On the Rutherford-Santilli neutron model1)

Chandrakant S. Burande

Citation: AIP Conference Proceedings **1648**, 510006 (2015); doi: 10.1063/1.4912711
View online: http://dx.doi.org/10.1063/1.4912711
View Table of Contents: http://scitation.aip.org/content/aip/proceeding/aipcp/1648?ver=pdfcov
Published by the AIP Publishing

On the Rutherford-Santilli Neutron Model[1]

Chandrakant S. Burande

Vilasrao Deshmukh College of Engineering and Technology, Mouda, India-441104,
***Email**: csburande@gmail.com*

Abstract. In 1920 H. Rutherford conjectured that the first particle synthesized in stars is neutron from a proton and an electron after which all known matter is progressively synthesized. However, Pauli objected Rutherford's version of neutron synthesis because inability to represent spin $1/2$ of the neutron. Using this objection E. Fermi proposed emission of massless particle, called "neutrino". However, Santilli has dismissed the neutrino hypothesis following certain ambiguities such as positive binding energy required in synthesis of neutron. He found that celebrated Schrödinger's equation of quantum physics is not suitable for obtaining positive binding energy for bound state at the dimension of 10^{-13}cm. In order to remove these shortcomings, Santilli has developed isomathematics and then hadronic mechanics, which allowed the time invariant representation of Hamiltonian and non-Hamiltonian interactions as needed for the neutron synthesis (see for example: References cited at [1]).Thus the anomalies pertaining to the binding energy, the spin and the magnetic moment got resolved. He successfully calculated missing positive binding energy via isonormalization of the mass for electron when totally immersed within the hyper-dense medium inside the proton. Considering Rutherford's compression of the isoelectron within the proton in the singlet coupling, he also identified the spin $1/2$ for neutron and calculated the magnetic moment of the neutron. In order to verify his logical concept, he repeated the Don Carlo Borghi experiment of synthesis of the neutron from proton and electrons and verified that the said setup indeed produces neutron-type particles called "neutroids" which latter is absorbed by the activated detector substances that produces known nuclear reactions. He dismissed the neutrino hypothesis and replaced it with a longitudinal impulse originating from the ether as a universal substratum, named, "etherino". He pointed out that all the physical quantities missing in the neutron synthesis, such as energy and spin, are delivered by said impulse.

Keywords: neutron, binding energy, isoelectron, Hulthen potential, Lie-Santilli isoalgebras.
PACS: 87.19.ll, 21.10.Dr, 02.20.Sv;

INTRODUCTION

In 1920, Rutherford [2] submitted the hypothesis that hydrogen atoms in the core of stars are compressed into new neutral particles having the size of the proton that he called neutrons, according to the synthesis

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

The existence of the neutron was confirmed in 1932 by Chadwick [3]. However, Pauli [4] noted that the spin $1/2$ of the neutron cannot be represented via a quantum state of proton and electron, each having spin $1/2$. Fermi [5] adopted Pauli's objection and, he then developed the theory of weak interactions according to which the synthesis of the neutron is characterized either by emission of a neutral and massless particle, named neutrino (ν) or absorption of antineutrino $(\bar{\nu})$. However, Santilli [1, 6, 7] has dismissed the Fermi's version of synthesis of neutron on following grounds: (1) the sum of the rest energies of the proton and of the electron, $m_p + m_e = 938.272\text{MeV} + 0.511\text{MeV} = 938.783\text{MeV}$ is smaller than the rest energy of the neutron, $m_n = 939.565\text{MeV}$, with positive energy (binding energy) difference, (2) Schrödinger equation does not admit positive binding energy for quantum bound states when electron totally immersed within the hyper-dense medium inside the proton structure, (3) neither, antineutrino can deliver the 0.78 MeV needed for the neutron synthesis because the cross section of former with electron or proton is null, and (3) the proton and

[1] This work is being presented at ICNAAM 2014 being held at Rhodes, Greece during September 22-26, 2014.

Proceedings of the International Conference on Numerical Analysis and Applied Mathematics 2014 (ICNAAM-2014)
AIP Conf. Proc. 1648, 510006-1–510006-6; doi: 10.1063/1.4912711

the electron are the only experimentally discovered stable massive particles. Hence, emission of neutrino in neutron formation does not have any relevance. Moreover, it cannot be directly detected.

HADRONIC ENERGY

The only bound state of a proton and an electron predicted by quantum mechanics is the hydrogen atom, with smallest orbit (Bohr's orbit) of the order of 10^{-8}cm. Santilli's hadronic mechanics has identified the existence of an additional bound state when the electron orbits within the proton structure at distances of the order of 10^{-13}cm or less. The difference between these two bound states is depicted in "**FIGURE 1**". The mutual overlapping of wavepackets of electron and proton leads to new interactions of contact type. However, this type of interaction is unknown for conventional quantum mechanics because it deals only particles as dimensionless point masses; quantum mechanics has a local-differential structure ruling out any appropriate representation for nonlocal integral interactions. In this event, Santilli's isomechanics is ideally suited for a quantitative study of the neutron synthesis because, in addition to all interactions characterizing the hydrogen atom, it allows the new interactions caused by deep mutual penetration of the constituents. This method has been used by Santilli in numerous applications. Santilli [6, 7] obtained an isoequation for the neutron by isotopically lifting of Schrödinger equation introducing additional potential term (trigger) of Coulomb nature that reads as,

$$\left[\frac{\widehat{p}\times\widehat{T}\times\widehat{p}\times\widehat{T}}{m}-\frac{z\times e^2}{r}+\frac{e^2}{r}\times\widehat{T}\right]\times\widehat{\psi}(r)=E\times\widehat{\psi}(r) \tag{2}$$

with isounit, $\widehat{I}=U\times I\times U^{\dagger}=1/\widehat{T}>0$, of the form,

$$\widehat{I}=Diag\left(n_1^2(1),n_2^2(1),n_3^2(1),n_4^2(1)\right)\times Diag\left(n_1^2(2),n_2^2(2),n_3^2(2),n_4^2(2)\right)\times e^{(\psi/\widehat{\psi})\times\int dr^3\,\widehat{\psi}(r)^{\dagger}_{1\downarrow}\times\widehat{\psi}(r)_{2\uparrow}} \tag{3}$$

for the two particle penetration (now termed as an isoelectron), where the two diagonal matrices represent the shapes (assumed to be spheroids) and the densities of the particles considered, while the last term represents the non-Hamiltonian interactions. For spherical point-like charge particle, such as electrons, the diagonal matrices get reduced to 1. Next, the evaluation of the volume integral into a constant, $N=\int dr^3\,\widehat{\psi}(r)^{\dagger}_{1\downarrow}\times\widehat{\psi}(r)_{2\uparrow}$, and the expansion of the isoexponent up to the second term, yields,

$$\widehat{I}\approx e^{N\times\psi/\widehat{\psi}}\approx 1+N\times\psi/\widehat{\psi},\quad \widehat{T}\approx e^{-N\times\psi/\widehat{\psi}}\approx 1-N\times\psi/\widehat{\psi},\quad |\widehat{I}|\gg 1,\quad |\widehat{T}|\ll 1,\quad \lim_{r\to 1fm}\widehat{I}=1. \tag{4}$$

In above equations ψ and $\widehat{\psi}$ behave respectively as

$$\psi\approx P\times e^{-br},\qquad \widehat{\psi}\approx Q\times(1-e^{-br})/r \tag{5}$$

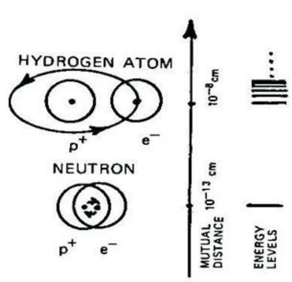

FIGURE 1.

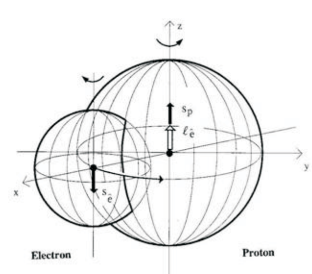

FIGURE 2.

where P and Q are constants and b is inverse of hadronic horizon, r_h.Using eq.(5), the isotopic element depicted in eq.(4) reads as

$$\widehat{T} \approx 1 - N \times \psi/\widehat{\psi} = 1 - N\left(\frac{P}{Q}\right)\frac{1}{r}\frac{V_0 e^{-br}}{(1-e^{-br})} = 1 - \frac{1}{r}\frac{V_0 e^{-br}}{(1-e^{-br})} = 1 - \frac{V_{Hulthen}}{r}, \tag{6}$$

where $V_0 = (P/Q) \times N$, is the Hulthen's constant and $V_{Hulthen} = V_0(e^{-br}/1 - e^{br})$ is the Hulthen potential. Using eqs.(2) and (6), Santilli obtained the nonrelativistic radial equation of the hadronic two-body structure model that reads as

$$\left[\frac{1}{r^2}\left(\frac{d}{dr}r^2\frac{d}{dr}\right) + \frac{m}{\rho^2\hbar^2}\left(E_{hb} + V_0\frac{e^{-br}}{1-e^{-br}}\right)\right] \times \widehat{\psi}(r) = 0 \tag{7}$$

where E_{hb} is hadronic binding energy. Assuming the change of variable, $x = 1 - e^{-hr}$, the expression for hadronic binding energy obtained as

$$|E_{hb}| = E^{Bind} = (V_0/4k_2)\left[(k_2/n) - n\right]^2, \qquad k_2 = (mV_0)/\left(\hbar^2\rho b^2\right). \tag{8}$$

For an isoparticle to be bounded inside the hadronic horizon, b^{-1}, its isowavelength, $\lambda = (2\pi k_1 b)^{-1}$, must be proportional to the horizon itself. Finally Santilli arrives at the following result namely the total hadronic energy of the neutron is primarily characterized by the rest energy of the proton and the isonormalized rest energy of the isoelectron,

$$E_n \approx E_p + E_{hr,\widehat{e}} = E_p + m_e c_0^2/\rho^2 = 938.272 + 1.294 = 939.586\text{MeV} \tag{9}$$

where $\rho^2 = 0.3949$ is a geometrization of the departure of the interior of hadrons from our space-time. For the details of above final result the reader is advised to see the original writings of Santilli.

THE NEUTRON SPIN

In 1990, the conceptual interpretation of the observed spin $1/2$ of the neutron, was successfully explained by Santilli [1, 6, 7]. Considering the initiation of Rutherford's process of compression of the isoelectron within the proton in singlet coupling, it is evident that, as soon as the penetration begins, the isoelectron is trapped inside the hyperdense medium inside the proton, thus resulting in a constrained orbiting motion of the isoelectron that must superpose on the proton spin (**FIGURE 2**). Santilli stresses that the proton is not mutated because it is 2000 times heavier than the electron, and that the coupling must be in singlet for stability. This implies that, for the case of the neutron structure, the spin of the electron is also not mutated. However, the angular momentum of electron is mutated inside the hadronic sphere. The needed mutation of the quantum into the hadronic angular momentum is trivially given by the nonunitary transforms

$$U \times U^{\dagger} = \widehat{I} = \frac{1}{2}, \qquad \widehat{T} = 2, \tag{10}$$

The mutation is supported by the isotopic invariance of the Hilbert space. Nonunitary lifting of angular momentum and use of eq.(10), in this case, reads

$$U \times [\langle l,m| \times L_3 \times |l,m\rangle] \times U^{\dagger} = \langle \widehat{l},\widehat{m}|\widehat{T} \times \widehat{L}_3 \times \widehat{T}|\widehat{l},\widehat{m}\rangle \times \widehat{I} = |\widehat{l},\widehat{m}|2 \times \widehat{L}_3 \times 2|\widehat{l},\widehat{m}\rangle \times \frac{1}{2}. \tag{11}$$

In this case, Santilli [8, 9] has selected the two-dimensional irregular isorepresentation of $\widehat{SU}(2)$ and then computed the total angular momentum of the neutron model, $n = (p^+, \widehat{e}^-)_{hm}$ as,

$$J_n = J_p + \widehat{L}_{\widehat{e}}^{orbital} + \widehat{J}_{\widehat{e}}^{intrinsic} = \frac{1}{2} + \rho - \frac{\Delta}{2} \tag{12}$$

resulting in the values anticipated above, namely:

$$\rho = \frac{1}{2}, \qquad \Delta = 1. \tag{13}$$

It shows that the spin of the isoelectron is not mutated and the angular momentum is mutated in such a way that the isoelectron is merely carried out by the proton spin.

THE NEUTRON MAGNETIC MOMENT

In view of the hadronic orbiting motion of isoelectron, the magnetic moment of the neutron was generated by Santilli by considering the following three contributions,

$$\mu_n = \mu_p^{intrinsic} - \mu_{\hat{e}}^{orbital} + \mu_{\hat{e}}^{intrinsic} \tag{14}$$

Consequently,

$$\mu_n = -1.9 \times e(2m_p c_0)^{-1} = 2.7 \times e(2m_p c_0)^{-1} - 4.6 \times e(2m_p c_0)^{-1}, \tag{15}$$

From eqs.(14) and (15), Santilli derived the desired value

$$\mu_{\hat{e}}^{orbital} = (1 + 2.5 \times 10^{-3}) \times \mu_e \tag{16}$$

The small value of the total magnetic moment of the isoelectron is fully compatible with the null value of its total angular momentum.

DON BORGHI EXPERIMENT ON THE SYNTHESIS OF NEUTRONS

The first experiment on the synthesis of neutrons from protons and electrons was conducted by Carlo Borghi, C. Giori and A. Dall'Olio in the 1960s at the CEN Laboratories in Recife, Brazil [11, 12]. Hydrogen gas at fraction of 1 bar pressure was obtained from the electrolytical separation of water and was placed in the interior of a cylindrical metal chamber (called klystron) and kept mostly ionized by an electric arc with about 500 V and 10 mA. Additionally, the gas was traversed by microwaves with $10^{10} s^{-1}$ frequency. Suitable materials which are vulnerable to nuclear transmutation when exposed to a neutron flux, were placed exterior of the chamber. Following exposures of the order of days or weeks, the experimentalists reported nuclear transmutations that were based on the observed neutron counts of up to 104 cps. To verify the claim of Don Borghi's experiment, Santilli repeated this experiment in large number of laboratories and institutions the world over.

SANTILLI EXPERIMENT ON THE SYNTHESIS OF NEUTRONS

Santilli conceived his experiment [10] as being solely based on the use of an electric arc within a cold (i.e., at atmospheric temperature) hydrogen gas without any use of microwave at all. Three different klystrons were manufactured, tested and used for the measurements.

Klystron-I was cylindrical and sealed, of about 6" outside diameter and 12" height, made of commercially available, transparent, PolyVinyl Chloride (PVC) housing along its symmetry axis a pair of tungsten electrodes. The klystron cylindrical wall was transparent so as to allow a visual detection of arc. After initiation of DC arc there was no detection for hours. However, shaking of klystron the neutrons were detected in a systematic and repetitive way. The detection was triggered by a neutron-type particle, excluding contributions from photons.

Klystron-II was a rectangular, transparent, made up of PVC of dimension . This klystron was small in size than earlier one to avoid implosion caused by combustion with atmospheric oxygen. This test was conducted only once because of instantaneous off-scale detection of neutrons by all detectors which led to evacuation of the laboratory. Hence, this test was not repeated for safety.

Klystron-III was cylindrical made up of carbon steel pipe with 12" outer diameter, 0.5" wall thickness, 24" length and 3" thick end flanges to sustain hydrogen pressure up to 500 psi with the internal arc between throated tungsten electrodes controlled by outside mechanisms. This test was conceived for the conduction of the test at bigger hydrogen pressure compared to that of Klystron I. The test was conducted only once at 300 psi hydrogen pressures because of instantaneous, off-scale, neutron detections such to cause another evacuation of the laboratory.

INTERPRETATION OF DON BORGHI AND SANTILLI EXPERIMENTS

Santilli [1, 10] excludes that the entities produced in the tests with Klystron I are true neutrons for various reasons, such as: Delayed detection, unavailability of environment in Klystron-I that provide missing energy 0.78Mev and absence of suitable trigger. In view of above reasons, Don Borghi [11, 12] submitted the hypothesis that the "entities" are neutron-type particles called "neutroids". Santilli adopted this hypothesis and presented the first technical characterization of neutroids with the symbol, $\tilde{n}$ and the characteristics in conventional nuclear units, $A=1, \quad Z=0, \quad J=0, \quad amu=$ 0.008. Hence, Santilli assumed that in Klystron-I, he produced the following reaction precisely along Rutherford's original conception

$$p^+ + e^- \longrightarrow \tilde{n}(1.0, 0, 1.008) \tag{17}$$

where the value $J=0$ is used for the primary purpose of avoiding the spin anomaly in the neutron synthesis as indicated above and the rest energy of the neutroids is assumed as being that of the hydrogen atom. Considering the neutrino hypothesis has no sense for the neutron synthesis for various reasons, Santilli assumes that the energy, spin and magnetic anomalies in the neutron synthesis are accounted for by their transfer either from nuclei or from the aether via his etherino hypothesis [13]

$$\tilde{n}(1.0, 0, 1.008) + a \longrightarrow n(1.0, 0, 1.008), \tag{18}$$

where a is the aetherino or etherino, the entity permitting the energy, spin and other anomalies in the synthesis of the neutron. Assuming the binding energy of a neutroid is similar to that of an ordinary nucleon (since neutroids are assumed to be converted into neutrons when inside nuclei, or to decompose into protons and electrons, thus recovering again the nucleon binding energy), Santilli indicates the following possible nuclear reaction for one of the activated substances in Don Borghi's tests

$$\text{Au}(197, 79, 3/2, 196.966) + \tilde{n}(1.0, 0, 1.008) + a \longrightarrow \tilde{\text{Au}}(198, 79, 2, 197.972), \tag{19}$$

produces known nuclide, hence it indicates that neutrons were synthesized by the activating substances themselves on absorption of neutroid. The nuclear reaction with steel wall of the klystron,

$$\text{Fe}(57, 26, 1, 57.935) + \tilde{n}(1.0, 0, 1.008) + a \longrightarrow \tilde{\text{Fe}}(58, 26, 1, 57.941), \tag{20}$$

yields an unknown nuclide, $\tilde{\text{Fe}}(58, 26, 1, 57.941)$ because the known nuclide is $\text{Fe}(58, 26, 0, 57.933)$. This indicates that the neutrons in Don Borghi experiment were not synthesized in the walls of his klystron. Eq.(2) also allow an interpretation of some of Santilli detections [1, 10], with the understanding that the anomalous behavior of the detectors, such as the delayed neutron counts, requires special studies and perhaps the existence of some additional event not clearly manifested in Don Borghi's tests.

To initiate the study, Santilli considered the first possible reaction inside the klystron

$$\text{H}(1, 1, 1/2, 1.008) + \tilde{n}(1.0, 0, 1.008) + a \longrightarrow \text{H}(1, 1, 1, 2.014), \tag{21}$$

delivers ordinary deuteron on coupling of hydrogen atom and neutroid. This indicates neutrons cannot be originated inside the klystron-I. Next, Santilli considered following nuclear reactions with the polycarbonate of Klystron-I wall containing about 75 percent carbon and 18.9 percent oxygen

$$\text{C}(12, 6, 0, 12.00) + \tilde{n}(1.0, 0, 1.008) + a \longrightarrow \tilde{\text{C}}(13, 6, 1/2, 13.006) \longrightarrow \text{C}(13, 6, 1/2, 13.006) + \gamma, \tag{22}$$

$$\text{O}(16, 8, 0, 16.00) + \tilde{n}(1.0, 0, 1.008) + a \longrightarrow \tilde{\text{O}}(17, 8, 1/2, 17.006), \tag{23}$$

do not give conventional activation processes. Thus, in Santilli's experiment too, it does not appear that the detected neutrons are synthesized by the walls of klystron. The above analysis leads us to the only remaining possibility that in Santilli tests, the neutrons are synthesized by the detectors themselves. To study this possibility, Santilli considered the reaction using Li-activated detectors,

$$\text{Li}(7, 3, 3/2, 7.016) + \tilde{n}(1.0, 0, 1.008) + a \longrightarrow \tilde{\text{Li}}(8, 3, 2, 8.022) \longrightarrow \text{Be}(8, 4, 0, 8.005) + e^- \longrightarrow 2\alpha, \tag{24}$$

that behaves fully equivalent to detection of neutriods or neutrons. This indicated that neutrons detected in Santilli experiment were synthesized by the substance used for detection after absorption of neutriods.

CONCLUDING REMARKS

It is observed that Santilli's novel discovery of hadronic mechanics appropriately explains the Rutherford's conjecture on neutron as a compressed hydrogen atom. He evidently dismissed the neutrino hypothesis and resolved the anomalies pertaining binding energy, spin and magnetic moment without any theological assumption that the proton and the electron "disappear" at the time of the synthesis. It should also be stressed that the representation is invariant, due to the isounitary character of the model, namely, the numerical values remain the same under the same basic assumptions at different times. After successful mathematical explanation of Rutherford's conjecture on neutron synthesis, Santilli ventured experimentation to strengthen his support. For experimentation, he adopted the methodology already conceived by Don Borghi and his team for synthesis of neutron from hydrogen atom. He never claimed the direct detection of neutron. He claimed the detection of neutron through nuclear transmutations. He never ruled out that the detected entities are only the neutrons. He proposed the emission of neutron like particle, named "neutriod", in Klystrons because direct production would require a trigger, which is absent in the experimental set-up. He interpreted the detection of neutron through the possible nuclear reactions by activated substances after absorption of neutriods.

ACKNOWLEDGMENTS

The author is highly grateful to Professor R. M. Santilli, his team and Professor C. Corda for valuable guidance in preparing and for suggestions to improve this paper. The financial support from the R. M. Santilli Foundation is gratefully acknowledged. The author is also highly indebted to Professor A. A. Bhalekar for suggesting me this topic and helping me in writing this paper by his valuable advices and suggestions in its overall improvement.

REFERENCES

1. R. M. Santilli, *Hadronic Mathematics, Mechanics and Chemistry*, Vol. I-V, International Academic Press, Palm Harbor, U.S.A., 2008, http://www.i-b-r.org/Hadronic-Mechanics.htm.
2. H. Rutherford, *Proc. Roy. Soc. A*, **97**, 374 (1920).
3. J. Chadwick, *Proc. Roy. Soc. A*, **136**, 692 (1932).
4. W. Pauli, *Handbuch der Physik*, **24**, Berlin, Springer Verlag, 1933.
5. E. Fermi, *Nuclear Physics*, Chicago, University of Chicago Press, 1949.
6. R. M. Santilli, "Apparent Consistency of Rutherford's Hypothesis on Neutron as a Compressed Hydrogen Atom", *Hadronic J.* **13**, 513-531(1900), http://www.santilli-foundation.org/docs/Santilli-21.pdf.
7. R. M. Santilli, "Apparent Consistency of Rutherford's Hypothesis on Neutron Structure via Hadronic Generalization of Quantum Mechanics-I: Nonrelativistic Treatment", in *ICTP-1991*, International Academic Press, Palm Harbor, Florida, 1992, http://www.santilli-foundation.org/docs/Santilli-150.pdf.
8. R. M. Santilli,*Lie-admissible Approach to the Hadronic Structure, Volume I: Non-applicability of the Galilei and Einstein Relativities* in the series Monographs in Theoretical Physics, Hadronic Press, Palm Harbor, Florida, 1978, http://www.santilli-foundation.org/docs/santilli-71.pdf.
9. R. M. Santilli, *Lie-admissible Approach to the Hadronic Structure, Volume II: Coverings of the Galilei and Einstein Relativities* in the series Monographs in Theoretical Physics, Hadronic Press, Palm Harbor, Florida, 1981,http://www.santilli-foundation.org/docs/santilli-72.pdf.
10. R. M. Santilli, "Apparent Confirmation of Don Borghi's Experiment toward the Synthesis of Neutron from Protons and Electrons", *Hadronic Journal*, textbf30, 709 (1997).
11. C. Borghi, C. Giori C. and A. Dall'Olio, Communications of CENUFPE, **8**(1969) and **25** (1971).
12. C. Borghi, C. Giori C. and A. Dall'Olio, (in Russian), *Phys. Atomic Nuclei*, **56**, 205 (1993).
13. R. M. Santilli, "The etherino and/or the neutrino hypothesis", *Foundation of Physics*, **37**, 670 (2007).