor with hydrogen; setting up the desired hydrogen pressure in the reactor; activate cameras filming the reactor as well as the remote sensors; activate remotely the TNS; conduct the test for the desired duration of time; disconnect all switches; move the electrodes into a short to discharge residual charges; verification that the capacitors are indeed discharged; and collect neutron and gamma CPS from the Ludlum 375, the SAM 940 and the Polimaster PM1704.

Figure 23:

4.2. Experimental confirmation of the synthesis of neutroids

The reactor (TNS) is working with low power, as we don't want to synthesize neutrons, but only neutroids which require lower energies. No neutron detection should occur during the test, but readings are expected sometime after the arc has been turned off, due to the decay of the nuclei made unstable by the neutroids themselves. These neutron emissions are expected to be very directional and random, so the detectors are not likely to see them at the same time.

TESTS SUMMARY:

Test 1 - Reactor filled with H_2 at ambient pressure, power unit set at 0.75 kW power	
Start Time	**11:23 am**
End Time	**11:27 am**

Ludlum Neutron Detections during test	None
Ludlum Gamma Detections during test (CPS)	11.6, 8.8, 10.7, 12.9, 13.8, 14.1 (coherent with background)
Ludlum neutron detections after the end	1 CPS 4 minutes later
SAM Neutron Detections	0 CPS, 0 counts
SAM Gamma Detections	43.9633 CPS

Test 2 - Same configuration as previous test	
Start Time	1:40 pm
End Time	1:44 pm
Ludlum Neutron Detections during test	None
Ludlum Gamma Detections during test	Coherent with background
Ludlum neutron detections after the end	None
SAM Neutron Detections	0.0033 CPS, 1 counts
SAM Gamma Detections	44.3733 CPS

Test 3 - Same configuration as previous test	
Start Time	1:50 pm
End Time	1:55 pm
Ludlum Neutron Detections during test	None
Ludlum Gamma Detections during test	Coherent with background
Ludlum Neutron detections after the end	1 CPS 30 secs later
SAM Neutron Detections	0.0017 CPS, 1 counts
SAM Gamma Detections	44.995 CPS

Test 4 - Same configuration as previous test	
Start Time	2:04 pm
End Time	2:10 pm
Ludlum Neutron Detections during test	None
Ludlum Gamma Detections during test	Coherent with background
Ludlum neutron detections after the end	None

SAM Neutron Detections	**0 CPS, 0 counts**
SAM Gamma Detections	**47.7433 CPS**

Test 5 - Reactor with H_2 at 10 psi, power unit set at 0.75 kW power	
Start Time	**2:25 pm**
End Time	**2:30 pm**
Ludlum Neutron Detections during test	**None**
Ludlum Gamma Detections during test	**Coherent with background**
Ludlum neutron detections after the end	**1 CPS 1 min later**
SAM Neutron Detections	**0.005 CPS, 3 counts**
SAM Gamma Detections	**44.6533 CPS**

4.3. Experimental confirmation of the synthesis of neutrons

The reactor (TNS) is working with different power units and various levels of power. Two power units designed ad hoc by Information Unlimited and one commercially available by MagnaPower have been used. The pressure of hydrogen inside the reactor has been used as a variable as well, changing it in a controlled way to verify the effects on neutron CPS.
It should be noted that the Ludlum detector provides a real-time record of the neutron and gamma counts, while the SAM940 detector only records an average neutron and gamma CPS for the entire duration of the test. The neutron CPS values reported for the Ludlum in the tests with the two Information Unlimited power units are just the peak values corresponding to the capacitors discharge, which typically happen every 5 seconds. The typical shape of neutron emission during test time can be seen in Figure 24, together with the trend of power consumption from the unit. During the tests with the MagnaPower unit, however, on the other end, the discharges were much quicker, resulting in a continuous neutron production, as can be seen in Figure 25, so the values reported in the table do represent the actual neutron CPS variations recorded by Ludlum detector.

TESTS SUMMARY:

- Tests with Information Unlimited power unit 1

Test 1 - Reactor filled with H_2 at 5 psi, power unit set at 2 kW, electrodes gap at 2.2 mm	
Ludlum Neutron Detections (CPS)	**4.06, 4.06, 4.06, 3.06, 3.05, 3.05, 4.05, 4.05, 4.06**
Ludlum Gamma Detections (CPS)	**15.6, 11.2, 8.6, 9.0, 10.9, 9.8**

	(coherent with background)
SAM Neutron Detections (CPS)	**0.5444**
SAM Gamma Detections (CPS)	**46.2611 (coherent with background)**
PoliMaster Detection	**Neutron Alarm**

Test 2 - Reactor filled with H_2 at 20 psi, power unit set at 2 kW, electrodes gap at 2 mm	
Ludlum Neutron Detections (CPS)	**4.00, 6.00, 5.00, 5.00, 4.00, 5.00, 4.00, 4.00, 4.00**
Ludlum Gamma Detections (CPS)	**coherent with background**

Test 3 - Reactor filled with H_2 at 20 psi, power unit set at 2 kW, electrodes gap at 2.2 mm	
Ludlum Neutron Detections (CPS)	**4.00, 4.00, 2.00, 5.00, 4.00, 4.00, 4.00, 4.00, 5.00**
Ludlum Gamma Detections (CPS)	**coherent with background**

Test 4 - Reactor filled with H_2 at 27 psi, power unit set at 2 kW, electrodes gap at 1.9 mm	
Ludlum Neutron Detections (CPS)	**4.00, 4.00, 4.00, 4.00, 4.00, 5.00, 5.00, 4.5, 4.00**
Ludlum Gamma Detections (CPS)	**coherent with background**

Test 5 - Reactor filled with H_2 at 20 psi, power unit set at 2 kW, Ludlum detector at 2 cm from the reactor wall, electrodes gap at 2 mm	
Ludlum Neutron Detections (CPS)	**6.00, 5.00, 5.00, 5.00, 5.00, 5.00, 5.00, 5.00, 5.00**
Ludlum Gamma Detections (CPS)	**coherent with background**

Test 6 - Reactor filled with H_2 at 20 psi, power unit set at 2 kW, Ludlum at 1.5 m from the reactor wall, electrodes gap at 2 mm	
Ludlum Neutron Detections (CPS)	**1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00**
Ludlum Gamma Detections (CPS)	**coherent with background**

Test 7 - Reactor filled with H_2 at 15 psi, power unit set at 2 kW, Ludlum again at 2 cm from the wall, electrodes gap at 2 mm	
Ludlum Neutron Detections (CPS)	**4.00, 3.00, 4.00, 4.00, 4.00, 4.00, 4.00**
Ludlum Gamma Detections (CPS)	**coherent with background**

Test 8 - Reactor filled with H_2 at 15 psi, power unit set at 2 kW, electrodes gap at 2 mm	
Ludlum Neutron Detections (CPS)	**3.00, 3.00, 2.76, 2.58, 2.64, 3.33, 3.41, 3.41, 4.20**
Ludlum Gamma Detections (CPS)	**coherent with background**

Test 9 - Reactor filled with H_2 at 20 psi, power unit set at 2 kW, electrodes gap at 2 mm	
Ludlum Neutron Detections (CPS)	**4.00, 5.00, 5.00, 4.00, 5.00, 4.00, 5.00**
Ludlum Gamma Detections (CPS)	**coherent with background**

Test 10 - Reactor filled with H_2 at 25 psi, power unit set at 2, electrodes gap at 1.9 mm	
Ludlum Neutron Detections (CPS)	**5.00, 6.00, 5.00, 5.00, 5.00, 4.00, 5.00, 6.00, 4.00**
Ludlum Gamma Detections (CPS)	**coherent with background**

Test 11 - Reactor filled with H_2 at 30 psi, power unit set at 2, electrodes gap at 1.9 mm	
Ludlum Neutron Detections (CPS)	**4.00, 6.00, 5.00, 6.00, 4.00, 4.00, 5.00, 5.00, 5.00**
Ludlum Gamma Detections (CPS)	**coherent with background**

Test 12 - Reactor filled with H_2 at 30 psi, power unit set at 2, electrodes gap at 1.8 mm	
Ludlum Neutron Detections (CPS)	**4.00, 4.00, 4.00, 5.00, 4.02, 4.00, 5.00, 4.00, 5.00**
Ludlum Gamma Detections (CPS)	**coherent with background**

Test 13 - Reactor filled with H_2 at 30 psi, power unit set at 2 kW, electrodes gap at 1.7 mm	
Ludlum Neutron Detections (CPS)	**2.28, 2.28, 2.28, 2.53, 3.32, 3.41, 2.42, 2.42, 2.30**
Ludlum Gamma Detections (CPS)	**coherent with background**

Test 14 - Reactor filled with H_2 at 30 psi, power unit set at 2 kW, electrodes gap at 1.6 mm	
Ludlum Neutron Detections (CPS)	**1.73, 1.42, 1.71, 1.42, 1.71,**

	1.85, 1.46, 1.36, 1.68
Ludlum Gamma Detections (CPS)	**coherent with background**

- **Tests with Information Unlimited power unit 2**

Test 1 - Reactor filled with H_2 at 10 psi, power unit set at 3.5 kW, electrodes gap at 2.0 mm, then at 4.5 kW with electrodes gap at 2.2 mm	
Ludlum Neutron Detections (CPS), 3.5 kW	**3.00, 3.05, 3.05, 3.02, 3.02, 3.05, 3.05, 3.02, 3.02**
Ludlum Neutron Detections (CPS), 4.5 kW	**4.09, 4.05, 3.05, 3.05, 4.05, 3.05, 3.05, 4.02, 3.09**
Ludlum Gamma Detections (CPS)	**coherent with background**
SAM Neutron Detections (CPS)	**0.372222**
SAM Gamma Detections (CPS)	**45.4222**
PoliMaster Detection	**Neutron Alarm**

Test 2 - Reactor filled with H_2 at 5 psi, power unit set at 2.5 kW, electrodes gap at 2.0 mm	
Ludlum Neutron Detections (CPS)	**4.00, 4.00, 4.00, 4.00, 4.00, 4.00, 4.00, 4.00, 4.00**
Ludlum Gamma Detections (CPS)	**coherent with background**

Test 3 - Reactor filled with H_2 at 10 psi, power unit set at 2.5 kW, electrodes gap at 2.0 mm	
Ludlum Neutron Detections (CPS)	**3.01, 3.02, 5.00, 4.00, 4.00, 4.00, 4.00, 5.00, 4.00**
Ludlum Gamma Detections (CPS)	**coherent with background**

Test 4 - Reactor filled with H_2 at 20 psi, power unit set at 3.5 kW, electrodes gap at 2.0 mm	
Ludlum Neutron Detections (CPS)	**5.00, 4.00, 4.00, 4.00, 4.00, 5.00, 5.00, 5.00, 5.00**
Ludlum Gamma Detections (CPS)	**coherent with background**

Test 5 - Reactor filled with H_2 at 30 psi, power unit set at 3.5 kW, electrodes gap at 2.0 mm	
Ludlum Neutron Detections (CPS)	**4.02, 4.01, 5.03, 4.02, 4.01, 4.03, 4.03, 4.03, 4.03**
Ludlum Gamma Detections (CPS)	**coherent with background**

- **Tests with MagnaPower**

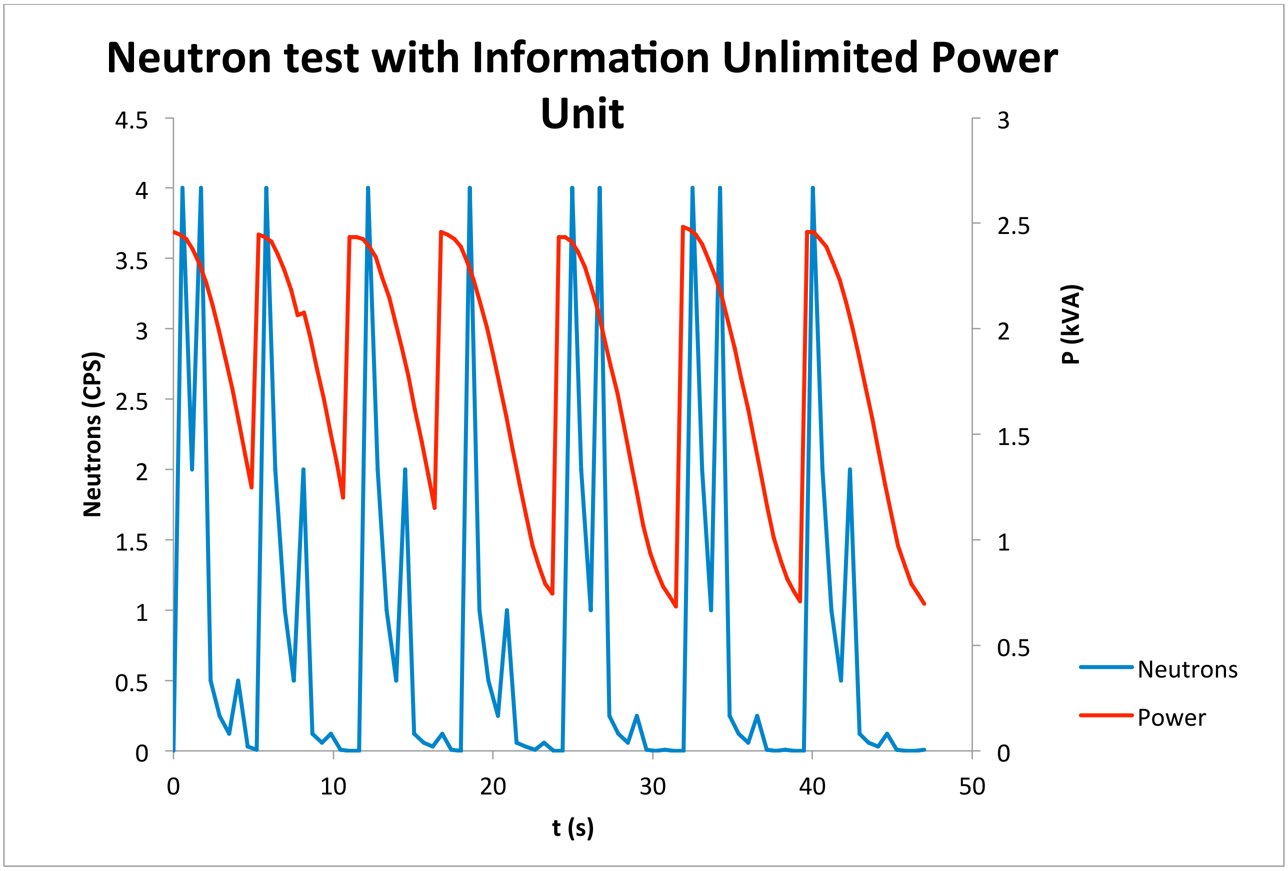
Test 24 - Reactor filled with H_2 at 10 psi, power unit operating at 1.5 kV and 0.5 mA, electrodes gap at 2.0 mm	
Ludlum Neutron Detections (CPS)	**3.50, 3.75, 3.94, 3.98, 4.00, 4.00, 4.00, 6.00, 6.01**
Ludlum Gamma Detections (CPS)	**coherent with background**
SAM Neutron Detections (CPS)	**0.222222**
SAM Gamma Detections (CPS)	**47.4778**
PoliMaster Detection	**Neutron Alarm**

Test 25 - Reactor filled with H_2 at atmospheric pressure, power unit operating at 1.5 kV and 0.5 mA, electrodes gap at 2.0 mm	
Ludlum Neutron Detections (CPS)	**5.12, 6.25, 4.78, 3.39, 3.69, 4.78, 3.92, 2.96, 3.48**
Ludlum Gamma Detections (CPS)	**coherent with background**
SAM Neutron Detections (CPS)	**0.366667**
SAM Gamma Detections (CPS)	**61.1444**

Test 26 - Reactor filled with H_2 at 10 psi, power unit power unit operating at 1.5 kV and 0.5 mA, electrodes gap at 2.1 mm	
Ludlum Neutron Detections (CPS)	**8.27, 9.08, 12.07, 10.03, 8.01, 12.07, 7.50, 6.25, 9.37**
Ludlum Gamma Detections (CPS)	**coherent with background**
SAM Neutron Detections (CPS)	**0.688889**
SAM Gamma Detections (CPS)	**44.5889**

Test 27 - Reactor filled with H_2 at 20 psi, power unit power unit operating at 1.5 kV and 0.5 mA, electrodes gap at 1.9 mm	
Ludlum Neutron Detections (CPS)	**4.25, 4.12, 4.06, 4.25, 6.01, 5.01, 4.50, 6.01, 4.12**
Ludlum Gamma Detections (CPS)	**coherent with background**
SAM Neutron Detections (CPS)	**N/A**
SAM Gamma Detections (CPS)	**N/A**

Test 28 - Reactor filled with H_2 at 30 psi, power unit power unit operating at 1.5 kV and 0.5 mA, electrodes gap at 1.8 mm	
Ludlum Neutron Detections (CPS)	**4.58, 5.29, 4.32, 5.16, 4.58, 5.29, 4.64, 5.32, 4.66**
Ludlum Gamma Detections (CPS)	**coherent with background**
SAM Neutron Detections (CPS)	**N/A**
SAM Gamma Detections (CPS)	**N/A**



Neutron test with Information Unlimited Power Unit
Neutrons (CPS)
P (kVA)
t (s)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
3
2.5
2
1.5
1
0.5
0
0
10
20
30
40
50
Neutrons
Power

Figure 24:

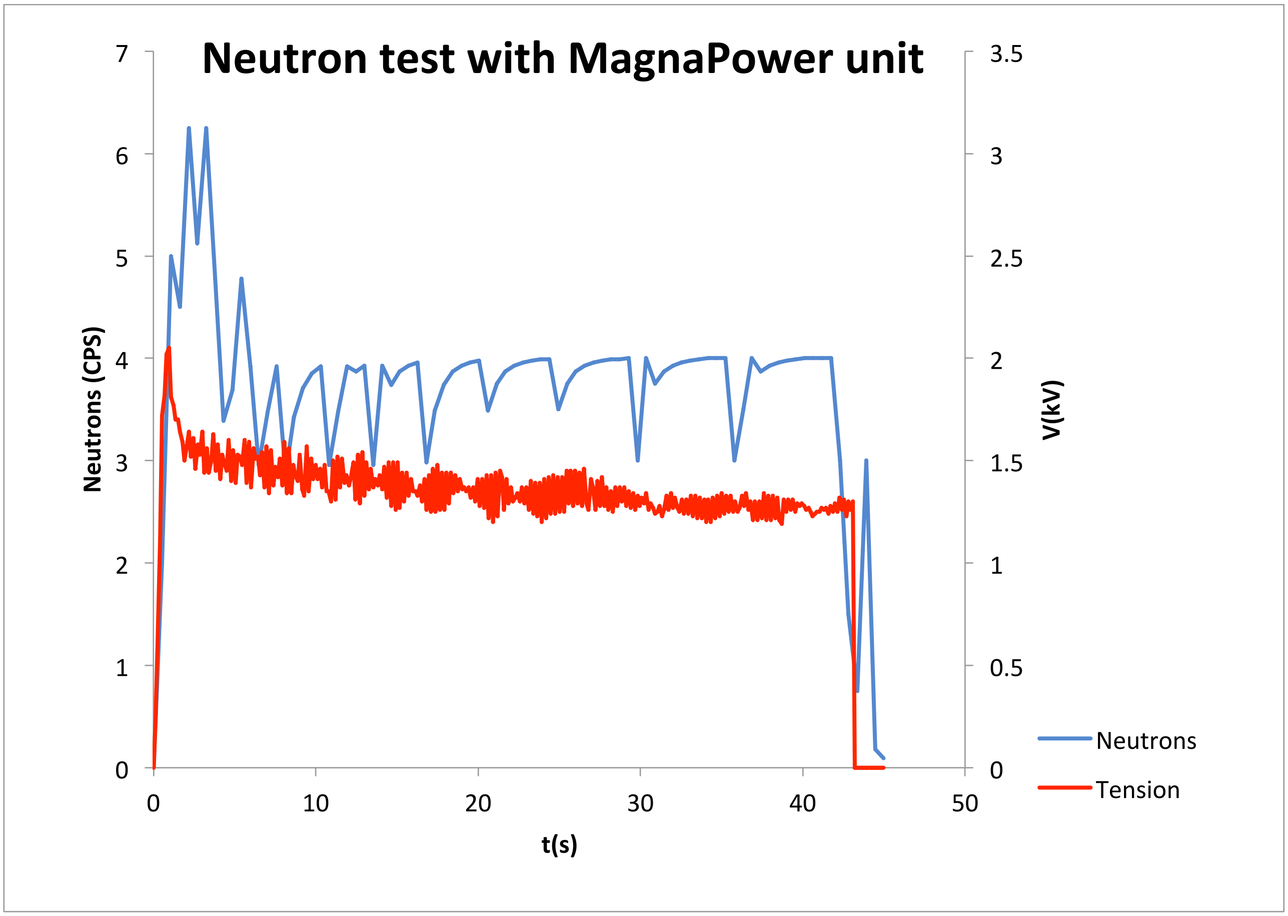


Figure 25:

CONCLUDING REMARKS

As reviewed in Section 1, H. Rutherford [1] conceived the neutron in 1920 as a "compressed hydrogen atom" in the core of stars. The existence of the neutron was experimentally verified by J. Chadwick [2] in 1932. The complexity of the problems created by the neutron synthesis emerged soon thereafter with the exchange in the 1940's between W. Pauli and E. Fermi [3,4] that resulted in the hypothesis of the emission of the massless and chargeless neutrino.

The first experimental tests on the laboratory synthesis of the neutron from the hydrogen were initiated in the 1950's by E. J. Sternglass, were repeated soon thereafter by E. Trounson, and then conducted by Don Carlo Borghi and his associates in the 1960's [4]. All of these initial tests presented serious evidence of nuclear transmutations that could solely be due to a flux of neutrons synthesized by the reactors, although none of them directly detected neutrons. Also, these initial tests implied that the neutron was a conventional, quantum mechanical bound state of a proton and an electron under strong Coulomb attractions, which view was known since the early 20th century to be impossible for various reasons [5,6,15]. Consequently, none of the initial tests were published in scientific journals.

The lack of direct detection of neutrons while detecting clear nuclear transmutations suggested to Don Borghi the hypothesis of the existence of an intermediate state called the *neutroid.* Nuclear transmutations were then assumed to be due to the absorption of neutroids by nuclei, the completion of the neutron synthesis inside nuclei, resulting in instabilities of natural elements with ensuing delayed emission of neutrons, electrons, gamma and other radiations.

In the late 1970's, while being in the faculty of Harvard University under DOE support, R. M. Santilli [5-7] initiated systematic studies on the neutron synthesis beginning with the identification and resolution of the *mathematics* underlying 20th century science due to their local-differential character with ensuing necessary abstraction of particles as being point-like. Santilli's argument is that such an abstraction is certainly acceptable for particles at large mutual distances (exterior dynamical conditions), but it becomes insufficient when extended particles are in conditions of mutual penetration (interior dynamical conditions) due to the emergence of non-linear, non-local and contact non-Hamiltonian interactions simply beyond any hope of quantitative treatment with 20th century theories. In order to achieve the needed representation, Santilli worked out the foundations of the new mathematics, today known as *isomathematics* and related *isomechanics* in which the proton is represented with its actual, experimentally measured dimensions [5-12].

Thanks to the broader mathematical and physical methods, Santilli achieved the first and only known exact representation of *all* characteristics of the neutron in its synthesis from a proton and electron at the nonrelativistic [17,18] and relativistic [18,19] levels. Based on the understanding of the neutron synthesis achieved via these mathematical and theoretical studies, Santilli conducted systematic experimental confirmation on the synthesis of both neutrons and neutroids from a hydrogen gas [21-26]. Subsequently, the U. S. publicly traded company *Thunder Energies Corporation* (thunder-energies.com) began production and sale of *Thermal Neutron Sources* (TNS), consisting of equipment producing an on demand desired flux of low energy neutrons from a commercially available hydrogen gas via the control of the electric power, hydrogen pressure, electrode gap and other engineering means (patent pending).

Particularly significant are the industrial applications of the novel TNS under development at Thunder Energies Corporation, including: the detection of fissionable material that can be smuggled in container and suitcases via the detection of the radiation emitted by their decay when irradiated by thermal neutrons; the stimulated decay of radioactive nuclear waste and consequential reduction of those wastes' mean lives when activated by a sufficiently strong flux of sufficiently energetic neutrons; the detection of concentrations in mines of precious minerals and other elements via the detection of the sharp gammas emitted under their irradiation by thermal neutrons; the treatment of cancerous cells when irradiated by a thin beams of thermal neutrons; the study of esoenergetic nuclear transmutations without the emission of harmful radiations and without the release of radioactive waste as illustrated by Eqs. (3.8)-(3.10); the test of welds in naval constructions; and other applications open for collaboration to qualified scholars. In this paper, we have presented systematic experimental confirmation of the syntheses of both neutrons and neutroids from a commercially available hydrogen gas (hereon referred as the neutron synthesis) with 98% purity. A few comments are in order on the implications of these experimental confirmations.

The first important implication of the experimental confirmation of the neutron synthesis is that the Pauli-Fermi [3] hypothesis of the neutrino did salvage the conservation of the angular momentum, but said hypothesis did not salvage the validity of quantum mechanics and special relativity for the neutron synthesis due to mass excess (1.5) and other reasons [5,6,15], thus confirming expected "inapplicability" (rather than the "violation") of said theories for particles in conditions of mutual penetration.

A broader implication of the experimental confirmation of the neutron synthesis is a necessary revision of 20th century view on the structure, rather than the classification of particles. In fact, the experimental confirmations presented in this paper establish that *the neutron cannot be a bound state of quarks obeying quantum mechanical laws, but is a generalized bound state of one proton and one electron under the laws of isomathematics and isomechanics.*

In any case, the assumption that quarks are the physical constituents of the neutron would have the manifestly untenable consequences that, at the time of the neutron synthesis, the permanently stable proton and electron literally "disappear" from the universe to mysteriously be transformed into the hypothetical quarks, and at the time of the neutron spontaneous decay, quarks "disappear" from the universe and the permanently stable proton and electron reappear because of "fiat."

The return to actual physical particles as the ultimate constituents of matter raises the still broader impossibility of using one single model, the standard model, for both the classification of particles into family and the structure of individual particles of a given family, contrary to historical teaching, such as that for atoms that required a classification model and a different, yet compatible, model for the structure of individual atoms. The implausibility of a joint classification and structure by the same model is ultimately established by the inapplicability for the structure problem of the *mathematics,* let alone the physics which is so effective for the classification problem.

Independently from the inapplicability of 20th century mathematics and physics for structural problems, the assumption of quarks as the ultimate constituents of matter is a theoretical proposition afflicted by numerous consistency problems that have generally remained unaddressed by experts in the field (see e.g., the 1981 Ref. [44] and references quoted therein), such as: the lack of detection of quarks at the extremely high energies currently available at CERN; the impossibility of defining quarks as physical particles in our spacetime since they are not representable with the Poincaré symmetry; the impossibility of achieving their serious confinement, one with an identically null probability of tunnel effects into free particles, due to the uncertainty principle, and other problems. The view here adopted is that advocated since Refs. [5,6] (see also Refs. [13-15]) consisting in the assumption of the standard model as the final classification of particles into families, while the problems of the structure of individual particles of a given family, with the exception of mesons and the neutron [5,6], is open for study by interested physicists.

The serious understanding of the implications of the synthesis of the neutron from a proton and an electron requires the additional awareness that the inability to achieve new environmentally acceptable nuclear energies is ultimately due to the same insufficiencies of 20th century sciences for the neutron synthesis, namely the abstraction of protons and neutrons as massive points. In fact, their representation as extended, and therefore deformable particles has permitted the first and only known numerically exact and time invariant representation of nuclear magnetic moments [31,32] and spins [33]. The same representation has permitted the initiation (now under development at Thunder Energies Corporation) of the *Intermediate Controlled Nuclear Syntheses* (also called "warm syntheses") [34-38] without the emission of harmful radiation and without the release of radioactive nuclear waste.

The additional implication of the neutron synthesis is given by the characterization of new composite, thus unstable particles with actual physical constituents and mean lives of the order of seconds, thus having industrial, let alone scientific relevance, with the clear understanding that these new particles are impossible for the point-like abstraction of their constituents under quantum mechanical laws, while they are fully consistent under the representation of their constituents as extended particles verifying covering laws.

The first particle of this new class is the neutroid treated in Sections 2 - 4 whose industrial relevance is set by its predicted mean life of 9 seconds, thus being suitable for new activations. A second group of particles of the new class stems from the fact that the experimentally established finite probability for an electron to be "compressed" inside the proton to create the neutron implies the consequential existence of a finite probability to "compress" an electron, this time inside a neutron, resulting in the new *pseudoproton* denoted with the symbol in the notations of Section 3.1 $p^-(-1,1,1/2)$ [46] (see also Refs. [46.47]])

$$n + e^- \rightarrow p^-(-1,1,1/2), \qquad (5.1)$$

with intermediate state with spin zero called the *pseudoprotoid* [48]

$$n_\uparrow + e^-_\downarrow \rightarrow \tilde{p}^-(-1,1,0), \qquad (5.2)$$

whose relevance is evident to all since they are *attracted* by nuclei, thus resolving the central problem of nuclear fusions at large, the Coulomb barrier [26], as illustrated by the esoenergetic nuclear transmutations in lieu of Eqs. (3.8)-(3.12) [48]

$$Ag(47,107,1/2) + \tilde{p}^-(-1,1,1/2) \rightarrow \tilde{Ag}\,(46,108,1) \rightarrow$$

$$\rightarrow Pd(46,108,0)[stable\ isotope] - \gamma(0,0,1), \qquad (5.3a)$$

$$Ag(47,107,1/2) + \tilde{p}^-(-1,1,0) \rightarrow \tilde{Ag}^{\,0}(46,108,1/2) \rightarrow$$

$$\rightarrow Pd(46{,}108{,}0)[stable\ isotope] - \nu(0{,}0{,}1/2). \quad (5.3b)$$

Via the use of the novel technologies based on isomathematics and isomechanics, there is the prediction of additional, heavier composite particles such as the *deuteroid* [48]. An additional class, this time, of pseudo-particles implied by the neutron synthesis is that of the *etherino* [49].

All in all, we can safely conclude with the view, evident to all "True Researchers" in the sense of Albert Einstein that, despite historical advances, our current mathematical, physical and chemical knowledge is extremely limited and so much remains to be discovered, provided that the emphasis is placed in *the pursuit of new knowledge,* rather than in "the preservation of old doctrines" for evident political gains.

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http://thunder-energies.com/Mlovie0-fourth-tests.MOV

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Movie on the settings:
http://thunder-energies.com/docs/Magnapower-Alarms.mp4
Movie on the Ludlum remote neutron and gamma sensors:
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Movie on the joint use of SAM 940
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