PROCEEDINGS OF THE THIRD INTERNATIONAL CONFERENCE ON LIE-ADMISSIBLE TREATMENT OF IRREVERSIBLE PROCESSES (ICLATIP - 3)
Kathmandu University, Nepal, April (2011) pages 163-177

ADDITIONAL CONFIRMATION OF "INTERMEDIATE CONTROLLED NUCLEAR FUSION" WITHOUT HARMFUL RADIATIONS OR WASTE

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Abstract

In this paper, we report three tests providing additional experimental confirmations of the recently achieved and verified *Intermediate Controlled Nuclear Fusions* (ICNF). Thanks to various chemical analyses performed by independent laboratories, the first test established the ICNF of silica from carbon and oxygen; the second test confirmed the preceding results; and the third test established the ICNF of oxygen from helium and carbon.

PACS 25.70.Jj, 24.10.-i, 25.70.-z

1. Introduction

Following decades of studies for the prior development of mathematical, physical and chemical formulations as structurally irreversible over time as the energy releasing processes that have to be described (see review [1] and general presentations [2]), and as a result of extensive tests and experimentations conducted for years, in the preceding paper [3] we released, apparently for the first time, experimental evidence on the "existence" of *Intermediate Controlled Nuclear Fusions* (ICNF) whose primary features are the following:

1) *Lack of emission of harmful radiations (such as n, p, α, etc.) and lack of release of radioactive waste.* This fundamental feature is achieved by conceptually and technically restricting the syntheses to light, natural and stable elements.

2) *Control of the fusions via multiple means.* This second important feature is achieved via the control of power, temperature, pressure, flow and other engineering means.

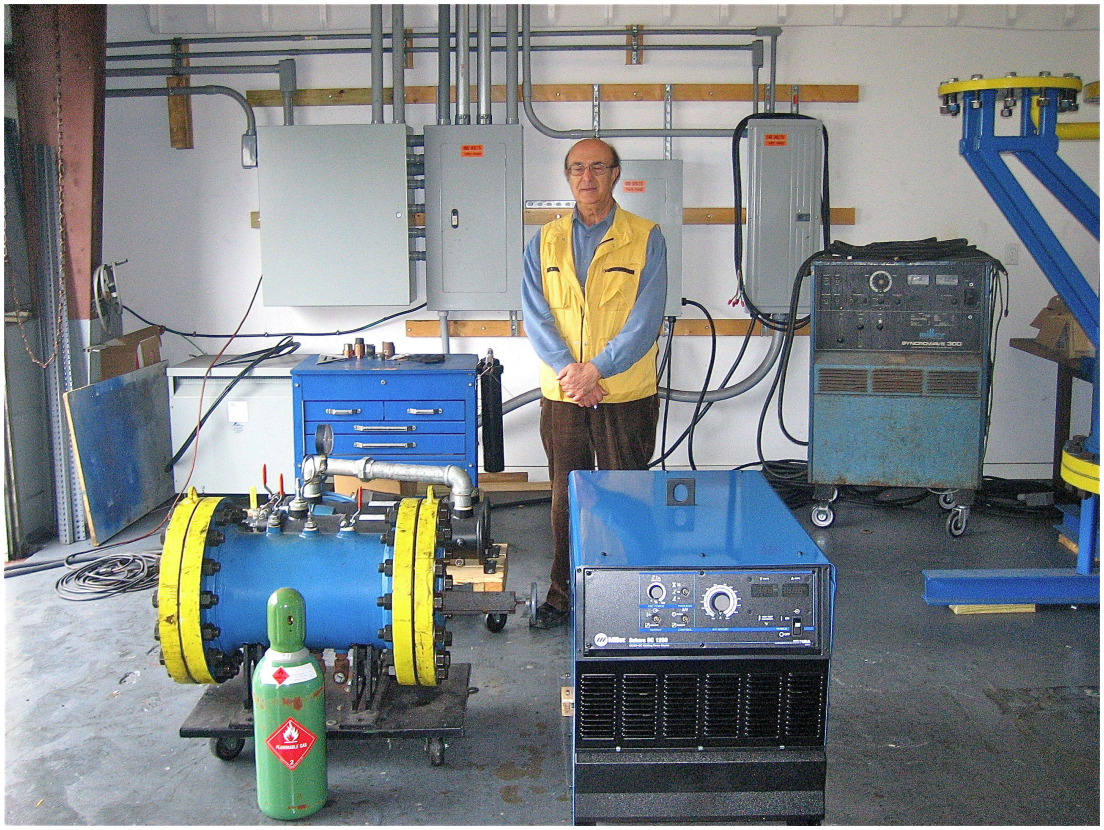

Figure 1: A view of the author with the equipment used for the synthesis of nitrogen from carbon and deuterium [3] showing from the r.h.s.:. the Miller Dimension 1000 AC-DC converter; the pressure bottle of 99.99 pure deuterium; and the carbon steel, 12" x 24" schedule 80 hadronic reactor.

3) *Intermediate character between the so-called hot and cold fuions,* in the sense that the used temperature has values in between the high temperatures of the hot fusion and the low temperature of the cold fusion.

ICNF are achieved via the use of specially constructed, high pressure, steel vessels known as *hadronic reactors* because conceived and constructed via the laws of hadronic mechanics and chemistry [1,2]. Their main function is that of delivering a DC electric arc between suitably selected electrodes submerged within a suitably selected gas at pressure. Under the condition that, for selected electrodes, the gas does allow ICNF, it is called *hadronic fuel.* All tests herein considered deal with hadronic fuels suitably selected to achieve ICNF when traversed by a DC arc between carbon electrodes.

In particular, paper [3] presented the following ICNF

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

$$\rightarrow N(14,7,1^+,14.0030)+\Delta E, \tag{1a}$$

$$\Delta E=(E_{car}+E_{deu})-E_{nitr}=0.0111\ u, \tag{1b}$$

where TR stands for the *trigger,* namely, an external action (such as instantaneous increase in pressure) forcing exposed nuclei at mutual distances of 1 fm against their repulsive Coulomb forces, at which occurrence the strongly attractive nuclear force is activated between the two nuclei and their fusion is inevitable under the principles of ICNF reviewed below. The reader should note that ICNF (1) verifies all conceivably possible nuclear and other laws.

As described in detail in Ref. [3], ICNF (1a) was achieved via a schedule 80 carbon steel hadronic reactor of $1ft\times 2ft$ (see Figure 1) filled up with the hadronic fuel given by pure deuterium gas at 100 psi (following pulling out of a vacuum) that was traversed by a DC electric arc between commercially available graphite electrodes powered by a 50 kW DC-AC converter built by the U. S. company Miller Electric. The test had to be systematically interrupted following a maximum of 2 min operation to prevent melt-down of the equipment. Independent chemical analyses, done by the *Oneida ORS Laboratories* on samples of the interior gas before and after the activation of the arc, measured a macroscopic percentage of nitrogen after the activation of the arc that did not exist before, thus establishing its synthesis. The nitrogen synthesis so detected was independently confirmed by the heat produced that was definitely bigger than that provided by the 50 kW AC-DC converter.

ICNF (1a) was selected among a variety of possibilities to prevent wasteful academic discussions on the excess heat in the event interior combustion had been allowed. In fact, the interior gas, that was confirmed as being 99.99 % pure deuterium, positively cannot experience any combustion when traversed by a DC arc. Therefore, the heat measured in excess of the heat produced by the arc can solely be explained, on serious scientific grounds, as originating from ICNF (1).

ICNF (1a) was also selected among a considerable variety of possibilities to prevent wasteful academic discussions on the absence of harmful radiations. In fact, we have the synthesis of a light, natural and stable element, the nitrogen, from two ligher, natural and stable elements, the deuterium and the carbon, Therefore, when synthesis (1) occurs, there is no possibility whatsoever, not even remote, to produce harmful radiations or release radioactive waste as routinely expected by the community in nuclear fusions. In the event syntheses (1a) do not occur, there is equally the impossibility of producing harmful radiations or releasing radioactive waste because the energy of the 50 kW AC-DC converter is about one billion times short of the

Figure 2: A view of the participants in the verification [4], showing from the left: G. West (IBR), R. M. Santilli (IBR), T. Kuliczkowski (PGTI), L. Ying (PGTI), M. Rodriguez (IBR), R. Brenna (PGTI), and C. Lynch (IBR). The picture also shows the used equipment.

energy needed to fracture the deuterium and/or the carbon nuclei for the production of the harmful radiation and waste expected by the physics community in the field.

Following the appearance of paper [3], the author requested nuclear physicists **Robert Brenna, Theodore Kuliczkowski and Leong Ying** of *Princeton Gamma Tech Instruments* to conduct independent verifications or dismissals of the results presented in Ref. [3]. Following extensive and detailed tests via the use of the same equipment and same set up of tests [3], the indicated nuclear physicists released paper [4] (see also ref. [5]) confirming all main results of Ref. [3], including: the synthesis of nitrogen from deuterium and carbon; the excess heat over that produced by the AC-DC converters; and the complete absence of harmful radiations or radioactive waste.

Refs. [3,4,5] have essentially confirmed the following *Santilli's Principles of ICNF* (see Refs. [2] for extensive studies):

PRINCIPLE 1: Need to achieve a controlled exposure of nuclei. Nuclei are naturally protected by their electron clouds, as well known. Consequently, no nuclear fusion is conceivably possible or otherwise plausible without the systematic exposure of nuclei as an evident necessary preparatory step for their fusion. This is the reason the author dedicated decades of research for the *new chemical species of Santilli magnecules* (see

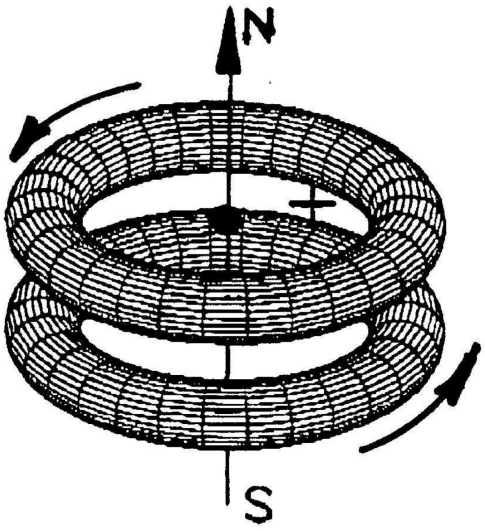

Figure 3: A conceptual view of the simplest possible example of the new chemical species of Santilli magnecule which is a necessary prerequisite for all ICNF studied in this paper.

the review in Ref. [1] or Vol. IV of Refs. [2] and original literature quoted therein). This new species is schematically represented in Figure 3 for the simplest possible biatomic case, and clearly shows the controlled exposure of nuclei via the polarization of the orbitals into toroids permitted by DC electric arc. The same picture shows the maintenance of said polarization via couplings. In the author's opinion, *the most important scientific contribution by R. Brenna, T. Kuliczkowski and L. Ying in Refs [4] has been the experimental confirmation of the existence of Santilli magnecules, not only for their evident independent chemical value, but also as a necessary prerequisite for fusion.*

PRINCIPLE 2: The need to achieve the correct spin coupling. Following the exposure of nuclei, no controlled fusion is conceivably possible, or otherwise plausible, without the additional systematic control of spin couplings. In fact, triplet couplings of spin notoriously cause strong repulsive forces in which case fusions can at best be at random. Ref. [3] established the second necessary condition for truly controlled fusions, the achievement of *systematic spin couplings either of planar singlet or of axial triplet type.* Another illustration of the fundamental character of Santilli magnecules for ICNF is visually represented in Figure 3 with the automatic achievement of the axial triplet coupling of nuclear spins (same spin direction for nuclei along the same

symmetry axis).

PRINCIPLE 3: Use the minimal possible energy required by conservation laws, called "threshold energy." A reason stressed by the author for the inability by hot fusions to achieve systematic and controlled nuclear fusions (following half a century of research and the expenditure of over one billion dollars) is the use of excessive energies under which the control of the fusion is practically impossible due to inevitable instabilities and to the extreme technological difficulties for their control. Similarly, the author has stressed that a reason for the inability by cold fusions to achieve systematic and controlled fusions has been the use of insufficient energies, e.g., as needed for a systematic exposure of nuclei. These two opposite extremes illustrate the third principle of ICNF according to which, in order to avoid uncontrollable instabilities, following the achievement of the configuration of Figure 3 via the implementation of Principles 1 and 2, the fusion reactor must operate at "threshold energy," namely, the minimal possible energy needed to push the two nuclei at a mutual distance of 1 fm against their repulsive Coulomb forces, with the consequential activation of nuclear forces, at which activation fusion is simply unavoidable under the indicated premises.

2. Review of the New Tests

In this paper, we report three tests providing additional experimental confirmation of the preceding results [3,4,5]. It should be stressed to prevent misconceptions, that as it was the case for the preceding tests, the sole objective at this time of the tests reported below is that of **confirming the "existence" of systematic and controlled nuclear fusions without harmful radiation or waste.** Any expectation of "measurements" of heat produced, flow, temperature gradient and other data would be grossly premature at this time since the equipment could only be operated for a few minutes due to excessive production of heat. Also, the achievement of measurements will require the investment of millions of dollars for the construction of a hadronic reactor suitable to operate for the sufficient long time needed for meaningful measurements. Under these understandings, the new tests can be reported as follows:

TEST 1.

the main objective of this test was the experimental confirmation of the existence of the following new ICNF

$$O(18,8,0^+,17.9991)+C(12,6,0^+,12.0000)+TR\rightarrow$$

$$\rightarrow Si(30,14,0^+,29.9737)+\Delta E, \tag{2a}$$

$$\Delta E=0.0254\ u, \tag{2b}$$

that also verifies all possible nuclear laws. The test was suggested by the fact that, during the years of experimentation on ICNF, the author has systematically seen a

Figure 4: A picture of the hadronic reactor used in Tests 1, 2, 3.

"whitish powder" on the edge of carbon electrodes that is somewhat suggestive of the synthesis of silica.

For the test of ICNF (2a), the author and his technicians **Chris Lynch, Michael Rodriguez, Gene West, Donald Roch, Ray Jones and Jim Alban** constructed in early 2010 a new, hadronic reactor with automatic controls of the arc and main functions. as depicted in Figures 4, 5 and 6. This is the first automatic hadronic reactor for ICNF since it creates and controls automatically the DC arc, but also monitors all main features, including power, temperature, pressure, flow, trigger, and other features with automatic shut off in the event of any malfunction. The reactor essentially consists in an internal, carbon steel, schedule 80, cylindrical vessel $1\ ft \times 5\ ft$ filled up with the desired gaseous hadronic fuel and traversed by a DC arc between carbon electrodes. The internal chamber is then completed with an external water jacket used to cool down the reactor and for the production of steam. An AC-DC converter was used with 100 kW maximal power, although actual uses were restricted to 50 kW for safety. The reactor is then completed with a variety of sensors for internal as well as external temperature, pressure and other data connected to the automatic controls.

Following over one year of tests, verifications and tuning to assure the proper operation and safety of the reactor, on April 11, 2011, with the assistance of the

Figure 5: A view of the production of steam during test 3.

above indicated technicians, the author pulled a vacuum from the interior chamber of the reactor, that was subsequently filled up with commercially available oxygen at 100 *psi* pressure. The reactor was then operated for six minutes, at which time there was a violent increase in the production of steam out of the cooling jacket (see Figure 5) that forced the shut down of the reactor for safety.

After cooling off, the reactor was open and solid samples of the electrodes were sent for independent chemical analysis by *Princeton Gamma Tech Instruments* on a comparative basis with a solid sample of the same electrodes before the activation of the arc. **These analyses, entirely reported in Ref. [6], establish the distinct detection of silica following the activation of the DC arc that, under the above conditions, confirm the synthesis in laboratory of silica via ICNF (2a).** Note that no sample of the interior gas was taken because its analysis would have no impact on the desired verification, the latter dealing with a solid.

We should add that, as it was the case for all preceding tests, no measurable radiation was detected in the outside and no radioactive waste was detected in the inside of the hadronic reactor following its opening up after cooling. The various detectors used for radiations have been described in detail in Refs. [3,4] and their identification is ignored hereinafter to avoid repetitions.

TEST 2.
The controlled fusion of oxygen and carbon into silica was done because particularly important for environmental reasons since it is the premise for *the use of the green house gas CO_2 as a hadronic fuel for the production of clean energy.* In fact, a hadronic reactor can be filled up with CO_2 at pressure; the DC arc will be quite efficient in its separation into oxygen and carbon; part of the separated oxygen and carbon will evidently combust and produce CO that, in the presence of oxygen and an arc, reproduce again CO_2, thus recovering in great part the energy used for the separation of CO_2. However, jointly with the conventional combustion at a loss for the energy balance, the hadronic reactor will produce a net positive energy output due to the fusion of oxygen and carbon into silica. Test 1 described above and the second test here considered confirm the possible use of CO_2 as hadronic fuel for the production of energy without harmful radiation or waste via the indicated processes.

However, the use of oxygen in a hadronic reactor is very dangerous because it is known that virtually all substances, including metals, ignite when exposed to oxygen at high temperature. In fact, the local temperature at the tip of the DC arc when hitting the cathode is estimated as being, locally, of the order of $10^6 C$. Even though such a temperature decreases quite rapidly with the distance from the arc, it nevertheless causes a rapid increase in the temperature of the oxygen. This essentially implies the achievement of high oxygen temperatures in a matter of minutes at 100 *psi* pressure, and in seconds at higher pressures, at which value combustion of most substances exposed to oxygen is expected.

Following the adoption of due safety precautions, and in view of the indicated environmental relevance, the author and his technicians repeated Test 1 on April 14, 2011 for the specific intent of verifying or disproving results [6]. This second test was done under exactly the same conditions and setting of Test 1, thus without any modifications, to prevent variations. As predicted from carbon powder accumulated in the preceding Test 1, the internal oxygen achieved metal combustion temperature in about *three seconds* of operations, at which time an external metal fitting measuring pressure ignited and the operation has to be instantly interrupted. Nevertheless, despite its shortness, the test was sufficient to secure sample of "glassy-type small droplets" formed in the top of the cathode that were sent to *Princeton Gamma Tech Instruments* for study. **The resulting analyses, reported in full in Ref. [7], confirmed for the second time the synthesis of silica from oxygen and carbon via ICNF (2a)** via a comparison of the solid samples of Test 2 with those of the electrodes prior to the activation of the arc.

We should add again that, as it was the case for all preceding tests, no measurable radiation was detected in the outside and no radioactive waste was detected in the inside of the hadronic reactor following its opening up after cooling.

Figure 6: A view of the scorched carbon cathode following test 3.

TEST 3.
Following the successful synthesis of silica and its confirmation, among a variety of possible additional syntheses, the author selected Test 3 the ICNF of helium and carbon into the oxygen according to the rules

$$C(12,6,0^+,12.0000)+He(4,2,0^+,4.0026)+TR\rightarrow$$

$$\rightarrow O(16,8,0^+15.9949)+\Delta E \tag{3a}$$

$$\Delta E=0.0077\ u \tag{3b}$$

which synthesis also verifies all possible nuclear laws.

The test was done by the author and the above identified technicians on April 15, 2011, along lines similar to the preceding ones. The interior of the reactor was cleaned, and various components replaced; a vacuum was pulled out of the interior chamber; the reactor was filled up with commercial grade helium at 100 *psi*; a sample of the interior gas was taken following due flushing and marked $He1$; the reactor was activated for about six minutes and then shut off because of excessive increase of the produced steam from the water jacket; a sample of the interior gas was then taken and, again after flushing, marked $He2$; and the two samples $He1$, $He2$ were sent to the *Oneida ORS Laboratories* for chemical analyses. **the results, reproduced in full in Ref. [8] with main results reported in Figure 7, confirm the synthesis of helium and carbon according to ICNF (3)** because, as one can see, the oxygen content decreased from 117 *ppmv* in $He1$ to a non-detectable amount

in $He2$ but the CO increased from a non-detectable amount in $He1$ to 4.24% in $He2$, an increase solely possible from the synthesis of oxygen in the interior of the reactor.

We should indicate that, following test 3, samples of the electrodes were sent to *Princeton Gamma Tech Instruments* for comparative analysis with the sample electrode not exposed to the arc. The analysis was done because, following the test, the top of the cathode acquired a "glassy-type" appearance suggesting the possible synthesis of silica following that of the oxygen as per Tests 1 and 2. The results of the analyses, reported in full in Ref. [9] , show *complete absence of silica in Test 3,* and the production instead of a large peak of Fluorite that could originate from the melting of some internal plastic component of the hadronic reactor. Jointly we also note the increase of CO_2 from non-detectable in $He1$ to 914 *ppmv* in $He2$.

The latter negative result establishes that *the double nuclear synthesis, first of helium and carbon into oxygen and then of oxygen and carbon into silica, "cannot" be controlled.* In fact, during the first step, the oxygen is synthesized at the tip of the DC arc when hitting the carbon in the cathode surface. The ensuing large local production of heat as per value (3b) rapidly expels the synthesized oxygen from the DC arc, thus preventing any additional nuclear synthesis. The creation of CO is then consequential due to the great affinity of carbon and oxygen which is at the foundation of our lives.

Needless to say, the peak reported in analyses [9] for $F(19, 9, 1/2^+)$ could have interpretation other than the aboce indicated melt down of internal plastic components of the reactor, such as the ICNF of $O(18, 8, 0^+)$ and $H(1, 1, 1/2^+)$. Similarly, inspection of analyses [8] reveals the increase of the percentage of a number of elements. Of course, these increases are expected from the heat produced by the arc and the consequential conventional release of gases from the various substances composing the hadronic reactor, although some of the new elements could be the result, at least in part, of additional ICNF. The study of these possibilities requires additional tests with related analyses and they are planned for release in future presentation.

We should add again that, as it was the case for all preceding tests, no measurable radiation was detected in the outside and no radioactive waste was detected in the inside of the hadronic reactor following its opening up after cooling.

3. Concluding Remarks.

The preceding tests [3,4,5] and the additional tests presented in this paper have completed the author's intent Phase I consisting in establishing the "existence" of ICNF without harmful radiations or waste, and provided the necessary credibility for the transition to Phase II consisting in the construction of a prototype hadronic reactor producing clean electric energy in excess of that used.

Despite these promising results, the author would like to caution the reader against easy expectations of rapid achievement of Phase III, consisting in commercially avail-

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ORS REPORT NO. : 189920-001
DATE TESTED : 4/8/2011
QUANTITY TESTED : 2
PACKAGE TYPE : CYLINDER
MFG. CODE :

PO: 724
Rel. No:

SAMPLE ID		HE1	HE2						
INLET PRESSURE	torr	387	474						
NITROGEN	ppmv	665	5,431						
OXYGEN	ppmv	117	ND						
ARGON	ppmv	ND	40						
CO2	ppmv	ND	914						
MOISTURE	ppmv	1,281	3,061						
HYDROGEN	%v	0.03	3.06						
METHANE	ppmv	ND	ND						
AMMONIA	ppmv	ND	ND						
HELIUM	%v	99.8	91.7						
FLUORO-CARBONS	ppmv	ND	ND						
KRYPTON	ppmv	ND	ND						
BENZENE	ppmv	ND	158						
CO	%v	ND	4.24						

COMMENTS:

ND = None Detected
1% = 10,000 ppm

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

Page : 1of1

APPROVED BY: Daniel J. Rossiter

Figure 7: A reproduction of the main results of the chemical analyses on gases for Test 3 conducted by Oneida ORS Laboratories

able new clean energies, due to the complexity of the engineering problems to be solved for extended use, as well as the large investments needed for their achievement.

Acknowledgment

The content of this note is the output of long and solitary consideration by the author expressed in ref. [2]. The main point of this note was then first discussed during the recent *Third International Conference on the Lie-Admissible Treatment of Irreversible Processes* held at the University of Kathmandu, Nepal, from January 5 to 9, 2011. The author would like to thank all participants for invaluable comments. Additionally, very special thanks are due to R. Brenna, T. Kuliczkowski and L. Ying of *Princeton Gamma Tech Instruments* and to D. J. Rossiter of *Oneida ORS Laboratories* because, without their detailed independent analyses, this paper would not have been possible. Additional thanks are due to Dorte Zuckerman for linguistic control and to Christian Corda, the Editor of the proceedings for an impeccable editorial control.

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