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A Brief Review of Intermediate Controlled Nuclear Syntheses (ICNS) without Harmful Radiations

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Abstract. Hadronic mechanics gave birth to new magnecular fuels. The present day demand is of clean energy source that is cheap and abundant. Clean energy can be obtained by harnessing renewable energy sources like solar, wind etc. Nuclear energy conventionally produced by fission reactions emits hazardous radiation and radioactive waste. The requirements of clean and safe energy gets fulfilled by novel fuel that achieved by elevating the traditional quantum mechanics to hadronic mechanics and to hadronic chemistry. In the present paper, a comprehensive review on both the theoretical and experimental aspect of the Intermediate Controlled Nuclear Synthesis (ICNS) as developed by Italian American Scientist Professor R. M. Santilli.

Keywords: Hadronic chemistry, ICNS, Nuclear energy
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INTRODUCTION

According to Professor R. M. Santilli the quantum chemistry contributes one of the most important scientific achievements of last century who's manifold and diversified applications have offered clear benefits to mankind. With the advancement of experimental and technological knowledge, there surfaced out some limitations of quantum chemistry [1, 2]. This fact led to the development of hadronic mechanics and thereby hadronic chemistry [3, 4]. One of the outcome of hadronic chemistry proposed and developed by Prof. Santilli is intermediate controlled nuclear synthesis (ICNS) without harmful radiation. The conventional source of nuclear energy is unacceptable because of harmful radiation. The shielding of these radiations is cumbersome as well as expensive whereas disposal of the radioactive waste poses environmental risks. In case of high energy nuclear fusion, the atomic electron clouds are completely stripped off and energy attained by the nuclei are generally higher than the fission barrier which results in fission reactions or nuclear decay as prominent exist channels rather than forming stable heavy nucleus [5 - 9]. The requirement of clean and safe energy gets fulfilled by the novel fuel that got achieved by elevating the traditional quantum mechanics to hadronic mechanics and to hadronic chemistry [10 - 19] based on Santilli's Iso, Geno and Hyper Mathematics [20 – 22].

ORIGIN OF NEUTRON SYNTHESIS AND INSUFFICIENCIES

In 1920, H. Rutherford proposed the synthesis of neutron in the core of star of the hydrogen atom according to the reaction

$$p^+ + e^- \rightarrow n \tag{1}$$

J. Chadwick confirmed in 1932 the existence of the neutron, but W. Pauli expressed that the above reaction violate the quantum mechanical principle of conservation of the angular momentum. Therefore, E. Fermi concluded that there is emission of neutrino with spin ½ and zero mass in the synthesis of neutron according to the reaction

$$p^+ + e^- \rightarrow n + \nu \tag{2}$$

by initiating the theory of weak interactions that led to standard model of elementary particles

Santilli further studied in 1978, the synthesis of neutron with the conclusion that Pauli and Fermi did not salvage quantum mechanics with neutrino hypothesis because of rest mass of neutron is 0.782 MeV bigger than the sum of

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the rest energies of the proton and of the electron. Under these conditions there is a need for positive binding energies resulting in a mass excess that is anathema for quantum mechanics. Using a positive binding energy, Schrodinger's and Heisenberg's equations of quantum mechanics no longer admit physical meaningful solutions. Due to small cross section of electron-proton scattering, Santilli pointed out the missing energy 0.782 MeV cannot be supplied by the relative kinetic energy of proton and electron.

$$p^{+} + a + e^{-} \rightarrow n \tag{3}$$

where 'a' represents Santilli's etherino in the left hand side in eq.(3) which is not a physical particle but rather to represent in a conventional Hilbert space the transfer of 0.782 MeV and spin ½ missing in the synthesis of the neutron from the environment to neutron structure as per Pauli-Fermi's hypothesis. However, the reformulation of synthesis with anti-neutrino does not allow a physically meaningful synthesis of hydrogen atom into neutron because of null cross section of anti-neutrino and proton or electron.

In view of above insufficiencies, Santilli suggested construction of hadronic mechanics over the quantum mechanics for the synthesis of neutron from the hydrogen atom as well as for hadrons at large. Santilli in 1978, was clear that for neutron synthesis required a non-unitary covering quantum mechanics representing internal non-linear, non-local and non-Hamiltonian effect caused by the total penetration of wave packet of the electron within the hyperdense medium in the interior of proton.

EARLIER ATTEMPTS OF NEUTRON SYNTHESIS

The laboratory synthesis of neutron from a hydrogen gas was first achieved in the 1960s by physicist Don Carlo Borghi and his colleagues. The results were presented in the communications, whose publication was rejected by various journals on grounds that the synthesis is not possible being contrary to quantum mechanics. Don Borghi continued to try for the rest of his days to dismiss his findings with independent re-runs.

Santilli repeated the Don Borghi work himself at the laboratory of the *Institute for Basic Research* in Florida. The tests were conducted and repeated throughout the entire 1996 and concluded in early 1997 by confirming in full Don Borghi's results, although with a number of variations in its technical realization. The combined tests are today known as the *Don-Borghi-Santilli experiment.*

Santilli's experiment confirms Don Borghi's 1969 experiment because the latter test detected nuclear transmutations on various substances placed in the outside of the klystrons, which transmutations are necessary under the detected neutral particles in Santilli's tests [7].

INSUFFICIENCIES OF "LOW ENERGY" AND "HIGH ENERGY" NUCLEAR SYNTHESES

In 1989 Martin Fleischmann and Stanley Pons have studied the nuclear fusion at room temperature but such nuclear fusions could not possible because of insufficient energy to verify physical and engineering requirements. However, in nuclear fusion at high temperature, the released energy is so high; it is uncontrollable irrespective of most advanced technologies. In view of these limitations of both low and high energy nuclear fusions, Italian-American Scientist Ruggero Maria Santilli has discovered new type nuclear syntheses called Intermediate Controlled Nuclear Syntheses (ICNS).

PHYSICAL LAWS OF INTERMEDIATE CONTROLLED NUCLEAR SYNTHESES:

The main objective of Santilli's ICNS is the achievement of the controlled synthesis of nucleus from properly selected light, natural and stable nuclei under following conditions [8]:

i) The systematic and controlled exposure of the original nuclei from their electron clouds and their coupling by magnecular bonding.
ii) The systematic and controlled triggering of the exposed and coupled nuclei to mutual distances of the order of the nuclear forces (1 Fermi) by a trigger (TR) under which the synthesis is unavoidable.
iii) The selection of the original nuclei in such way that the synthesized third nucleus is also light, natural and stable without any emission of harmful radiation or released of radioactive waste.

Santilli conducted quantitative experiment via use of hadronic mechanics and chemistry. The light, natural and stable nuclei fulfilling the above requirements are called hadronic fuels. The reactor used is engineering implementation of the above conditions and are called *Santilli hadronic reactors*. Santilli first presented intermediate nuclear syntheses by applying some physical laws for their achievements:

Threshold Energy: The minimum energies for activating ICNS must be "intermediate" between the energies of cold and hot syntheses. This minimum value needed to verify all necessary physical, chemical and engineering requirements because excess energies cause instabilities and other uncontrollable effects.

Nuclear Exposure: The nuclei of hadronic fuels must be subjected to systematic and controlled exposure out of their electron clouds via the toroidal polarization of atomic orbitals and then coupled via industrial available technologies,

Spin Alignment: Exposed nuclei must be coupled either according to planar anti- parallel spin (planar singlet) or axial parallel spins (axial triplet). Santilli has pointed out those different types of spin coupling causes strongly repulsive forces that prevent systematic and controlled nuclear syntheses.

Triggering Nuclear Forces: Hadronic reactors should have a triggering mechanism to bring systematic and controlled exposed nuclei at one Fermi mutual distance where the strong attractive nuclear forces becomes inevitable and nuclear synthesis takes place.

No harmful radiations or radioactive waste: The reacting nuclei should be selected such that the daughter nucleus formed should be light and stable to ensure that no harmful radiations or radioactive waste are released.

INTERMEDIATE CONTROLLED NUCLEAR SYNTHESES (ICNS)

Using standard nuclear terminologies and symbols with: *A*, *Z*, *Jp*, *u* and *E* denoting the atomic number, the nuclear charge, the nuclear angular momentum, the parity, and the nuclear energy in amu units, respectively, the ICNS proposed by Santilli are of the generic type

$$N_1\left(A_1, Z_1, J_1^{p1}, u_1\right) + N_2\left(A_2, Z_2, J_2^{p2}, u_1\right) + TR \rightarrow N_3\left(A_3, Z_3, J_3^{p3}, u_3\right) + heat$$

$$A_1 + A_2 = A_{3,}\ \ Z_1 + Z_2 = Z_3,\ \ J_1 + J_2 = J_3, p_1 + p_2 = p_{3,}$$

$$\Delta \mathrm{E} + A_2 = A_{3,}$$

where E, energy measured in units u (atomic mass unit), *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 massive radiations.

Santilli then first studied the synthesis of nitrogen as accepted in lightning. The simplest reaction with related energy output is given by:

$$C(12, 6, O^+\ 12.0000) +\ H(2, 1, 1^+, 2.0141) \rightarrow N(14{,}7, 1^+ 14.0030 + heat)$$
$$\Delta E = (E_c + E_H) - E_0 = 0.0111u = 10.339MeV{\sim}1.5x10^{-15}BTU$$

where very light elements, such as hydrogen and helium, are expected to be completely ionized at the intermediate energies needed for the ICNS.

CONCLUSION

ICNS seems to be more promising than hot or cold fusion. The original and final nuclides are light and stable isotopes of naturally occurring elements. The nuclear syntheses are known and certified to cause zero emission of ionizing radiations or particles. The energy produced ΔE is much bigger than the total energy used by the equipment for its production. Hence ICNS is found to be safe and can be explored commercially for energy production.

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