On the laboratory synthesis of neutrons from protons and electrons

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Abstract

Following Rutherford's 1920 historical hypothesis of the neutron as a compressed hydrogen atom in the core of stars, the laboratory synthesis of the neutron from protons and electrons was claimed in the late 1960s by the Italian priest-physicist Don Carlo Borghi and his associates via a metal chamber containing a partially ionized hydrogen gas at a fraction of 1 *bar* pressure traversed by an electric arc with 5 J energy and microwaves with 10^{10} s^{-1} frequency. In this note we report various measurements showing that, under certain conditions, electric arcs within a hydrogen gas produce neutral, hadron-size entities, here tentatively called *pseudoneutrons,* that are absorbed by nuclei thus causing nuclear transmutations that seemingly confirm Don Borghi's experiment. Since the detected nuclear reactions are esoenergetic, a primary aim for the study is the possibility of achieving, in due time, basically new, environmentally acceptable energies so much needed by mankind in view of the increasingly cataclysmic climactic changes.

The hypothesis of the synthesis of the neutron inside stars from protons and electrons was submitted by Rutherford [1] in 1920. The existence of the neutron was experimentally confirmed by Chadwick [2] in 1932. The first experiments on the laboratory synthesis of the neutron from proton and electrons were conducted in the late 1960s by the Italian priest-physicist Don Carlo Borghi in collaboration with experimentalists from the University of Recife, Brazil [3].

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.

In this note we report various measurements showing that, under certain conditions, *electric arcs within a hydrogen gas cause processes resulting in nuclear transmutations that seemingly confirm Don Borghi's experiment.* In essence, Don Borghi and his associates used the electric arc for the sole purpose of maintaining the hydrogen gas inside the klystron at least partially ionized [3]. The measurements presented below indicate that nuclear transmutations may originate from processes solely caused by electric arcs within a hydrogen gas. The use of high frequency microwaves has not been studied by the author during these first measurements. A picture of the various klystron used for the tests as well as copies of the print outs of the most significant scans are presented in the web site [4]. A summary of the theoretical aspects are presented in [4]. This note is purely experimental. A summary of the complex theoretical problems connected to the synthesis of neutrons from protons and electrons is presented in paper [5a] with comprehensive treatments available in monographs [5b].

All tests here reported were conducted at the laboratory of the Institute for Basic Research in Palm Harbor, Florida. 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) Foils of commercially available silver and gold used for their activation.

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, tested and used for the measurements (see [3t] for pictures):

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" × 3" × 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 mechanisms.

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.

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.

The traditional use of silver and gold foils placed around Klystron I was expectedly inconclusive because it showed various electron and photon emissions, but no clearly identifiable conventional emissions as expected from activation via the conventional use of a neutron flux.

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 [3p,3s], 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 [3t]. 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.

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 [3t] confirming the measurements reported above.

Particularly unusual was a kind of "detector self-activation". In fact, detector $PM1703GN$ entered into neutron alarm a first time with no appreciable photon count while driving miles away from the test about $15m$ following exposure to the klystron, and then a second time about an an additional $15m$ later. This anomalous behavior was confirmed while driving away from the tests in a different directions. Similarly, BF^3 detector 12-4 entered into such repeated, often off-scale self-alarms following exposure to tests with Klystron I and then its moving about $100'$ away, to such an extent to prevent additional measurements for three days. This anomalous behavior excludes the sole origination by neutrons because neutron detectors are not built for this type of self-activation.

No meaningful counts were detected with the above identified klystron 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.

In summary, we cannot exclude that some of the tests did indeed produce ordinary neutrons, as it is expected for the case of the tests under implosion caused by oxygen contamination. However, in general, we can say that, under the conditions reported above, electric arcs within a hydrogen gas produce "entities" that: 1) are not hydrogen atoms (because in that case the detectors would show no counts); 2) have dimensions of the order of $1F$ as for all hadrons (otherwise, again, the detectors would show no counts); 3) are necessarily neutral (because they move freely through walls); 4) are essentially 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

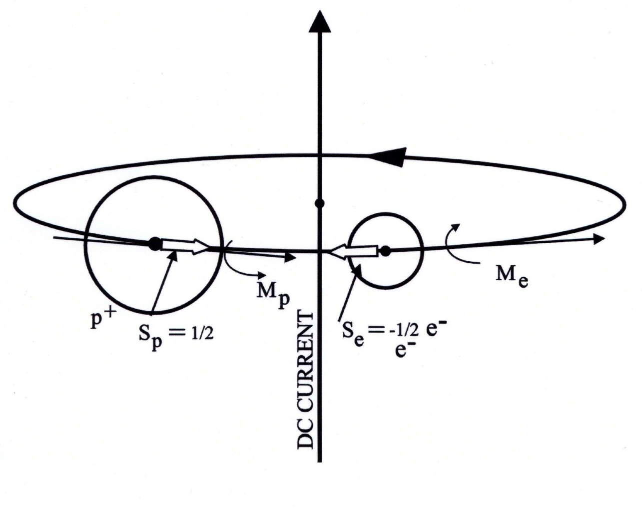

Figure 1: A schematic view of the alignment of protons and electrons along a magnetic force line of a DC electric arc.

of production under implosion causing rapid propagation, or mechanically impacting the klystron; 6) are generally released several hours following the tests, with anomalous electron and photon counts lasting for weeks; 7) are not necessarily neutrons, although the "entities" do cause nuclear transmutations established by the duration of secondary radiations way beyond those for atomic standards, which transmutations could themselves release conventional neutrons; 8) neutron counts increase with the size of the activating isotopes; and 9) the detector plastic casings appear to be most activated by the "entities" in comparison with other substances, with subsequent possible release of neutrons outside conventional knowledge in nuclear physics both in origin and meanlives.

Whatever their interpretation, we can state that the above findings do confirm Don Borghi's experiment [3] because we detected nuclear transmutations on various substances placed around the klystrons confirmed by large electron and gamma emissions, which transmutations are the main claim of Ref. [3].

Hoping that readers will not expect a fully exhaustive interpretation of the above data already in this first note, we present below a plausible interpretation mainly intended to stimulate contributions by interested colleagues.

Following extensive theoretical studies of the synthesis of the neutron from protons and electrons [5,6], we do not believe that an electric arc in *steady operation* (e.g., continuous) and with *low power* (e.g., of $5KW$) or less) can systematically synthesize neutrons when released within a *low pressure* hydrogen gas (e.g., of $30psi$ or less). Hence, the "entities" produced under the preceding conditions are basically *new particles.* At the same time, we believe that neutrons can indeed be synthesized under the same conditions plus a suitable "trigger" [5,6] such as the added implotion. The difference between the former and the latter case appears to be related to the value of the spin because, normally, according to quantum mechanics protons and electrons can only produce a bound state with *integer spin.* Hence,

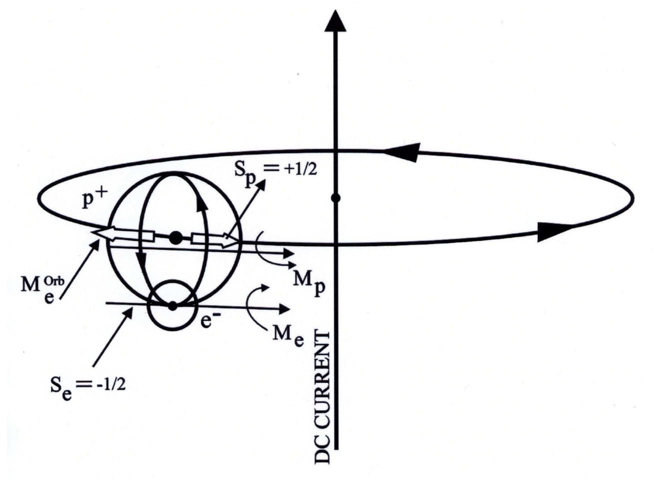

Figure 2: A schematic view of the psedoneutron expecteds from the collapse of the electron into the proton structure following the alignment of Fig. 1 due to very strong attractive Coulomb forces at $1F$ mutual distances from opposing charges and magnetic polarities.

the achievement of the spin 1/2 of the neutron appears to require special processes referred in the field as "trigger."

Our main conception is that the geometry of the electric arc, illustrated in Fig. 1, is quite conducive to processes that may imply the synthesis of neutron-type particles, since said geometry aligns protons and electrons with their magnetic moments along the tangent to the local magnetic force. This causes the axial pairing of protons and electrons under very strong Coulomb attractions at short distances due to both, opposite charges and opposite magnetic polarities that can well result into a neutral particle of the type depicted in Fig. 2.

Hence, we here conjecture that *steady and low power* electric arcs within a low pressure hydrogen gas create a *mini-hydrogen,* namely, a new bound state of a proton and an electron at distances of the order of $1F$ here tentatively called *pseudoneutron,* with the following features: charge 0; spin 0; rest energy essentially that of the proton in atomic mass units $1u = 931.49 MeV$, $938.27 MeV = 1.007u$ (because the electron mass $0.511 MeV = 0.0005u$ is ignorable for our approximation at best expected to hold up to the second digit, and the $p - e$ binding energy of Coulomb nature is predicted to be of the order of $10^{-3} MeV$ [2e]); and symbol $\hat{n}$ with specifications in (A, Z, J, u) units $\hat{n}(1, 0, 0, 1.007)$.

It should be also noted that hydrogen atoms with orbits smaller than conventional ones have been predicted in the literature (see, e.g., [6]). However, these studies are aimed at processes related to *anomalous atomic orbits,* while our studies deal with *anomalous nuclear transmutations.*

In summary, our main assumption is that a *steady* electric arc within a hydrogen gas causes the laboratory synthesis of pseudoneutrons mostly along Rutherford's historical conception [1], although in the form compatible with quantum mechanics, namely, with spin zero

$$p^{+}+e^{-}\rightarrow\hat{n}=\hat{n}(1,0,0,1.007), \tag{1}$$

Therefore, the main differences between the neutrons and the pseudoneutron are that the former has spin $\frac{1}{2}$ and rest energy $939.56MeV = 1.008u$, while the latter has spin 0 and rest energy $938.27MeV = 1.007u$, namely, $0.78MeV$ less energy of the former.

The nuclei resulting from the absorption of pseudoneutrons cannot possibly be conventional isotopes due to the differences in spin and rest energies between neutrons and pseudoneutrons. Consequently, we formulate the hypothesis, also presented in this note apparently for the first time, that *the absorption of pseudoneutrons creates a new class of nuclei* here tentatively called *pseudonuclei* (or *pseudoisotopes,* or *pseudonuclides*) that are evidently expected to be unstable (because not detected so far in a stable form), thus decaying into known isotopes with the release of radiations as reported above.

Predictably, the biggest difficulty is that we are dealing with *terra incognita* without knowledge at this writing of the meanlives of pseudonuclei. Hence, we are left with the sole possibility of assuming meanlives as suggested by evidence, *i.e.*, variable from nanoseconds to weeks.

By using the symbol $N(A,Z,J,u)$ for ordinary nuclei as currently known, and the symbol $\hat{N}(A,Z,J,u)$ for pseudonuclei and assuming that the binding energy of the pseudoneutron is the same as that of an ordinary neutron (e.g., $BE = 0.0002u$ for the deuteron), we have the first possible reaction

$$H(1,1,\frac{1}{2},1.008)+\hat{n}(1,0,0,1.007)\rightarrow$$

$$\hat{H}(2,1,\frac{1}{2},2.015)+EC\rightarrow H(2,1,1,2.014)+\gamma, \tag{2}$$

where: the mass of the electron has been again ignored because much smaller than the used approximation; there is the prediction of the emission of a photon with energy $0.001u = .93MeV$; and the alternative reaction $\hat{H}(2,1,\frac{1}{2})\rightarrow He(2,2,1)+e^{-}$ is prohibited because $He(2,2,1)$ does not exist;

$$He(3,2,\frac{1}{2},3.016)+\hat{n}(1,1,0,1.007)\rightarrow$$

$$\hat{He}(4,2,\frac{1}{2},4.023)+EC\rightarrow He(4,2,0,4.002)+\gamma, \tag{3}$$

where: we have the emission of aphoton with energy of $0.021u = 19.56MeV$ and, again, the alternative reaction $\hat{He}(4,2,\frac{1}{2})+EC\rightarrow Li(4,3,0)$ is again prohibited because $Li(4,3)$ does not exist;

$$Li(7,3,\frac{3}{2},7.016)+\hat{n}(1,1,0,1.007)\rightarrow\hat{Li}(8,3,\frac{3}{2},8.023)$$
$$\rightarrow Be(8,4,0,8.005)+e^{-}+\gamma\rightarrow 2\alpha+\gamma, \tag{4}$$

with energy release of $0.018u = 16,76MeV$, while the reaction $Li(7,3,\frac{3}{2},7.016)+\hat{n}(1,1,0,1.007) \to \hat{Li}(8,3,\frac{3}{2},8.023) + EC \to He(8,2,0,8.033)$ is prohibited because of the lack of conservation of the energy;

$$B(10,5,3,10.012) + \hat{n}(1,0,0,1.007) \to \hat{B}(11,5,3,11.019)$$
$$\to C(11,6,\frac{3}{2},11.011) + e^- + \gamma, \quad (5)$$

$$B(11,5,\frac{3}{2},11.009) + \hat{n}(1,0,0,1.007) \to \hat{B}(12,5,\frac{3}{2},12.016)$$
$$\to C(12,6,0,12.00) + e^- + \gamma; \quad (6)$$

From the above reactions we can see a conceivable explanation of the reason the $He-3$ detected resulted to be the least active of all, as well as a plausible reason for the $Li-7$ activated detector to be so active. However, the explanation of the large activity by the BF^3 activated detector requires a study of the absorption by its plastic casing that cannot be possibly done in this initial note.

It is an instructive exercise for the reader interested in studying pseudonuclei to work out all possible reactions permitted by silver, gold and other elements following the absorption of a pseudoneutron. The reader will see in this way that the method of activating silver and gold, while of proved validity for a flux of *neutrons,* is currently inapplicable for the case of *pseudoneutrons, e.g.,* because of lack of knowledge of the resulting meanlives.

It should be noted that pseudoneutrons are expected to be created also with means other than electric arcs within a hydrogen gas. The best illustration is given by numerous known reports of neutron emissions from electrolytic cells with beryllium electrodes saturated with hydrogen, which radiations could be mainly due to neutron synthesis rather than sole emissions from nuclear transmutations as interpreted so far. other approaches are based on quasirelativistic scattering of ions [7].

Needless to say, an in depth knowledge of the field requires comprehensive, experimental and theoretical studies on a number of topics, among which we indicate:

1) Confirmation and measurement of the main features of pseudoneutrons as well as of their nuclear reactions, including their meanlives;

3) The test of a variety of "triggers" suitable for the systematic synthesis of neutrons.

Above all, a primary aim of the study is to initiate the laborious process of trial and errors for the future achievement of clean energies so much needed by our society in view of the increasingly cataclysm,ic climactic changes, under the admission that, to be really clean, the energies are to be really new, that is, beyond orthodox lines due to the insufficiencies to date of the latter to achieved the needed energies in over one century.

The possibility here advocated is that of creating the *mini-Helium* or similar reductions of other light elements and study the nuclear transmutations they are expected to stimulate via absorption. Since the absorptions of the mini-hydrogen by nuclei creates indeed highly esoenergetic processes, the expectation that the absorption of mini-helium also causes esoenergetic processes is sufficiently plausible to warrant its study, particularly when compared to the continuation of studies on new energies that are by now known to be sterile.

It is hoped that colleagues will participate in these studies in view of the societal need to contain the alarming deterioration of our environment, since all available energies were identified and proved to be environmentally unsuitable half a century ago, thus restricting the hope for society to the search for "new" clean energies.

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