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EXPERIMENTAL CONFIRMATION OF THE NOVEL“INTERMEDIATE CONTROLLED NUCLEAR FUSION” WITHOUT HARMFUL RADIATIONS

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Abstract

In this paper, we present, apparently for the first time, experimental confirmation of the *Intermediate Controlled Nuclear Fusion* without harmful radiations proposed by the author in preceding works. The fusions are centered in the synthesis of nitrogen from deuterium and carbon that, at low energies, cannot possibly release neutron or other harmful radiations. The fusions then include other syntheses. The controlled fusions here reported have been achieved via a *hadronic reactor* built and operated according to the laws of hadronic mechanics and chemistry; the absence of harmful radiations has been established via a number of neutron and other counters; the resulting fusions rare truly controlled thanks to the control of pressure, power, flow, temperature, trigger, and other engineering means, but cannot be explosive for various reasons. The reported measurements also provide experimental confirmation of the new chemical species of *magnecules.*

Key words: neutron synthesis, nuclear reactions, controleld nuclear fusion
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1. Historical Notes.

The first and most fundamental nuclear synthesis in nature is that of the neutron from a proton and an electron in the core of a star according to the historical reaction

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

first predicted by Rutherford [1] in 1920 and confirmed by Chadwick [2] in 1932. Only following the neutron synthesis, can stars synthesize deuterium, helium and other natural elements.

The author has dedicated most of his research life to the study of synthesis (1.1) because the neutron is one of the biggest reservoirs of clean energy available to mankind, since it is naturally unstable (when isolated) and decays into a highly energetic electron that can be trapped with a thin metal shield, plus the emission of the innocuous neutrino, by conceivably producing electric and thermal energies. Also, an understanding of the mechanisms leading to the neutron synthesis is evidently useful, if not necessary, for serious advances in nuclear fusions.

The biggest technical difficulty facing the above studies is that the neutron rest energy is $0.782 MeV$ *bigger* than the sum of the rest energies of the proton and the electron, thus requiring a *positive binding energy,* or causing a *mass excess,* under which the Schrödinger equation no longer admits physically acceptable solutions. As it is well known, consistent quantum mechanical bound states at the particle, nuclear and molecular levels solely occurs under a *negative binding energy* resulting in the *mass defect.*

The use of relative kinetic energy between the proton and the electron to account for the missing energy does not allow a consistent solution because the $p - e$ cross section at the indicated energy is excessively small. The use of the antineutrino as the carrier of the missing energy in the conjugate reaction $p^+ + e^- + \bar{\nu} \to n$ must also be excluded due to the essentially null cross section between the antineutrino and the electron or the proton. Following extensive research, no other mechanism verifying quantum mechanics could be found to achieve a *quantitative* representation of *all* characteristics of the neutron in synthesis (1.1), thus excluding the sole representation of neutron rest energy via models of hadronic classifications and related mass spectra.

The above occurrences mandated the construction of the covering mechanics, today known as *hadronic mechanics,* essentially consisting of a step-by-step *nonunitary* image of quantum mechanics for the representation of non-Hamiltonian interactions expected in the deep mutual penetration and overlapping of the wavepackets of the proton and the electron as necessary for synthesis (1.1). One of the features of hadronic mechanics permitting a consistent representation of the neutron synthesis is a new renormalization of the rest energy of the electron caused by non-Hamiltonian interactions that restores the conventional *negative* binding energy, as expected for the Coulomb *attraction* between the opposite charges of the proton and the electron.

Following decades of research in the construction of a new mathematics, today known as *Santilli isomathematics,* and the construction of a covering of Lie's theory, today known as the *Lie-Santilli isotheory,* including the isotopies of the rotational, spin, Lorentz and other symmetries (see the mathematical memoirs in Ref. [3] and works quoted therein), plus the construction of *hadronic mechanics* (see the five volumes of Refs. [4]) and *hadronic chemistry* (see monograph [5]), the first *nonrelativistic*, exact and invariant representation of *all* characteristics of the neutron in synthesis (1.1) was achieved by Santilli [6] in 1990, and its *relativistic* extension was achieved also by Santilli [7] in 1993. Numerous additional aspects were then studied, including the possible *laboratory synthesis and stimulated decay of the neutron.* A comprehensive review of the studies on the synthesis of the neutron has been provided by J. V. Kadeisvili [8]. The ensuing model is today known as the *Rutherford-Santilli neutron.*

2. Laboratory Synthesis of the Neutron.

Since quantum mechanics does not provide a quantitative representation of the neutron synthesis in the core of stars, that is, at extremely high pressure, it has been widely believed in the 20th century that the synthesis of the neutron is impossible in a laboratory on Earth.

By contrast, hadronic mechanics and chemistry predict that said laboratory synthesis is indeed possible and provide the necessary conditions known as *hadronic laws for nuclear syntheses,* where the term "hadronic" stands to indicate the characterization of the laws via hadronic mechanics.

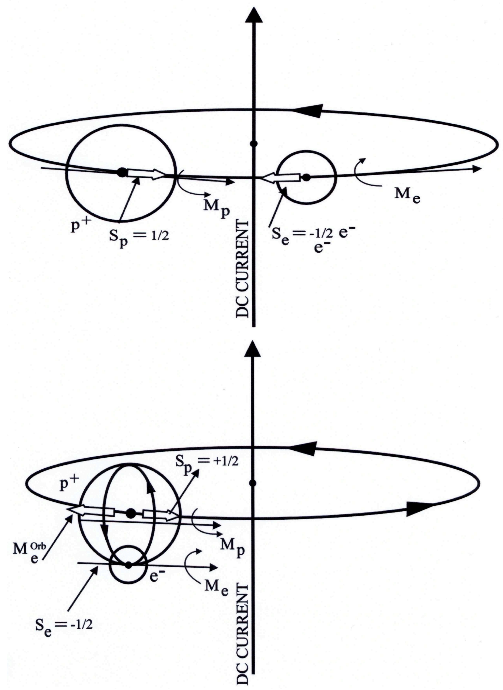

Figure 1: *A view of the correct spin coupling of the proton and the electron (top view), and the realization of Rutherford's compression (bottom view) caused by a strong magnetic field as available at atomic distances from a DC electric arc.*

The first laboratory synthesis of the neutron was achieved in the 1960s by a team of experimentalists headed by the Italian priest-physicist *Don Carlo Borghi* [9] who used a metal reactor (called klystron) filled up with hydrogen gas that was kept partially ionized by an electric discharge, and traversed by a particular type of microwaves. Various substances placed in the outside of the reactor showed clean nuclear transmutations that could solely be due to a flux of neutron originating in the interior of the reactor. Note that, according to the view of the experimenters, the neutron synthesis originated from the microwaves, the DC arc being solely interpreted as maintaining the hydrogen gas partially ionized.

Due to the fundamental character of the neutron synthesis for all of physics, Santilli proposed for decades the repetition of Don Borghi experiment to various physics laboratories around the world, but none of them expressed interest due to the indicated conflict of the neutron synthesis with quantum mechanics. As a result of such a long impasse, Santilli [10] repeated Don Borghi's experiment himself in 2007 at the laboratory of the *Institute for Basic Research* in Florida via the full implementation of the hadronic laws.

The neutron synthesis was essentially achieved via a reactor filled up with a pure hydrogen gas traversed by a DC arc between tungsten electrodes. Various neutron counters were used for the detection of neutrons in the outside of the reactor. At moderate pressures (of the order of 5 psi) and power (of the order of 30 kW), there was the detection in the outside of the reactor of an intermediate state called *neutroid,* appearing as being a particle with essentially the same features of the neutron,. except for the spin.

By contrast, clear detection of synthesized neutrons were achieved by operating the reactor at bigger pressures (of the order of 100 psi or more), bigger powers (of the order of 50 kW or more), or by using a "trigger" realized via sudden implosions or other means. In the latter cases, the laboratory had to be evacuated various times and the related tests interrupted for safety (see the data in website [10b]).

With reference to Figure 1, in this case the arc decomposes hydrogen molecules and ionizes hydrogen atoms, providing in the atomic vicinities of the arc a plasma of protons and electrons. Then, the strong magnetic field of the arc provide the necessary spin alignment, in this case of axial character, with consequential activation of the Coulomb attraction between the proton and the electron and the creation the intermediate neutroid. It should be stressed that this first phase has been studied via the laws of *quantum* mechanics that is assumed as being exactly valid at mutual distances bigger than 1 fm.

The synthesis of the neutron, that is, the complete immersion of the electron within the hyperdense medium inside the proton and consequential applicability of hadronic mechanics, occurs under a suitable trigger. The missing 0.782 MeV are evidently provided by the DC arc (see Kadeisvili [6] for a detailed review).

3. Intermediate Controlled Nuclear Fusion.

As it is well known, rather vast experimental evidence has established the existence beyond doubt of *low energy nuclear fusions,* popularly known as "cold fusion." However, following decades of attempts, various reasons indicate that this type of nuclear fusions occur at random, thus in an uncontrolled way, with resulting inability of reaching an energy output of industrial value.

It is equally well known that additional experimental evidence has established the existence, also beyond doubt, of *high energy nuclear fusions,* popularly known as "hot fusion." However, it is equally well known that the latter approach does not allow the achievement of truly controlled fusions due to extreme technical difficulties in controlling the instabilities that are inherent in high energy nuclear fusions.

The above protracted insufficiencies and very large expenditures of public funds for over half a century clearly indicate the need of basically new approaches to achieve truly controlled and industrially viable fusions. Following, and only following, a theoretical and experimental representation of the synthesis of the neutron, Santilli [11] has proposed a new fusion under the name of *Intermediate Controlled Nuclear Fusion* (ICNF) whose main idea is that of occurring at the threshold energy necessary for the fusion itself, thus being "intermediate" between the cold and hot fusions. Thanks to the preceding construction of hadronic mechanics and chemistry, ICNF were proposed under various hadronic laws, some of which are the following (see Ref. '[11[for details and Ref. [12] for a general review):

1) The need to expose nuclei from their electron clouds as an evident premise for any nuclear fusion. This exposure is systematically achieved via the new chemical species of *magnecules* [5], essentially consisting of axially coupled, toroidal deformations of atomic orbitals achieved under extremely strong magnetic fields (of the order of $10^{14} Gauss$ or more) available at atomic distances from DC electric arcs.

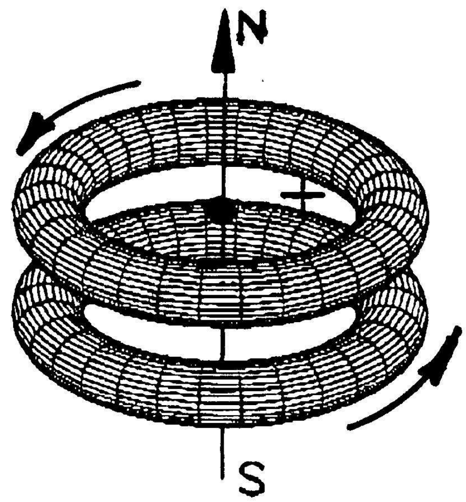

Figure 2: *A view of an "elementary magnecule" illustrating: 1) The need to expose nuclei as a pre-requisite for their fusion; 2) the need for the proper nuclear spin coupling (here given by an axial triplet coupling) to prevent strong repulsive forces for other couplings; and 3) the need to develop the new chemical species of magnecules as a pre-requisite for the controlled fusion here reported.*

2) The need for the proper couplings of nuclear spins. Hadronic mechanics predicts very strong *attractive* forces for either the planar singlet or the axial triplet coupling between *extended* nuclei and a very strong *repulsive* forces for other couplings (as it is the case for ordinary gears). Note that these predictions are evidently absent for quantum mechanics due to its point-like abstraction of particles.

3) The enhancement of the probability for nuclear fusions at threshold energies (evidently under the verification of all conservation laws). In fact, at insufficient energies the fusion is evidently impossible or at random at best, and under very high energies we have evident instabilities preventing a true control;, thus explaining the reason for the "intermediate" character of the nuclear fusion herein considered (see Ref. [11] for brevity).

Once all necessary conditions are realized via actual engineering means, fusions are predicted under the addition of a suitable trigger as used for the neutron synthesis (Section 2), whose functions is that of overcoming repulsive Coulomb forces between nuclei, and bringing them at mutual distances of 1 fm, at which value fusions are unavoidable due to the activation of nuclear forces.

Ref. [11] also reported initial engineering realizations via the so called *hadronic reactors,* consisting of high pressure metal vessels containing a suitably selected gas traversed by a DC electric arc between suitably selected electrodes. Industrially usable energy outputs are predicted when flowing the gas through the arc, a process known as *PlasmaArcFlow* (patented and international patents pending), plus the use of a suitable trigger. A true and effective control of the nuclear fusions is achieved via a variety of engineering means all readily feasible with current technologies, including the control of the pressure, power, flow, temperature, trigger, and other means.

Note that the synthesis of neutrons from protons and electrons is much simpler than that of nuclei due to the Coulomb *attraction* between protons and electrons compared to the Coulomb *repulsion* for nuclei. This illustrates the view expressed in Section 2, namely, that hadronic mechanics and chemistry predict that neutron synthesis (1.1) can be simply achieved via a sufficiently strong DC electric arc traversing a hydrogen gas. As we shall see, the neutron synthesis is the most fundamental one in nature, and remains fundamental for the controlled fusions here studied.

The decades of research at the mathematical, physical and chemical levels reported above were intended as merely preparatory for its main objective: the quantitative prediction and industrial realization of new clean energies. By using standard nuclear terminologies and symbols with: A, Z, J^p, u denoting the atomic number, the nuclear charge, the nuclear angular momentum, the parity, and the nuclear energy in amu (or u)units, Ref. [11] predicted the following generic ICNF

$$TR + N_1(A_1, Z_1, J_1^{p_1}, u_1) + N_2(A_2, Z_2, J_2^{p_2}, u_2) \quad \rightarrow$$

$$\rightarrow \;\; N_3(A_3, Z_3, J_3^{p_3}, u_3) + Heat, \tag{3.1a}$$

$$A_1 + A_2 = A_3, \;\; Z_1 + Z_2 = Z_3, \;\; J_1 + J_2 = J_3, \;\; p_1 = p_2 = p_3, \tag{3/1b}$$

$$\Delta E = E_3 - (E_1 + E_2) > 0 \tag{3.1c}$$

where TR denotes the trigger and the heat is essentially produced by the release of excited states of the synthesized nucleus N_3 under energies insufficient to produce nuclear fissions and related secondary massive radiations.

The first ICNF suggested for study in Ref. [11] is that of the nitrogen from deuterium and carbon

$$TR + H(2, 1, 1^+, 2.0141) + C(12, 6, 0^+, 12.0000) \quad \rightarrow$$

$$\rightarrow \quad N(14, 7, 1+, 14.0030) + \Delta E_{heat}, \tag{3.2a}$$

$$\Delta E = (E_C + E_H) - E_C = 0.0111 \; u = 10.339 \; MeV \approx 1.5 \times 10^{-15} \; BTU, \tag{3.2b}$$

The above synthesis is suggested in Ref. [11] as having a distinct priority over other syntheses currently receiving the majority of interest, such as the synthesis of the helium, for various reasons, such as:

1) Since the carbon isotope has null spin, the engineering realization of a controlled spin coupling is dramatically simplified, e.g., with respect to the synthesis of the helium;

2) When occurring at threshold energies, and only in that case, the above synthesis cannot possibly release any harmful radiation, e.g., it is impossible for various reasons to have proton, neutron or alpha radiations as a byproduct; and

3) Since all hadronic laws are verified, the realization of the nitrogen synthesis is essentially reduced to engineering issues.

The nitrogen synthesis is indeed of industrial interest because the hourly rate of 10^{30} ICNF, a rather reasonable expectation due to the volume of available gas, would overcome the used energy and yield the hourly production of about 10^{10} BTU, namely, a rather significant new clean energy.

Ref. [11] then suggested the possible achievement of the nitrogen synthesis starting from a hydrogen gas, rather than the deuterium, via the ICNF

$$TR + 2 \times H(1, 1, \frac{1}{2}^{+}, 1.0078) + C(12, 6, 0^{+}, 12.0000) + EC + \nu \quad \rightarrow$$

$$TR + C(12, 6, 0^{+}, 12.0000) + H(2, 1, 1^{+}, 2.0141) \quad \rightarrow$$

$$\rightarrow \quad N(14, 7, 1+, 14.0030) + \Delta E_{heat}, \tag{3.3}$$

where one should note first the *loss* of energy to synthesize the neutron (with the emission from Eq. (1.1) of the innocuous neutrino), and then the *production* of energy from the ensuing nuclear synthesis.

In essence, the electric arc first polarizes the carbon and hydrogen atoms by forming the magnecule $C_{\uparrow} \times H_{\uparrow} \times H_{\uparrow}$ as in Figure 2. including the necessary axial coupling of spins. Under a suitable trigger, the magnecule $C_{\uparrow} \times H_{\uparrow} \times H_{\uparrow}$ alone would yield a nucleus with $A = 14,\ Z = 8,\ J^{p} = 1^{+}$ that is known not to exist (since $O(14, 8)$ has spin $J = 0$). The electron capture (EC) and emission of the neutrino then yield the desired nitrogen isotope.

It should be indicated that ICNF (3.3) is expected as being realized in nature by lighting. In fact. pockets of air contained in amber indicate that the nitrogen content in our atmosphere has progressively increased through the ages, thus suggesting a natural process synthesizing nitrogen in our atmosphere for which lighting is manifestly plausible. Additionally, nuclear fusions are necessary for a quantitative (rather than the current qualitative) interpretation of thunder. In fact, conventional physical and/or chemical processes have not provided a quantitative representation of the large amount of energy needed for the thunder, due to the very small cylindrical area surrounding lightings as well as their extremely short durations of microseconds.

Another ICNF also suggested by lighting is given by [11]

$$TR + H(2, 1, 1^{+}, 2.0141) + O(16, 8, 0^{+}, 15.9949) \quad \rightarrow$$

$$\rightarrow \quad F(18, 9, 1+, 18.0009), \tag{3.4a}$$

$$\Delta E_1 = 0.0081\ u = 7.545\ MeV, \tag{3.4b}$$

and secondary process due to the instability of $F(18,9,1+,18.0009)$

$$F(18,9,1+,18.0009)+EC \quad \rightarrow \quad O(18,8,0^{+},17.9991)+1.656\ MeV, \tag{3.5}$$

resulting in the following total energy output per synthesis

$$\Delta E_{tot}=9.201\ MeV \ \approx \ 1.30\times 10^{-15}\ BTU, \tag{3.6}$$

in which case, again, 10^{30} syntheses per hour would yield a rather substantial new clean energy.

An additional selection recommended in Ref. [11] is given by a 50-50 mixture of deuteron and helium gases with the following ICNF

$$TR+H(2,1,1^{+},2.0141)+He(4,2,0^{+},4.0026) \quad \rightarrow$$
$$\rightarrow \quad Li(6,3,1^{+},6.0151)+\Delta E_{heat}. \tag{3.7}$$

with energy output

$$\Delta E=0.0016 \ \ u\approx 2.5\times 10^{-16}\ BTU, \tag{3.8}$$

that verifies all ICNF laws. Hence, one can see that a hadronic reactor with the above hadronic fuels becomes industrially relevant under the achievement of about 10^{30} ICNF per hour, that would yield the hourly production rate of about 10^{9} BTU.

Note the need, again, of deuterium for ICNF (3.4) and (3.7) or the need that deuterium be synthesized following the prior synthesis by. In turn, these aspects have a crucial relevance for the achievement of ICNF with industrially valuable energy output.

Yet another ICNF based on lithium is given by [11]

$$TR+H(1,1,\frac{1}{2_{\downarrow}}^{+},1.0078)+Li(7,3,\frac{3}{2_{\uparrow}}^{-},7.0160) \ \rightarrow$$
$$\rightarrow \ 2\times He(4,2,0^{+},4.0026)+\Delta E_{heat}, \tag{3.9a}$$
$$\Delta E=2.887\times 10^{-12}\ J, \tag{3.9b}$$

where one should know the opposing nuclear polarizations $Li_{\uparrow}$ and $H_{\downarrow}$ to verify the law of the conservation of the angular momentum, a feature of crucial relevance for the engineering realization of industrial relevance.

The energy output of reactions (3.9) is significant. By using one mole of lithium that has 20^{23} nuclei; by assuming an efficiency of 10^{16} per minute; and by using energy units in Joules, we could have the energy output

$$E_{out}=(2.88\times 10^{-12}\ J)\times 10^{16}=2.8\times 10^{4}J/min=1.7\times 10^{6}J/h. \tag{3.10}$$

that is indeed industrially relevant.

Note the *impossibility for all above nuclear fusions to release protons, neutrons, alpha or other massive radiations,* trivially, because of lack of sufficient energy for the fission of light stable nuclei. Gamma and beta radiations are indeed predicted, but they are easily absorbed by the thick metal walls of hadronic reactors. Hence, hadronic reactor release no harmful radiations in their outside.

Note also the great emphasis in using *light natural isotopes,* rather than heavy isotopes, another condition crucial to avoid the release of harmful radiations. In fact, the proposed ICNF essentially deal with *the controlled fusion of two light, natural and stable nuclei a third a third lighting natural and stable isotope without possibilities for harmful radiations.* In simple terms, either two properly selected isotopes yield a third without secondary radiations, or there is no fusion at all.

It should be additionally indicated that *the proposed nuclear syntheses cannot possibly be explosive,* since they are restricted to a very small area surrounding the arc, which area is disrupted by the fusions themselves, thus illustrating the need for the PlasmaArcFlow process because., in its absence, the energy release can be small and not fully controlled.

Finally, the reader should keep in ,mind that *the hadronic reactors used the measurements reported below are patterned along the behavior of lighting in their conception, operations and produced ICNF.* In fact, as we shall seen, spectral analyses appear to confirm precisely the nuclear fusions expected in lighting.

In this paper we report, apparently of the first time, experimental evidence confirming the *existence* of the proposed ICNF without harmful radiations and their truly controlled character under hadronic laws, by deferring all other aspects to future papers.

It is hoped readers do not expect in this first experiment the achievement of vast maturity, including that in peripheral aspects inessential for the first basic issue, the existence or lack of existence of said nuclear fusions under said conditions. Additionally, it is hoped reader will abstain from venturing judgments without a serious knowledge of the quoted literature to prevent the illusion of knowledge. Above all, it is hoped readers carefully avoid expectations of quick achievement of unlimited clean energies, due to the enormity of the problems to be solved for a large industrial realization, let alone the corresponding need of large funds.

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4. Nitrogen Synthesis from Deuterium and Carbon.

With reference to Figure 3, the author constructed a hadronic reactor consisting of a 1 ft diameter and 2 ft length Schedule 40 steel pipe with related flanges, tested at 300 *psi* so as to safely operate at 100 *psi* pressure, equipped with internal electrodes composed of commercial grade graphite, the anode being stationary and the position of the cathode being controllable from the outside via a suitable insulated knob allowing the initiation and disconnection of the arc, said reactor being completed by inlet and outlet gaseous ports, pressure and other gauges.

On January 7 2010, a vacuum was first pulled out of said reactor by technicians *Gene West* and *Michael Rodriguez* who subsequently filled up the reactor up to 100 *psi* with deuterium gas 99.99% pure supplied by *Advanced Special Gases* of Reno, Nevada. The original deuterium tank was then disconnected. A two-valves laboratory bottle market $HT1$ was then filled up with the gas in the interior of the reactor following due flushing. Commercially available digital sensors were used for the recording of temperatures.

No PlasmaArcFlow of the deuterium through the arc was not activated because the

Figure 3: *An illustration in the top view of the equipment used in the tests, showing the pressure tank for the selected gas, the hadronic reactor, the AC-DC converter and the panel for remote controls. An illustration in the bottom view of the carbon electrodes following the tests reported below. whose whitish scorching is visual evidence of nuclear fusions since the tests dealt with pure gases without oxygen that could not possibly iignote under the arc.*

first reactor here referred to did not have a cooling system and, in its absence, operations had to be stopped in one or two minutes with or without PlasmaArcFlow due to excessive heat produced. Also, the experiment is intended solely to establish the *existence* of nuclear synthesis (3.2) and the securing of basic numerical data, since the study of various peripheral aspects as well as the achievement of a large scale production of energy requires basically different approaches and vast developments in due time.

The electrode terminals of the reactor were connected to a commercially available Miller Electric Dimension 1000 AC-DC converter set to operate at 40 Kwh. Gene West and Michael Rodriguez activated the DC electric arc in the interior of the reactor for two minutes, after which time the arc had to be disconnected because the reactor, originally at about 20^oC, had reached well over 150^oC and the external paint showed signs of scorching.

A second two-valves laboratory bottle was marked $HT2$ and filled up with the gas in the interior of the reactor following the activation of the arc and due flushing. Under the trail of custody by technicians *Jim Alban,* the two laboratory bottles so obtained were shipped to *ORS Oneda Research Services* of Whitebnodo, New York, for analyses.

Radiation counts during the test 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 but with both visual and sonic means;

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

5) Various material suitable for nuclear transmutations.

The first and perhaps most important feature to report, under the eyewitnessing of Gene West, Michael Rodrigues and Jim Alban, is the absence of any massive radiations in the outside of of the hadronic reactor, with particular reference to the absence of any detection of neutrons that, in case produced, are predicted to be detectable outside the reactor. Internally produced charged particles are easily absorbed by the thick Schedule 40 metal walls of the reactor and not be measurable in the outside. No production of alpha particles is possible due to insufficient energies for the fission of light stable nuclei.

The analyses on samples $HT1$ and $HT2$ were conducted by ORS Oneda Research Services, via an Internal Vapor Analyzer, model 110-s which is the latest version of the system. The Analyses were performed per ORS SOP MEL-1070,Gas Analysis of Sealing Chamber Atmosphere. The main results are shown in Figure 3.

Heat measurements were done as follows. With reference to Figure 3, the reactor essentially consisted of a schedule 40 pipe 1 ft diameter and 2 ft long, with two hollow flanges welded at its ends. According to tabulated data (verified with approximate but actual measurements), the weight of this assembly is of 325 lbs plus the weight of the steel in the four (two external and two internal) weldings. To be conservative, we assume below that the

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ORS LOT NO 184443-001
DATE TESTED 1/18/2010
QUANTITY TESTED 2
PACKAGE TYPE CYLINDER
MFG CODE Date filled: 01/14/10
Filled by: R.S.
PO: XXXX-XXXX-XXXX-7641
Rel. No:
RUGGERO SANTILLO
INSTITUTE FOR BASIC RESEARCH

720 WESLEY AVE
SUITE #1
TARPON SPRINGS, FL 34689
UNITED STATES

SAMPLE ID			HT1	HT2
INLET|PRESSURE		torr	219	333
NITROGEN		ppmv	49042	61085
OXYGEN	ppmv	13254	3211	
ARGON	ppmv	542	592	
CO2	ppmv	ND	497	
MOISTURE		ppmv	402	10705
HYDROGEN		ppmv	3321	3937
METHANE	ppmv	ND	ND	
AMMONIA	ppmv	ND	ND	
DEUTERIUMppmv		933379	917980	
FLUOROCARBONS		ppmv	ND	NDπ
BENZENE	ppmv	60	ND	
UNKNOWN*		ppmv	ND	1993

COMMENTS:
Tested per ORS SOP MEL-1070: Gas Analysis of Sealing Chamber Atmosphere.
Mass 3 was not quantitated but is shown in the spectra report.

APPROVED BY: Daniel J. Rossiter

Figure 4: *A view of the the results of the analysis of samples $HT1$ and $HT2$ by ORS Oneda Research Services.*

weight of this assembly, hereon referred to as the "cylindrical component," is of 300 *lbs*.

Additionally, the reactor comprises two plain flanges each having a tabulated (and approximately but actually verified) weight of 189 *lbs*. However, these flanges are thermally isolated from the cylindrical component to a great extent due to the gaskets between the plain flanges and the cylindrical component. In fact, systematic heat measurements showed that the cylindrical component would acquire heat much faster and in much greater amount than the terminal flanges.

Consequently, the heat measurements below are solely referred to the cylindrical component. The measurements on the terminal flanges are deferred to future independent verifications since the primary objective of this first paper is to ascertain the *existence* of ICNF, and not their energy output.

As indicated earlier, the tests on deuterium gas at 100 *psi* with a 40 kW arc between carbon electrodes operated for two minutes showed a systematic increase in temperature, from the ambient temperature in the range of 20^o C to generally over 150^o C with a conservative average here assumed of about 127^o C, The use of the known expressions $449J/kg.C \times 136.077kg \times 127C)/1055.06J/BTU$ then yields the heat acquires by the cylindrical component (cc)

$$\Delta T_{cc} = 7404BTU \tag{4.1}$$

By recalling the known value $1kwh = 3400BTU$, the use of 40 Kwh for two minutes yields

$$\Delta T_{arc} = 4533BTU. \tag{4.2}$$

Consequently, the internal reactions produced, subject to independent confirmation, the net heat in two minutes of

$$\Delta E_{out} = 7,404 - 4,533 = 2,871 \ BTU > 0, \tag{4.3}$$

thus confirming a significant internal source of energy beyond that of the AC-DC converter. It should be stressed that the primary emphasis of the above measurements has been the detection of a systematic *excess* heat over that produced by the arc. Its actual value under given conditions is evidently the subject of future tests.

Recall that a vacuum was pulled out of the reactor, that was then filled with 99.99 % pure deuterium gas which, prior to the test, measured 93.3 %, the residual gases being noncombustible except for traces of oxygen. Consequently, *the excess energy release cannot possibly be attributed to internal combustion since the deuterium gas is not combustible when alone. Hence, the sole credible interpretation is that the excess energy is due to nuclear fusions.*

The most significant measurements (Figure 4) is that *the deuterium gas decreased in two mutes of operation from* 93.3% *to* 91.8% *while nitrogen has increased from* 4.90% *to* 6.11%*, thus providing experimental confirmation of the nitrogen synthesis (3.2) as predicted in ref. [11].*

5. Heat Measurements in Hydrogen and Air.

In order to confirm whether or not the excess heath reported in the preceding section is specific for the combination of deuterium gas traversed by a DC arc between carbon electrodes, the author conducted systematic measurements by replacing the carbon electrodes with electrodes fabricated from commercially available tungsten and the use of a number of different gases.

It is important to report for independent verification that, *under the same conditions of pressure, power, duration, etc., as those of the preceding section, the operation of the hadronic reactor with gases composed by commercially available hydrogen and air traverses by a* 40 kW *DC arc between tungsten electrodes arc produced no appreciable energy excess at all.*

As an indication, systematic tests on air showed the transition in two minutes, in the cylindrical component of the reactor, from the ambient temperature of about $20^o\ C$ to about $60^o\ C$, thus showing a temperature increase of about $40^o\ C$ compared to the average temperature increase of the tests of the preceding section of about $127^o\ C$.

This result is, perhaps, the most important confirmation of the tests of the preceding section, because it illustrates the crucial role of carbon for the ICNF here reported, In any case, the synthesis of the neutron would *requires,* rather than releases energy.

It should be indicated that the use of different combination of gases and electrodes did produce an excess heat as reported in the subsequent sections. This additional aspect is important to illustrate that, by no means, ICNF are restricted to the combination of deuterium gas and carbon electrodes. in fact, the author gave priority to such a combination solely because ideally suited to void the usual alternative interpretations of excess heat as due to combustion and other conventional processes, since, when in a 99.99% pure deuterium gas, carbon cannot burn or have any other possible conventional esoterically chemical reaction.

6. Nitrogen Synthesis from Hydrogen and Carbon.

The author has also conducted systematic tests to achieve ICNF via the use of the same equipment as that of Section 4, but filled up with hydrogen instead of deuterium gas.

Among a number of tests conducted from January 2009 to February 2010, we report a test done on February 9, 2010 in which a vacuum was pulled out of the hadronic reactor of Figure 3, that was filled up with commercial grade hydrogen at 100 psi pressure; a sample of the gaseous content of the reactor was taken and market $HCN1$; the reactor was then operated for two minutes; a new sample of the gas content was taken and market $HCN2$; the two samples were then shipped via FedEx Next Day Air to Oneda Research Laboratories for analysis; and some of the results are presented in Figure 5.

The important result of this test is that *under the same conditions of pressure, power, electrodes, etc., the operation with hydrogen gas produced an energy excess bigger than that with deuterium gas, since in two minutes the temperature of the reactor went from* $80^o\ F$ *to* $490^o\ F$*, i.e., with about* 50% *increased energy oputput over the test with deuterium..*

The increased energy output was predicted in Ref. [11] from the energy output of lighting due to much bigger possibilities of ICNF. In fact, the analysis of Figure 5 shows that nitrogen (at 28 amu) has indeed increased from $24,684$ to $30,171$ counts. However, we additionally have: the species at 4 amu increased from ND to 76 counts; the species at 14 amu increased

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SPECTRA REPORT
INTERNAL VAPOR ANALYSIS

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ORS JOB NO. : 184727-001

DATE TESTED : 2/12/2010

QUANTITY TESTED : 2

PACKAGE TYPE : CYLINDERS

MFG. CODE : Date filled: 2/10/10

Filled by: Gene West

PO: HTI-10-44-83654
Rel. No:

SAMPLE ID	HCN1	HCN1						
AMU 2	16,075,402	18,550,801						
AMU 3	30,269	41,165						
AMU 4	-	76						
AMU 12	33	31						
AMU 14	2,841	3,555						
AMU 15	116	278						
AMU 16	1,205	3,010						
AMU 17	1,097	2,489						
AMU 18	2,718	2,949						
AMU 27	100	90						
AMU 28	24,684	30,171						
AMU 29	532	736						
AMU 30	66	81						
AMU 32	5,300	6,621						
AMU 40	272	366						
AMU 44	180	190						

COMMENTS:

Tested per ORS SOP MEL-1070: Gas Analysis of Sealing Chamber Atmosphere.
Mass 3 was not quantitated but is shown in the spectra report.

Figure 5: *A view of the the results of the analysis of samples $HCN1$ and $HCN2$ by ORS Oneda Research Services.*

from $2,841$ to $3,555$ counts; the species at 15 *amu* increased from 116 to 378 counts; the species at 16 *amu* increased from $1,205$ to $2,948$ counts; etc.

Consequently the measurements here reported provide experimental confirmation, not only of the synthesis of the nitrogen from hydrogen and carbon via the intermediate synthesis of the deuterium, but also the synthesis of the oxygen, as well as other nuclear syntheses.

7. Nuclear Synthesis from Magnegas.

We here report for future detailed study that the repetition of the tests of Sections 4 and 5 via the use of the *magnegas* (chemical symbol MG [13]) a gaseous clean burning fuels developed by the U. S. company *Magnegas Corporation* [14]. produced an energy output bigger than that of the preceding cases.

The tests were done on November 28, 2009 by filling up the hadronic reactor of Figure 3 with magnegas after pulling out a vacuum and a sample bottle was taken market $MG1$; the reactor was operated for one minute and a second sample bottle was taken market $MG2$; the two bottles were then sent to ORS Oneda Research Laboratory for analysis via next day deliver, with results are partially reported in Figures 6. for brevity

On a comparative basis with preceding tests, the most significant result is that the reactor had to be stopped after only one minute of operation, rather than the two minutes of operation of the preceding tests, to avoid damage due to excess heat not being dissipated.

This result was also predicted in Ref. [11] because the acquisition of a magnecular structure is necessary for the ICNF here considered since said structure is necessary for the exposure of nuclei and their proper spin alignment. In the preceding tests, the deuterium and hydrogen gases did not originally have any magnecular structure that, therefore, had to be created by the arc prior to possible nuclear fusions. It is then evident that the conduction of the same tests with a gas already possessing a magnecular structure must have a bigger efficiency and energy output

The test was repeated in the same day with hydrogen and two samples were taken market $HC1$ and $HC2$, one before and the other after activation of the arc. The results of their analysis are combined with those for magnegas in Figures 6 for confirmation of the preceding results.

To conclude the presentation of our long testing, in Figure 7 we report analyses on the repetition of the hydrogen tests exactly as done in Section 5, with the sole difference that the electrodes were given by *tungsten,* rather than carbon rods. The tests were repeated twice in succession, resulting in the two sets of two samples of Figure 7, the first and third columns presenting commercial grade hydrogen with the contaminants contained in the reactor due to preceding tests, while the second and forth columns present the data on the preceding samples after activation of the arc for two minutes.

The important result to report is the definite increase of the species with 3 *anu* from $23,638$ to $27,078$ counts for the first set and from $58,537$ to $66,427$ counts for the second set of samples. Evidently, *these systematic increases confirm the laboratory synthesis of the neutron from a hydrogen gas* as achieved by Don Borghi [9] and Santilli [10]. Following its synthesis, the neutron is then captured by the hydrogen molecule, by increasing in this way its weight to 3 !*amu* apparently for a yet unexplored ca[pability of electric arcs to attract

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ORS JOB NO. : 184033-001

DATE TESTED : 12/3/2009

QUANTITY TESTED : 4

PACKAGE TYPE : CYLINDERS

MFG. CODE : Date filled: 12-2-09

PO: XXXX-XXXX-XXXX-7641
Rel. No:

SAMPLE ID		HC1	HC2	MG1	MG2				
AMU	2	19,247,560	17,401,980	5,856,860	6,199,590				
AMU	3	124,952	100,326	13,153	14,740				
AMU	4	74	68	3,515	3,708				
AMU	6	-	-	623	663				
AMU	11	-	-	157	131				
AMU	12	158	5,783	170,042	180,955				
AMU	13	43	12,223	95,753	102,621				
AMU	14	5,575	28,847	183,460	200,608				
AMU	15	439	148,998	932,097	1,025,447				
AMU	16	3,621	170,812	1,102,872	1,209,096				
AMU	17	9,146	12,454	25,515	26,046				
AMU	18	27,751	32,087	23,935	21,142				
AMU	19	252	269	742	738				
AMU	20	139	115	-	-				
AMU	22	-	-	1,379	1,440				
AMU	24	-	1,147	23,544	23,635				
AMU	25	-	4,381	84,937	84,755				
AMU	26	250	24,314	439,169	438,430				
AMU	27	497	18,353	219,214	232,044				
AMU	28	42,692	94,667	2,620,060	2,752,030				
AMU	29	3,362	8,868	92,706	99,472				
AMU	30	111	6,102	38,497	41,798				
AMU	31	62	195	2,323	2,564				
AMU	32	13,766	6,778	4,150	1,582				
AMU	33	123	-	114	113				
AMU	36	-	-	1,360	1,368				
AMU	37	-	-	7,727	8,150				
AMU	38	-	92	10,563	10,967				
AMU	39	170	335	39,221	41,043				
AMU	40	690	543	13,582	13,199				
AMU	41	300	241	24,509	24,867				
AMU	42	-	-	11,591	11,871				
AMU	43	-	-	2,546	2,585				
AMU	44	642	1,272	140,842	146,039				
AMU	45	-	-	3,027	3,142				

OMMENTS:

sted per ORS SOP MEL-1070: Gas Analysis of Sealing Chamber Atmosphere.

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DATE TESTED : 12/3/2009

QUANTITY TESTED : 4

PACKAGE TYPE : CYLINDERS

MFG. CODE : Date filled: 12-2-09

PO: XXXX-XXXX-XXXX-7641
Rel. No:

SAMPLE ID		HC1	HC2	MG1	MG2				
AMU	46	-	-	653	703				
AMU	48	-	-	607	602				
AMU	49	-	-	3,812	3,806				
AMU	50	-	196	16,967	17,718				
AMU	51	-	201	16,262	17,135				
AMU	52	-	169	15,373	16,131				
AMU	53	-	-	5,503	5,673				
AMU	54	-	-	5,723	5,802				
AMU	55	-	-	2,538	2,658				
AMU	56	-	-	2,753	2,812				
AMU	57	-	-	226	239				
AMU	58	-	-	250	248				
AMU	59	-	-	145	-				
AMU	60	-	-	382	395				
AMU	61	-	-	679	763				
AMU	62	-	-	905	1,018				
AMU	63	-	-	2,647	2,953				
AMU	64	-	-	262	310				
AMU	65	-	-	2,660	2,848				
AMU	66	-	-	3,474	3,766				
AMU	67	-	-	1,846	1,853				
AMU	68	-	-	684	670				
AMU	69	-	-	208	185				
AMU	70	-	-	327	348				
AMU	72	-	-	84	88				
AMU	73	-	-	934	1,008				
AMU	74	-	-	2,707	2,925				
AMU	75	-	-	977	1,065				
AMU	76	-	156	2,558	2,825				
AMU	77	-	153	12,308	13,170				
AMU	78	131	697	50,466	55,332				
AMU	79	-	-	4,426	4,766				
AMU	80	-	-	568	606				
AMU	81	-	-	135	135				
AMU	82	-	-	117	130				

COMMENTS:

Tested per ORS SOP MEL-1070: Gas Analysis of Sealing Chamber Atmosphere.
Mass 3 was not quantitated but is shown in the Spectra Report.

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DATE TESTED : 12/3/2009

QUANTITY TESTED : 4

PACKAGE TYPE : CYLINDERS

MFG. CODE : Date filled: 12-2-09

PO: XXXX-XXXX-XXXX-7641

Rel. No:

SAMPLE ID	HC1	HC2	MG1	MG2				
AMU 84	-	-	177	191				
AMU 89	-	-	145	168				
AMU 91	-	-	2,912	3,168				
AMU 92	-	-	1,523	1,703				
AMU 93	-	-	130	150				
AMU 102	-	-	79	89				
AMU 103	-	-	201	236				
AMU 104	-	-	426	445				
AMU 105	-	-	90	97				
AMU 106	-	-	115	108				
AMU 115	-	-	82	141				
AMU 116	-	-	-	117				
AMU 128	-	-	-	77				

MMENTS:

sted per ORS SOP MEL-1070: Gas Analysis of Sealing Chamber Atmosphere.
ass 3 was not quantitated but is shown in the Spectra Report.

Figure 6: *A view of the the results of the analysis of samples* $HC1 - HC2$ *and* $MG1 - MG2$ *by ORS Oneda Research Services.*

polarized particles toward its symmetry asis. As indicated earlier, this synthesis is crucial for subsequent ICNF in a way similar to what is the case in the Stars.

8. Experimental Confirmation of Santilli Magnecules.

Experts in quantum chemistry, but without a technical knowledge of the covering hadronic chemistry [5], may be confused by the inspection of the measurements due to the presence of anomalous chemical species, i.e., species that are generally unknown, such as the species at 6 *amu*. the species at 19 *amu* (called H_3O), and numerous others (see the recent review [12]).

Since these anomalous species cannot possibly be quantitatively, or otherwise credibly represented as having a *molecular* structure (namely, originating from a *valence bond*), the sole quantitative interpretation known at this time is that they are characterized by the new chemical species of *Santilli magnecules,* given by clusters of H, C, O and other atoms, plus HO, CH and other dimers and ordinary molecules H_2, CO, H_2O etc., under the new non-valence *magnecular bond* responsible of structures of the type of Figure 2 [5,13]. As a result, the tests here presented provide additional experimental evidence on the existence of the new chemical species of magnecules. These aspects cannot possibly be studied in this initial paper and have to be deferred to subsequent works so as to avoid un-necessary delays in the search for new clean energies.

9. Concluding Remarks.

It should be recalled in closing that the author has indicated in various works (see, e.g., Refs. [5,13,15]) that the widespread use of hydrogen as automotive fuel cause serious environmental problems, such as:

1) The *oxygen depletion,* referred to the permanent removal of breathable oxygen from our atmosphere and its conversion into H_2O whose separation to restore the original oxygen balance in our atmosphere is costly;

2) The *ozone depletion,* referred to the permanent loss of ozone due to hydrogen seepage and its rapid raising to the ozone layer with resulting very rapid reaction $H_2 + O_3 \rightarrow H_2O + O_2$;

3) The need of liquefy hydrogen and maintain it as such,, which is necessary for hydrogen to have any appreciable automotive range, with serious risks in the event of a malfunction of the cooling system;

4) The pollution created by the current means for hydrogen production;

5) The well known problem called *embrittelment;* and other problems.

It has been rewarding for the author to see that, hydrogen can indeed be useful for new clean energies, but for its use in intermediate controlled nuclear fusions, rather than for automotive use, of course, following predictably long developments.

However, the achievement of said ICNF via the use of hydrogen as “hadronic fuel” mandates the surpassing of quantum mechanics in favor of the covering hadronic mechanics. As recalled earlier, quantum mechanics is strictly reversible over time, while all energy releasing processes, including above all nuclear syntheses based on hydrogen, are strictly irreversible. Therefore,. it is scientifically appropriate to debate the correct covering theory, but not its need.

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ORS JOB NO. : 183831-001
DATE TESTED : 11/12/2009
QUANTITY TESTED : 4
PACKAGE TYPE : CYLINDERS
MFG. CODE : Date filled: 1-1-09
Filled by: Gene West

PO: XXXX-XXXX-XXXX-7641
Rel. No:

SAMPLE ID		EQ09016	EQ09016	EQ09018	EQ09018				
AMU	2	10,710,660	11,454,640	11,579,230	11,934,680				
AMU	3	23,628	27,078	58,537	66,427				
AMU	12	37	38	86	87				
AMU	13	-	-	18	18				
AMU	14	3,075	3,376	2,673	2,812				
AMU	15	92	183	369	413				
AMU	16	1,375	2,337	1,425	1,772				
AMU	17	5,668	7,648	12,305	12,866				
AMU	18	19,338	20,219	46,144	45,938				
AMU	19	56	55	290	324				
AMU	20	66	-	72	90				
AMU	27	-	-	84	55				
AMU	28	26,085	27,706	18,213	18,386				
AMU	29	646	713	926	1,038				
AMU	30	221	200	114	101				
AMU	32	5,250	5,580	-	-				
AMU	40	316	360	220	240				
AMU	44	257	295	361	326				
AMU	78	-	-	164	189				

COMMENTS:

Tested per ORS SOP MEL-1070: Gas Analysis of Sealing Chamber Atmosphere.
UNKNOWN*: Unidentified organic compound(s).
UNKNOWN spectra may be Benzene.

Figure 7: *A view of the the results of the analysis of two sets of two identical samples obtaiend before and after the activation of the DC arc on tungsten (rather than carbon) electrodes.*

Supporters of hydrogen should be warned that its use for arc based ICNF will inevitably produce *neutrons* [9,10], thus voiding the primary environmental advantage of other light stable natural elements, such as the deuterium, whose ICNF produce no harmful massive radiations according to comprehensive and repeated evidence.

In view of all the above, the attentive reader may have asked which is the best hadronic fuel for ICNF. In the author's view, the best hadronic fuel is that for which ICNF were conceived for: *study the possibility of turning carbon dioxide CO_2 into an energy source,* in the hope of alleviating the most serious environmental problems facing mankind today for which it is hoped colleagues provide their contribution, rather than the often implemented opposition against basic scientific novelty.

It should be recalled that a DC arc is the most efficient means to separate the CO_2 molecule and create a plasma composed by carbon and oxygen. The arc then triggers their combustion with the very esoenergetic creation first of CO and then again of CO_2. However, it should be stressed that, in this process, *the energy out must be smaller than the electric energy,* due to known conservation laws. Therefore, the possibility of using CO_2 as a source of energy crucially and centrally depends on the presence of ICNF.

The author is conducting systematic mathematical, theoretical, experimental and industrial studies on the latter possibility and the results may be reported in some future paper in the event successful or at least valuable.

On personal grounds, the author would like to indicate that, at the end of a scientific journey that lasted for decades, it was pleasantly surprising to see that the magnificent element *carbon,* which is at the foundation of our lives, subject to independent confirmations, may also have a fundamental;l character for controlled nuclear fusions without harmful radiations.

Acknowledgments.
The author would like to to thank Gene West, Michael Rodriguez and Jim Alban for invaluable technical assistance in the realization and conduction of the measurements. Additional particular thanks are due to Michele Sacerdoti for verifications of data (4.1)-(4.3) and penetrating critical comments.

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