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Re-evaluation of Fermi's theory of beta-decay

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ABSTRACT

Another published paper of the author proposes that proton and neutron radii have contraction inside the atomic nuclei, generating a discrepancy of 8s between the neutron lifetime measured in beam and bottle experiments. According to the present theory, the neutron radius in beam experiments dilates from 0.26fm up to 0.87fm during the initial 8s, after which begins the process of decay. The present paper proposes a new neutron model with quark structure d(u-e-u), with an electron sandwiched between two up quarks. It reproduces very well all neutron properties, as for instance the radial charge distribution, impossible to be reproduced considering the current quark model ddu. So, the radial charge distribution of neutrons (obtained from beam experiments, if measured in the first initial 8 seconds of their lifetime) has to exhibit a curve a little different of that measured in 2007 in the Jefferson Lab. Here is proposed to JLab to repeat the experiment under such new condition.

Keywords: Fermi's beta-decay, Neutron quark model, Neutron distribution, Jefferson Lab (JLAB)

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INTRODUCTION

In 2016 a reviewer of a reputable international journal of physics declined this present paper with the report ahead. Therefore, the failure of their udd model does not mean we need to abandon completely the current theoretical paradigm of the nucleon structure, which is built upon QCD.
In other words, they are attacking a theory that nobody thought was correct. The report actually represents a confession of the reviewer, according to which the physicists know that the current neutron quark model ddu is wrong, but they cannot reject it, because its rejection compromises the credibility on QCD. And thereby, according to his report, the researchers need to continue using the wrong neutron model ddu, in their search for the discovery of the structure of the universe, and we have to trust blindly in the discoveries obtained from such a method of investigation, developed from a model which everybody know to be wrong. The criterion used by the referee is very strange, because, when we know that a theoretical model is wrong, then according to the scientific criterion the theorists have to undertake efforts in order to discover a better

model. Theoretical Physics cannot progress by relying on erroneous theoretical models.
If the current quark neutron model of the Standard Model represents the correct image of the neutron structure existing in nature, the nuclear theorists are right in considering the deuteron as the simplest microscopic test for the Standard Nuclear Physics, since the neutron model has already surpassed the stage of tests (as the nuclear theorists believe). So we have to agree with the assumption that the simplest test must be done with the deuteron: The deuteron, the only $A = 2$ nucleus, provides the simplest microscopic test of the conventional nuclear model, a framework in which nuclei and nuclear interactions are explained as baryons interacting through the exchange of mesons (Gilman & Gross, 2002). However, if the current quark model of neutron is wrong, then any effort, of trying to make theoretical physics evolve the right way, will fail.

THE REASONS WHY RUTHERFORD'S MODEL $n = p.e$ MODEL WAS DISCARDED

A good historical description on the discoveries that led the nuclear theorists to the conclusion that there was no other alternative unless to abandon the Rutherford's model. In 1932, there was no satisfactory theory of the nucleus. The nucleus was thought to be composed of protons and electrons since these were the only known charged particles and nuclei were seen to emit electrons (decay). The electrons were needed to cancel the positive charge of some of the protons in order to account for nuclei with identical charges, but with different masses, and to allow for the possibility of binding of the nucleus by means of electric forces. This was clearly unsatisfactory because the Coulomb force could not account for the binding energies of nuclei and the attempt to construct the nuclei from the incorrect number of spin -1/2 particles could not produce the correct nuclear spins. The discovery of the neutron, shortly after that of the deuteron, did not immediately eliminate the confusion since the previous model persisted by simply describing the neutron as a bound system of a proton and an electron. Based on this faulty assumption, Heisenberg produced the first model of proton-neutron force (Werner Heisenberg, 1932; W Heisenberg, 1933).
Since it was not possible to actually construct a description of the neutron with the ep model, Heisenberg simply assumed that the pn force could be described by a phenomenological potential and that the neutron was a spin -1/2 object like the proton. Based on an analogy with the binding of the H^{+2} ion by electron sharing, Heisenberg proposed that the force must involve the exchange of both spin and charge in the form of $\sigma^{(1)}\sigma^{(2)}\,\tau^{(1)}\tau^{(2)}$.
Forces containing the remaining forms of spin and isospin operators were soon introduced (Bartlett Jr, 1936; Majorana, 1933; Wigner, 1933). In all cases the spatial form of the potentials was to be determined phenomenologically to reproduce the deuteron properties and the available nucleon-nucleon (NN) scattering data. In 1935 (H Bethe, 1935) wrote the Hamiltonian of the "diplon" with an explicit introduction of a short range interaction. This approach became the mainstay of nuclear physics which has produced considerable success in describing nuclear systems and reactions. The ep model of the neutron was not completely abandoned until after the of decay became widely accepted (Fermi, 1934). The progress in discoveries and understanding was then so great that, in spite of an otherwise bleak social or political situation in many countries involved, this period is recalled as "The Happy Thirties" from a physicist's point of view (HA Bethe, 1979).
One of the other great theoretical preoccupations of the late 1920's and the 1930's was the development of quantum field theory starting with the first works of Dirac on quantum electrodynamics (QED) (P. A. M. Dirac, 1927), the Dirac equation for the electron (P. A. Dirac, 1928), and the Dirac hole theory (P. A. Dirac, 1929, 1930), with field theory reaching its final modern form with Heisenberg (Werner Heisenberg, 1934). QED at this time was very successful at tree-level but the calculation of finite results from loops was not really tractable until the introduction of systematic renormalization schemes in the late 1940's. The first attempt to apply quantum field theory to the strong nuclear force was Yukawa's suggestion (Yukawa, 1935, 1937) that the force was mediated by a new strongly coupling massive particle which became known as the pion. This started another strong thread in the theoretical approach of the nucleus by using meson-nucleon theory to obtain nuclear forces consistent with the phenomenological potential approach. The primary attraction of this approach is that a more microscopic description of the degrees of freedom of the problem is provided and that additional constraints are imposed on the theory by the necessity of simultaneously describing nucleon-nucleon and meson-nucleon scattering.
Ultimately, as it became clear that the mesons and nucleons were themselves composite particles, meson-nucleon theories were replaced as fundamental field theories of the strong interactions by quantum chromodynamics(QCD). However, the meson-nucleon approach is still a strong element in nuclear physics as a basis for phenomenology and is making a potentially more rigorous comeback in the form of the effective field theories associated with chiral perturbation theory. This situation is unlikely to change until it becomes possible to at least describe the NN force and the deuteron directly from QCD (Garçon & Van Orden, 2001). Another fundamental discovery that supplied strong certainty to the nuclear theorists for rejecting the neutron model p.e was the measurement of the neutron mass.
After the discovery of the neutron by James Chadwick, attention turned to its mass and structure. Was the neutron a fundamental particle, like the proton and electron, or was it a bound state of the electron and proton, different from the hydrogen atom? If it was a bound state of the proton and electron, how were the electrons confined into the small nuclear volume? Conflicting experimental evidence on the neutron mass prevented resolution of the issue until 1934, when Chadwick and Maurice Goldhaber used deuteron photodisintegration to determine that the neutron mass was slightly heavier than that of the hydrogen atom. Thus, the neutron, being heavier than the proton plus electron, was a fundamental particle, and there was no longer any basis for thinking electrons could be present in nuclei (Garçon & Van Orden, 2001) .

MAGNETIC MOMENT OF DEUTERON

At Fig 1 is the deuteron in the 3S1 state with s =1 and zero angular moment $l = 0$. The magnetic moment produced by that structure is $\mu = +2.793\mu N - 1.913\mu N = 0.88\ \mu N$.

However the nuclear magnetic moment for the deuteron measured by experiments is $\mu = +0.857\mu N$, and so there is a difference $\Delta = 0.880\mu N - 0.857\mu N = +0.023\ \mu N$, and there is no way to explain it by considering the pure 3S1 state of the deuteron composed by the neutron model ddu.

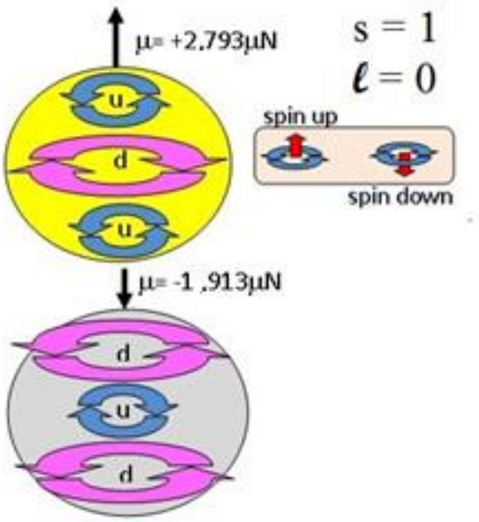

Fig 1. Deuteron in the $3S_1$ state composed by a neutron model ddu

That's why it was concluded that the deuteron is a mixture of the states 3S1 and 3D1, because there is no way to explain the difference 0.023μN with the deuteron existing only in the 3S1 state through a model of deuteron composed by neutron composed of quarks (or by the Yukawa's model). Fig 2 shows the 3D1 state of the deuteron.

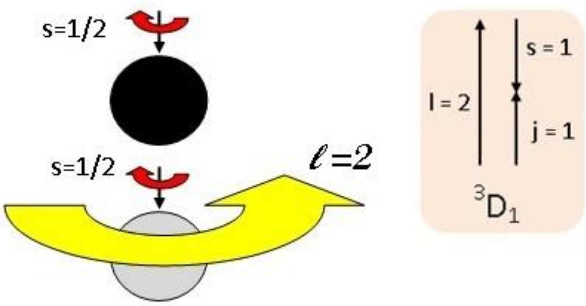

Fig 2. Deuteron at the $3D_1$ state

The theoretical values calculated for the 3S1 state and 3D1 states give respectively

$$\mu_S = \left(\frac{1}{2}\right)(g^s p + g^s n) = 0.879$$

$$\mu_D = -\left(\frac{1}{4}\right)(g^s p + g^s n) + \frac{3}{4} = 0.310$$

And so, according to the SM, the magnetic moment of the deuteron is 0.857 because, in average, there is a little decrease due to the magnetic moment 0.310 produced along 4% of the time. However, such solution of considering that deuteron is a mixture of states 3S1 and 3D1 (with the goal of explaining the difference 0.023μN) was accepted in 1934 and the years along which the methods of measurement have used the technique of atomic beam deflection, because they measure the statistical result of the atomic beam behavior. But today the solution is no valid anymore, because (with the improvement of the technique) nowadays the experiments are measuring the properties of one atom. The first measurement of the deuteron magnetic moment was performed by Rabi in 1934, based on a principle already alluded to. From the defection of an atomic beam in an inhomogeneous magnetic field to the use of molecular beam resonance and other methods, these techniques were continuously improved. Precise measurements of nuclear magnetic resonance frequencies of the deuteron and proton in the HD molecule give the ratio of deuteron to proton magnetic moments. However, the adopted value in Table 1 results from a simultaneous determination of the electronic and nuclear Zeeman energy levels splitting in the deuterium atom, yielding the ratio of deuteron to electron magnetic moments (Garçon & Van Orden, 2001).

Garçon and Van Orden wrote that in 2001, and it's very hard to believe that along 15 years the many experimentalists worldwide have never measured any magnetic moment 0.310, because (as it exists in 4% of the time) from the laws of probability at least 4% of the measurements would have to get the value of 0.310. Besides, the experiments would have to measure the value 0.880 for the magnetic moment of the deuteron in 96% of the measurements. Table 1, ahead reproduces the Table 1 mentioned by Garçon & Van Orden in the page 8 of their paper. But the value quoted (measured by JLab) is 0.857, and not 0.880 as we would have to expect. If the theory on the magnetic moment of the deuteron was correct, the experiments would have to measure the value 0.880 and occasionally, in 4% of measurements, the value 0.310 would have to be measured.

Quantity	Most recent determination	Value
Mass M_d	47, 48	1875.612762 (75) MeV
Binding energy ε	49	2.22456612 (48) MeV
Magnetic dipole moment μ_d	48	0.8574382284 (94) μN
Electric quadrupole moment Q_d	46, 50, 51	0.2859 (3) fm^2
Asymptotic ratio $\mu_d = A_D/A_S$	52	0.0256 (4)
Charge radius r_{ch}	53	2.130 (10) fm
Matter radius r_m	54, 55	1.975 (3) fm
Electric polarizability α_E	56, 57	0.645 (54) fm^3

Table 1. Magnetic moment 0.857μN measured at JLab with new improved techniques.

If you ask to a nuclear theorist, he will allege that the value 0.857 of the Table 1 is the result of the overlap between the 3S1 and 3D1 states (because he has no other alternative for justifying the value 0.857). But obviously such argument makes no sense, since the deuteron is not the superposition of two states 3S1 and 3D1, because they actually exist in different times (according to the Standard Nuclear Theory), and not at the same time. As the explanation makes no sense, other theorists would allege Quantum Mechanics is counter intuitive. The question is also intriguing from another viewpoint, because the confirmation of the existence of the pure 3D1 state with $0.310\mu N$ would represent an important confirmation for the SM, and thereby many experimentalists would have to be eager for detecting it. Probably some experimentalists have even already tried to measure the pure 3S1 state with the value $0.880\mu N$ and the pure 3D1 state with $0.310\mu N$. But as both values $0.880\mu N$ and $0.310\mu N$ do not exist, all the attempts have failed.

ELECTRIC QUADRUPOLE MOMENT AND MAGNETIC MOMENT OF DEUTERON

The value of the electric quadrupole moment of deuteron, $Q = 2.7 \times 10^{-31}\, m^2$, measured by experiments, can be obtained by calculation when we consider a neutron model p.e , with the deuteron being 100% of time in the 3S1 state. Fig 3 shows the two-nucleons density of the deuteron at the $M_j = 0$ substate.

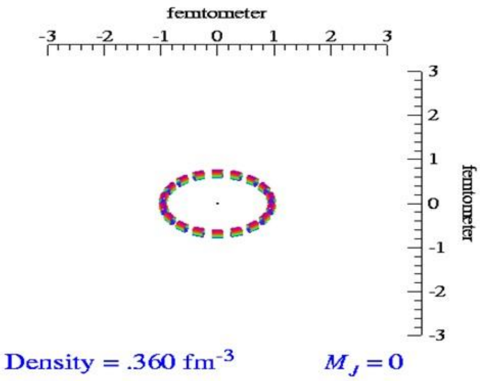

Fig 3. Two-nucleons density of deuteron for magnetic-substate $M_j = 0$ (Shapes in the Deuteron) (Seakeasy, 1996)

First of all, note that the radius of the deuteron in Fig 3 is about *1.0fm*. So, there is no way to put the proton and the neutron together into the deuteron (in the case of the proton and neutron having a radius about of *0.87fm*, as considered in SM). So we have to conclude that the proton radius is not unshrinkable as considered in SM.

It seems the proton radius actually shrinks depending on the intensity of the interactions it has with other nuclei. Such controversy will be solved with the MUon proton Scattering Experiment (MUSE) to be made between the end of 2018 and 2019, because (as the muon is very heavier than the electron used up to now in the experiments), probably the experiments will measure a radius between *0.3fm* and *0.7fm*, and so MUSE may either prove definitively or not that proton radius shrinkages and is shorter within the nuclei.

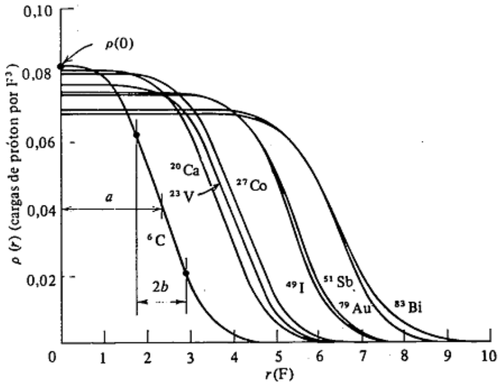

Fig 4. Charge density of some nuclei. The shell thickness 2b is shown for ^{12}C (Eisberg & Resnick, 1974).

So, instead of using the radius $R = 0.87\, fm$ measured for a free proton via scattering with electrons, we will use the radius of the proton within the nuclei, and we get it from the charge density of some nuclei, taking in consideration that some experiments suggest that protons and neutrons are bound within the nuclei in the form of deuterons, and they form a shell thickness $2b = 1.1\, fm$, shown in the Fig 4. In such a way, considering $2b = 1.1\, fm$ to be the length of the deuteron diameter at the shell thickness, the proton radius is $R_p = 1.1/4 = 0.275\, fm$. The two protons of the deuteron have $Q = 0$, because each one of them has a spherical distribution of charge. The electron moving around one of the protons can be considered like a proton with negative charge, with punctual concentrated configuration around the proton with which the electron forms the neutron.

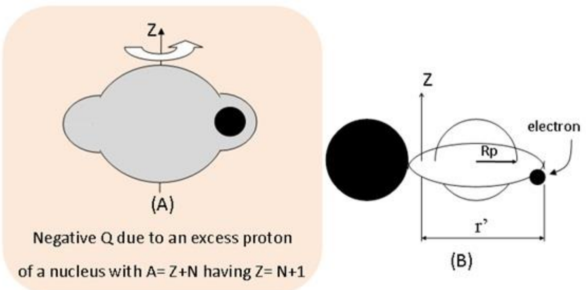

Fig 5. Deuteron structure with elec. quad. mom. $Q = 3 \times 10^{-31} m^2$ (see Eq 2)

Fig 5.(A) shows a nucleus where an excess proton with positive charge $q = +1$ yields $\int \rho d\tau = +1$. Consider an electron with negative charge $q = -1.e$ moving around one of the protons within the deuteron in the magnetic state $Mj = 0$ shown in the Fig 3. The electron yields $\int \rho d\tau = -1$. Thereby, the electric quadrupole moment of deuteron shown in the Fig 5(B) will be

$$Q = -(r')^2 \int \rho d\tau = -(r')^2(-1) = +(r')^2 \qquad (1)$$

As $r = 2R_p$ and $R_p = 0.275\, fm$ being the proton radius, we finally get,

$$Q = +(r')^2 = +(0.55 fm)^2 = 3 \times 10^{-31}\, m^2 \qquad (2)$$

RADIAL CHARGE DISTRIBUTION FOR NEUTRONS ddu AND duu-e

Fig 6 shows the radial charge distribution for the proton and neutron, obtained from polarized electron scattering being performed at the Jefferson Lab (Advisory, 2007). The unit of charge distribution is $4\pi r^2 \rho_{Breit} (fm^{-1})$.

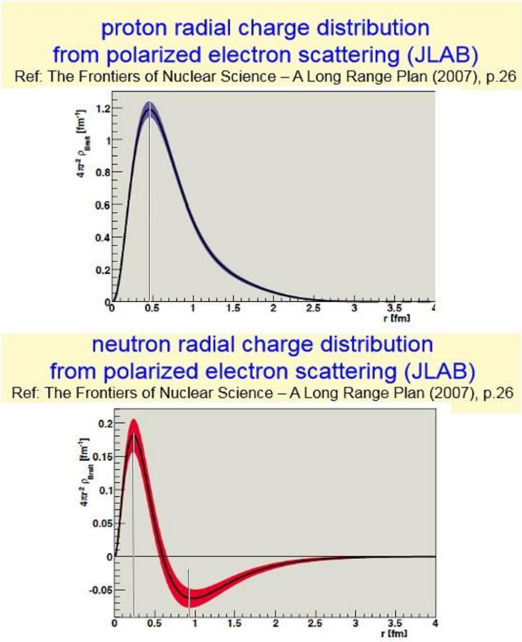

Fig 6. Radial charge distribution for proton and neutron, according to JLab measurements (2007)

Looking at the proton charge distribution, we realize that the maximum density occurs at the radius 0.45fm, and therefore $R = 0.45fm$ must be the orbit radius of the two u quarks within the structure of the proton.

Looking at the neutron charge distribution, we realize that the maximum density of positive charge occurs at the radius $0.23fm$, and the maximum density of the negative charge occurs about the radius $0.92fm$. These two radii suggest the following about the neutron:

1. The radius orbit of the up quark is near to $0.23fm$
2. There is a down quark with orbit radius between 0.8fm and 1.0fm.
3. If the neutron structure is really ddu, the distribution of d and u quarks have indeed to be as indicated in 1 and 2 above.

Based on the two curves of the JLab shown at the Fig 6, we will construct the following curves for the neutron, with the aim of comparison:

1. Curve of the radial charge distribution for the quark model udd.
2. Curve of the radial charge distribution for the model duu-e.

First of all, we have to discover how is the curve for the two up quarks in the proton. The curve shown in Fig 6 for the proton is a consequence of the following charges overlap: two u quarks and one d quark. We must eliminate the negative contribution of d quark. This is done in Fig 7, where the curve in light blue is the charge distribution for one d quark, considering that its orbit radius is $Rd = 0.8fm$. The curve in green is the charge distribution of the two up quarks, after elimination of the negative contribution of d quark.

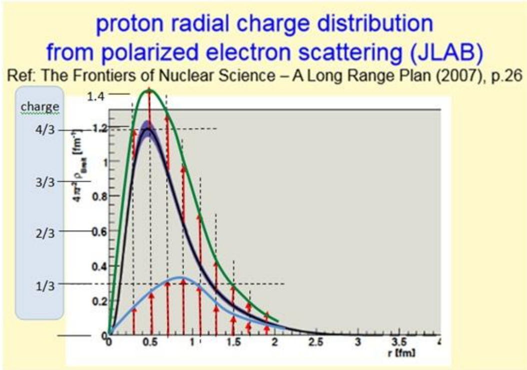

Fig 7. Density charge curve for the proton (obtained from Fig 6) having d quark contribution been suppressed, and the green curve is due to the two u quarks of proton

The next step is to find the curve for one up quark only. By considering that the two up quarks have orbit radius $Ru = 0.45fm$, and considering that the charge density of one quark is half of the density of two quarks, we get the curve for one up quark, as shown in Fig 8.

Now we need to discover how is the curve for two d quarks. We will adopt the radius $R = 0.8fm$ for their radii orbits. Fig 9 shows how to get the curve of charge distribution for two d quarks, taking as point of departure the curve for one d quark with orbit radius $R = 0.8fm$ adopted in the Fig 7 (light blue curve).

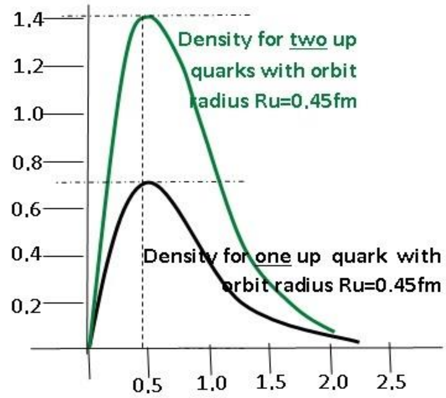

Fig 8. Density charge curve (black) for one up quark obtained from the (green) curve for two up quarks (green curve is obtained from Fig 7)

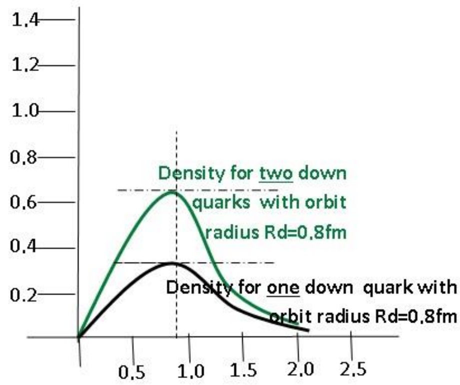

Fig 9. Density charge (green) curve for two d quarks, obtained from the (black) curve for one d quark (black curve is obtained in the Fig 7)

CURVE FOR THE NEUTRON STANDARD MODEL ddu

At the Fig 10.(A) are ploted the curves for the two d quarks and one u quark of the neutron model ddu, as follows:
1-Charge distribution for one up quark, moving within the neutron's structure with radius Ru= 0.45fm.
2-Charge distribution for two d quarks, both moving within the neutron's structure with radius Rd= 0.8fm
At the Fig 10.(B), we see that:
-Maximum positive charge density is +0.3 and the maximum negative charge density is -0.25,
-In the JLab curve, the average values are respectively +0.18 and -0.062.

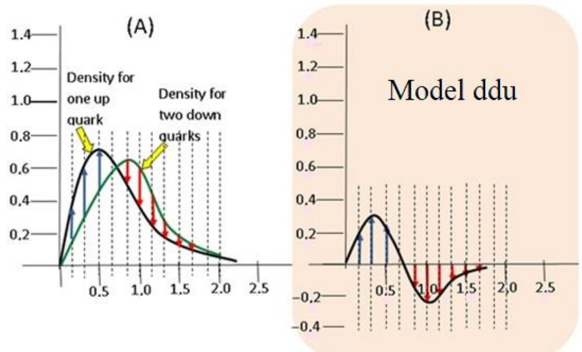

Fig 10. (A) Densities of quarks obtained from Figs 8 and 9. **(B)** The sum of positive charges (blue arrows) and negative charges (red arrows), seen in (A), are transferred to the theoretical graphic of radial charge distribution for a neutron model ddu, seen in (B). Maximum and minimum values in (B) are in disagreement with the values measured in JLab, as commented ahead.

In the Fig 10 we have standard model of ddu and JLab.

Model ddu of the Standard Model,

-Max. positive: +0.3 between 0.3fm and 0.5fm
-Max. negative: -0.26 between 1.0fm and 1.1fm
-Changes from positive to negative at the point 0.70fm

JLab

-Max. positive: (+0.145),(+0.208) at the point R=0.23fm
-Max. negative: (-0.050),(-0.075) between 0.9fm and 1.0fm
-Changes from positive to negative at the point 0.60fm

So, from graphical method, we verify that the neutron model ddu of the SM cannot reproduce with a satisfactory accuracy the values +0.18 and -0.06, and we will point out about the reason when we will analyze the difference between the charge distributions in the models ddu and duu-e. If the neutron existing in nature had the structure ddu as considered in the Standard Model, its radial charge distribution measured in the JLab would be near to that shown in the Fig 10.(B), with maximum values close to +0.3 and -0.25.

CURVE FOR THE QUARK RUTHERFORD'S NEUTRON MODEL duu-e

The next step is to verify whether from the neutron model duu-e is possible to reproduce with accuracy the values +0.18 and -0.062 measured in the JLab. As said before, looking at the curve of radial charge distribution for the neutron shown in Fig 6, we realize that the maximum positive density charge occurs close to the radius $0.23fm$.

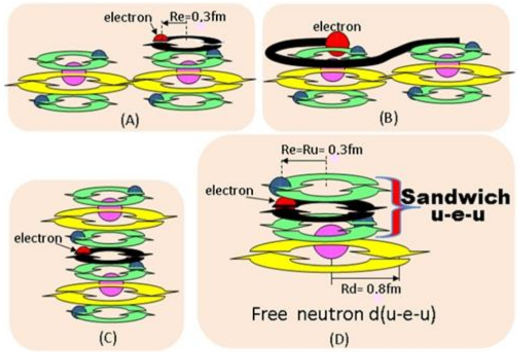

Fig 11. A, B and C are Neutron's structure d(u-e-u) within three structures of the deuteron , B- Electron orbiting the two protons of the deuteron and D- Structure of the free neutron.

Fig 11 shows in (A), (B), and (C) the three sort of structures for the deuteron, when one proton and one neutron are bound so that they form a deuteron. The structure shown in 12.(A) for the deuteron, with the electron moving with an orbit radius Re= 0.3fm, was used in the Fig 5.(B) for the calculation of the deuteron electric quadrupole moment. The value obtained is $Q = +3.0\times10^{-31}\,m^2$ (see eq. 2), which is very close to the value measured in experiments. Fig 11.(D) shows what happens when the neutron exits its partnership with the proton in the deuteron, becoming a free neutron: the electron moves in an orbit between the two up quarks, forming a sandwich u-e-u with orbit radius $R_e = R_u = 0.3fm$. The structure of the free neutron shown in Fig 11.(D) is used in the graph in such a way to reproduce its radial charge distribution measured in JLab, with the two up quarks and the electron moving as a sandwich u-e-u with orbit radius $R = 0.3fm$. The sandwich (u-e-u) shown in the structure of the free neutron in Fig 11.(D) behaves as a charge $q= +1/3$ moving with orbit radius $R = 0.3\ fm$, and so, for the curve obtained in the Fig 12 it was considered, 1-The d quark with charge -1/3 has orbit radius $Rd = 0.8fm$. 2-The sandwich u-e-u with charge +1/3 has orbit radius $R = 0.3fm$

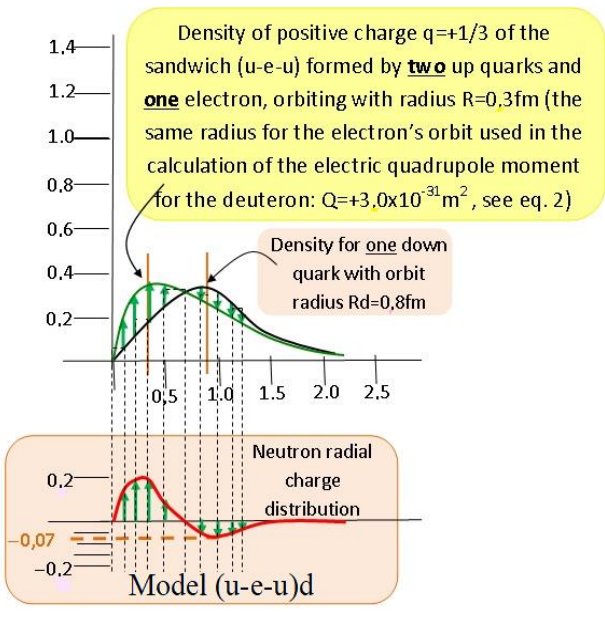

Fig 12. Neutron radial charge distribution for the model d(u-e-u), obtained from the charge distributions for u and d quarks (Figs 8 , 9).

In the Fig 12 we have

Model d(u-e-u)
-Max pos: + 0.2 between 0.2fm and 0.3fm
-Max neg: -0.07 between 0.8fm and 1.0fm
-Changes from positive to negative at the point 0.70fm

JLab
-Max pos: (+0.145), (+0.208) at the point $R = 0.23$
-Max neg: (-0.050), (-0.075) between 0.9fm and 1.0fm
-Changes from positive to negative at the point 0.60fm

In spite of the model d(u-e-u) gives good results, we see that density charge changes from positive to negative at the point 0.70fm, whereas, from JLab exeperiments, it changes at the point 0.60fm. We will see later that such unsatisfactory result disappears when we plot four curves: one for the electron, two independent curves for each of the two u quarks (with two different radii Ru1 and Ru2), and one curve for d quark.

COMPARISON OF THE CHARGES IN THE MODELS ddu AND d(u-e-u)

The difference between the ddu and d(u-e-u) models are as,
-Model ddu: there is a dispute between charges +2/3 versus -2/3, as we see in the graph of the Fig 10.(A), due to the dispute between one u quark and two d quarks.
-Model d(u-e-u): there is a dispute between charges +1/3 versus -1/3.

The difference between the magnitude of charges dispute in the structures d(u-e-u) and ddu shown above is the reason why the model ddu cannot reproduce satisfactorily the results of the JLab, while the model d(u-e-u) is able to reproduce them very well, as seen in the Fig 12. Let us try a model ddu where one d quark gets a partnership with the u quark both of them having radius 0.45fm, while the other has radius 0.80fm, in order to have a model ddu with a charge +1/3 versus -1/3, in a situation similar to what occurs in the model d(u-e-u). Fig 13 shows the charge distribution, and we realize that, whereas, according to JLab experiments, the positive changes to negative in the point 0.6fm, on the other hand with the model ddu it occurs at the point 0.95fm.

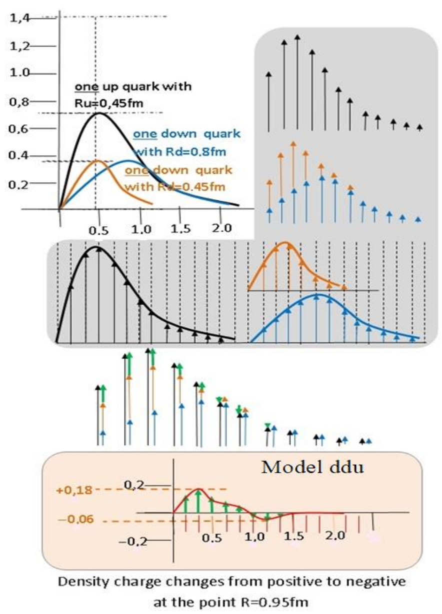

Fig13. Radial charge distribution for a model ddu with a dispute of charges +1/3 vs -1/3 (obtained from Figs 8 and 9)

In the Fig 13 we have

Model ddu
-Max pos: + 0.18 at the point 0.3fm
-Max neg: -0.06 at the point 1.2fm
-Changes from positive to negative at the point 0.95fm

JLab
-Max pos: (+0.145), (+0.208) at the point $R = 0.23$
-Max neg: (-0.050), (-0.075) between *0.9fm* and 1.0fm
-Changes from positive to negative at the point *0.60fm*

Model ddu
For the model d(u-e-u) in Fig 12, the reason why positive changes to negative near to the point 0.6fm (whereas for the model ddu in Fig 13 this changes at the point $0.95fm$) is easy to understand and this is shown in Fig 14 (the yellow arrows).

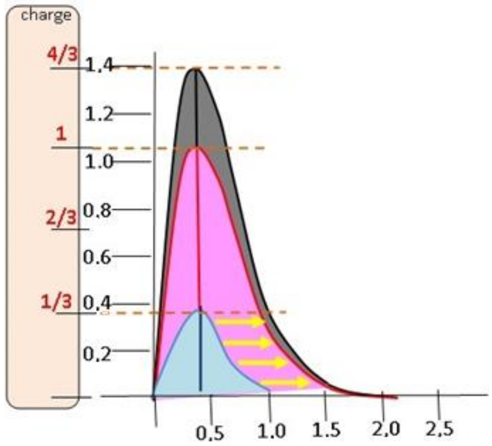

Fig 14. The reason why ddu model with a dispute of charges +1/3 vs -1/3 cannot reproduce experimental data on radial charge distribution

The fundamental difference between the models ddu and d(u-e-u), concerning the charge distribution, is the following.
-**Model d(u-e-u):** the difference of charge between the two up quarks and the electron is 4/3-1=+1/3. However, the difference of charge density between the electron and the two up quarks is practically null in the range between *0.7fm* and 1.5fm.
-**Model ddu:** unlike, in spite of the difference of charges between d quark with orbit radius $R = 0.45fm$ and u quark is also +1/3, however from the Fig13, we realize that the difference of charge density in the range between *0.45fm* and *2.0fm* is very large. Therefore, although d quark (blue) with orbit radius $R = 0.8fm$ has a dispute between its charge -1/3 versus the charges +1/3 due to the overlap between the up quark & the other d quark (orange), nevertheless we see that the density charge of the orange d quark vanishes at the distance 1.0fm, while the density of the up quark vanishes at 2.0fm. So, the overlap is not perfect, and this explains why the dispute between the charges +1/3 and -1/3 by considering the model ddu is not able to reproduce the JLab results. The graphic method of curves superposition would be acceptable for the model d(u-e-u) if the electron and the two up quarks had the same orbit radii $R_e = R_u = 0.3fm$. However, as we will see in the item 8, they have different orbit radii, and in spite of the difference is small, the graphic method gives a satisfactory result. Nevertheless, although the model d(u-e-u) considered in the graph method is not correct, the objective here was to show that

is possible to reproduce the JLab measurements with the model d(u-e-u), whereas it is impossible to reproduce them with the model ddu.

REPERCUSSIONS IN THE STANDARD MODEL

Having a wrong neutron model as a constituent within the nuclei, the consequence could not be other than the generation of ambiguities, and the first victim is obviously the deuteron model adopted in SM, because it is the simplest composed particle formed by two nucleons, but not free of ambiguities: Yet, ambiguities remain in the relativistic description of this system and the two-nucleon picture is incomplete: meson exchange and nucleon excitation into resonances should be considered in the deuteron description. The question of rare configurations where the two nucleons overlap and loose their identity is still under debate. We are still looking for the elusive effects of quarks in the nuclear structure (Garçon & Van Orden, 2001). Among several other ambiguities, the question on the meson exchange remains because nowadays the most theorists worldwide agree that Yukawa's model of neutron is impracticable and was replaced definitively by the quark model. So, appeal to Yukawa model so that to solve puzzles is a strange ambiguity, try to solve puzzles with a wrong model. On another hand, among the theoretical failures of the Yukawa's model, it seems the worst is its incompatibility with the existence of free neutrons. Indeed, Yukawa's model makes sense only when two protons are exchanging a meson. But a free neutron has not the partnership of a proton for the meson exchange between them, and therefore when a neutron exits its partnership with a proton there would have a decay in the time of 10^{-23}s. But the free neutron's lifetime is about 12 minutes, and there is no way to justify it with Yukawa model. However, some theorists still use the meson exchange in order to explain some nuclear properties that cannot be explained through the quark model. For instance, the charge distribution shown in Fig 3 cannot be explained by considering the quark model, because in the 3S1 state, the deuteron does not rotate, and therefore by considering the model ddu, the negative charge in the deuteron cannot be spread surrounding the deuteron, as occurs in Fig 3. In order to explain the charge distribution at Fig 3 by using the Standard Model deuteron composed by uud, ddu there is need to consider the meson exchange, which obviously is a nonsense. Unlike, by considering the model duu, d(u-e-u) the puzzle is solved, because in spite of the deuteron does not rotate in the 3S1 state, the electron moves around the two protons in $M_j = 0$ magnetic state, and such orbital motion of the electron explains why the negative charge is distributed involving the whole deuteron. As we realize, by taking in account the model of neutron d(u-e-u), we eliminate the need of adopting ambiguities as occurs when the model ddu is adopted. Interpretation of experiments is crucial in the process of scientific discovery. In the beginning of the development of Nuclear Physics some experimental results known at the present time were not available at that time, and the theorists at that age had interpreted the experimental results in the way suggested by Heisenberg, in order to avoid speculations. Nowadays, with the refinements of the experiments performed with new technologies, the new experimental discoveries are suggesting that the SM was developed in a wrong way, because, in the beginning of its development, there were not available technology enough to make the experiments performed nowadays. It is the time to change the direction of the way by adopting suitable new interpretations, with the aim to eliminate so many unsolved puzzle abandoned in the long path of development of the SM. Otherwise, if we do not try to correct the way, the SM will never be successful for an accurate description and coherent interpretation of the physical phenomena, free of ambiguities and philosophical incoherencies.

ON THE QUESTION REGARDING THE SPIN OF THE NEUTRON MODEL *n = p - e*

It seems to be out of doubt that the neutron model ddu cannot be correct and we must reconsider the Rutherford neutron model p-e, and so there is need to propose conjectures in order to solve the question about the spin 1/2 of the neutron model composed by proton and electron. Two conjectures can be considered, as follows.

First conjecture: The Schrödinger's zbw

In spite of Schrödinger's intention was not to propose a conjecture in order to solve the puzzle of the neutron spin in the Rutherford's model, he had proposed a conjecture concerning the mechanism responsible for the spin of elementary particles. The idea that the electron spin and magnetic moment are generated by a localized circulatory motion of the electron has been proposed independently by many physicists.

Schroedinger's zitterbewegung (zbw) model for such motion is especially noteworthy, because it is grounded in an analysis of solutions to the Dirac equation. Surely, if the zbw is a real physical phenomenon, then it tells us something fundamental about the nature of the electron. However, the role ascribed to the zbw in standard formulations of quantum mechanics has been metaphorical at best (Hestenes, 1990).

We realize that Schrödinger had understood that it's impossible to avoid conjectures in the development of the Quantum Mechanics, and the way proposed by Heisenberg could not be entirely successful. Soon or later the way pointed by Heisenberg would fail, because sometimes he was neglecting some physical aspects involved in the phenomena, and replacing them by abstract mathematical entities. The first conjecture, based on Schrödinger's zbw, is the following: consider that the spin s=1/2 of an electron measured in experiments is the product of Z and Si (s=ZSi) , where Z is a quantum integer due to zbw's contribution for the spin, and Si= 1/2 is the intrinsic spin due to the rotation of the electron about its axis. For a free electron, Z=1, because the electron moves with zbw. So, we may consider a model of the neutron p.e where the electron has orbital motion around the proton with relativistic speed. As consequence of the interaction proton-electron at a very short distance within the neutron (in the range of few femtometers), the electron stops moving with helical trajectory (it acquires around the proton a circular motion with the intrinsic spin Si=1 only). As the zbw vanishes, then Z=0, and the electron spin becomes s= 0×Si = 0×1 = 0, with the electron having spin zero orbiting the proton within the structure of the neutron. In the present theory this mechanism is nominated "spin-fusion". By considering the spin-fusion it is possible to eliminate some puzzles, as for instance about the neutron beta-decay. Because, if the neutron had the quark structure ddu, it could not have beta-decay, since its time decay would have to be in the order of 10^{-23}s, as happens with the nucleons whose structure is bound via the strong interaction, because the quarks interact via the strong interaction. However, the neutron decay takes 12 minutes, because the structure of the neutron actually is d(u-e-u) and the electron as a lepton is not bound to the proton via strong interaction. In this way, the neutron-decay does not involve an intermediate boson W. Actually, when the neutron decays, a boson W is created, since the electron is bound to the proton via weak interaction, and the bosons W and Z can be created during a weak interaction. When a free electron is captured by a proton and they form a neutron, the electron loses its zbw and in this process a neutrino is created. During the neutron decay, when the electron leaves the p-e interaction, it recovers the zbw and, in this process, an antineutrino is created.

Second Conjecture: A structure for the neutrino

We will realize that the second conjecture seems to be the best one. It is based on the proposal of a structure for the neutrino and a mechanism for neutron beta-decay, by introducing a little detail possibly missing in the theory proposed by Fermi. This second conjecture does not need to consider that spin is generated by zbw, in spite of the Schrödinger conjecture does not need to be discarded, because it is useful in order to solve other puzzle, as we will see later. The second conjecture is exposed ahead, but it's of interest to remember that when Fermi submitted his paper on the beta-decay theory to the journal Nature, it was rejected for being too speculative. Therefore, sometimes along the development of Science, there is no way to avoid conjectures, because they are proposed when the theorists do not have any idea on what is the way they need to choose so that to continue the process of Science advancement. And whether the speculation is good or bad, it is the future that will assume the task of telling us whether the speculation adopted is correct, or not, because the conjecture will face the challenge of surviving to the new discoveries along the years. But a good speculation must be able to solve at least the puzzles of the present time, of course, otherwise it cannot be considered good. In the case of the Fermi speculation, the present time is telling us that his theory is incomplete. But wrong speculations sometimes are necessary and unavoidable, because they were the best idea among other ones available at that time. Perhaps other speculation was available and it was the correct one, however it was more speculative and, at that time, it was so much soon for its acceptance. Now let us see what can be missing in the Fermi's theory on the beta-decay. When the proton captures an electron and they form a neutron, a boson Z is created within the newborn neutron, with the structure shown in Fig 15. The boson Z has a structure $u - G - u'$, where u is a quark, u' is the antiquark and G is the Gell-Mann's gluon with electric charge zero and spin 1 (we call it here "big gluon G"). The two quarks have contrary spins, and so boson Z has no charge and spin 1.

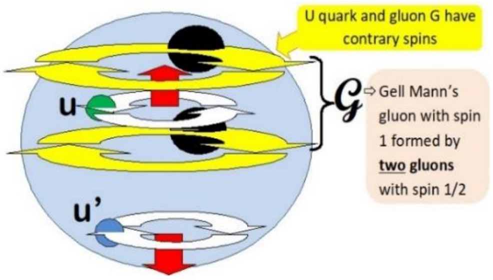

Fig 15. Boson Z is created when a proton captures an electron

As shown in Fig 15, the big gluon G is composed by two gluons, g' and its antigluon g'', both of them with spin 1/2. When the proton captures the electron and the neutron is formed, the electron displaces the d quark, in order to form a sandwich with the two up quarks of the proton, whereas the boson Z decays, as shown in Fig 16, as follows: its gluon g' is captured by the electron inside the sandwich (u-e-u), and the rest of the boson Z becomes a neutrino, which structure is $(u - g'' - u')$, and it leaves the newborn neutron. Also note that U2 quark changes its spin from up to down, whereas the d quark changes its spin from down to up. From Fig 16 we realize that neutron has spin +1/2, because, up quarks U1 and U2 cancel each other their spins. Electron and d quark have spin up, and they perform an up spin +1. Two G gluons have contrary spins and cancel each other.

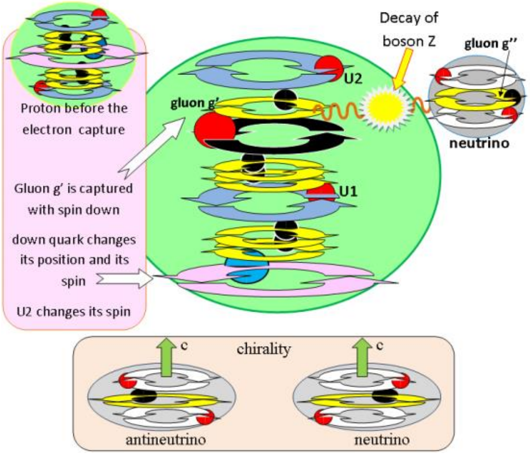

Fig 16. Creation and decay of a Z boson inside the newborn neutron, in the instant when the proton captures a free electron

In the Fig 16 we have, when Z boson decays, its big gluon G is decomposed in two g' and g'' gluons, whereas g' is captured by the proton for the formation of the neutron, u and u' quarks capture the g'' gluon, and they form the neutrino. Before the neutron creation, the proton has up spin +1/2, (because the two gluons have contrary spins) the two up quarks sum an up spin +1, and the down quark has a down spin -1/2. The electron Is captured with up spin +1/2, and the G gluon of the Z boson is created with down spin -1. In Fig 16, after the decay of the Z boson, as the electron moves inside the proton positive magnetic moment $+2.793\mu N$, the electron is captured with spin up (having negative magnetic moment regarding the proton). Inside the proton with spin +1/2 the Z boson is created in a position upside down, in order that its G gluon has spin down -1. Therefore, the g' gluon of the Z boson is captured by the electron with down spin -1/2. So, the spin of the neutron is $+1 - 1/2 = +1/2$. As the total electric charge is zero in the antineutrino and the total magnetic moment is also zero, and because u and u' are very close, as consequence they have positive and negative electromagnetic fields practically coincident with the same center, and by this reason the overlap of their electromagnetic fields results in a practically total zero charge and also total null electromagnetic field, in order that the antineutrino has practically zero interaction with matter and vacuum energy, and this is the reason why it behaves as if it were a massless particle, in spite of the quarks u and u' have mass. As neutrinos do not interact with matter or vacuum energy, they move with the speed of light, as already verified experimentally. The most precise agreement with the speed of light, as of 2012 in MINOS at the LHC (Adamson, 2013), was determined in 1987 by the observation of electron antineutrinos of energies between 7.5 and 35 MeV originated at the Supernova 1987A at a distance of 157000±16000 light years. Supernova 1987A detected neutrinos with speed 1.000000002 times the speed of light.

This value was obtained by comparing the arrival times of light and neutrinos. The difference of approximately three hours was explained by the circumstance, that the almost noninteracting neutrinos could pass the supernova unhindered while light required a longer time (Hirata et al., 1987). According to Guglinski-Nassif theory (regarding the origin of mass of the elementary particles), neutrinos can move with the speed of light because actually the vacuum energy is no empty, as is inferred from new experimental findings (Wilson et al., 2011). So inertia can be resulted from the interaction between matter (electric fields of particles) and a new concept of aether (vacuum energy), as proposed recently in a series of papers (Cláudio Nassif, 2008; Claudio Nassif, 2010; Cláudio Nassif, 2012, 2015; Cláudio Nassif & de Faria Jr, 2012), where some fundamental principles of the Special and General Relativity are being reevaluated. Reevaluation is a process indispensable for the advancement of Science, when new experimental findings bring to light new properties of the matter and spacetime that cannot be fit to the current models. So, the neutrino and antineutrino are "apparently" massless and they can move with the speed of light because they do not interact with the aether. The fact that neutrinos have mass and move with the speed of light implies that something is missing in the Einstein's interpretation for the Theory of Relativity (where the space was considered empty), and reinforces the new interpretation according to which the mass of particles is due to their interaction with the aether, as proposed recently by Nassif. Thereby, from this new interpretation for the origin of the mass, the structure for the neutrino proposed herein is justified. In his paper, Nassif shows that electric charge of an elementary particle plays a fundamental role for preventing such particle reaches the speed of light (Nassif da Cruz, 2016). In other words, this means that, if the particle net charge is zero, it moves at the speed of light. The neutrino is massless because is perfect the concentric superposition of the two electric fields of the pair quark-antiquark along the direction of the neutrino motion, and so the net electric charge of the neutrino is exactly zero. But there is no perfect concentric superposition of electric fields along a direction perpendicular to the neutrino motion, and this is the reason why sometimes it can interact with matter. Regarding the photon, it can be considered as composed by a particle and an antiparticle of the aether, they moving with zbw. A paper was published (Urban, Couchot, Sarazin, & Djannati-Atai, 2013), suggesting that vacuum permeability and permittivity may originate from the magnetization and the polarization of continuously appearing and disappearing fermion pairs of the aether. However, in the case of the photon the particle moves a little ahead the displacement of the photon toward its motion. Due to this delay of the antiparticle along the direction of the photon motion, there is no concentric superposition between the magnetic fields of the particle and antiparticle, and this is the reason why the photon interacts with matter. But toward the direction of the photon motion, the concentric superposition between the two electric fields is perfect, and so the net charge of the photon is exactly zero, and this is the reason why it is exactly massless. With such model of photon is possible to reproduce all the properties of the light, as it will be shown in a future paper. The gap due to the delay between the particle and antiparticle (positions in the longitudinal line along the photon motion) gives to the photon the ability of being, or not, polarized when it crosses a polarizator, because, (when length of the distance between two atomic plans of the crystal is a multiple of the length of the gap, there is a resonance between the photon and the atomic plan) the photon is able to cross the polarizator, and such passage through the polarizator changes the relative positions of the particle and the antiparticle inside the photon (positions in the plan orthogonal to the photon motion, i.e., the angle $\propto$ between their positions when the photon enters inside the polarizator is changed to β when the photon leaves the polarizator). Note that, whereas the photon, (formed by particle-antiparticle) is created when the atom is excited and the electron jumps between to energy levels, the Z boson (formed by quark-antiquark) is created when the proton is excited with the capture of an electron and they form the neutron. In the case of the neutron, in spite of it has zero charge, however there is no concentric superposition of the positive and negative electric fields, because the presence of the electron introduces a symmetry breaking, and this is the reason why the neutron does not move with the speed of light. If the neutron had the structure ddu formed by quarks as proposed by SM, even in this case the superposition of electric and magnetic fields would not be perfect, because a particle with three quarks cannot have a perfect superposition, and so the neutron with structure ddu could not move with the speed of light. Only a particle composed by quark and antiquark can have a perfect concentric superposition regarding the direction of the particle motion.

There are some questions that deserve to be clarified. For instance, the neutral pion π^0 has structure u, GG, u' and it has spin zero, whereas the Z boson has the structure u, G, u', and it has spin 1. So, in spite of they both are formed by u and u' quarks, they have different structures. Why?

Some questions are explained ahead, as,

1-The big gluon G is formed by strong interactions, whereas the gluons g' and g'' are formed by weak interactions.

2-Look at the structure of the proton in Fig 16. The d quark has attraction with the two u quarks, and so the sandwich G, d, G promotes the stability of the proton.

3-The structure of the positive π^+ pion is u, g'', e^+, d', where the positron and g'' cancel each other their spins, and u and d' also cancel their spins.

4-The structure of the negative π^- pion is u', g', e^-, d , where the electron and g' cancel each other their spins, and u' and d also cancel their spins.

5-A neutral π^0 with structure u, GG, u' is formed from the decay of a positive (or negative) pion, whose spin is zero, $\pi^+ \rightarrow \pi^0 + e^+ + \nu_\varepsilon$. So, in order to keep the angular moment zero after the creation of the neutral pion, the u and u' quarks take contrary spins, and the two big gluons G also take contrary spins, given a total spin zero of the neutral pion.

6-Regarding the Z boson, we need to consider the angular moment before its creation. Consider the Z boson with structure u, G, u' (see Fig 16). Before the creation of the Z boson (which occurs inside the proton, when it captures an electron), the proton has an up-spin +1/2. The electron is captured with an up- spin +1/2. Therefore, before the creation of the Z boson, the angular moment due to the proton and the electron is +1. In order to keep the angular moment, the u and

u' quarks of the Z boson are created with contrary spins, because the big G gluon has spin +1 (the Z boson is created upside down inside the proton, i.e., the big G gluon has down spin -1, so that to keep the angular moment). Also note that the Z boson is created via capture of a lepton (electron) by a proton, whereas the neutral pion is created via decay of a charged pion (composed by quarks).

7-There are three sort of Lepontic gluons g' and g'': electronic g_E gluons, muonic g_M gluons, and tauonic g_τ gluons. Gluons have no mass because they have no electric charge, in spite of they have different sizes, interpreted in SM as 8 linearly independent types (color charge).

8-In order to be massless, a particle (formed by two fermions which perfect superposition of charges (toward the direction of the motion) promotes a zero net charge) needs to satisfy a second condition: they need to have contrary spins, and they must be bound by the weak g gluons with spin 1/2. The photon is massless because the two fermions $Q^{(+)}$ and $Q^{(-)}$ have contrary spins, and (as there is a gap between them along the direction of the photon motion) instead of being bound by a big G gluon they actually are bound by two g gluons. The structure of the photon is [$Q^{(+)}g'$, $Q^{(-)}g''$], with spin 1. With such a structure, $Q^{(+)}$ and $Q^{(-)}$ have two independent zbw (with contrary direction of rotation). Such motion with two independent zbw, with contrary directions, promotes a perfect superposition of charges toward the direction of the photon motion. Unlike, although in the Z boson with structure u, G, u' the u and u' quarks have contrary spins, they are bound via the big G gluon, which does not allow them to have two independent zbw. In order that the two quarks move together with an unique zbw, and this is the reason why the Z boson has mass. The u and u' quarks of the π^O meson with structure u, GG, u' have contrary spins, and the two G gluons also have contrary spins. As u and u' are bound by strong gluons G, they move with an unique zbw, and that's why the π^O meson has mass. In the neutrino with structure u, g', u' the u and u' quarks have contrary spins. The direction of the zbw depends on the spin, and so they have tendency to move with two independent zbw with contrary direction. Nevertheless, they are bound by a weak g' gluon, and because of such weak interaction they are able to move with two independent zbw with contrary directions, promoting to the neutrino a perfect superposition of charges, and this is the reason why it is massless. The structures of the photon, neutrino, and neutral pion, will be shown in detail in the paper "Lorentz's factor violation by neutrinos moving with the speed of light", to be submitted later.

In sum, the massless concept was conceived in order to introduce a distinction between matter and light, because, as according to the Special Relativity, the mass of a body increases with its speed and it can never reach the speed of light, there was need of proposing a philosophical justification for the difference between light and matter, in order that the photon was defined as being massless, otherwise it could never reach the speed of light measured in the experiments, because the mass of a non-massless photon would become infinite for the photon moving with the speed of light.

STANDARD MODEL DEFIED BY W BOSON

The W boson defies the SM with two intriguing puzzles. The first one is concerning its lifetime, in order of 10^{-25}s, which is close to the typical lifetime of the strong interaction. First of all there is no way to explain it by considering the SM, because as according to SM the W boson mediates the weak interactions, there is no way to explain why its lifetime in the order of 10^{-25} s, since it is even shorter than that of the strong interactions (10^{-24} s). However, we can explain such very short lifetime by considering the W boson structure proposed here. Indeed, we realize that W boson is not a boson. It is actually a pseudo-boson: a pseudo-particle composed by one electron and two quarks (before the quarks transmute to an antineutrino). Because as soon as the antineutrino is formed (see Fig 18), when the two quarks capture the gluon, in a very short time (almost instantaneous) is extinguished the partnership between the two particles (electron and quarks), because the newborn antineutrino has no interaction with the electron (since the antineutrino has not any sort of interaction with any sort of particle). So, 10^{-25} seconds after the creation of the pseudo boson W (composed by electron-quarks), the antineutrino is formed and it gets the speed of light, and leaves the lazy electron. The formation of the antineutrino in the neutron beta-decay is explained as follows. When the electron leaves the proton in the neutron decay, the electron and the proton constitute a newborn hydrogen atom, where the electron is very near to the proton, in a distance of few femtometers, and therefore the electron is moving into a very high energy level inside the proton electrosphere. Let us remember what occurs when photons are emitted by the hydrogen atom. Photons can be emitted when the electron jumps from a low energy level to other of higher level, and also when it jumps from a high level to other of lower level. Similarly, when the electron is moving toward the proton (in order to form the neutron), in this special form of hydrogen atom the antineutrino is emitted. In other hand, when the electron is leaving the proton (in the neutron decay), in this newborn hydrogen atom a neutrino is emitted. In the case of photons, as they are created in regions of low energy level, it happens the following, firstly, is created the particle with negative charge, which is extracted from the agglutination of some fermions of the aether. In this process, a positive "hole" is formed in the space filled by the aether. Due to repulsion with the electron, the newborn negative particle starts to move (but not with the speed of light, because it has mass). In order maintain the total charge conservation, a negative "hole" is dug, by creating the antiparticle. The particle and the antiparticle meet together by capture of gluons, the photon is born, and it starts to move with the speed of light. In this process, the difference of time between the creation of the particle and antiparticle is responsible for a distance d between them, along the direction of the photon motion. The length of the distance d depends on two conditions.

a-The energy level where the photon was created (when the electron jumps from the level n to $n + x$, $x = 1,2,3$ ..., the distance d depends on n and x).

b-The atomic number of the atom which has emitted the photon (H1, H2, He3, He4, Li6, Li7...). In the case of neutrinos and antineutrinos, because they are created in a very high energy level, the length of d is very short, almost zero, and this is the reason why neutrinos and antineutrinos have the zbw symmetry near to the perfection. When the electron leaves the proton in the neutron decay, within the electrosphere of that newborn hydrogen atom the quarks u' and u are created with a difference of time very short, shorter than 10^{-25}s. Before the decay of the pseudo boson W (along the 10^{-25}s of its life time). The quarks u and u' (together with the electron) compose a particle with mass 80GeV/c². After those 10^{-25}s of the W's life time, the quarks capture the gluon, the antineutrino is ready, and it starts to move with the speed of light. Therefore, the $10^{-25}s$ lifetime of the W boson is explained. And the best would be to call it "W no-boson". The second puzzle is concerning the magnetic moment.

For the W boson $\mu = (K+1)e/2MW$, where the SM value is $K = 1, \mu = e/MW$. However, the magnetic moment of a particle of spin S is generally assumed to be that given by the Belinfante conjecture and has the value $g = 1/S$ for its gyromagnetic ratio. Thus, for the spin 1/2 electron we find the Dirac value $g_e = 2$. However, in the SM the W boson, a spin one particle, is found to have the value $g_{W+} = 2$. Which is not a surprise if we consider the pseudo W boson proposed herein, since it is composed by electron + antineutrino, and by considering that the magnetic moment is produced by the electron charge, and the electron mass increases up to 80GeV/c² due to its relativistic spin, of course the magnetic moment of the W boson is given by $\mu = e/MW$ (as the experiments have measured) without the need of adopting the anomalous $k = 1$, adopted in the SM. Therefore, according to the SM it is really a surprise the anomalous $k = 1$, and the theorists try to solve the puzzle. Whereas some theorists have computed the anomalous magnetic moment of the W boson as a function of the unknown Higgs mass MH and the unknown top quark mass mt (Samuel, Samuel, & Li, 1990), others propose a new sort of Physics according to which the "natural" value of magnetic moment for any particle of spin S should be $g = 2$, independent of spin (Holstein, 2006), and others show that for $\lambda \gtrapprox 1$ TeV only the range $0 < \kappa < 2$ is allowed (Herzog, 1984). In other words a miscellaneous of desperate attempts.

STERILE NEUTRINO

A new kind of neutrinos that interact only via gravity and do not interact via any of the fundamental interactions of the SM are hypothetical particles under investigation, named sterile neutrinos. The search for this sort of neutrinos is an active area of Particle Physics. The decay proposed for the sterile neutrinos is shown at the Fig 17 (Gorkavenko, Rudenok, & Vilchynskiy, 2011). As they decay into Z and W bosons, this seems to corroborate the structure for neutrinos proposed herein.

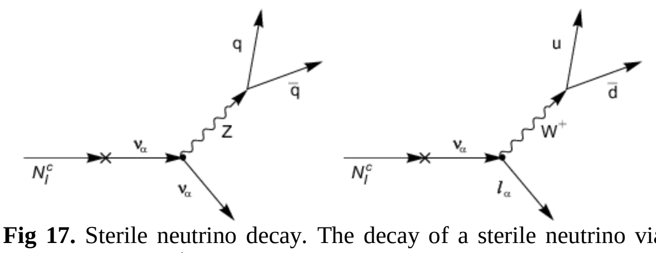

Fig 17. Sterile neutrino decay. The decay of a sterile neutrino via $Z-$boson and $W^+ -$ boson (the cross on line of a sterile neutrino means an oscillation of a sterile to an active neutrino) (Gorkavenko et al., 2011)

Actually it's the contrary, the structure for neutrinos proposed here justify the decay of a neutrino into a boson W or Z, because the mass of the neutrino is 0.32 eV/c², whereas the mass of the W boson is 80.4 GeV/c². A neutrino with so despicable mass cannot decay into a boson with so heavy mass, unless we consider the neutrino structure proposed here.

Fig 18 shows the neutron's beta-decay, as follows: the electron is leaving the neutron, and as it moves inside the neutron negative magnetic moment $-1.913\mu N$, the electron is constrained to change its up spin to down. As the g' gluon has and null magnetic moment no charge, it keeps its spin down. The electron leaves the neutron bound to the gluon g', as a composed pseudo particle $(e-g')$ with spin -1. The gluon g' captures a pair of quarks (quark and antiquark), in order that a pseudo W boson is formed, with spin -1, and at once occurs the pseudo-decay of W, with the antineutrino moving away with the speed of light leaving the electron back.

If the neutron model $d(u-e-u)$ is confirmed, the confirmation obviously will reverberate into the SM, in spite of some theorists consider that SM does not require that lepton number must be conserved. But according to SM, for every "electron-neutrino" produced, a positron is also produced, and for every "electron-antineutrino" produced, an electron is also produced. This conclusion was required because of the Fermi's interpretation for the beta-decay. And, from the model $d(u-e-u)$, we realize that the electron is not produced in the beta-decay.

Note- Scientists at the IceCube Neutrino Observatory in Antarctica who have been searching for sterile neutrinos have come up empty (Aartsen et al., 2016). But albeit this new research points out that sterile neutrinos do not exist, however it is of interest to mention them herein, because the hypothesis of their existence derives from the fact that neutrinos existence defy the SM, and so many theorists try to decipher the neutrino mysteries by moving beyond the SM.

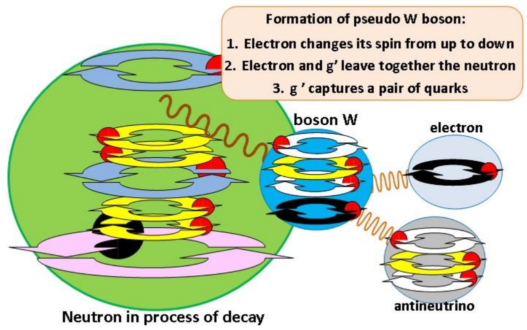

Fig 18. Neutron beta-decay

In the Fig 18 we have,

1. Electron changes its spin from up to down when leaving the neutron, because it was captured inside a proton with magnetic moment +2.793, but it is leaving the neutron with magnetic moment -1.913

2. Bound together as a composed particle with spin -1, the electron and the gluon g' leave the neutron

3. Gluon g' captures a pair of quarks and together with the electron they form the pseudo W boson with spin -1

4. Pseudo W boson has a pseudo-decay: the antineutrino moves away with the speed of light, leaving the electron back

LEPTON NUMBER CONSERVATION

The question on the lepton number conservation is still opened, and it represents a "headache" for the particle theorists. In Physics the laws are established so that they cannot be violated, otherwise they would not be laws. And so, such argument would have to be applied to the lepton number conservation, because when a law X of a theory is proposed, there is no need to set up: "this law X is not required by the theory for explaining data and there is no point in constructing the theory requiring that law X cannot be violated". However, later with the discovery of some experiments that violate the lepton number, the theorists started to allege that lepton number conservation is not required for explaining data, and at no point in constructing the SM was required that it must be conserved. Nowadays many physicists question whether it is actually conserved and many papers are published on the subject, the most of them published in 2015 (Abada, Arcadi, Domcke, & Lucente, 2015; Harz, Huang, & Päs, 2015; Maiezza, Nemevšek, & Nesti, 2015; Peng, Ramsey-Musolf, & Winslow, 2016; Zee, 1980), while also in 2015 the University of Massachusetts Amherst hosted the international "BLV 2015: International Workshop on Baryon and Lepton Number Violation". In the case the neutron model ddu adopted in the SM is really wrong the origin of the "headache" of the theorists lies in such a mistake, because surely such error could not remain unpunished, since soon or later new experimental findings would finally require the violation of some laws of the SM. Thus many theorists would fatally conclude that some laws of the SM cannot be conserved. The redemption must come with the recognition of the mistake, since the violation does not occur in the case of the neutron model $d(u-e-u)$, as the electron is not created in the neutron decay, and so the Rutherford's neutron can be the "aspirin" for the "headache" of the theorists in the upcoming years.

ZBW CAN PLAY FUNDAMENTAL ROLE IN PHYSICS

Regarding the two conjectures, although the second conjecture seems to be the best for the explanation of the neutron spin 1/2, from the Schrödinger's conjecture we can explain other puzzle of the neutron model p.e, concerning the magnetic moment. Indeed, the magnetic moment of the electron is by three order of magnitudes larger than that of the neutron, and so an opponent of the model p.e could allege that neutron magnetic moment should be in the same order of that of the electron. Such restriction against the model p.e is eliminated by considering Schrödinger's conjecture, because, when the electron is captured by the proton, within the newborn neutron the electron has no zbw, and so within the neutron, the electron magnetic moment has not the same magnitude of the free electron. Nassif demonstrates that zbw of both free proton and electron is due to fluctuations that have origin in a background field (aether) generated by gravity weakly coupled to electromagnetism(Nassif da Cruz, 2016). Therefore, together the works mentioned above provide a basis for considering that the electron loses its magnetic moment due to zbw inside the neutron. They justify why the neutron magnetic moment is three order of magnitudes less than that of the free electron moving with zbw. The need of proposing conjectures regarding the p.e neutron model is also reinforced by experimental findings, because in 1993 the American Institute of Physics published a paper reporting an experiment on the synthesis of the neutron from protons and electrons at conditions of low pressure and temperature (Borghi, Giori, & Dallolio, 1993). The experiment was replicated (Santilli, 2006).

SPIN-FUSION SOLVING UNSOLVED PUZZLES IN PARTICLE PHYSICS

Spin-fusion is not a mechanism proposed in ad hoc manner in order to be applied to the case of the neutron only. Actually it can be applied also for many reactions of particle physics which are impossible to be explained via the current models. Here we will show how three interesting puzzles concerning mesons and other particles are solved.

First puzzle: Mesons K

The first puzzle is concerning the mesons K. The mass of positive and negative mesons K are, $m_{K+} = m_{K-} = 494\ MeV/c^2$, and the mass of the neutralized mesons K are $m_{KO} = m_{K\emptyset} = 498\ MeV/c^2$. Consider the following structures.

$$K^- = (u', u \leftrightarrow e^-) \qquad (3)$$

$$K^+ = (u', u \leftrightarrow e^+) \qquad (4)$$

Where $u \leftrightarrow e^+$ is the spin-fusion between u quark and an electron in Eq (3). The structure of neutralized mesons K can be,

$$K^\emptyset = (u', u \leftrightarrow e^-) \qquad (5)$$

$$K^0 = (e^- \leftrightarrow u', u \leftrightarrow e^+) \qquad (6)$$

and we realize that Eq (5) is similar to a neutron with structure $(u, d, u \leftrightarrow e^-)$. By looking Eq (5), we see that the positron e^+ is tied to a negative u' quark, whereas in Eq (6) the electron e^- is also tied to a negative u' quark. Evidently, we must expect that the time decay of K^0 in Eq (6) must be very shorter. Indeed, the experiments show that K^0 has a time decay $t = 8.6\times10^{-11} s$, while $K^\emptyset$ has $t = 5.2 \times 10^{-8}$ s. Unlike, looking at Eq (3) and Eq (4) we have to expect the same time decay for K^- and K^+. Indeed, the experiments show that they both have $t = 1.2 \times 10^{-8}\ s$.

Also note that K^-, K^+, and $K^\emptyset$ have similar structures, because all they have a positive quark bound with a negative lepton (or a negative quark bound with a positive lepton). That's why they have lifetime in the order of 10^{-8}s. The different times decay $t = 8.6 \times 10^{-11}\ s$ for K^0 and $t = 5.2 \times 10^{-8}\ s$ for $K^\emptyset$ has another consequence, the particles K^- and K^+ have an uncommon distribution of time-decay. The theorists suppose that the existence of two life-time has an interesting origin: the participation of K^0 and $K^\emptyset$ in the process of decay for K^- and K^+. In 1964, Christenson and collaborators discovered that the system $(K^0, K^\emptyset)$ sometimes is responsible for a process interpreted as a "temporal reversion", because in 0.1% of the experiments the decays is $K \rightarrow \pi + \pi$.

According to their interpretation, sometimes nature induces a phenomenon where the flux of time goes in contrary direction. Such paradoxical conclusion can be avoided by considering the spin-fusion in the mesons K.

Second puzzle: Mesons Rho

The second puzzle refers to mesons Rho. Consider the mesons π^+ and the mesons Rho (they have the same structure, according to the SM, but Rho are excited mesons).

- The meson π^+ has structure ud', its rest mass is 140MeV , and its time decay is 2.6×10^{-8} s.

-The meson Rho+ has structure ud', its rest mass is 770MeV, and its time decay is 0.4×10^{-23}s.
-The meson π^0 has structure $(uu' + dd')/21/2$, its rest mass is 135MeV, and its time decay is 0.8×10^{-16}s.
The meson Rho^0 has structure $(uu' + dd')/21/2$. Its rest mass is 770MeV, and its time decay is 0.4×10^{-23}s.

We note here that,
1-The masses of pions π^0 and π^+ have a difference of 5MeV. But Rho^0 and Rho$^+$ have the same mass 770MeV
Why? As π^+ and Rho$^+$ have the same structure, whereas π^0 and Rho0 have the same structure, what is applied to π^0 and π^+ must be also applied to Rho0 and Rho+.
2-The pions π^O and π^+ have different time decays, 2.6×10^{-8} s and 0.8×10^{-16} s. But the mesons Rho have the same time decay 0.4×10^{-23}s. Why? There is no way to explain it based on the SM, because,
A- If we use an argument so that to explain the difference of mass 5MeV between π^0 and π^+, however the same argument would have to be applied to the masses of Rho^0 and Rho$^+$, and they also would have to exhibit a difference of mass. But Rho^0 and Rho+ have the same mass.
B- If we use an argument so that to explain the difference of time decay between π^0 and π^+, however the same argument would have to be applied to the time decay for Rho^0 and Rho$^+$, and they would have to exhibit a time-decay difference. But Rho^0 and Rho$^+$ have the same time-decay.

Explanation by considering spin-fusion
Such difference between the behavior of mesons π and Rho can be explained by considering the spin-fusion. Indeed, the structure of meson π^+ can actually be (π^0 -e$^+$), i.e., a spin-fusion of a meson π^O with a positron e$^+$.
A-Such structure explains the difference of mass 5MeV between π^0 and π^+ , the mass of positron is 0.5MeV, but its presence causes a reduction in the binding energy between quarks, and so there is a growth of the pion mass.
B- It also explains the difference of time-decay, π^0 with $0.8 \times 10^{-16}\ s$, with a shorter time because its structure is formed by quarks only, and it decays via strong interaction. π^+ with 2.6×10^{-8} s, with a long time because its structure has a positron, and it decays via beta-decay.
Due to the spin-fusion between the positron and a quark in the meson π^0, the meson π^+ with structure (π^O - e$^+$) has a spin $S = 0$, because the positron loses its spin 1/2. The meson Rho$^+$ has not a lepton in its structure, the reason why Rho^0 and Rho$^+$ have the same mass and the same time decay. Note that, as there is not a lepton in their structure, the time decay is very short, 0.4×10^{-23} s.

Third puzzle: Strangeness
The third puzzle is concerning the Strangeness. When a pion π^- collides with a proton into a chamber of hydrogen bubbles, the interaction is described by

$$\pi^- + p \ \rightarrow \ \Lambda^0 + K^0 \qquad (7)$$

The particles Λ^0 and K^0 are produced by a strong force interaction. Then, it would be expected a time decay in order of 10^{-23}s for those particles, which is characteristic of a decay by the strong force. Nevertheless, Λ^0 has a time decay 10^{-10}s , and the mesons K have a decay between 10^{-8}s and 10^{-10}s, which is characteristic of a decay governed by the weak force. By this reason, Gell-Mann and Nishijima proposed in 1953 the property Strangeness S. Their postulate proposes that the Strangeness S is kept in the strong interaction. Let us analyze the reaction in Eq(7). The particle Λ^0 has two decays,

$$\Lambda^0 \ \rightarrow \ p + \pi^- \qquad (8)$$

$$\Lambda^0 \ \rightarrow \ n + \pi^0 \qquad (9)$$

From Eq(8) and Eq (9) we can infer the structure for Λ^0 , as follows

$$\Lambda^0 = [(d', d), (u, d, u \leftrightarrow e^-)] \qquad (10)$$

where (d, d') has charge zero and spin zero, and $(u, d, u \leftrightarrow e^-)$ has charge zero and spin 1/2. So, Λ^0 is a fermion with spin 1/2, with no charge, similar to the neutron *(u, d, u ↔ e⁻)*, but with mass 1116MeV/c^2 (approximately the mass of neutron + the mass of π^0, $940 + 135 = 1075 MeV/c^2$). The structures for K^0 has already seen in Eq (5) and Eq (6).
Gell-Mann and Nishijima have proposed the Strangeness as an ad hoc postulate. By considering the spin-fusion, we may understand the Strangeness from the viewpoint of a physical phenomenon. It is considered in SM that parity is violated in the beta-decay. But instead of parity violation, actually there is violation of the addition of spins when we interpret the beta-decay without considering the spin-fusion. As we have seen, in the interactions ruled by the weak force a lepton is captured together with a gluon g' (or antigluon g''), and this is the reason why there is a “seemingly” violation of the addition of spins in the beta-decay.

ON THE QUESTION OF THE NEUTRON MASS

We will show that neutron anomalous mass is due to the growth of the electron mass, since the electron has a relativistic speed inside the neutron, as it will be calculated ahead. So, let us calculate the growth of electron mass.

ELECTRON SPEED

We get electron speed from the neutron beta-decay (Fig 19). Electron rest energy ($E_0 = m_0c^2$) is 0.511 MeV. From Kurie’s graph interpretation, electron kinetic energy Ke^{MAX} when emitted in beta-decay corresponds to the binding energy 0.78 MeV, i.e., the electron kinetic energy moving around the proton.

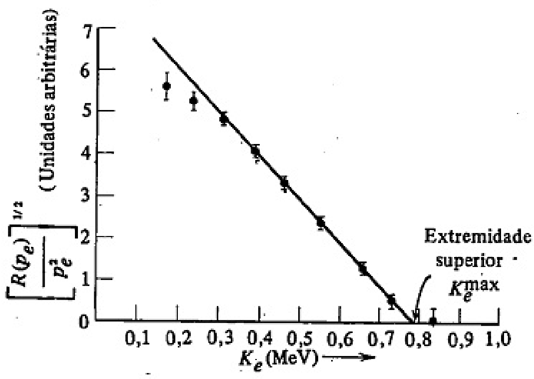

Fig 19. Kurie’s graphic for beta-decay of neutron (Eisberg & Resnick, 1974).

As 0.78MeV > 0.511MeV, such that $E_K > m_0c^2$, and therefore we need to apply Einstein's Relativistic dynamics if we want to know the electron speed in its orbit around the proton.
The relativistic kinetic energy is,

$$E_K = \frac{m_0 c^2}{\sqrt{1-\frac{v^2}{c^2}}} - 1 = m_0 c^2(\gamma - 1) \quad (11)$$

So we have

$$0.78\, MeV = 0.511\, MeV \frac{1}{\sqrt{1-\frac{v^2}{c^2}}} - 1 \quad (12)$$

$$v = c\sqrt{\left(\frac{5.383}{6.383}\right)} = 2.746 \times 10^8 m/s\ \sim 91.83c \quad (13)$$

The electron mass inside the neutron p.e is,

$$m = m_0\gamma \quad (14)$$

so that, from Eq(12) we get $\gamma = 2.5264$, and thus we find,

$$m = m_0\gamma = 0.511 \times 2.5264 = 1.291\ MeV/c^2 \quad (15)$$

By considering the growth of the electron mass, the proton and the electron perform the total mass,

$$m_p + m_e = \frac{938.3MeV}{c^2} + \frac{1.291MeV}{c^2} = 939.591\ MeV/c^2 \quad (16)$$

which is the neutron mass $m_N = m_p + m_e\ \approx\ 939.59\ MeV/c^2$. We see that such result is obtained from the neutron model p.e, being very close to the mass m_N = 939.6MeV/c^2, measured by experiments. This is a strong corroboration for the model p.e having the electron inside the neutron.

MAG. MOMENTS FOR NEUTRON d(u-e-u) AND DEUTERON (udu).d(u-e-u), AND RADIAL CHARGE DISTRIBUTION IN THE NEUTRON d(u-e-u)

The theoretical values for the magnetic moment of the proton and neutron according to the Standard Model are in Table 2.
So, whereas the value calculated for the proton is too close to the observed one (0.1% error), and this is not a surprise because obviously the quark model uud is correct and really represents the structure of the proton existing in the nature), the value calculated for the neutron has a considerable difference (3.3% error, 33% higher than 0.1% , and this is not a surprise too, because there is big possibility of the neutron model ddu is wrong (its structure does not corresponds to the structure of the neutron existing in nature) and then there is no chance to get a value very close to observed one (with 0.1% error, as occurs with the proton).

Baryon	**Magnetic moment of quark model**	**Computed (μ_N)**	**Observed (μ_N)**
p	$\left(\frac{4}{3}\right)\mu_u - (\frac{1}{3})\mu_d$	2.79	2.793
n	$\left(\frac{4}{3}\right)\mu_d - (\frac{1}{3})\mu_u$	-1.86	-1.913

Table 2. Magnetic moment of neutron model ddu. (Computed is -1.86 and Observed, -1.913) ("Neutron magnetic moment,")

THEORETICAL MAGNETIC MOMENT FOR NEUTRON MODEL d(u-e-u)

We see ahead how the magnetic moment of the neutron can be calculated via the model d(u-e-u). Fig 20 shows the free proton, and the dramatic changes of the positions of the quarks when the electron is captured, in order to form the free neutron.

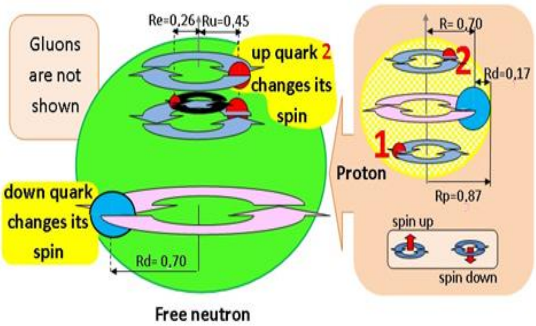

Fig 20. Changes in positions and spin of quarks when the electron is captured by the proton

The two up quarks gyrate in contrary directions. In the case of having the same orbit radius (we will analyze such conjecture later) they cancel each other their magnetic moments and their spins. But this does not affect the radial charge distribution of the neutron in Fig 20, because the total charge +4/3 of the two u quarks continues being the same. The electron and the d quark gyrate in the same direction with spin up, and so both of them produce a negative magnetic moment with spin $s = 1$. Let us calculate the magnetic moment due to the electron orbit and due to the down quark.

MAGNETIC MOMENT OF THE ELECTRON ORBIT

In Eq(2), the value of the electric quadrupole moment $Q = +3.0 \times 10^{-31}m^2$ for the deuteron was obtained by considering the radius $R = 0.275fm$ for the electron orbit in the neutron. First of all let us introduce a correction in the radius of the electron orbit in the sandwich u-e-u, because instead of the deuteron $Q = +3.0 \times 10^{-31}m^2$ obtained from the proton radius $Rp = 0.275fm$ in the Eq(2), we will consider the correct value measured by experiments for the electric quadrupole moment, which is $Q = +2.7 \times 10^{-31}m^2$. Considering $Rp\ =\ 0.26fm$, thus $r^2\ =\ 0.52fm$, and so we find

$$Q = +(r')^2 = +(0.52fm)^2 = +\,2.7 \times 10^{-31}m^2 \quad (17)$$

Therefore, we will consider that the radius of the electron orbit in the sandwich u-e-u is $0.26fm$, and the two u quarks have orbit radii $Ru = 0.45fm$ (see Fig 20). Then let us calculate the magnetic moment produced by the electron by using the well-known equation

$$\mu_e = -\left(\frac{e}{2m}\right)L$$

$$\mu_e = -\left(\frac{e}{2m}\right)mV_eR_e \qquad (18)$$

where $V_e = 2.746 \times 10^8 m/s$ is the electron speed calculated in Eq(13) and $R_e = 0.26fm$ is the radius of the orbit.

$$\mu_e = -\frac{1}{2}(1.6 \times 10^{-19})(2.746 \times 10^8)(0.26 \times 10^{-15})$$

$$= -5.7117 \times 10^{-27}\, J/T \qquad (19)$$

As $\mu N = 5.05 \times 10^{-27}\, J/T$, we have,

$$\mu_e = -1.131\mu N \qquad (20)$$

MAGNETIC MOMENT OF d QUARK WITH RADIUS ORBIT Rd=0.70 fm

For the magnetic moment due to d quark, we will consider that it gyrates with orbit radius $R_d=0.70fm$ inside the proton (see Fig 20: the proton radius is $R_p=0.87fm$ and the radius of d quark is $R_d=0.17fm$, and so the orbit radius is $R_d = 0.87- 0.17 = 0.70$fm). From the JLab graph in Fig 6, we realize that the two u quarks have orbit radius Ru around *0.45fm*. Being X the magnetic moment per total charge in the proton, we have,

$$X\left(\left(\frac{2}{3}+\frac{2}{3}\right)0.45 + \left(\frac{1}{3}\right)0.70\right) = 0.833 \qquad (21)$$

where the charge of d quark is considered positive because it contributes with a positive magnetic moment inside the proton. Two up quarks contribute with

$$\left(\frac{2}{3}+\frac{2}{3}\right)\left(\frac{0.45}{0.833}\right) = 0.72 = 72\% \qquad (22)$$

and the down quark with

$$\left(\frac{1}{3}\right)\left(\frac{0.70}{0.833}\right) = 0.28 = 28\% \qquad (23)$$

So the magnetic moment of d quark within the proton, moving with an orbit radius $0.70fm$ and down spin, is

$$\mu_d = +2.793 \times 0.28 = +0.782\mu N \qquad (24)$$

We note that the contribution of quark d for magnetic moment is positive inside the proton, but it's negative inside the neutron, because d quark changes its spin inside the neutron.

MAGNETIC MOMENT OF THE NEUTRON d(u-e-u) WITH Rd= 0.70fm

As d quark contributes with$-0.782\mu N$ inside the neutron (and the two up quarks cancel each other their magnetic moments, because they have contrary spins within the neutron, as seen in Fig 20), the magnetic moment of the neutron, from Eq (20) and Eq (24) is,

$$\mu_n = -(1.131 + 0.782) = -1.913\pi N \qquad (25)$$

which is in agreement with experimental value, $\mu_n = -1.913\pi N$. Note that the value of $R_e = 0.26\, fm$ for the electron radius orbit leads to a good result, when we consider it together with the orbit radius $R_d = 0.70\, fm$ for the down quark. However, with $R_e = 0.26\, fm$ we do not reach to a good radial charge distribution, no matter if we consider $R_d = 0.6fm$, $R_d = 0.70fm$, or $R_d = 0.80fm$. The reason maybe is,

1- $R_e = 0.26\, fm$ was calculated from the electric quadrupole moment for the deuteron, $Q= +2.7\times10^{-31}m^2$, where the neutron radius is shorter than that of the free neutrons used in JLab experiments, for the measurements of the radial charge distribution of the neutron.

2-The orbit radius Re can be a little larger in free neutrons. So, we will test a range between $R_e= 0.26\, fm$ and $R_e=0.32\, fm$ in the analysis of the model d(u-e-u), exposed ahead.

NEW PROCEDURE TO COLLECT DATA IN JEFFERSON LAB, FOR THE MEASUREMENT OF THE NEUTRON RADIAL CHARGE DISTRIBUTION

Since September 2017, Jefferson Lab begins a new era of research upon completion of the 12 GeV Upgrade of the Continuous Electron Beam Accelerator Facility. An experiment of interest would be to measure again the neutron radial charge distribution, but through a new procedure: the data must be collected in the 6 initial seconds when the neutrons get freedom outside the nucleus, as explained ahead. The neutrons used in the beam experiments have lifetime 8s longer that neutrons used in bottle experiments. There is big chance that such discrepancy is caused by the shrinkage of the radius of the neutrons used in the beam experiments (Guglinski, 2018). Their lifetime is 8s longer because within the atomic nuclei the neutron radius is shortened. When a neutron exits a nucleus, along the 6 initial seconds occurs the dilation of the electron orbit inside the neutron, from Re= 0.26fm up to 0.31fm, and only after those 8s begins the process of neutron decay. Therefore, along the 6 initial seconds, there must be a little difference in the radial charge distribution of those neutrons, compared with the radial distribution already measured in JLab, because the difference $\Delta = 0.05$fm in the electron orbit will change the radial charge distribution of the neutron, along the initial 8 seconds.

CONCLUSIONS

It shall be very interesting to repeat the experiments in the JLab, but the data must be collected in the first initial 8 seconds after the neutron exiting a nucleus. It shall be of interest to measure also the magnetic moment of the neutron, in the first initial 8 seconds, in spite of it is possible the magnetic moment does not change, because with the growth of the orbit radius, from 0.26 to 0.31fm, the angular velocity of the electron decreases. The kinetic energy lost by the electron, due to the reduction of its speed, is absorbed by the up and down quarks, their velocities increase, and the neutron radius dilates.

ORIGIN OF THE MASS

When a free proton is captured by an atomic nucleus, the energy due to the mass defect is absorbed by the up and down quarks, and their velocities increase. The growth of their velocities increases their interaction with the n(o)-flux (Guglinski, 2018), causing the shrinkage of the proton radius. When a proton exits a nucleus, the proton radius dilates, and the energy gained in the mass defect (when the proton was captured) is converted again in mass, restoring the original mass of the free proton, through the Einstein's equation $E = mc^2$. The n(o)-flux is composed by a flux of gravitons moving with the speed of light. When the proton radius shrinkages, the diameter of the n(o)-flux also shrinkages, in order that the number of line fluxes per unity of transverse area decreases (there is a growth of the density of the flux). When the proton radius shrinkages, the energy due to the reduction of the transverse area of the n(o)-flux, $E = (S_0 - S).H.d.c^2$ is converted to mass defect energy, $E = \Delta m.c^2$ where,

1. $S_0.H$ is the volume of the n(o)-flux before the contraction of the radius of the area S_0.
2. d here is the density of strings formed by gravitons, of the n(o)-flux.
3. $S.H.d$ is the mass of the proton when occurs the mass defect.
4. $S_0.H.d$ is mass m_0 of the proton before the occurrence of the mass defect $\Delta S.H.d = \Delta m = m_0 - m$.

The origin of the mass cannot be due to only the interaction between electric charges and gravitons, because, when a proton is captured by a nucleus, the proton charge does not decrease inside the nucleus, and therefore the mass defect cannot be attributed to the interactions of gravitons with charge itself. The contribution of the electric charge of elementary particles in preventing they reach the speed of light was already shown (Cruz, 2016), but as only the interaction between the charge and the aether cannot explain the mass defect, it seems the mass M of a particle must be originated from the combination of two sort of interactions.

$$M = M_{gravitons}^{charge} + M_{gravitons}^{n(o)-flux}$$

Here $M_{gravitons}^{charge}$ is Interaction of the electric charge of particles with the gravitons existing in the aether filling the space and $M_{gravitons}^{n(o)-flux}$ is the interaction of the n(o)-flux with the gravitons existing in the aether filling the space. The first interaction will be consider in later in a new paper.

RADIAL CHARGE DISTRIBUTION OF THE NEUTRON d(u-e-u) WITH *Rd=0.70fm* & *Re=0.29fm*, AND BOTH UP QUARKS WITH *Ru=0.32fm*

Several attempts were done with the value $Re = 0.26fm$, but all them have resulted in unsatisfactory radial charge distribution for the model $d(u-e-u)$, compared with that measured by JLab. Then we will start by using $Re = 0.29fm$. From Eq (19) we get the magnetic moment due to the electron, as follows,

$$\mu_e = -\frac{1.131 \times 0.29}{0.26} = -1.262\mu N$$

From Eq(24) and Eq(26) the magnetic moment of the neutron d(u-e-u) is

$$\mu_n = -(1.262 + 0.782) = -2.043\mu N \qquad (27)$$

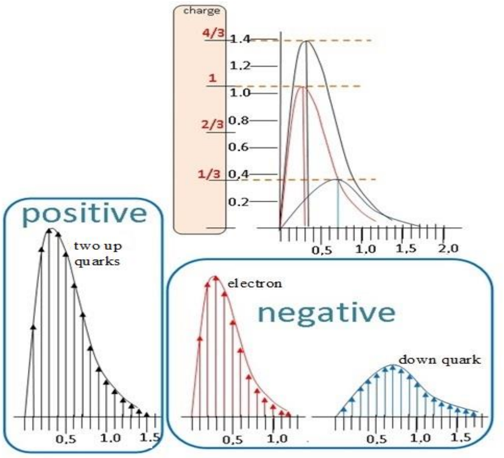

Fig 21. Distribution of quarks and electron in the model d(u-e-u), obtained from Figs 8 and 9, with adoption of the following values $Rd = 0.70fm$, $Re = 0.29fm$, $Ru1 = Ru2 = 0.32fm$.

Fig 21 shows the construction of graph for radial charge distribution with $Rd = 0.70fm$, $Re = 0.29fm$, and $Ru = 0.32fm$ (the radius $Ru = 0.32fm$ does not have influence over the magnetic moment, since the two up quarks cancel each other their magnetic moments, but it influences over the radial charge distribution, as seen in Fig 21). In Fig 22 we have the values of the radial charge distribution for the neutron d(u-e-u) having the down quark with a radius orbit $Rd = 0.70fm$.

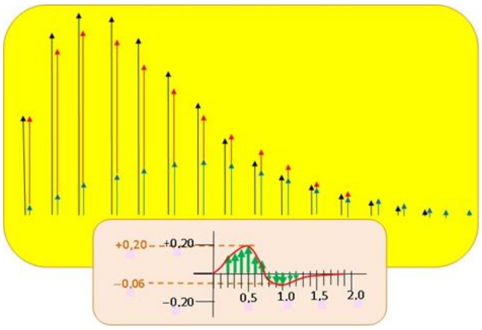

Fig 22. Radial charge distribution for the model d(u-e-u), obtained from Fig 21, with, $Rd = 0.70fm$, $Re = 0.29fm$, $Ru1 = Ru2 = 0.32fm$

In the Fig 22 we have the following.

Model d(u-e-u)
-Max pos: +0.20 at the point 0.5fm
-Max neg: -0.06 between 0.9fm and 1.0fm
-Changes from positive to negative at the point 0.75fm

JLab
-Max pos: (+0.145), (+0.208) at the point R=0.23
-Max neg: (-0.050),(-0.075) between 0.9fm and 1.0fm
-Changes from positive to negative at the point 0.60fm

As seen, whereas for JLab measurements the maximum positive charge occurs at $R = 0.23fm$, the maximum for the model $d(u-e-u)$ occurs at $R = 0.50fm$, whereas the charge distribution changes from positive to negative at the point 0.75fm in the model $d(u-e-u)$, and at the point 0.60fm according to JLab. Therefore, the model is no satisfactory.

RADIAL CHARGE DISTRIBUTION OF THE MODEL d(u-e-u) WITH Rd=0.60fm

We will consider $Rd = 0.60fm$ for the orbit radius of the down quark, $Ru = 0{,}4fm$ for the two up quarks, and $Re = 0.286fm$. For the radius $Re = 0.286fm$ we get the following magnetic moment due to the electron orbit,

$$\mu_e = -\frac{1.131\times 0.286}{0.26} = -1.244\mu \qquad (28)$$

From $\mu_d = -0.782\mu N$ in Eq (24), the magnetic moment due to d quark with $Rd = 0.6fm$ is

$$\mu_d = -\frac{0.782\mu N\times 0.6}{0.7} = -0.670 \qquad (29)$$

So we obtain the magnetic moment for the neutron $d(u-e-u)$

$$\mu_n = -(1.244 + 0.670) = -1.914\mu N \qquad (30)$$

Fig 23 shows the construction of graph with the following radii, $Re = 0.286fm$, $Ru = 0.30fm$, $Rd = 0.60fm$

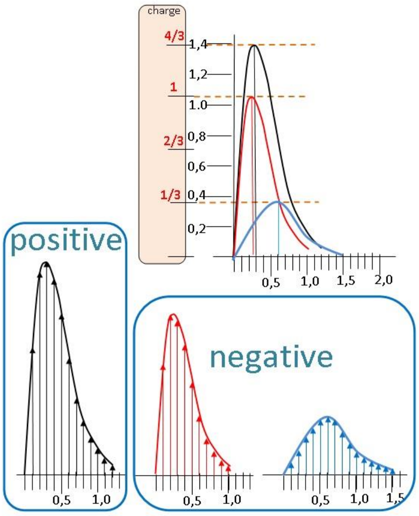

Fig 23. Distribution of quarks and electron in the model d(u-e-u), obtained from Figs 8 and 9, with adoption of the following values: $Rd = 0.60fm$, $Re = 0.286fm$, $Ru1 = Ru2 = 0.30fm$

In Fig 24 we have the values for the radial charge distribution of neutron d(u-e-u) having the down quark a radius orbit Rd= 0.60fm.

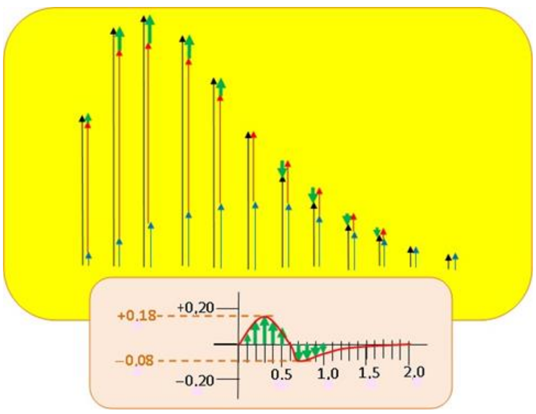

Fig 24. Radial charge distribution for the model d(u-e-u), obtained from Fig 23, with: $Rd = 0.60fm$, $Re = 0.286fm$, $Ru1 = Ru2 = 0.30fm$

In the Fig 24 we have:

Model d(u-e-u):

- Max pos: +0.18 at the point 0.3fm
- Max neg: -0.08 at the point 0.70fm
- Changes from positive to negative at the point 0.60fm

JLab:

- Max pos: (+0.145),(+0.208) at the point R=0.23
- Max neg: (-0.050),(-0.075) between 0.90fm and 1.0fm
- Changes from positive to negative at the point 0.60fm

So, the model d(u-e-u) with Rd=0.60fm is also no satisfactory, because the maximum negative charge density does not occur between 0.90fm and 1.0fm. We realize that, although the model d(u-e-u) having Rd between 0.60fm and 0.70fm produces theoretical values of magnetic moments very close to neutron $\mu = -1.913\mu N$, nevertheless they cannot reproduce with satisfactory agreement with experimental data the radial charge distribution of the neutron, when we consider that $Ru_1 = Ru_2$. If we try a model d(u-e-u) with radius $Rd = 0.8fm$ and $Ru_1 = Ru_2$ the result is worst: both magnetic moment and charge distribution have large deviation from the experimental results. That's why we will try the model d(u-e-u) with different orbit radii for the up quarks.

RADIAL CHARGE DISTRIBUTION OF THE MODEL d(u-e-u), WITH THE TWO UP QUARKS HAVING DIFFERENT RADII, HAVING R_d= 0.70 fm

We will first consider a d(u-e-u) model with $Rd = 0.70fm$, and by considering that the proton has $Ru = 0.45f$m and Rd=0.70fm (two up quarks contribute with 72%, and d quark contributes with 28%, as seen in Eq. (22) and Eq(23) for $Rd = 0.70fm$). Suppose that in Fig 21 the up quark U2 inside the neutron has actually orbit radius 0.39fm and the up quark U1 has orbit radius 0.40fm. So, the contribution for the magnetic moment of the neutron due to a difference $\Delta Ru = 0.01fm$ will be:

$$\mu = +\left(\frac{2.793x0.72}{2}\right)x\left[\frac{0.40-0.39}{0.45}\right] = +0.02234\pi N \qquad (31)$$

Fig 25 shows the construction of the graph with one of the up quarks with an orbit radius $0.12fm$ larger than the electron orbit radius, and the two up quarks having a difference of radius $\Delta Ru = 0.15fm$, and Fig 26 shows the charge distribution.

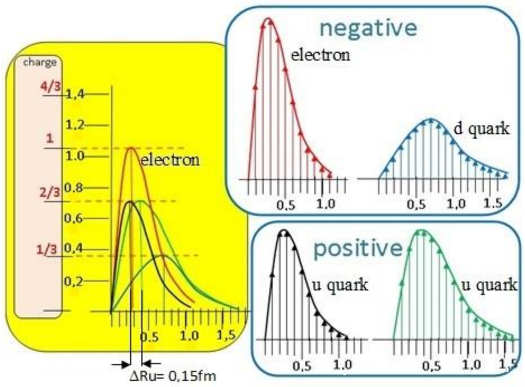

Fig 25. Construction of graph for the model d(u-e-u) having the up quarks with a difference $\Delta Ru = 0.15fm$ in their orbit radius, and $Rd = 0.70fm$

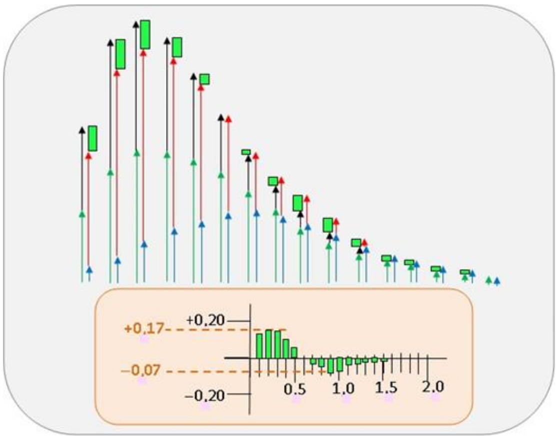

Fig 26. Radial charge distribution for the model d(u-e-u), obtained from Fig 25, having Rd=0.70fm, and the up quarks with a difference ΔRu= 0.15fm in their orbit radius.

In the Fig 26 we have,

Model d(u-e-u)

-Max pos: +0.17 between 0.20fm and $0.3fm$

-Max neg: -0.07 between 0.90fm and $1.0fm$

-Changes from positive to negative at the point $0.60fm$

JLab

-Max pos: (+0.145), (+0.208) at the point $R = 0.23$

-Max neg: (-0.050),(-0.075) between 0.90fm and $1.0fm$

-Changes from positive to negative at the point 0.60fm

The model is satisfactory from the viewpoint of radial charge distribution, and the curve is in agreement with the JLab. Let us calculate the magnetic moment. From Fig 25 we have: $Re = 0.27fm$, $Ru_1 = 0.26fm$, $Ru_2 = 0.41fm$, $Rd = 0.70fm$. We get

$$\mu_e = -\frac{1}{2}(1.6 \times 10^{-19})\left(\frac{2.746\times10^8\times0.27x10^{-15}}{5.7117x10^{-27}}\right) \quad (32)$$

$$\mu_e = -1.1745 \quad (33)$$

$$\mu_d = -2.793 \times 0.28 = -0.7820 \quad (34)$$

$$\Delta\mu_u = +\left(\frac{0.15}{0.01}\right) \times 0.02234 = +0.3351 \quad (35)$$

where +0.3351 is the contribution of ΔR_U, because the up quarks u_1 *and* u_2 tends to cancel each other their magnetic moment, and so only $\Delta R_U = 0.15$ produces magnetic moment.

$$\mu_n = -(1.1745 + 0.7820) + 0.3351 = -1.6214\mu N \quad (36)$$

and so this model d(u-e-u) is satisfactory from the viewpoint of the neutron radial charge distribution, but it is not satisfactory from the viewpoint of the neutron magnetic moment.

RADIAL CHARGE DISTRIBUTION OF THE MODEL d(u-e-u), WITH THE TWO UP QUARKS HAVING DIFFERENT RADII, WITH Rd= 0.80fm & Re=0.31fm

The positions of the electron and the quarks is shown in Fig 27 and the radial charge distribution is shown in Fig 28.

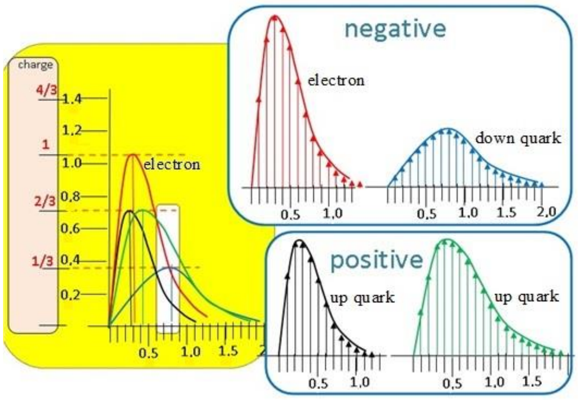

Fig 27. Construction of graph for the model d(u-e-u), obtained from Figs 8 and 9, having the up quarks a difference $\Delta Ru = 0.42 - 0.28 = 0.14fm$ in their orbit radius, with $Rd = 0.80fm$ and $Re = 0.31fm$

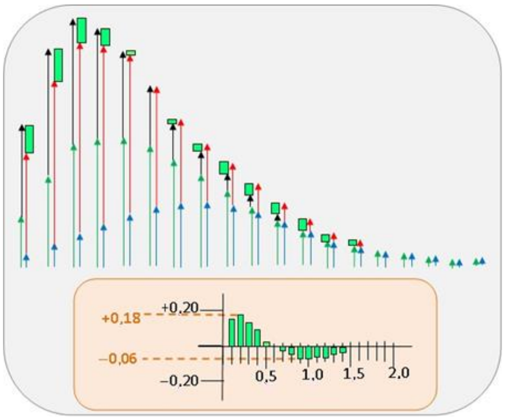

Fig 28. Radial charge distribution for the model d(u-e-u), obtained from Fig 27, having $Rd = 0.80fm$, and up quarks with a difference $\Delta Ru = 0.14fm$ in their orbit radii, and $Re = 0.31fm$

In the Fig 28 we have

Model d(u-e-u):

-Max pos: +0.18 at the point 0.20fm

-Max neg: -0.06 between 0.90fm and 1.0fm

-Changes from positive to negative at the point 0.60fm

JLab:

-Max pos: (+0.145),(+0.208) at the point R=0.23

-Max neg: (-0.050), (-0.075) between 0.90fm and 1.0fm

-Changes from positive to negative at the point 0.60fm

This model d(u-e-u) is satisfactory from the viewpoint of the neutron radial charge distribution. By looking at the yellow graphic of the Fig 27, the value of Re can even be between 0.31 and 0.33fm.

MAGNETIC MOMENT CALCULATION WITH PERCENTAGES

Let us calculate the contribution of the d quark for the neutron magnetic moment, by starting from a proton where Ru=0.45fm and $Rd = 0.80fm$, as follows

$$X = \left(\frac{2}{3} + \frac{2}{3}\right)0.45 + \left(\frac{1}{3}\right)0.80 = 0.8667 \quad (37)$$

Percentage of the two up quarks contribution inside the proton

$$Y = \left(\frac{2}{3} + \frac{2}{3}\right)\left(\frac{0.45}{0.8667}\right) = 0.6923 = 69.23\% \quad (38)$$

Percentage of d quark contribution inside the proton

$$Z = \left(\frac{1}{3}\right)\left(\frac{0.80}{0.8667}\right) = 0.3077 = 30.77\% \qquad (39)$$

For each $\Delta Ru = 0.01fm$ we have

$$\Delta\mu = +\left(\frac{2.793x0.6923}{2}\right)\left(\frac{0.01}{0.45}\right) = +0.02148\mu N \qquad (40)$$

From Fig 27 we have for the neutron, $Re = 0.31fm$, $Ru1 = 0.28fm$, $Ru2 = 0.42fm$, $Rd = 0.80fm$.
Then we have

$$\mu_e = -\frac{1}{2}(1.6\times10^{-19})(2.746\times10^{8})\left(\frac{0.31x10^{-15}}{5.7117x10^{-27}}\right) \qquad (41)$$

$$\mu_e = -1.3485 \qquad (42)$$

$$\mu_d = -2.793\times0.3077 = -0.8593 \qquad (43)$$

$$\Delta\mu_u = +(0.02148)\left(\frac{0.42-0.28}{0.01}\right) = +0.3008 \qquad (44)$$

$$\mu_n = -(1.3485+0.8593)+0.3008 = -1.9071\mu N \qquad (45)$$

which is a satisfactory result.

MAGNETIC MOMENT CALCULATION WITH EQUATION μ=-(e/2m)L

Let us remember the values of the orbit radii for the model d(u-e-u) in Fig 27, $Re = 0.31fm$, $Rd = 0.8fm$, $Ru1 = 0.28fm$, $Ru2 = 0.42fm$. First of all, we have to discover the speed of the quarks inside the proton. We will suppose that u and d quarks move with the same speed in their orbit inside the proton. As known, in the proton we have considered $Ru = 0.45fm$ and $Rd = 0.8fm$.

$$\mu_P = +V\left(\left(\frac{4}{3}\right)0.45+\left(\frac{1}{3}\right)0.8\right)\times10^{-15}\left(\frac{1.6\times10^{-19}}{2\times5.05\times10^{-27}}\right)$$

$$= +2.793\mu N \qquad (46)$$

$$V = 20.35\times10^{7}\ m/s = 2.035\times10^{8}\ m/s \qquad (47)$$

We have, $V_e = 2.746\times10^{8}\ m/s$ and $V_u = V_d = 2.035\times10^{8} m/s$. In Fig 20 was explained,

1. In the proton structure, all the three quarks induce positive magnetic moments (down quark induces positive mag. mom. because it has down spin).

2. In the structure of the neutron, the two up quarks form a sandwich with the electron: (u-e-u). One of the up quarks changes its spin. Obviously the up quark whose spin is changed must be that of the shorter orbit radius, because it is easier for the d quark to change it, with the help of the electron.

3. So, according to the Fig 20, the electron, the down quark, and the quark u_2 (with orbit radius $R_{U1} = 0.42fm$) have spin up, while the quark u_1 (with orbit radius $R_{U1} = 0.28fm$) has down spin.

4. Therefore the electron, the down quark, and the quark u_1 induce negative magnetic moment, while the quark u_2 induces positive magnetic moment. The magnetic moment of the neutron is therefore

$$\mu_n = -\left(\frac{e}{2}\right)V_eR_e - \left(\frac{e}{3\times2}\right)V_dR_d - \left(\frac{2e}{3\times2}\right)V_UR_{U1} + \left(\frac{2e}{3\times2}\right)V_UR_{U2}$$

$$= -1.9073\mu N \qquad (47)$$

which is practically the same value obtained in Eq(45). The conclusion here is that, this model d(u-e-u), with $Re = 0.31fm$, is satisfactory under the viewpoints of the magnetic moment and also the radial charge distribution of the neutron measured by experiments.

TRANSVERSE NEUTRON CHARGE DISTRIBUTION: STRANGE, ABSURD, AND UNNACEPTABLE

Because of the model ddu is unable to reproduce the radial charge distribution of the neutron measured by experiments, some theorists have concluded that traditional methods cannot be applicable for the neutron. In a paper published in 2010 Miller writes in the Abstract that , Electromagnetic form factors have long been used to probe the underlying charge and magnetization densities of hadrons and nuclei. Traditional three-dimensional Fourier transform methods are not rigorously applicable for systems with constituents that move relativistically.
The use of the transverse charge density is a new, rigorously defined way to analyze electromagnetic form factors of hadrons. This review is concerned with the following issues: what a transverse charge density is, how one is extracted from elastic scattering data, the existing results, its relationship with other observable quantities, and future prospects(Miller, 2010).
In a paper published three years before he wrote:The surprising result is that the central neutron charge density is negative(Miller, 2007). It seems there is now a dispute between some theorists and experimentalists who have applied the traditional method for the neutron, because Miller published a homepage in order to explain what form factors really measure. Fig 29 reproduces the page where he writes: Sorry, not correct! No density interpretation of 3D FT of form factors(Miller, 2009).

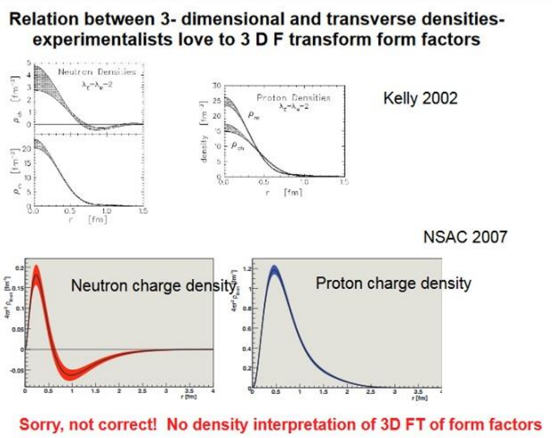

Fig 29. Sorry, not correct! No density interpretation of 3D FT of form factors (Miller, 2009)

The summary of Miller based on I-The central transverse charge density of neutron is negative. II-There are d quarks in the center of the neutron (Miller, 2009) is
1-Transverse densities give model-independent charge density in infinite momentum frame.

2- 3D FT only gives the charge density in nonrelativistic, weak binding limit -e.g nuclei.
3-The central transverse charge density of neutron is negative.
4-There are d quarks at the center of the neutron. 5- Transverse density can be obtained by integration over z. First of all, the question is not so simple, because, in spite of the theoretical calculation do not compute a value very close to $\mu = -1.913\mu N$ for the magnetic moment of the model ddu, however the value obtained is at least a little close to $\mu = -1.86\mu N$, and it seems to be impossible to get at least $\mu = -1.86\mu N$ for a model ddu where there are down quarks in the center of the neutron. Let us estimate with simple calculation the magnetic moment for two ddu models, as

- A neutron model where two d quarks have orbit radius *Rd=1.0fm* and u quark with $Ru = 0.2fm$.
- A neutron model where one d quark has orbit radius Rd_1*=1.0fm*, the other d quark has orbit radius close to zero, Rd_2*= 0*, and u quark with *Ru=0.2fm*.

As we know that $\mu_{PROTON} = +2.793\mu N$, and thanks to JLab we know the distribution of the quarks in the proton is *Ru=0.4fm* and *Rd=0.8fm*, then we will use the proton for the calculation of the percentages Pu and Pd due to quarks contribution. After getting *Pu* and *Pd*, we will apply them to the two neutrons models: (ddu) of the SM and (ddu) according to Miller, as

$$K = \left(\frac{2}{3} + \frac{2}{3}\right) 0.4 + \left(\frac{1}{3}\right) 0.8 = 0.8 \quad (48)$$

For two u quarks,

$$Pu = \left(\frac{2}{3} + \frac{2}{3}\right)\left(\frac{0.4}{K}\right) = 0.6667 = 66.67\% \quad (49)$$

For one d quark,

$$Pd = \left(\frac{1}{3}\right)\left(\frac{0.8}{K}\right) = 0.3333 = 33.33\% \quad (50)$$

First model: calculation of the magnetic moment of neutron ddu (with R_{d1}=R_{d2}=0.7fm and R_u=0.2fm), according to the SM

μ_U of one u quark (with negative μ_U contribution, because, as neutron has spin ½, the u quark must have spin contrary to the two d quarks)

$$\mu_U = -2.793 \times \left(\frac{Pu}{2}\right)\left(\frac{R_U^{neutron}}{R_U^{proton}}\right)$$

$$= -2.793\left(\frac{0.6667}{2}\right)\left(\frac{0.2}{0.4}\right) = -0.4665 \quad (51)$$

μ_d of two d quarks

$$2\mu_d = -2 \times 2.793 \times (Pd)\left(\frac{R_d^{neutron}}{R_d^{proton}}\right)$$

$$= -2 \times 2.793 \times 0.3333\left(\frac{0.7}{0.8}\right) = -1.628\mu N \quad (52)$$

Magnetic moment of the neutron of SM,

$$\mu_n = -1.628 - 0.4665 = -2.094\mu N \quad (53)$$

whereas the value calculated from the SM is $\mu_n = -1.86\mu N$.

In spite of the theorists may claim that $\mu_n = -1.86\mu N$ is satisfactory, this is no true, because looking at the neutron structure of the model ddu shown in the Fig 13, we realize that Ru and Rd have actually have values *Ru*= Rd_1*= 0.45fm* and Rd_2 *= 0.8fm*. Calculation with those values gives $\mu_n = -2.499\mu N$, very larger than $-1.913\mu N$. If used the distribution of quarks in the model ddu of the Fig 10, the calculation gives $\mu_n = -3.023\mu N$ However, the worst and unacceptable failure of the quark ddu model is its inability to reproduce the radial distribution of the neutron measured in JLab experiments.

Second model: calculation of the magnetic moment of Miller's neutron ddu (with R_{d1}= 1.0 fm , R_{d2} = 0 and Ru = 0.2fm)

- μ_U of one u quark,

$$\mu_U = +2.793 \times \left(\frac{0.6667}{2}\right)\left(\frac{0.2}{0.4}\right) = +0.4665\ \mu N \quad (54)$$

- μ_d of one d quark (only one, because the other has $R_{d2} = 0$),

$$\mu_d = -2.793 \times 0.3333x\left(\frac{1.0}{0.8}\right) = -1.1637\mu N \quad (55)$$

- Magnetic moment of Miller's neutron model,

$$\mu_n = -1.1637 + 0.4665 = -0.6972\mu N \quad (56)$$

a value totally unacceptable. Such new open divergence between theorists, (due to the impossibility of reproducing with the model ddu the experimental data for the radial charge distribution of the neutron), is proving that theorists are very far away from the correct way for reproducing the experimental neutron charge distribution, because it is impossible to do it with the model ddu, and the simple reason is because the neutron existing in nature has not a structure ddu.

THEORETICAL MAGNETIC MOMENT FOR THE DEUTERON (udu)d(u-e-u)

The magnetic moment for the deuteron can be calculated in the pure state 3S1, by considering that, when the electron passes between the proton 1 and 2 of the Fig 31, the radius orbit increases because, in that position the electron is also under the attraction with the proton 2. The area ΔA produces a negative magnetic moment $\Delta\mu = -0.023\mu N$, and so the total moment for the deuteron in the 3S1 state is $\mu_D = +0.880 - 0.023 = +0.857\mu N$.

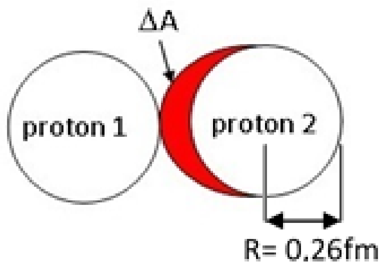

Fig 30. Growth of the radius of the electron orbit in the deuteron when it passes between the two protons, inducing a little reduction in the magnetic moment, responsible for the difference $\Delta = -0.023\mu N$

We will not exhibit calculations here, because there is need to adopt some arbitrary assumptions, since it is very hard to calculate the area ΔA . But it is clear that, by considering the model of neutron d(u-e-u) it is possible to calculate the magnetic moment, the deuteron being 100% of the time in the 3S1 state. Actually the most interesting is to consider the question in the contrary way; to calculate the deviation of the electron in its circular orbit by starting from the magnetic moment of the deuteron measured in experiments.

HEISENBERG'S UNCERTAINTY

The last restriction against the Rutherford model comes from the Heisenberg's uncertainty principle: the p.e model requires a force with magnitude 10^3 stronger than the strong nuclear force, in order to keep the electron into the nuclei. In 2001 the author had submitted to the Chinese Journal of Physics the paper "Anomalous Mass of the Neutron", where was proposed a new sort of Planck's gravitational constant, in order to solve the puzzle of the electron's permanence within the nuclei. In 2002 a reviewer declined the paper with the following report ahead. It is hard for me to believe those difficulties raised in this manuscript will have escaped the scrutiny of all those prominent particle theorists. For instance, the author proposes a new Planck constant for the uncertainty principle in the femtometers scale.

Had this been true, the string theorists should have encountered the difficulty long time ago and even have proposed their own third different Planck constant. His report lost credibility ten years later, because some new experiments invalidated his argument, as also other fundamental arguments against the neutron model formed by proton + electron. First of all, the European Space Agency's Integral gamma-ray observatory has provided results that will dramatically affect the search for physics beyond Einstein (Laurent, Götz, Binétruy, Covino, & Fernandez-Soto, 2011). It has shown that any underlying quantum 'graininess' of space must be at much smaller scales than previously predicted. Einstein's General Theory of Relativity describes the properties of gravity and assumes that space is a smooth, continuous fabric. Yet quantum theory suggests that space should be grainy at the smallest scales, like sand on a beach. Some theories suggest that the quantum nature of space should manifest itself at the 'Planck scale': the minuscule 10^{-35} of a meter.

However, Integral's observations are about 10^4 times more accurate than any previous and show that any quantum graininess must be at a level of 10^{-48} m or smaller. So, the restriction of the reviewer of the Chinese Journal of Physics was invalidated. But other experiment published in 2012 has shown a violation even of the own Heisenberg's uncertainty. In the abstract is said: Our experiment implements a 2010 proposal of Lund and Wiseman to confirm a revised measurement-disturbance relationship derived by Ozawa in 2003. Its results have broad implications for the foundations of quantum mechanics and for practical issues in quantum measurement (Rozema et al., 2012). Obviously one of the implications must be to consider seriously a reevaluation on the possibility of the Rutherford's model of the neutron to be correct, when we introduce the suitable improvements for his model. The paper "Anomalous Mass of the Neutron" was finally published the years later its submission in 2001 to the CJP, by the online JNP(Wladimir Guglinski, 2004).

WHY IS AN ISOLATED NEUTRON UNSTABLE?

Such question was risen by a reader in the blog "Quora", with the following question.

Both protons and neutrons are hadrons consisting of quarks, which are held by gluons. Then how is an isolated proton stable while an isolated neutron isn't?

Then a physicist posted the following explanation ahead. A free neutron, composed of two down quarks and one up quark, can decay into a proton (two ups and a down), an antineutrino, and an electron through the W- boson, since a down quark is more massive than the resulting up quark. However, when a neutron is bound in a stable nucleus, the proton that's left behind by this decay finds itself in an extremely positively charged environment, and is not happy to be there. Such explanation is no true. Because the 4Be7 has a half-life of 53 days in spite of it has four protons and only three neutrons, and so the unpaired fourth proton (even being unhappy) is able to survive there along 53 days.

Therefore, inside the nuclei the neutrons could decay and become unhappy protons for at least 53 days. Besides, along 53 days the unhappy proton could leave the nucleus, because when somebody is unhappy in some bad environment, he simply leaves that bad place. But in the case of 4Be7, after 53 days the unpaired unhappy proton captures an electron, for becoming a neutron. In this process, u quark is converted to a d quark by absorbing the electron (according to the SM) and by creating a neutrino. The neutron has zero charge, and the proton has charge +1e. By considering the model ddu, such a process violates the least action principle. Such process is very disadvantageous for the skinny proton with high positive charge +1, and it would prefer to leave the 4Be7, happy for leaving it and to promote the birth of a happy and stable newborn 3Li6 (also skinny), instead of to become a fat happy neutron with zero charge within an also fat 3Li7, where a u quark with charge +2/3 became a d quark with charge -1/3.

Let' see how explain it by considering a neutron model du-e-u. When after 53 days inside the 4Be7, the unpaired proton captures an electron in the 54th day and is converted to a neutron, and such process occurs because the 4Be7 supplies the energy for the conversion, and in spite of the neutron has no charge, a free neutron is actually a proton energetically higher than a free proton, because there is an electron moving with speed $2.7 \times 10^8\ m/s$ inside the free neutron with structure d(u-e-u), where, as we have seen in Fig 16, have occurred drastic changes in the structure of the free proton from which the neutron was created (change of the spin of the d quark and the U2 quark).

In the case of the model ddu, such neutron cannot be energetically higher than the proton. There is not any physical law that justifies the decay of a structure formed by ddu (a free neutron), unless one alleges that one of the two d quarks feels itself "unhappy" as being a d quark with a low negative charge -1/3, and it decides to convert itself to a high positive charge +2/3.

The exact value of the 4Be7 half-life is 53.22 days. So a very intriguing question is: Why the exact time of 53.22 days? Radionuclide Be7 is produced in a nuclear reactor by secondary nuclear reactions exited with recoil protons + deuterons on Li and B. What difference occurs within the 4Be7 between the first day of its formation and the last 54th day? Such question was never responded, because if we consider the SM the answer must be the following: nothing different

occurs, since the proton is a stable nucleon, and therefore nothing different may occur with the unpaired proton of the 4Be7 between the first and the 54th day of the 4Be7 existence. But if we consider that proton radius shrinkages inside the atomic nuclei, perhaps we can find the answer. Indeed, when the 4Be7 is produced, the unpaired proton gets a shorter radius, because of its binding energy with the rest of the nucleus 4Be7. And we can suppose that, in such a condition, it cannot capture an electron in order to form the neutron. In such hypothesis, in order to be able to capture an electron, the proton must have the radius *0.87fm*, otherwise it cannot do it. So, during 53days and 5.28 hours the 4Be7 emits radiation. In the last seconds of the 5.28 hours of the 54th day the unpaired proton begins to leave the 4Be7, because the binding energy was lost in radiation (the mass of the proton grew). And when the proton finally starts to leave the 4Be7 its shortened radius begins to dilate, and so finally the unpaired proton is ready to capture an electron, so that they form the neutron. The neutron is captured again, and becomes stable within the newborn 3Li7.
Perhaps this is not the best explanation. However, if any other best explanation does not exist, it is of the interest of the Science to investigate and discover the best solution for the puzzle.

CONCLUSIONS

Beyond the violation of the Special Relativity by the neutrinos, are there more reasons for the reevaluation of the Fermi's theory of beta-decay? The answer is yes, because the foundations of the Standard Nuclear Physics (SNP) are based on some fundamental principles of Quantum Mechanics, and some of them were disproved by new experiments published between 2008 and 2015. Also, some dogmas of the SNP, considered untouchables along 80 years, were debunked by new experiments published in the last 10 years. Let us mention some of them.
1- In order to explain the nuclear properties, several nuclear models have been proposed along the development of SNP, and there are philosophical incompatibilities between the models. For instance, the shell model considers that all protons and neutrons are distributed in a shell, while other models consider that protons and neutrons are distributed in several layers around the center of the nuclei. In order to justify why the incompatible models can be applied in SNP without invalidate the philosophical aspect of the theory, the nuclear theorists use an argument based on the Bohr's Principle of Complementarity, because, according to their argument, thanks to Bohr's principle (Rabinowitz, 2013) incompatible models can be used in a theory. However, the year of 2012 was dramatic for the nuclear physics, and other new experiment invalidated the Bohr's principle Therefore, the SNP lost its philosophical coherence.

2-Violation of the Heisenberg's Uncertainty Principle (Rozema et al., 2012).

3-End of the magic Shell model for beryllium isotopes invalidated (Krieger et al., 2012).

4- The hypothesis that strong nuclear force is responsible for the bind of atomic nuclei was debunked by an experiment (Nörtershäuser et al., 2009).

The experiment detected that there is a distance of 7 fm between the halo neutron and the core of the Be11. As the strong force actuates in a maximum distance of 3fm, it is obvious that the halo neutron of the Be11 cannot be bound via the strong force. And what is worst, it is impossible to find any theory, based on the foundations of the SNP, able to explain the puzzle, and the reason is

A. The Be11 half-life is 13.81s,
B. Then suppose that one argues that the halo-neutron is weakly bound (via strong force) to the core, and it leaves the nucleus after 13.81 seconds, as consequence of the weak link,
C. However this is no true, because in 97% of decays 4Be11 transmutes to 5B11, and therefore the neutron does not leave the nucleus,
D. In the 4Be11 the neutron decays into a proton and electron, and the proton turns back to the core. If the strong nuclear force was responsible for the cohesion of nuclei, the proton could never go back to the core, because in a distance of 7fm it cannot interact with the core via strong force, and the classical Coulomb repulsion between the core and the proton would be so strong that the proton would be expelled from the 4Be11,
E. Therefore the 5B11 could never be formed in 97% of the 4Be11 decay. Conclusion: the Be11 halo neutron demolishes the fundamental pilar of the SNP.

5- Along 80 years the nuclear theorists had an untouchable belief: even-even nuclei with Z=N have spherical shape. One of the reasons is because from the principles of the SNP it is impossible to have a non-spherical shape for those nuclei. But an experiment, published in the dramatic year of 2012, which debunked several fundamental principles of the current nuclear theory, disproved also that untouchable dogma in which nuclear theorists trusted blindly along 80 years: those nuclei have ellipsoidal shape (Ebran, Khan, Nikšić, & Vretenar, 2012).
First of all, it is impossible to explain (by considering the SNP) the reason why those nuclei have ellipsoidal shape. The authors of the paper published by Nature show "how" atomic nuclei cluster (according to what the experiments have detected). But they do not explain "why" the even-even nuclei with $Z = N$ do it in that way (producing a non-spherical shape). But the situation is worst. Because ellipsoidal nuclei have non-null electric quadrupole moment (Q), whereas experiments detect that even-even nuclei have $Q = 0$.
In order to justify why they have $Q = 0$, there is need to consider that those nuclei have rotation in the ground state. However, by considering that they rotate it is impossible to explain (from the foundations of the SNP) why they have null magnetic moment (detected by experiments), because due to the protons rotation a non-null magnetic moment must be induced. Such puzzle can be solved only by considering a new nuclear model in which, due to some special conditions within the nuclei, the interaction of the protons with the aether (due to the rotation of the protons) does not induce magnetic moment.

6- Pear-Shaped Nucleus Boosts Search for Alternatives to Standard Model Physics. The strange shape of radium 224 could lead to new physics (Battersby, 2013). The experiment (Gaffney et al., 2013), which detected that Ra224 is pear shaped, not only defies the SNP, but also brings other puzzle, in order to explanation the pear shape, the nuclear theorists are supposing that 224Ra rotates at the ground state (see Fig 31).

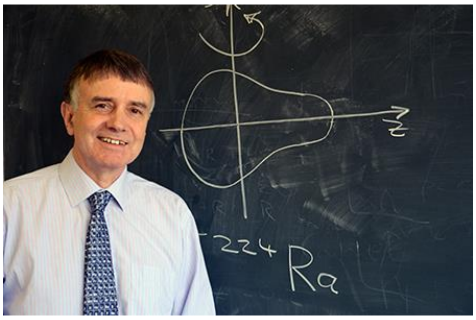

Fig 31. Professor Peter Butler suggests that 224Ra gyrates about an internal axis, along which protons and neutrons are in slightly different places (UMichigan: Evidence of pear-shaped atomicnuclei).

But if atomic nuclei, with Z and N pairs, were rotating at the ground state, they could not have null magnetic moment, because the rotation of the protons charges would have to induce magnetic moments. Nevertheless, the experiments detect that nuclei with Z and N pairs have null magnetic moments. Therefore, if the pear shape requires the rotation of 224Ra, as the nuclear theorists are suggesting, then they are also suggesting that 224Ra debunks the principles of the SNP, because (by considering the foundations of SNP) a nucleus with Z and N pairs cannot rotate at the ground state, because it could not have null magnetic moment. As we may realize from (Battersby, 2013), many nuclear theorists agree that there is need a search for alternatives to the SM. But the fundamental question is: where to begin from? Well, it seems the crisis generated by the neutrino in the Special Relativity gives us the answer: there is need to begin from the beginning. And the beginning is the neutron, because the neutron is the sole simplest particle within the atomic nuclei subject to have decay. As it decays, it must be composed. And as shown in this paper, a neutron composed by quarks with structure ddu cannot reproduce satisfactorily all the properties of the neutron, detected by experiments. In particular, the present paper has shown that the neutron radial charge distribution obtained by JLab experiments cannot be reproduced by the quark model ddu. Of course is very hard to start everything again, from the beginning. But the worst is to continue persisting in the error.

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