International Journal of Engineering Research and Development
e-ISSN: 2278-067X, **p**-ISSN : 2278-800X, www.ijerd.com
Volume 7, Issue 9 (July 2013), PP.29-53

The Mechanics of Neutron and Proton Creation in the 3-Spaces Model

André Michaud
SRP Inc Service de Recherche Pédagogique Québec Canada

Abstract:- Description of the mechanics of creation of protons and neutrons in the 3-spaces model from the mutual capture within a very small volume of space of 2 electrons plus one positron, or alternately, of 2 positrons plus one electron, possessing insufficient energy to escape each other's mutual Coulombian interaction and the mechanics of the β- decay process involving the conversion of a neutron to a proton and an electron leading to the eventual emission of neutrinos.

Keywords:- Electron, positron, neutron, proton, neutrino, 3-spaces

I. THE INTERNAL STRUCTURE OF NUCLEONS

As soon as protons and then neutrons were identified in the 1920's and 30's, there was a suspicion that they may not be elementary, contrary to electrons. The first non-destructive high energy scattering experiments carried out in the 1940's and 50's also seemed to confirm that they occupied very small but definitely non-punctual volumes in space, contrary to electrons that systematically behave as if they were point-like even when subjected to the highest possible energy non-destructive collision experiments.

The first high energy accelerators in use at the time were not powerful enough to cause the scattering bullets (high energy electrons) to actually enter the target proton and neutron structures. The community had to way until 1966 for the Stanford Linear Accelerator (SLAC) to come online for the required energy levels to become available.

Experiments carried out from 1966 to 1968 at the SLAC facility with high energy non-destructive scattering of electrons against the inner components of nucleons allowed identifying three elementary massive particles inside the target protons, two up quarks having a charge equal to 2/3 of that of a positron, and one down quarks having a charge equal to 1/3 of that of an electron. Neutrons on the other hand revealed a structure made up of 1 up quark and two down quarks identical to those found in protons.

These same experiments also revealed that these particles, that behave point-like in all circumstances just like electrons, were moving locally at highly relativistic velocities and that it is their closed orbit translating motion that determines the actual volume occupied by nucleons in space.

Highly inelastic collisions were also recorded ([1]) of some electrons directly back-scattered against these quarks, as revealed by an important loss of energy of these electrons. This revealed that up and down quarks are only marginally more massive than electrons, which implicitly means also that the greater part of protons and neutrons rest masses can only be relativistic in nature, a relativistic mass that can only be due to the highly relativistic velocities of the moving locally captive up and down quarks.

No other scatterable components were ever found inside nucleons. Up and down quarks have been confirmed as being the only scatterable point-like behaving components of all atomic nuclei in existence.

II. THE FRACTIONAL CHARGES OF UP AND DOWN QUARKS

The simple fact that the charges of up and down quarks can individually measured through study of the scattering patterns of the rebounding bullet electrons and/or positrons confirms out of any doubt that they always remain at some distance from each other within each nucleon, a distance that can obviously be related to the radius of the nucleons volume.

Since charges cannot be dissociated from electrostatic attraction and repulsion, particularly intense at such close range since the radius of nucleons is known to be in the 1.2E-15 m range, it is a given that the charges of up and down quarks do play a role in defining the actual equilibrium distances that they maintain as they translate and rotate inside the nucleon structure without ever coming close enough to cause the nucleon to behave point-like, the other factor at play being the magnetic aspects of the up and down quarks, since like electrons, they have to be electromagnetic in nature since they are charged, a charge which by definition is inseparable from a magnetic counterpart.

The symbol universally associated with the electron is $\mathbf{e}^-$, and that of the positron $\mathbf{e}^+$**.** Also, protons and neutrons are often represented by symbols $\mathbf{p}^+$ and $\mathbf{n}^0$.

To make easier the analysis that we are about to carry out, we will momentarily redefine the symbol of the electron as $\mathbf{e}^{---}$, and that of the positron as $\mathbf{e}^{+++}$. The symbol for the up quark can now be defined as $\mathbf{U}^{++}$ (that is, 2/3 the charge of a positron), and that of the down quark as $\mathbf{D}^-$ (that is, 1/3 the charge of an electron). This will allow us to more easily visualize the relationship between up and down quarks' charges as we examine the internal structure of protons and neutrons.

The symbol for the proton can then be defined as:

$$p^{+++} = U^{++} + U^{++} + D^{-} \tag{1}$$

And that of the neutron:

$$n^{0} = U^{++} + D^{-} + D^{-} \tag{2}$$

Considering that in Nature, no effect occurs without a cause, it seems logical to try and trace the still nebulous origin of these up and down quarks, whose captive motion determines the physical volume of protons and neutrons. Since up and down quarks, which are scatterable, elementary, massive and charged just like electrons and positrons, have been proven not to exist as isolated free moving particles, we know *de facto* that they do not come into being by a process similar to that which causes the creation of electron/positron pairs.

On the other hand, given that electrons and positrons prove to be the only stable elementary scatterable charged and massive particles that can be produced from the direct conversion of the energy of single photons interacting with heavy nuclei, this gave rise to the idea that Nature may well not have had at its disposal no other material already massive, stable, elementary, scatterable and charged than these electrons and positrons to construct protons and neutrons, despite their experimentally measured differences in masses and intensity of electrical charges.

III. QUARKS MASSES VS NUCLEON MASSES

Also, the best estimates of up and down quarks' masses from the results of all deep inelastic non-destructive back-scattering experiments show that they are only marginally more massive than electrons. As already mentioned, experiments have also shown that they are captive of a system of interactions that keeps them translating at highly relativistic velocities at distances of each other that physically define the actual measurable volume of the nucleons.

Considering this, an increase in relativistic mass due to such highly relativistic velocities of up and down quarks becomes the only mechanically sound explanation for the difference in mass observed between the sum of the experimentally verified masses of the 3 quarks and the actual measured effective masses of nucleons.

IV. NUCLEONS CONSTRUCTION FROM ELECTRONS AND POSITRONS

So let us examine how such nucleon construction could come about with electrons and positrons, in a manner that would provide a logical and rational explanation to the drifting of their charges and masses during such a process.

We know from positronium experiments that when a pair of electron/positron is forced into a volume smaller in diameter than $2.116708996E10^{-10}$ meter ([2], p.323), with insufficient energy to escape mutual capture, a metastable system is established whose decay eventually results in the dematerialization of the pair into 2 or 3 photons, depending on the relative spin orientation of the incident particles. Such dematerialization is totally coherent with Dirac's theory of complementary particle/antiparticle pairs, and has been extensively confirmed by experiment.

We are faced however, with a very special problem when any one of the two possible combinations of three particles involving both electrons and positrons mutually capture in this volume of space, and we are not talking here of the documented case of the positronium negative ion, which for a fleeting instant is also made up of two electrons and a positron, and which is still too energetic a case of the configuration that we are going to explore here.

I found only one reference in literature indicating that such combinations have been considered in the past, possibly leading to understanding the mechanics of creation of protons and neutrons. M. Haïssinsky, then Director of Research at the C.N.R.S. in Paris, reveals in his book "**La chimie nucléaire et ses applications**", that it had been theoretically demonstrated that combinations of 2 positrons + 1 electron, or alternately 2 electrons + 1 positron show some stability, but that it is much less than that of positronium, and that no experimental verification had been carried out at the date of publication (1957). ([3], p. 33).

However, after the 7.4 GeV Stanford Linear Accelerator came online in 1966, systematic experiments involving the head-on scattering of high energy beams of electrons and positrons confirmed the systematic, although then unexplained production of quantities of baryons and mesons ([4]), which validates to a comfortable degree the hypothesis described by Haïssinsky.

Considering the presence of 2 electrons plus 1 positron thermal enough and close enough to each other to meta-stabilize before inevitably decaying, we observe that we are dealing here with two electrons that homostatically repel each other, while both are at the same time simultaneously and equally being attracted by the same single positron.

It would seem all too logical then that such a system would eventually decay still more rapidly than in the case of positronium, as mentioned by Haïssinsky.

V. THE 3 SPACES DIMENSIONS AND 9 INNER SPATIAL DIMENSIONS

Before proceeding further, it is useful to reproduce here for convenience the complete set of dimensions required in the expanded Maxwellian 3-spaces geometry previously described in ([14], Section VII).

For coherence, we will identify normal, electrostatic and magnetostatic spaces as being X-space, Y-space and Z-space respectively. Within normal space, let us rename the three minor spatial dimensions: X-x, X-y and X-z and likewise, for electrostatic and magnetostatic spaces: Y-x, Y-y, Y-z and Z-x, Z-y, Z-z.

Let us assume furthermore that the minor x-axes of all 3 spaces are mutually parallel in a direction corresponding to the conventional direction of motion of energy in normal space in plane wave treatment. Of course, when x, y and z dimensions are used without major axis prefix they will by default refer to the usual normal 3-D space x, y and z dimensions.

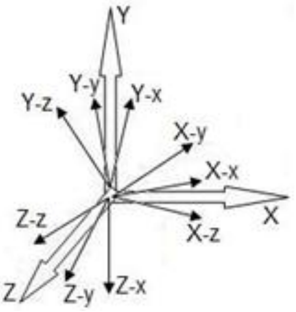

Fig.1: Orthogonal structure of the 3-spaces model.

Referring to the accompanying dimensions drawing (**Fig.1**), remember the 3-ribs umbrella metaphor representing the opening from 0^o to 90^o of the inner dimensions of each space to allow easier visualization.

In this space geometry, electrostatic properties such as Coulombian inverse square interaction with distance belongs to electrostatic space, while magnetostatic inverse cube interaction, as analyzed in ([9]), belongs to magnetostatic space.

Free fall acceleration induced kinetic energy will appear massive to an observer located in normal space when it is in motion in either one of the other two spaces, but would locally be perceived as non-massive. For example, as perceived from normal space, magnetostatic space and electrostatic space would be the realm of massive states, while normal space would be, as far as we observers located in this space are concerned, the realm of free fall acceleration induced unidirectional quantities of kinetic energy between bodies.

With the umbrella metaphor, it is easy now to visualize the three orthogonal spaces as three umbrellas meeting at their tips. We only need to mentally open any one of them to examine what is occurring in it at any given moment of the electromagnetic cycle.

VI. IRREVERSIBLE ADIABATIC ACCELERATION

A. Initiation of a neutron creation process

Before considering the implications of the Principle of conservation of energy, let us summarily analyze what should be expected to logically occur when 2 thermal electrons and 1 thermal positron are captured in such a common system with insufficient energy to escape from each other,

We are then dealing with 3 particles instead of 2 Dirac-complementary particles, none of which can be split or forced to convert to energy at such a low energy level, as well as with 2 equal strength occurrences of linear Coulomb electric attraction instead of one for the positronium system, and that also involves the presence of two tri-spatial junctions instead of one, that is one per linear attraction occurrence (See Fig.4).

B. Proof of existence of tri-spatial junctions between electron-positron pairs

The reason why a tri-spatial junction can be postulated to exist between each electron-positron pair originates from the manner in which such a pair is created in the 3-spaces model from a decoupling 1.022 MeV photon, which involves that both particles eventually separate in space due to their inability to join at this junction located at the centre of the photon ([8]). There is no reason to believe that such a junction would cease to exist even if both particles have become unable to join at this junction, located by definition half-way between any pair of electron-positron such as a positronium metastable system. It is to be noted that both electron and positron are equally attracted to such a junction by definition.

Of the various cases of positronium dematerialization, those resulting into two or three photons are well known and documented. But one case is of particular interest to us here, a case for which I found only two references dating back to before 1950 ([21], p.79) and ([3], p.34), of electron-positron annihilation resulting in the production of a single photon thus proving by the same token that such a junction point can be assumed between any pair of electron and positron in the 3-spaces model.

Such decay into a single photon is reported to have been confirmed by Irène Curie, Frédéric Joliot and J. Thibaud in 1933, a case which, to my knowledge, has not been referred to in scientific literature until experiment E632 at the FERMILAB 4,6 meters bubble chamber.

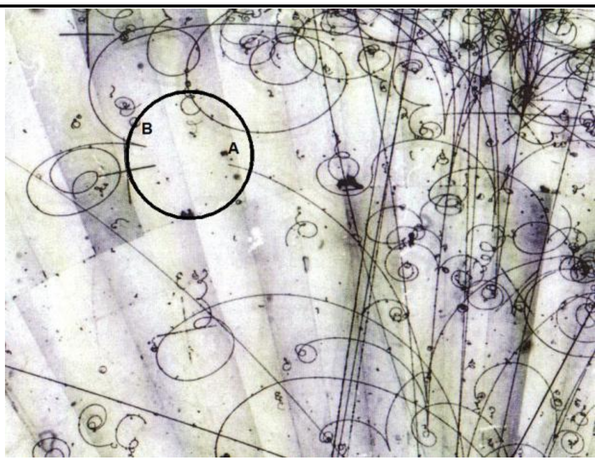

Fig.2: Bubble chamber photograph of FERMILAB experiment E632.

On a very clear bubble chamber photograph of experiment E632, a high energy positron is observed as dematerializing as it encounters a hydrogen atom electron (at point **A**), and a little further on, in direct line with the trajectory that the positron had been following before dematerializing, a new electron-positron pair appears (at point **B**), which means that the positron-electron annihilation (at point **A**) mandatorily resulted in the production of a single photon having the minimal energy required to produce a new pair, that is 1.022+ MeV, and what is more, a photon energetic enough to transfer to the created pair all of the kinetic energy of the initial positron.

As theorized by Curie, Joliot and Thibaud, when an electron and a positron are made to interact close to a heavy nucleus, a process opposite that of materialization is thus likely to occur, involving that both particles could succeed in finding their way back to a common tri-spatial junction, with the resulting single 1.022+ MeV photon recovering its regular locally stationary pulsating motion between Y-space and Z-space across a 3-spaces junction at the speed of light in normal space (X-space) as analyzed in a separate paper ([14]).

C. Irreversible adiabatic acceleration

As decay of the triad proceeds and the particles accelerate on their tightening orbits, the two electrons will electrically repel each other more and more intensely as the radius of the orbit diminishes in electrostatic space.

The repulsion between the electrons, combined with the translational velocity of the three particles in electrostatic space about the coplanar axis corresponding to a line passing through the two junction points located in the centre of each occurrence of attraction, will gradually force the three particles into an approximately equilateral triangular configuration (See **Fig.3** further on), which would now presumably be forced to also accelerate in electrostatic space about this axis, a change in configuration that can only force the tri-spatial junctions to gradually drift towards the two electrons.

It should be clear that when equilibrium light speed (**c**) is established, which is the case in normal space for free photons and in electrostatic space for electrons and positrons, any extra "acceleration" of these particles in their respective spaces can only result in a "balanced increase in energy" of the whole particle that constantly seeks to maintain that speed of light in the space concerned.

This equilibrium takes a particular form however in electrostatic space in the case of the rotating triad, a form that we will examine later but that will immediately name **coplanar equilibrium velocities**.

This acceleration in electrostatic space induces in each of the three particles a much greater quantity of kinetic energy than they can use in that space on their ever-contracting orbit, given that such induction is cumulative with diminishing distance (see **Section VII** further on).

This excess quantity of energy, having no possibility of escaping through the junctions about which the particles are orbiting, the particles will be forced to begin orbiting in a circle in normal space, besides continuing their coplanar translation in electrostatic space, while accelerating more and more in both spaces as their orbit contracts, driven by the two occurrences of attraction that are getting stronger as a function of the inverse square of the diminishing distance between the particles and the tri-spatial junctions.

A final stable state will be reached (See **Fig.3**); a point at which it becomes impossible for the now slightly more massive particles to approach any closer when the intensity of the mutual magnetic repulsion between the various components in motion exactly counterbalances their electrostatic attraction ([5]).

The triangular formation is now inertialy orbiting at coplanar equilibrium velocities about the coplanar Y-z axis in electrostatic space while the ring formation translates inertialy in normal space about the perpendicular X-x axis at near light speed, while they are prevent from getting any closer to each other by their mutual magnetic repulsion ([5], Section R), unable to escape, except to fleetingly occupy a limited range of metastable states when excited by inelastic collisions or gamma photons.

The analysis conducted in separate paper ([5]) provides certainty that magnetic interaction at such close range between the separate energy quanta making up the various particles involved travelling at high frequency in and out of magnetostatic space through the particles internal junctions will also contribute to the definition of this smallest possible volume of space that can be occupied by the triad.

The diameter of this new dynamic structure is well known. It is that of the neutron, which is approximately 100 000 times smaller than that of the initial metastable orbit of the triad in our example. A new minute and extremely energetic orbit on which the quantity of kinetic energy induced by electrostatic acceleration, both in electrostatic and in normal spaces, is very precisely counterbalanced by the combined action of inertia of the particles in motion and the magnetic repulsion between each quark and the energy that animates the other two quarks in magnetostatic space ([5]).

Although if observed from outside their local reference frame, the three particles can be visualized as individually accelerating on inward spiraling trajectories, as we have just done, it must be considered that in their own reference frame, the three equal energy particles were simply linearly approaching each other while the intensity of the interactions between them was increasing as a function of the inverse square of the distances between them.

D. Translation of the three quarks about two orthogonal axes

Geometrically speaking, it was the shrinking triangular formation as a whole that was accelerating during its rotation about the coplanar electrostatic axis, while at the same time the shrinking ring shaped formation of the same particles was accelerating in its rotation about the orthogonal normal space axis. In the final state of the triad, the three particles can be seen as geometrically immobile with respect to one another, in their own reference frame.

Before discussing what happens as the triad stabilizes into its final state, let us put in perspective some known facts regarding emission of energy as an electromagnetic particle stabilizes on a stable orbit after freefall electrostatic acceleration toward this orbit. In other words, let’s mathematically define how kinetic energy is physically induced in a system when particles accelerate in free fall and what happens when they stabilize in a stable equilibrium state.

VII. THE PRINCIPLE OF CONSERVATION OF ENERGY

It is well documented that the famous ***Principle of conservation of energy*** precludes the very possibility of energy addition from within an isolated system. Did we not here involve such an addition of energy precisely from within an isolated system?

E. Particles in least action energy equilibrium systems

Actually, the Principle of conservation of energy absolutely applies with any transformation involving matter and energy in any system having previously attained a state of least action energy equilibrium. This is precisely the case of all isolated systems that are within our reach at the macroscopic level, all of which having previously reached such a least action energy equilibrium.

For example, before an object found on the ground can be dropped to accelerate in free fall by the force of gravity, there is no other way but to introduce the energy required (coming from outside of the system made up of this body and the Earth) to elevate it to the distance above ground at which we will release it to then measure its acceleration and its energy gain towards the ground. All calculations will show that the kinetic energy gained during such acceleration is exactly equal to the energy that had to previously be invested to lift it to the distance above ground at which we let it go.

We are confronted with the same situation when experimenting at the atomic level. Atoms in our environment are not typically ionized in nature, and can even seldom be found in atomic state, being practically always associated in molecules of all sorts in various states of least action equilibrium.

To measure the acceleration of an electron toward a proton with our macroscopic tools, we must invest the energy required to chase this electron away from the proton to then measure the energy it will gain as it is again captured by the proton by electrostatic attraction.

All other cases of isolated systems readily available to us are of the same nature, including all reversible adiabatic processes, whence the long standing axiomatic adoption of the Principle of conservation of energy as allowing no exception.

F. First adiabatic acceleration of newly created massive particles

But it would seem that when an electron has just been created through a pair separation process from a 1.022+ MeV photon ([8]), and that this newly created electron, free moving to start with, is then attracted **for the first time of its own existence** to an ionized proton, no potential energy could have accumulated through the expected process of it first having been forced away from a proton since this particular electron did not exist before coming into being as the photon that produced it converted to a pair.

So without theorizing on the possible physical origin of the kinetic energy that this electron will gain as it irreversibly adiabatically accelerates for the first time towards a proton, it would seem that this energy really will be added to the isolated system made up of that proton and this newly created electron without any possibility that this could be a case a reconversion of potential energy that would have been accumulated previously by the electron.

In other words, it would seem that first time adiabatic acceleration of newly created particles towards their first least action rest state (a newly created electron reaching the ground state orbital in a hydrogen atom for the first time as in our example) is not subject by definition to the Principle of conservation of energy that it consequently cannot possibly violate, but rather answers all criteria of an irreversible adiabatic process.

However, once least action energy equilibrium has been reached for the first time by an electron up to a given electronic layer of a given energy intensity in an atom, the Principle of conservation will apply to this electron up to and including any electronic layer of same or lower energy intensity forever after.

But if later, in the course of the usual subsequent process of repeated liberations and recaptures, this electron ever happens to stabilize to an electronic layer requiring more intense energy than it ever reached even once before, then by very definition, the added energy required, which will be induced by this further irreversible adiabatic additional first time acceleration sequence, will also not be subject to the Principle of conservation without violating it.

G. State of all massive particles previously existing

Let us now consider the case of all charged stable scatterable massive particles already in existence in the universe. Isn't it a given that all of these particles have not eternally been in existence but have individually come into being at some point in their own individual past?

Doesn't this mean also that every single one of them mandatorily had to irreversibly adiabatically accelerate for a first time after it first came into being before it could reach for the first time whatever state of least action equilibrium that happened to be available for it then?

If the answer to the last question is yes, then wouldn't this mean that application of the Principle of conservation to all cases including first time adiabatic acceleration after first coming into being of any massive particle amounts to assuming that all existing particles would have always existed with all of them having already reached maximum intensity least action energy equilibrium at the very moment of their creation?

On top of electrons and positrons, this obviously also concerns protons and neutrons, and consequently also up and down quarks. Let us completely clarify the mechanics of acceleration which is of course the same for first time adiabatic acceleration and Principle of conservation subjected acceleration.

VIII. DEFINING ACCELERATION

What better way to clarify such an issue but to give a practical example, which also applies to all possible cases of freefall acceleration whether or not it involves a first time adiabatic acceleration, electrostatic attraction between elementary particles being known to induce this type of acceleration.

Let's consider a free moving electron that just appeared by production of an electron/positron pair from a single 1.022 MeV photon ([8]), a free moving electron now being attracted for the first time by a proton to form a hydrogen atom. It is well documented that a photon of energy 13.6 eV is emitted as an electron settles to the ground state of a ionized hydrogen atom (in other words: a proton), a mean rest state orbital in real hydrogen atoms corresponding to the rest orbit in a Bohr atom, and whose radius corresponds besides, to a constantly induced energy of 27.2 eV, which is twice the energy of the escaping photon.

From the Coulomb equation, we have:

$$E = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{a_0} = 4.359743805\,\mathrm{E\text{-}18\,J} \quad \text{(that is 27.2 eV)} \tag{3}$$

Note that 13.6 eV is the quantity of kinetic energy expelled as a photon when a “free” electron has presumably accelerated from an infinite distance to be captured at distance $\mathbf{a_0}$ = 5.291772083 E-11 m from a proton. This energy can thus be calculated by integrating all of the kinetic energy that accumulates as the electron accelerates towards the proton due to the electrostatic attraction, including the part of this kinetic energy that converts to relativistic mass ([22]).

Momentum (p) is traditionally defined as the product of the mass of a body by its velocity (mv). Let us consider however that when this definition was established, it was not yet known that part of the energy imparted to a body was converted to increased relativistic mass that momentarily added to the body’s rest mass, and that (mv), consequently, represents only part of the total complement of energy that must be imparted to a body for said velocity to be reached, since (m) represents only the actual rest mass of the body. The formula was eventually amended by introducing the gamma factor (γ) and Special Relativity.

It was then verified that the correct formula should be $\mathbf{p = \gamma mv}$ (also formulated as $\mathbf{p = mc(\gamma\text{-}1)}$), where $\boldsymbol{\gamma = 1/\sqrt{(1-(v^2/c^2))}}$. This total amount of energy that animates a body can be obtained only indirectly however, by calculating the kinetic energy that this body releases when it is forced to come to a dead stop, leaving behind only the energy making up the rest mass of the body. This kinetic energy in excess of rest mass is calculated with $\mathbf{E_K = (mv^2)}/2$ for non relativistic velocities (leaving out the part that converts to momentary added relativistic mass, which is infinitesimal in such cases), and more precisely with $\mathbf{E_K = mc^2(\gamma\text{-}1)}$ when relativistic velocities are reached. In both cases however, $\mathbf{E_K}$ does not include the energy that momentarily converts to relativistic mass and is the cumulative effect of a force measured by its integrated effect over time:

$$\int F\,dt$$

The doubled amount of kinetic energy mentioned first, comprising both the unidirectional propelling energy plus the amount that converts to the corresponding momentary relativistic mass, corresponds however to the expression $\mathbf{Fr = E = mv^2}$.

This last quantity is the cumulative effect of a force measured by its integrated effect over space (that is, distance):

$$\int F\,dx$$

This last quantity, that Leibnitz considered being the true measure of a force ([6], p.222) is considered in classical mechanics as being the potential energy, which is twice what we name the kinetic energy (**E_K** quoted previously).

Since the 3-spaces model is grounded on the concept that energy is induced as a function of distance from the source of a force, it is the measure of energy founded on distance in agreement with Leibnitz that will be considering as the active energy. The general formula for this relation is then:

$$\int_{ry0}^{\infty} F \cdot dr \text{ , the Coulomb force equation being } F = k\frac{e^2}{r^2} \tag{4}$$

Let us apply this general equation to the Coulomb equation for electrostatic force and calculate the total quantity of kinetic energy including the energy that progressively converts to relativistic mass that the electron accumulates before finally arriving at the Bohr orbit.

$$E = \int_{a_0}^{\infty} \frac{1}{4\pi\varepsilon_o}\frac{e^2}{r^2}\cdot dr = 0 - \frac{1}{4\pi\varepsilon_o}\frac{e^2}{a_0} = \text{-4.3597438 05 E -18 J} \tag{5}$$

We note here that 4.359743805 E-18 Joules corresponds to 27.2 eV, and not to 13.6 eV, that is, double the energy liberated as a bremmsstrahlung photon escaping in physical reality as the electron stabilizes on its mean rest orbital about the proton. Now why is there this difference?

An analysis was carried out in separate paper ([22]) describing how half the energy that a massive particle accumulates in excess of the energy of its rest mass systematically converts to additional momentary relativistic mass. This additional momentary electromagnetic mass (See [8], Table 1) depends entirely on the total additional amount of energy that the particle momentarily possesses and which in turn depends uniquely on the instantaneous local electromagnetic equilibrium, <u>which is determined exclusively by the sum of all of the individual energy quanta induced as a function of the various distances between this particle and all other charged particles in existence</u> ([7], Section 7.3).

It is well established that whatever the distance between 2 charged particles, the electrostatic force induces, in other words "adds", by a process not yet understood, an amount of unidirectional kinetic energy specific to this distance between the particles, plus a corresponding increment of additional momentary relativistic mass, which depends on the total electromagnetic mass of the particle at this distance, that is, its rest mass plus the added instantaneous relativistic mass, and this, independently of the amount of unidirectional kinetic energy and momentary relativistic mass already accumulated.

So let's see what amount of energy will have been induced when the electron finally reaches the Bohr orbit. Given that the amount of kinetic energy required by the force for the electron to remain at this distance of the proton is determined by the total electromagnetic mass that the electron will have at this distance, and that this total electromagnetic mass was, at an infinitesimal distance before arriving at this orbit:

$$m = m_0 + \frac{E_{(a_0+dr)}}{2c^2} \tag{6}$$

it will be at distance a_0:

$$m = m_0 + \frac{E_{(a_0+dr)}}{2c^2} + \frac{E_{(dr)}}{2c^2} \tag{7}$$

The total electromagnetic mass of the electron will thus increase by induction by the following infinitesimal quantity, which is the final momentary relativistic mass increment

$$\frac{E_{(dr)}}{2c^2} \tag{8}$$

that will render E/2 exactly equal to 13.6 eV (that is, the total amount of induced energy that will have converted to relativistic mass since the beginning of the acceleration), which means that the amount of corresponding unidirectional kinetic energy that will have been accumulated by acceleration at the moment of arrival at the Bohr orbit will of course be:

$$K = \frac{1}{4\pi\varepsilon_o}\frac{e^2}{2a_0} = 2.17987190\text{3 E -18 J} \tag{9}$$

which corresponds very precisely to 13.6 eV of unidirectional kinetic energy added by acceleration.

It can easily be verified that the mass calculated with equation (7) is exactly equal to the relativistic mass of an electron moving at relativistic velocity 2187647.561 m/s which is the relativistic velocity associated with the moving electron in the hydrogen atom ground state.

So let's summarize. Equation (7) reveals that half the energy of 27.2 eV calculated with equation (5), that integrates all of the energy induced from an infinite distance down to the Bohr orbit, is in reality converted to added relativistic mass, which is why only half of this energy accumulated by acceleration remains in the form of <u>unidirectionally directed kinetic energy</u> sustaining the motion of the associated mass.

So, at the precise moment of arrival of the electron at the Bohr ground orbit, we now have a total of 13.6 eV converted to relativistic mass, plus 27.2 eV of added unidirectionally directed kinetic energy, the latter quantity being made up of the remaining 13.6 eV not converted to mass coming from the acceleration down to the Bohr orbit and an additional 13.6 eV directly induced at the moment of arrival at the Bohr orbit to complement the 13.6 eV already converted to momentary relativistic mass.

Given that the energy allowed by the electrostatic force at the Bohr orbit can under no circumstance exceed 27.2 eV if the electron is to remain at this distance (13.6 eV as added relativistic mass and 13.6 eV as unidirectional kinetic energy), we now obviously have an excess of unidirectional kinetic energy of 13.6 eV that must separate from the electron when it reaches the Bohr orbit, or else the electron would remain way too excited and would have no choice but to rebound to escape from the proton.

This is the reason why a 13.6 eV bremmsstrahlung photon has to escape when a free electron is captured by a proton, which involves an abrupt slowing down and stabilization of the electron at a mean distance of $\mathbf{a_0}$ from the hydrogen nucleus.

It is to be noted that all electromagnetic photons coming from deep space or local earthly processes are assumed to have been emitted through the very same process of bremmsstrahlung, from the lowest energy photons, emitted by electrons moving to closer locations towards the nuclei of atoms, to the most intense gamma ray photons emitted by fissioning atomic nucleii or other nuclear rearrangements. Let us note also that all photons emitted during scattering events as elementary particles collide also enter the bremmsstrahlung category, such as when cosmic "rays" (in reality mostly hyper-energetic protons coming from deep-space) collide with atoms or molecules in the Earth's atmosphere.

IX. IRREVERSIBLE ENERGY INDUCTION BY INITIAL TRIAD ADIABATIC ACCELERATION

Let us now come back to what happens by similarity when the triad we are considering finally stabilizes. In the present case, we are dealing with a neutron, now possessing 600 times more energy than the three original particles, that is 939,56533 MeV/c^2!

We will see in further on that at the radius at which the triad stabilizes, which is of the order of 1.2E-15 m, an amount of kinetic energy of about 310 MeV has to be continuously induced for each of the quarks of the triad.

So quite logically, when the final state of the shrinking triad formation will be reached, three extremely energetic bremmsstrahlung photons of about 155 MeV each will be emitted as the 2 electrons and single positron (having now become up and down quarks) stabilize on their final orbits, carrying away the excess unidirectional kinetic energy that the three particles accumulated during acceleration.

X. CONVERSION OF BREMMSSTRAHLUNG PHOTONS TO MESONS

We link up here with a theoretical prediction made by Hideki Yukawa in 1935 of particles that would strongly interact with atom nuclei, as a basis to explain nuclear forces. They were named mesons and their existence was experimentally confirmed in 1947 by Powell and Occhialini. They are mesons π^+, π^- and π^o with respective masses of 139.6 MeV for π^+ and π^-, and 136 MeV for π^o.

We can then see that the masses of mesons observed escaping atomic nucleons are totally compatible with the quantities of energy that must be evacuated as triads stabilize in their fundamental state, the difference in energy between 155 MeV and the masses of the pions being assigned to the velocity with which the mesons would escape the triad. So, particles whose energy is in the same range as the escaping energy predicted by this model have been detected escaping from nuclei.

Mesons have an extremely brief half-life, of the order of 10E-8 s for mesons π^+ and π^-, and of 10E-17 s for meson π^o ([10], p.397). What is of particular interest to us here is that the ultimate end products of their rapid decay, through a cascade of muon state, various very energetic photons and neutrino emissions, is the ultimate production of about 2 electrons and/or positrons.

This indicates that since the three escaping 155 MeV photons are way more energetic than the 1.022 MeV decoupling threshold ([8]) and appear in the immediate vicinity of a neutron, which is rather massive, it is not at all unthinkable that besides possibly directly decoupling into hyper-energetic electron and positron pairs, they could also convert to more massive meson pairs before ultimately decaying further into final electron and positron state.

Such an immediate conversion of a photon just emitted by a nucleus into an electron/positron pair, before the photon can leave the immediate vicinity of the nucleus has in fact already been identified by Frédéric Joliot-Curie (then confirmed by Oppenheimer) at the beginning of the 1930's. He named this process "internal materialization" by opposition to "external materialization" which characterizes the production of a pair close to a nucleus, from the materialization of a photon of external origin that was just grazing the nucleus.

XI. CONVERSION OF MESONS TO MORE PHOTONS AND e^+ e^-

For simplicity's sake as our analysis proceeds, the generation of about 3 extra electron/positron pairs will be assumed for each stabilizing triad. But let's keep in mind that generally speaking, this ultimate generation more than likely is the end product of each of the three escaping 155 MeV photons immediately converting to mesons that will decay in a rapid cascade of muons, then photons, neutrinos and finally to stable electrons and positrons ([11]).

If nucleons really come into being as the end product of such a process and even if such nucleon creation occurred frequently during positronium experiments, it is entirely possible that these occurrences could have remained undetected ever since experimentation began, because the real frequency of the photons emitted by the 3 particles settling to ground state would be systematically masked by their practically immediate and automatic conversion to mesons, which would then proceed to rapidly decay and whose probability was calculated by Oppenheimer and Nedelski 1933 for a photon of sufficient energy emitted by the heavy particle itself ([12], p.244).

All that may have shown on gamma detectors may have been slightly above prediction occurrences of well known gamma frequencies stemming from decay of both flavors of positronium due to the recombining pairs of freshly generated excess electrons and positrons, and possibly a few free protons and neutrons on other detectors that could easily be interpreted as having been knocked off instruments atoms by some highly energetic photon produced in the course of the experiments.

XII. THE ISSUE OF UP AND DOWN QUARKS FRACTIONAL CHARGES

This manner of neutron creation implying that up and down quarks would be simple hyper-accelerated positrons and electrons raises the issue of reconciling the fact that up quark now has a charge of only ++ while the original positron had a charge of +++ before the related adiabatic acceleration process, and that the down quarks now have a charge of only **-** while the original electrons had a charge of **---**.

Let us recall that the charge of particles still is the deepest mystery of fundamental physics. Despite hundreds of years of experimentation and reflection, the scientific community is still down to the level of pure speculation as to the nature of charges.

What we know is that the only possible charge for an elementary particle moving freely is that of the electron, or of its converse, that of the positron. As for fractional charges, they cannot be dissociated from captive up and down quarks and can be observed only within the confines of complex particles made up of these captive up and down quarks.

Despite decades of high energy destructive scattering of protons and neutrons, not a single up or down quark could ever "apparently" be separated from its brothers to circulate freely to be observed and measured as a free moving particle.

<u>Or maybe they were separated and isolated to circulate freely, but without being recognized as such</u>!

Furthermore, since the energy level of incoming "bullet" particles (electrons or positrons) is so high above the 1.022 MeV decoupling threshold in such experiments, a large part of elementary partons observed is likely to be the parasitic product of decoupling of Bremmsstrahlung photons liberated by the incoming electrons as they directly back-scatter against the quarks of the target nucleons.

For example, if up quarks fundamentally were simple hyper-accelerated positrons, and down quarks, simple hyper-accelerated electrons, as we hypothesize here, they would certainly re-manifest their natural unitary charge under the guise of electrons, muons, tau particles, or their antiparticles at the very moment of their liberation from the charge-limiting stresses that we will soon identify and that they are subjected to within the confines of nucleons.

However, the natural but little documented process of ***magnetic drift*** described in separate paper ([13]) and that so easily explains the electron magnetic moment so-called "anomaly" seems able to explain just as easily the fractional charges of up and down quarks as we will see.

XIII. THE CLOSER TO THE TRI-SPATIAL JUNCTION THE SMALLER THE CHARGE

If the intensity of the charge of an electron or positron really is related to the radius of their decoupling orbit in electrostatic space as is logical in the 3-spaces model ([14], Section XVIII), it can easily be understood that as the triad is shrinking, the charges of the particles involved are likely to be affected as they are forced to come closer to the common tri-spatial junctions in electrostatic space, where the coplanar rotation axis is located, and that this distance decreases while remaining relative to this rotation axis (**Fig.3**).

In the neutron triad, the up quark located at the tip of the triangle formed by the 3 particles (see **Fig.3**), ends up as the final equilibrium state is reached, twice farther away from the coplanar axis than the two down quarks, which gives it a charge/distance of ++ relative to the tri-spatial junctions located on this axis, while the two down quarks end up with a charge/distance relation of **-**, on the other side of the axis, as they travel in the opposite direction about the coplanar axis.

It is quite interesting to note here that from the point of view of the up quark, each down quark is now located at a distance of **---** relative to it ($\mathbf{r'_u + r'_d}$), that is **--** ($\mathbf{r'_u}$) to reach the rotation axis, and an additional **-** ($\mathbf{r'_d}$) from the axis to any of the down quarks.

Conversely, if we place ourselves from the point of view of a down quark in electrostatic space, the up quark seems to be located at a distance of +++ relative to it, that is, a distance of + to get to the rotation axis, and an additional distance of ++ from the axis to the up quark.

So, we still recognize here in some fashion the +++ and **---** charges of electrons and positrons, but these charges are now relative to the distances between the particles themselves in the triad.

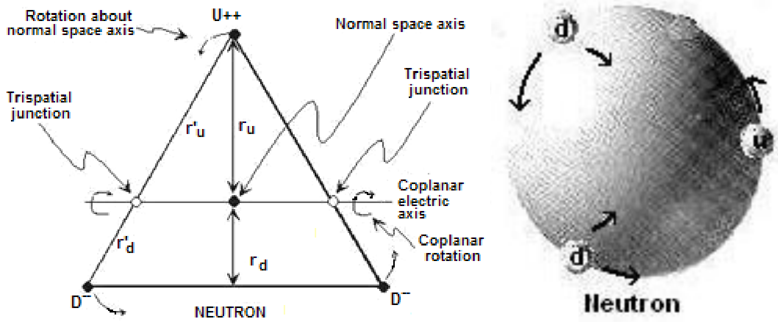

Fig.3: The Internal dynamic structure of the neutron.

So we can see the possibility that the up and down quarks fractional charges could be due to some stress that they would impose on each other in electrostatic space caused by the shorter distances from the tri-spatial junction that they are forced to stabilize at in the final state of the triad.

The presence of such a local stress could cleanly explain why fractional charge elementary partons have never been detected in high energy nucleon destructive scattering experiments. When a quark is scattered off, the stress imposed by the structure would of course instantly disappear and normal unit charge just as instantly resume for this "parton", which is the name given to any particle emitted when a nucleon is subjected to destructive scattering in high energy accelerators.

So a "stress factor" must be introduced in any dynamic field equation meant to describe either up or down quark, that would account for the observed decrease of the electric field energy of these particles, a decrease that needs to be coupled with a corresponding drift towards magnetostatic space of the energy associated to the charge default, that is, a reciprocal increase of their magnetic field energy if the equation is to remain coherent; in other words, a ***magnetic drift*** as a function of the up and down quarks gyroradii in the nucleon since their closed orbit status is identical to that of the orbiting electron whose closed orbit is precisely the cause of the magnetic drift directly explaining the electron magnetic moment anomaly([13]).

Let us be aware here that this drift can in no way change the total amount of energy of the "rest mass" of the particles concerned, and that we will calculate further on, since a "magnetic drift between electrostatic and magnetostatic spaces" linked to closed orbit motion concerns by definition only the internal distribution of electromagnetically oscillating half of the particle's energy.

So, referring back to the dynamic field equation established for the electron at the separate paper ([8], Section D), let's see how this stress factor must be introduced to account for the electrostatic acceleration that converts, so to speak, a positron into an up quark and an electron into a down quark. Logically, the equation for the up quark should thus take this form

$$m_U = \frac{E}{c^2} = \frac{V_{m_U}}{c^2}\left\{ S_U\left[\frac{\varepsilon_0 \mathbf{E}_U{}^2}{2}\right]_Y + (2-S_U)\left[2\left(\frac{\varepsilon_0 \mathbf{V}_U{}^2}{4}\right)_Z \cos^2(\omega t) + \left(\frac{\mathbf{B}_U{}^2}{2\mu_0}\right)_X \sin^2(\omega t)\right]\right\} \tag{10}$$

where

$$V_{m_U} = \frac{\alpha^5 \lambda_U{}^3}{2\pi^2},\ \mathbf{E}_U = \frac{\pi e}{\varepsilon_0 \alpha^3 \lambda_U{}^2},\ \mathbf{B}_U = \frac{\pi \mu_0 e c}{\alpha^3 \lambda_U{}^2} \text{ and } \mathbf{V}_U = \frac{\pi e}{\varepsilon_0 \alpha^3 \lambda_U{}^2} \tag{11}$$

and where $\mathbf{S_U}$ is the up quark final **stress constant**. As for the down quark, the equation would similarly be

$$m_D = \frac{E}{c^2} = \frac{V_{m_D}}{c^2}\left\{ S_D\left[\frac{\varepsilon_0 \mathbf{E}_D{}^2}{2}\right]_Y + (2-S_D)\left[2\left(\frac{\varepsilon_0 \mathbf{V}_D{}^2}{4}\right)_Z \cos^2(\omega t) + \left(\frac{\mathbf{B}_D{}^2}{2\mu_0}\right)_X \sin^2(\omega t)\right]\right\} \tag{12}$$

where

$$V_{m_D} = \frac{\alpha^5 \lambda_D{}^3}{2\pi^2},\ \mathbf{E}_D = \frac{\pi e}{\varepsilon_0 \alpha^3 \lambda_D{}^2},\ \mathbf{B}_D = \frac{\pi \mu_0 e c}{\alpha^3 \lambda_D{}^2} \text{ and } \mathbf{V}_D = \frac{\pi e}{\varepsilon_0 \alpha^3 \lambda_D{}^2} \tag{13}$$

with $\mathbf{S_D}$ being the down quark final **stress constant**. We will calculate both stress constants further on (See equations (35)).

XIV. PROOF THAT THE ATTRACTION COMES FROM THE TRI-SPATIAL JUNCTIONS

The best estimate of effective mass currently associated to the up quark lies with relative certainty between 1 and 5 MeV/c^2, while that of the down quark in the Standard Model lies with relative certainty between 3 and 9 MeV/c^2 ([10], p. 382), which perfectly correlates with the notion that up quarks would orbit at twice the distance from the coplanar rotation axis as do the down quarks, by just considering the apparent effective higher mass down quarks with respect to up quarks. These effective masses will be calculated further on.

Simple logic suggests that down quarks will be much more energetic than up quarks in electrostatic space, since the shorter distance between them and the tri-spatial junctions located on the coplanar axis implies that they are attracted much more strongly by the junctions than the up quarks are, on account of the inverse square rule. It is particularly interesting on the other hand to note that all experimental estimation methods provide similar ratios favoring down quarks ([10], p.382) as being more massive than up quarks.

This fact alone lends credit to the hypothesis of a rotation of the triad about a coplanar axis on top of translating about an axis normal to the plane of the triad, and by extension also strongly legitimizes the need for the real existence of the three orthogonal spaces that the 3-spaces model is grounded on, because a translation in circle of the quarks uniquely about a single perpendicular axis, which is the only possible translation configuration in normal space, can in no way explain why one of the two types of quarks should be more massive than the other, whereas a coplanar rotation axis located in a different and orthogonal electrostatic space, which is the only possible configuration in the 3-spaces model, explains it quite naturally.

Moreover, the final structure of the triad showing that the closer to a junction that a quark lies, the more massive it becomes, gives total credit to the hypothesis that it would be tri-spatial junctions located on the straight line joining any pair of particles that would attract the particles as a function of the inverse square of the distance, and not really the particles that would attract each other.

Despite appearances, this assertion is not in contradiction with the Coulomb law, according to which: *The force acting between two punctual electric charges is oriented along a straight line joining them and is proportional to their charges and inversely proportional to the square of the distance separating them*.

The reason why there is no contradiction is that when two equal energy particles are located at equal distances along a straight line on either side of a central attractive point that would attract both according to the same attractive law, then they behave as if they both are attracting each other according to this law, which is always the case for the pair of de Broglie half-photons as was mathematically demonstrated in separate paper ([15], Sections IV and V), where the decoupling radius (the distance between either half-photon and the central junction) was used to obtain totally consistent energy values for transverse acceleration, which allowed deriving the values of $\boldsymbol{\varepsilon_0}$ and $\boldsymbol{\mu_0}$ from first principles.

As for attraction at the macroscopic level, the large distances involved and the small range of masses of the particles making up matter (electrons, quarks up and quarks down, the latter two being only marginally more massive than electrons as shown in **Table II further** on), render the difference between the two methods infinitesimal and allow ignoring it.

Here, it might be argued that it is impossible for an object to orbit about two different axes at the same time. Let us note however that in this expanded space geometry, both axes about which the triad is orbiting belong to two different spaces that already are themselves, by definition, at right angles with respect to each other.

When we cause a spinning top to rotate on the floor, we are all familiar with the fact that if we attempt to push it in order to force it to lean on its axis, it will strongly resist, and will tend to continue rotating about its original rotation axis.

The same phenomenon obviously must apply to the triad if we assume inertia to universally apply, but the effect of resistance to displacement will occur here in relation to the combined effect of the translation about both axes. This is what creates in the 3-spaces model the impression of effective mass of protons and neutrons, an impression that will be constant no matter in what direction the triads are being pushed against in normal space.

XV. STRUCTURE OF THE TRIAD IN ELECTROSTATIC SPACE

Let us now get closer by imagination, and examine how the triad we just created behaves in electrostatic space.

Let us imagine that we are rotating at the same velocity as the triad about the coplanar axis, so that we perceive the triad as being immobile with respect to us. The approximate equilateral triangle that we are now observing is made up of one up quark at the summit, and two down quarks at the base (**Fig.4**).

To make comprehension easier, it is suggested to cut two small paper triangles, each corner of which would represent a quark. To represent a neutron, "–" should be marked in two corners and "++" in the remaining corner of one of the paper triangles. To represent a proton, "++" should be marked in two of the corners and "-" in the remaining corner of the other paper triangle. Lines can then be traced to represent axes and attractors, dots to represent junctions, etc.

The use of paper triangles is a rather good representation of real triads in electrostatic space, because despite the fact that the intrinsic motion of the triad requires the use of 5 dimensions (3 in electrostatic space plus 2 in normal space), the geometry of the triad proper in electrostatic space requires only 2 dimensions since the use of only 3 points does not allow defining a volume.

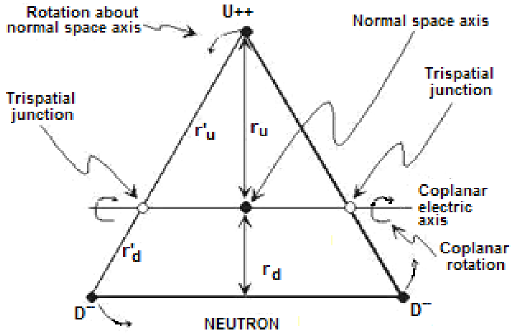

Fig.4: The Internal dynamic structure of the neutron.

The two intersection points of the three spaces can be found at a third of the distance between the down quarks and the up quark, starting from the base. The side lines represent of course the linear attraction between each quark and the corresponding junction.

Also, if the fractional charges of up and down quarks really are measures of distance, this mandatorily means that the coplanar axis will and invariantly be located, for protons as well as for neutrons, at 1/3 of the total distance with respect to down quarks and at 2/3 of the total distance from the up quarks.

The distance between the up quark and the two down quarks is maintained by the equilibrium established between the heterostatic attraction between the up quark and each of the down quarks, and the magnetic repulsion caused by the difference in spin reversal frequencies of each quark with respect to those of the carrier-photons of the two other quarks in magnetostatic space ([5]).

The distance between the two down quarks at the base is maintained by the combined action of the homostatic repulsion between the two particles, and the inertia due to the angular velocity of the triad in normal space. If we trace a line between each particle and the centre of the opposite side of the equilateral triangle, we observe that the three lines intersect at the geometric centre of the triad.

Now that the centre of the triad has been located, let's trace a line between the two tri-spatial junction points located at a third of the distance between the down quarks and the up quark, on the sides of the triangle. We observe that this line, which is the Y-z coplanar axis about which the triad rotates in electrostatic space, actually intersects the geometric centre of the triad, where is also located the exact centre of the coplanar axis.

With regards to the X-x rotation axis of normal space, which is mandatorily perpendicular to the surface delimited by the three particles, its location depends of course on the ratio of the masses in rotation. The estimation calculated previously revealed that down quarks would be about 4 times more massive than up quarks, which means that the mass ratio between the down quarks and the up quark favours the down quarks by a ratio of 8 to 1.

Equilibrium considerations then force the normal axis to intersect the plane of the triad at the very centre of the line representing the coplanar axis. So if we trace another line intersecting the centre of the triad, perpendicularly to the surface delimited by the three particles, we obtain the X-x axis of rotation about which the triad inevitably rotates in normal space.

We have then our triangular formation rotating with enormous velocity in electrostatic space about the coplanar Y-z axis which passes through the geometric centre of the triad and which is parallel to a line joining both down quarks, while simultaneously rotating at high velocity in normal space about the X-x axis.

XVI. MATHEMATIZING THE TRIAD STRUCTURE

To further validate the postulate according to which the unit charge could be a measure of the decoupling distance of electrons and positrons in electrostatic space, we will need to define a new constant, that we will name the **electrostatic Energy Induction Constant** (K) that will then be use to estimate the effective masses of up and down quarks.

However, we must first completely clarify the function of Coulomb's law in the context of Bohr atom. This very simple law postulates of course that in the hydrogen atom, the intensity of the force is a function of the inverse of the square of the distance between nucleus and orbiting electron.

XVII. DERIVING THE COULOMB EQUATION FROM MAXWELL

Initially, Coulomb deduced his famous law empirically from experimentation. Then came Gauss who generalized this law to large collections of charges whose energy behaves at the macroscopic level as if it were a continuous field. Then came Maxwell who established Gauss's equation as fundamental.

To clearly establish the link between the Coulomb equation and the first Maxwell equation, we will now derive the Coulomb equation precisely from that first Maxwell equation:

$$\varepsilon_o \oint \mathbf{E} \cdot dS = q \tag{14}$$

where $\boldsymbol{\varepsilon_o}$ is the permittivity constant of vacuum, **E** the intensity of the electric field at any point of the closed Gaussian surface considered, and **dS** the closed Gaussian surface enclosing a point-like behaving charge **q**.

To resolve the case of interest to us here, let us assume that the Gaussian surface is spherical with radius r, with the point-like charge located at its centre. The interest of this shape is that at all points of the surface the electric field are perpendicular to the charge and also have the same intensity. Since the angle between **E** and d**S** is zero in all directions as considered from the point charge, the Gauss equation becomes:

$$\varepsilon_o \oint \mathbf{E} \cdot d\mathbf{S} = \varepsilon_o \oint \mathbf{E}\ dS = q \tag{15}$$

and since **E** is constant at all points of the surface of the sphere

$$\varepsilon_o \mathbf{E} \oint dS = q \tag{16}$$

and finally, the integral reduces to the surface of the sphere

$$\varepsilon_o \mathbf{E}(4\pi r^2) = q \text{, that is } \mathbf{E} = \frac{1}{4\pi\varepsilon_o}\frac{q}{r^2} \text{ or } \mathbf{E} = k\frac{q}{r^2} \tag{17}$$

Where **k** is the traditional |Coulomb constant.

If we then place a second point charge anywhere on the sphere, that is, at distance **r** from the central point charge, the intensity of the force acting on it from the central charge will be

$$F = \mathbf{E}q_o \quad \text{that is} \quad F = k\frac{q q_o}{r^2} \tag{18}$$

and if both charges q and q_o are equal, we finally obtain the Coulomb equation:

$$F = k\frac{q^2}{r^2} \tag{19}$$

Let us note here that the speed of light calculated by Maxwell is very present in the Coulomb equation, although deeply hidden under two levels of constants, that is k, the Coulomb constant and $\boldsymbol{\varepsilon_o}$ that directly contains it:

$$F = \frac{1}{4\pi\varepsilon_o}\frac{q^2}{r^2} = \frac{1}{4\pi/4\pi c^2 \cdot 10^{-7}}\frac{q^2}{r^2} = \frac{q^2}{r^2}\frac{c^2 \cdot 10^{-7}}{} = \frac{q^2 \cdot 10^{-7}}{}\frac{c^2}{r^2} \tag{20}$$

If we then multiply the force by the distance between the two charges to obtain the energy induced at distance **r**, we obtain from the Coulomb equation a form that shows charges being accelerated, as clarified in separate papers ([8]) and ([15]).

$$E = \int F \cdot dr = \int \frac{q^2 \cdot 10^{-7}}{}\frac{c^2}{r^2} \cdot dr = Fr = \frac{q^2 \cdot 10^{-7}}{}\frac{c^2}{r} \tag{21}$$

To establish the electrostatic induction constant (K), we will use Bohr's radius, whose symbol is $\boldsymbol{a_o}$ and which is considered as a fundamental constant. The Coulomb equation becomes for this case:

$$F_o = k\frac{e^2}{a_o^2} = 8.238721759\text{E}-8\,\text{N} \tag{22}$$

where **k** is the Coulomb constant, with a value of $k = 1/(4\pi\varepsilon_o) = c^2 \bullet 10^{-7}$, and **e** is the unit charge in Coulombs, with value e = 1.602176462E-19 C.

XVIII. DIMENSIONAL ANALYSIS OF THE COULOMB EQUATION

Force F is expressed in Newtons (N), whose usual dimensions are $kg \bullet m/s^2$. But during this analysis however, to more easily see the relation between force and energy, we will use Joules per meter (J/m) as a unit for the Newton.

Here is how J/m can be derived for the usual Newton $kg \bullet m/s^2$ definition. The kg unit is a measure of mass, and equation $E=mc^2$ reveals that $m=E/c^2$, which means that $kg = J/m^2/s^2$, that is $J \bullet s^2/m^2$. If we replace the kg unit by this equivalence in the expanded units set $kg \bullet m/s^2$, we obtain $J \bullet s^2 \bullet m/s^2 \bullet m^2$, which, upon simplifying, becomes J/m, which is the unit that we need, that is, Joules per meter.

Although the product of a force by a distance is associated to work (W) in classical mechanics, in this analysis, and for reasons that will become obvious as we proceed, we will associate this product to the energy induced at that distance by the force considered.

The force here is in Newtons per meter at the distance considered. So, to find the energy induced at the Bohr radius from the force at this distance, the force needs to be multiplied by the distance considered.

XIX. TIME BASED ENERGY CALCULATION

We can thus write that at distance $\boldsymbol{a_o}$ the energy induced will be:

$$E_o = F_o a_o = \frac{e^2}{4\pi\varepsilon_o a_o} = 4.359743805\text{E}-18\,\text{Joules} \tag{23}$$

or converted to eV: 4.359743805E-18 ÷ 1.602176462E-19 = 27.21138345 eV

This precise quantity of kinetic energy is permanently induced at the Bohr radius and <u>does not depend on elapsed time</u>. The only possible way for that quantity of energy to vary is for the distance between the Bohr orbit and the nucleus to change.

To clearly establish the link between traditional physics, that calculates energy on a time basis (the second), and the 3-space model, that calculates energy on a distance basis (the meter), we will first associate time to that energy by establishing a link between that energy and the traditional time based Planck constant.

Let us first calculate the fundamental frequency (***f*$_o$**) of the energy induced in a particle located at the Bohr ground orbit, which also corresponds to the number of times that an electron is deemed to circle the nucleus of an isolated hydrogen atom each second according to the hypothesis that de Broglie formulated regarding the Bohr-Sommerfeld model:

$$f_o = \frac{E_o}{h} = 6.579683916\text{E}15\,\text{Hz} \tag{24}$$

Consequently, we can deduce that Planck's constant can be calculated as follows, from the Coulomb equation:

$$h = \frac{E_o}{f_o} = \frac{e^2}{4\pi\varepsilon_o a_o f_o} = 6.626068761\text{E}-34\ \text{J}\bullet\text{s} \tag{25}$$

But this association of time and energy induced as calculated from the Coulomb equation is artificial, and is not appropriate for the distance based exploration that we are about to undertake because in reality, energy is induced as a function of distance, not of time elapsed. We must then define a distance based constant for our purpose.

XX. DISTANCE BASED ENERGY INDUCTION CONSTANT

Knowing now the energy in joules at the Bohr radius, and the Bohr radius, we can recover again the **electrostatic energy induction constant** (K) already established in separate paper ([8], equation (18)), from the decoupling energy of electron-positron pairs. By multiplying equation (23) by ***a*$_o$**, we obtain:

$$K = E \bullet a_o^{\ 2} = \frac{e^2 a_o}{4\pi\varepsilon_o} = 1.220852596\ \text{E}-38\ \text{J}\bullet\text{m}^2 \tag{26}$$

or, in eV: K = 7.619963375E-20 eV$\bullet$m^2.

So we can write, by associating equation (24) with equation (26):

$$E_o = hf_o = \frac{K}{a_o^{\ 2}} \tag{27}$$

which means that to convert an equation from time based calculation to distance based calculation and *vice versa*, we only need to use the following conversion factors:

$$h = \frac{K}{f_o a_o^{\ 2}} = K \bullet 54274.10962\text{s}/\text{m}^2 \tag{28}$$

so that

$$K = hf_o a_o^{\ 2} = h \bullet 1.842499134\text{E}-5\text{m}^2/\text{s} \tag{29}$$

The main interest of this new constant is that contrary to Planck's constant that allows "horizontal" (or translational) exploration, so to speak, the electrostatic energy induction constant allows "vertical" (or axial) exploration that will now let us explore the nucleus of the hydrogen atom.

Another point of really great interest is that with this new constant, it is possible to establish an equation directly derived from the Coulomb equation exactly equivalent to de Broglie's equation to determine the orbital lengths in the Bohr atom without using Planck's constant, just as can be done with Rydberg's constant (R) ([12], p.331):

$$\lambda_{[\text{Broglie}]} = \frac{nh}{mv} = \frac{n\alpha}{2R} = \frac{n2\pi K}{ke^2} \quad [\text{where } n = (1,2,3\ldots)] \tag{30}$$

or very straightforwardly calculate the Lyman series :

$$E_n = \frac{K}{2}\frac{1}{(na_o)^2} \qquad [\text{where } n = (1,2,3\ldots)] \tag{31}$$

Right here, we can generalize this case to all atoms having only one remaining non-ionized electron. So here is the general equation giving the energy required to ionize the last remaining electron of any atom, Z being the atomic number.

$$E_{nZ} = \frac{K}{2}\left(\frac{Z}{na_o}\right)^2 \quad [\text{where } n = (1, 2, 3\ldots)] \tag{32}$$

XXI. REST MASS ENERGY OF UP AND DOWN QUARKS

But, let's come back to the primary use that constant **K** was meant for. From the energy contained in the electron invariant mass:

$$mc^2 / 1.602176462\text{E}-19 = 510\ 998.9027\ \text{eV}, \tag{33}$$

where m = 9.10938188E-31 kg, we can now get from equation (27) an estimate of its decoupling distance in electrostatic space, a distance that corresponds to its unit charge:

$$r = \sqrt{(K/E)} = 3.861592641\text{E}-13\ \text{m} \tag{34}$$

Concluding from this model that the energy of an up quark located in electrostatic space would settle at 2/3 of the decoupling distance of an electron and down quark at 1/3 of this distance (first column of **Table I**), we can establish the energy of their estimated masses in this model (second column of **Table I**), masses that quite interestingly fall right into the ranges considered valid by all recent estimation methods, that is, between 1 and 5 MeV/c^2 for the up quark, and between 3 and 10 MeV/c^2 for the down quark ([16], p. 11-6):

Table I: Calculated effective rest mass energies of up and down quarks in relation with **Fig.4**

Table of the energies contained in the effective masses of quarks Up and Down, estimated on the assumption that unit charge would be a measure of decoupling distance of electron/positron pairs in electrostatic space.			
Particle	**$r' = a_0\alpha$**	**$E = K / r^2$**	**λ=hc/E**
Electron	**r'_e = 3.861592641E-13 m**	**0.5109989027 MeV**	**2.426310215E-12 m**
Quark up	**r'_{eu} = 2.574395094E-13 m**	**1.149747531 MeV**	**1.078360096E-12 m**
Quark down	**r'_{ed} = 1.287197547E-13 m**	**4.598990173 MeV**	**2.69590021E-13 m**

XXII. THE UP AND DOWN QUARKS MAGNETIC STRESS CONSTANTS

The Third column of **Table I** also provides the absolute wavelengths of the up and down quarks energies. The stress constants mentioned previously (equations (10) and (12)) allowing calculation of the magnetic drift of the quarks electrostatic energy from their electric field to their magnetic field in direct correlation with the **magnetic drift** experimentally known to occur for the electron on the hydrogen atom rest state due to its gyroradius ([13]), can be calculated from ratios (equation (35)) of the distances at which the quarks translate about the coplanar axis (first column of **Table I**).

The same equations will be required to deal with and explain the drift of their charges from unity to 1/3 and 2/3 respectively of the charges of free electrons and positrons. This will become possible when the exact values of up and down quarks' carrying energy have been confirmed by other means. In the meantime, we know from experimental reality that the respective **magnetic drift stress constants** for the up and down quarks are:

$$S_U = \frac{r'_{eu}}{r'_e} = \frac{2}{3} \qquad \text{and} \qquad S_D = \frac{r'_{ed}}{r'_e} = \frac{1}{3} \tag{35}$$

It can be noted that the masses of both up and down quarks can now be calculated from the dynamic fields equations (10) and (12) previously established by using in equations (11) and (13) with the wavelengths now available in the third column of **Table I**. It can thus be verified that the mass values thus obtained exactly match those calculated in **Table II** by other means.

XXIII. RATIOS INVOLVING THE FINE STRUCTURE CONSTANT (α)

Note that the electron-positron pair decoupling radius, which is also equal to the amplitude of the electron Compton wavelength, is also equal to the Bohr radius multiplied by the fine structure constant α=1/137.0359998. It was established in a separate paper ([14], Sections XIX and XXIII) that the fine structure constant is the ratio of the theoretical classical speed of the electron on the Bohr orbit and the speed of light, and also the ratio of the wavelength of a free photon that would have the same energy as that induced at the Bohr radius, that is 27.21138344 eV and the de Broglie wavelength on the Bohr orbit.

So, of course, all directly or inversely related parameters will display the same ratio. For example, if we multiply the energy induced at the Bohr radius by the square of the inverse of the fine structure constant, we can directly obtain the energy contained in the invariant rest mass of the electron:

$$E_e = \frac{E_o}{\alpha^2} = 0.5109989024\,\text{MeV} \tag{36}$$

Formulated generally, we can thus write:

$$\lambda_{[a_o,c]} = \lambda_{[27.21138344\ ]} \bullet \alpha^n \qquad (n=1, 2) \tag{37}$$

Let's mention also that if we add exponentials 3 and 4 to the series, these further values obtainable are very close to the absolute wavelengths of unstable particles muon and tau, but the precision being insufficient (at least one more yet unidentified factor needing to be considered), we will not push forward in this direction for now.

So we now discover that <u>the decoupling radius of a photon of energy 1. 022 MeV or more is precisely 137.0359998 times shorter than the Bohr radius</u>, that is $r' = a_0\alpha$. Pursuing this line of reasoning, we will see that we end up recovering an equation for the Lyman series normally derived from the Schrödinger equation.

This relation now allows calculating the invariant mass of the electron from the Coulomb equation:

$$m_e = \frac{K}{(a_o\alpha c)^2} = \frac{k}{a_o}\left(\frac{e}{\alpha c}\right)^2 = 9.109381877E-31\text{kg} \tag{38}$$

Multiplying by c^2, we establish an interesting equation giving the energy of the electron involving the fine structure constant α:

$$m_e c^2 = \frac{K}{(a_o\alpha)^2} = \frac{ke^2}{a_o\alpha^2} = \frac{e^2}{4\pi\varepsilon_0 a_o\alpha^2} \tag{39}$$

Among other possibilities, from

$$m_e c^2 = \frac{e^2}{4\pi\varepsilon_0 a_o \alpha^2} \text{ we obtain } c^2 = \frac{e^2}{m_e 4\pi a_o \alpha^2 \varepsilon_0} \tag{40}$$

Which, since $c^2 = 1/\mu_o\varepsilon_o$ this means that

$$\mu_0 = \frac{m_e 4\pi a_o \alpha^2}{e^2} \text{ and thus } e^2 = \frac{m_e 4\pi a_o \alpha^2}{\mu_0} \tag{41}$$

From the standard Coulomb equation, we get

$$e^2 = E_0 4\pi a_o \varepsilon_0 \tag{42}$$

From equating equations (41) and (42), both of which being equivalents of e^2, we then get

$$E_0 = \frac{m_e \alpha^2}{\mu_0 \varepsilon_0} \quad \text{and finally} \quad E_0 = m_e c^2 \alpha^2 \tag{43}$$

From which we finally establish, by dividing by the usual $2n^2$, an equation for the Lyman series usually derived from the Schrödinger equation

$$E_{[Lyman]} = \frac{m_e c^2 \alpha^2}{2n^2} \qquad [\text{where } n = (1,2,3\ldots)] \tag{44}$$

With this confirmed decoupling radius of photons of sufficient energy, we can now verify from a second source that the speed of light really is the decoupling velocity of the pair when a photon of 1.022 MeV or more decouples ([8]).

XXIV. GENERAL REST MASS EQUATION FOR ELECTRON & QUARKS UP AND DOWN

So, we can now establish a general equation allowing calculating the invariant effective masses of the only three massive, point-like behaving, stable and charged elementary particles that exist in the universe from the Coulomb equation. Actually, these 3 particles are the only particles required to build all existing atoms in the universe. Of course, we consider here the positron as being identical to the electron except for the sign of its charge.

$$m_{i[d,u,e]} = K\left(\frac{3}{n a_o \alpha c}\right)^2 = \frac{k}{a_o}\left(\frac{3e}{n\alpha c}\right)^2 \quad (n = 1,2,3) \tag{45}$$

Let us recall that muon and tau particles are unstable even if they also behave point-like and seem to be simple hyper-energetic electrons that, on short notice, lose their excess energy via neutrino decay to end up as electrons anyway. Their decay process is analyzed in a separate paper ([23]).

XXV. ROTATION OF THE TRIAD IN ELECTROSTATIC SPACE

Let us now examine the rotating motion of the triad in electrostatic space. One particular aspect of this motion is the apparently compulsory invariance of the rotation radii of up (2r/3) and down (r/3) quarks with respect to the coplanar axis. This apparently mandated invariance is due to the fact that if the electron unit charge really is related to its decoupling distance from the junction in electrostatic space (**r'**), that is, the invariant decoupling distance of photons converting to electron-positron pairs, it follows that distances $\mathbf{r'_u}$ and $\mathbf{r'_d}$ also must be invariant, since they respectively represent 2/3 and 1/3 of the charge mandated by **r'**.

This also means that from the apparently fixed value of **r'**, we can establish the rotation radii of both types of quarks in the rotating triad (see **Table II**).

We also observe that the locations of the two tri-spatial junctions are immutably located by definition in the triad on straight lines joining each down quark to the up quark, and that both types of quarks are consequently forced to always remain in opposition, that is, on opposite sides of the coplanar axis.

If the energy of up and down quarks was balanced as expected with half of it alternating between magnetostatic and normal spaces while the other half would reside in electrostatic space, presumably unidirectionally auto-propelling the particle, we would of course expect a state of auto-propulsion at the speed of light about the coplanar axis.

We observe however that the down quarks, whose sum of masses is 8 times larger than that of the up quark, circulate on an orbit twice shorter than that of the up quark (see **Table II**). It thus becomes obvious that if the down quarks were to move at the same velocity as the up quark, that is, the *a priori* expected speed of light, they would travel their shorter orbit twice for each turn of the up quark on its own orbit.

But, such a motion would be in contradiction with the two parameters just established as being invariant, that is the rotation radii that we have established as being immutable, combined with the fact that down quarks cannot pivot about the coplanar axis otherwise than in opposition to the up quark. This means that within electrostatic space, the triad cannot rotate about the coplanar axis otherwise than as a solid rotating object.

XXVI. VELOCITY AND ENERGY OF UP AND DOWN QUARKS ABOUT THE NORMAL SPACE AXIS

Let's now see how we could tentatively estimate the equilibrium velocities about both orthogonal axes of the triad, that is, the normal axis and the coplanar axis, as well as their rotation radii. This will allow verifying that realistic theoretical values for the radii of protons and neutrons can be obtained, which have been experimentally confirmed to be of the order of 10E-15 m in normal space.

Let us first put in perspective some values that we will need, that is, the rotation radii about the coplanar axis in electrostatic space, the lengths of the orbits about this axis, and the quarks masses in kg as perceived from normal space, calculated with the corresponding energies obtained in **Table I**:

Table II: Relation between up and down quarks masses and the translation and rotation radii (Ref. **Fig.4**).

	Up quark	**Down quark**
Rotation Diameter	**r = r' sin 60° = 3.344237326E-13 m**	
Rotation Radii	**2r/3 = 2.229491551E-13 m**	**r/3 = 1.114745775E-13 m**
Orbit lengths D = 2πr	**1.400830855E-12 m**	**7.004154277E-13 m**
Quark masses in kg m=E•1.6E-19 /c²	**2.049610923E-30 kg**	**8.198443779E-30 kg**

Let us now calculate the energy in eV of protons and neutrons corresponding to their known masses. These values as well as the other values that we will estimate in relation with the normal space translation axis will be successively presented in **Table III**, as the following explanations unfold.

We can now determine the residual energy of nucleons, that is, the energy in excess of that making up the masses of up and down quarks, in other words, the carrying energy of the up and down quarks involved.

Since the geometry of their motion reveals that the three quarks orbit at the same distance from the normal rotation X-x axis, then all three carrier-photons possess the same energy (that we must keep in mind is strictly determined by the inverse square of the distance to the tri-spatial junctions lying on the coplanar Y-z axis). For simplicity's sake, we will ignore the wobble that must be caused by the fact that both normal and coplanar axis may not exactly intersect in both types of nucleons (protons and neutrons).

With the velocity formula established in ([9], Equation (52)), we will calculate the relativistic velocity of the particles from the quantities of extra kinetic energy of each of them:

$$v = c\sqrt{1-\frac{1}{\left(1+\frac{E_{cp}}{2mc^2}\right)^2}} \tag{46}$$

Since only half of the energy of a carrier-photon is sensitive to the transverse attraction of the tri-spatial junctions in the triad, we must of course use only half of the energy of the carrier-photon to establish this velocity.

We will also have to use the average mass of the quarks rotating about the normal axis, which we will calculate from the sum of the effective masses of the three quarks involved. We can see that the velocities reached are very close to the speed of light.

With the velocities just obtained, we can now calculate the de Broglie wavelength of the triad in normal space. To that effect, we will use the relativistic version of de Broglie's equation:

$$\lambda_B = \frac{h\sqrt{(c^2 - v^2)}}{mvc} \tag{47}$$

All we need to do now is to divide these lengths by **2π** to obtain the radii of proton and neutron, which just like the theoretical masses that this model proposes for up and down quarks, falls right into the range experimentally estimated, which is 10E-15 m.

The value obtained is in fact practically equal to the 1.2E-15 m "effective radius of a proton" mentioned in Resnick & Halliday ([6], p.4).

Table III: Motion of up and down quarks about the normal space axis.

Motion of up and down quarks about the normal space axis		
	Proton	Neutron
Energy in eV $E=mc^2/1.6E\text{-}19$	m=1.67262158E-27 kg E=938 271 996.1 eV	m=1.67492716E-27 kg E=939 565 331.8 eV
Combined energy of the constituting quarks	$(2E_u+E_d)$ 6 898 485.235 eV	(E_u+2E_d) 10 347 727.88 eV
Residual energy (E_R)	$E-(2E_u+E_d)$ 931 373 510.9 eV	$E-(E_u+2E_d)$ 929 217 603.9 m
Energy of each carrier-photon $E_{cp}=E_R/3$	310 457 837 eV or, in Joules : 4.974082389E-11 J	309 739 201.3 eV or, in Joules: 4.962568577E-11 J
Effective mass of the nucleon components m_i	$(2m_u + m_d)$ 1.229766563E-29 kg	$(m_u + 2m_d)$ 1.844649848E-29 kg
Average mass of quarks about the normal axis m_a	$m_i/3$ 4.099221875E-30 kg	$m_i/3$ 6.148832827E-30 kg
Rotating speed about the normal axis $v = c\sqrt{1-\frac{1}{\left(1+\frac{E_{cp}}{2m_a c^2}\right)^2}}$	299 760 516.1 m/s that is 99.9893453% of the speed of light	299 718 131.4 m/s that is 99.9762642% of the speed of light
De Broglie's wavelength $\lambda = \frac{h\sqrt{(c^2-v^2)}}{m_a vc}$	7.871428162E-15 m	8.005714473E-15 m
Radius of nucleons (without correction for magnetic interaction)	Radius of the proton 1.252776701E-15 m	Radius of the neutron 1.274149031E-15 m

XXVII. VELOCITY AND ENERGY OF QUARKS ABOUT THE CO-PLANAR AXIS

What now remains to be done is to estimate the rotation velocities of both types of triads (proton and neutron) about the coplanar axis within electrostatic space. The main reference available is of course that both types of quarks must take a measurable amount of time to complete each orbit, since our analysis shows that the triad has no choice but to rotate as a solid structure in electrostatic space.

After having established the quarks translational motion about the normal space axis (**Table III**), we will now establish a table of the pertinent values for the rotating motion of the triads within electrostatic space about the coplanar axis.

Let us recall that by definition, just like kinetic energy residing within electrostatic and magnetostatic spaces appears massive when considered from normal space, kinetic energy residing in normal space and magnetostatic space will appear massive when considered from electrostatic space (See [14], Sections VII).

So, seen from electrostatic space, the three carrier-photons now appear as three particles of equal mass while the quarks become the carrier-photons of these masses. Let us calculate these masses (See **Table IV**).

let us consider that within electrostatic space, 2 up quarks orbit opposite 1 down quark at 2/3 of **r** from the proton coplanar axis, and that for the neutron, 2 down quarks orbit in opposition to 1 up quark at 1/3 of **r** from the coplanar axis.

Let us now determine the energy that propels these masses from electrostatic space. As mentioned, it is the quarks themselves that now act as carrier-photons, and that for the proton, it is the energy of 2 up quarks that propel 2 masses at 2r/3 while it is the energy of 1 down quark that propels one mass at r/3, and reciprocally for the neutron.

We can now calculate the natural velocities at which the quarks would orbit about the coplanar axis if they were not captive of the rigid structure of the triad that this geometry imposes.

Curiously, while the geometry of this model imposes that the up quarks move twice faster than the down quarks about the coplanar axis, the natural velocities calculated paradoxically indicate precisely the opposite. The mean rotation time being however the main criterion, the model imposes that these velocities should be reversed due to the stress imposed by the geometry.

Obviously, more research is required to completely describe this motion.

Table IV: Motion of the triad about the electrostatic space coplanar axis.

Motion of the triads about the electrostatic space coplanar axis		
	Proton	**Neutron**
Masses at r/3 = $E_{cp} \bullet 1.6E\text{-}19 / c^2$	(E_{cp}= 310 457 837 eV) 5.534413049E-28 kg	($2E_{cp}$= 619478402.6 eV) 1.04320441E-27 kg
Masses at 2r/3 = $E_{cp} \bullet 1.6E\text{-}19 / c^2$	($2E_{cp}$= 620 915 674 eV) 1.10688261E-27 kg	(E_{cp}= 309 739 201.3 eV) 5.521602205E-28 kg
Energy at r/3	$E = m_d c^2$ 4 598 990.173 eV or 7.368393804E-13 J	$E = 2 m_d c^2$ 9 197 980.346 eV or 1.473678761E-12 J
Energy at 2r/3	$E = 2 m_u c^2$ 2 299 495.062 eV or 3.684196863E-13 J	$E = m_u c^2$ 1 149 747.531 eV or 1.842098431E-13 J
Natural rotation speeds at r/3 of the coplanar axis $v_{r/3} = c\sqrt{1 - \frac{1}{\left(1 + \frac{E_{r/3}}{2m_{r/3}c^2}\right)^2}}$	36 286 781.85 m/s or 12.1039675% of the speed of light	37 365 307.92 m/s or 12.4637251% of the speed of light
Natural rotation speeds at 2r/3 of the coplanar axis $v_{2r/3} = c\sqrt{1 - \frac{1}{\left(1 + \frac{E_{2r/3}}{2m_{2r/3}c^2}\right)^2}}$	18 218 731.94 m/s or 6.0771148% of the speed of light	18 239 795.99 m/s or 6.084141% of the speed of light
Mean rotation time	5.774701519E-20 sec	2.85727356E-20 sec

XXVIII. THE INVARIANT REST MASSES OF ELEMENTARY PARTICLES

Time has come now to clearly define the nuances that must be assigned to the notion of "rest mass" typically symbolized by $\mathbf{m_o}$ for bodies at rest.

In the case of truly free stable elementary particles such as the electron and positron, that display point-like behavior in all circumstances, and whose "rest mass" is verifiably made up of only fundamental kinetic energy, it has been extensively verified that this rest mass is totally invariant.

The proof that they can be made up of only kinetic energy comes from the sequence of events leading to their creation. First, kinetic energy can be accumulated by acceleration. For example, like electrons accelerating between the electrodes of a Coolidge tube, ultimately releasing X-ray photons as they suddenly come to a relative stop as they are captured by the anode (or anti-cathode). These X-ray photons are verifiably made up of only the kinetic energy accumulated during the acceleration of the electrons.

It is well understood that all electromagnetic photons are of the same nature, varying only in the amount of energy that they carry. A separate paper ([8]) analyses how photons of 1.022 MeV or more can be destabilized into converting to a pair of massive electron and positron, thus conclusively demonstrating that the energy making up the rest mass of electrons and positrons can be nothing else but some of this fundamental kinetic energy that can be accumulated through acceleration.

The current analysis explains how electrons and positrons can be further adiabatically accelerated until they reach a further more energetic stable state as respectively down and up quarks, thus completing an uninterrupted sequence of causality from acceleration induced kinetic energy to the creation of free moving massive electrons and positron, to the final creation of captive up and down quarks yet more massive.

It turns out that these 4 particles, electron, positron and up and down quarks make up the complete and ultimate sub-set of stable, point-like behaving, scatterable and charged building blocks required to construct all nucleons and all atoms that can exist in the universe.

It is to be noted that all other particles detected in high energy accelerators and as by-product of cosmic radiation scattering, are highly unstable and systematically decay into one or other of the stable components making up normal atoms; that is, electrons, protons and neutrons, besides positrons and electromagnetic photons after at most a few micro-seconds half-lives. None of these highly unstable particles can be found anywhere into stable atoms.

Free moving electron and positron have been extensively verified to be totally stable and as having totally invariant rest masses. The same can apparently be said of captive up and down quarks, in the current state of our knowledge.

XXIX. THE VARIABLE EFFECTIVE MASS OF COMPLEX PARTICLES

But is must be noted that in addition to recognizing that these elementary particles have invariant masses, Special Relativity (SR) also considers that protons and neutrons have invariant rest masses. This is due to the fact that SR was elaborated before it was known that protons and neutrons are not elementary particles.

Given that the greater part of proton and neutron masses can only be relativistic as we just verified, it is impossible that their rest mass will not vary with the density of surrounding matter on account of the universal inverse square interaction with distance of all charged particles making them up and the surrounding matter.

The more atoms will be regrouped, the more intense the inverse square Coulombian interactions will be between the charged scatterable quarks of the local set, causing a slackening of the structure of each triad involved, lessening the energy of the quarks carrier-photons and ultimately causing a lessening of the relativistic masses to be added to those of the quarks proper.

The effective masses of protons and neutrons as determined at the surface of the Earth can then only be lower than those that would be measured in deep space, far from any accumulation of matter. See separate paper ([17]) in this regard.

But to this date, SR has not yet been modified to integrate the fact that protons and neutrons are not elementary but have variable rest masses depending on environment, even if they are now known not to be elementary, and even if the masses of their constituting scatterable sub-components, up and down quarks, are known to have masses amounting only to a tiny fraction of the nucleons measurable masses.

In SR, $\mathbf{m_0}$ designates the "rest mass" of any massive body being considered, and m_0c^2 as the sum of all forms of *internal* energies that this body may contain, that is, electrical energy, nuclear energy, thermal energy, etc, on top of the energy making up the masses of all elementary (electrons) and complex particles (protons and neutrons considered as having invariant masses) constituting the atoms that this body is made up of.

Consequently the value of m_0c^2 for a given body is likely to vary with ambient temperature, for example. Given that the speed of light (**c**) is a constant, this means that in SR, the rest mass of macroscopic bodies can vary depending on external conditions, which can hardly be disputed.

The further step of SR taking in to account the variability of nucleons rest masses with local density of surrounding matter should however be considered and would no doubt bring unsuspected benefits.

XXX. CONVERSION FROM NEUTRON TO PROTON STATE

H. Magnetic Presence of up and down quarks

We have analysed in ([8], Sections XVI and XVII) that even after the decoupling of an electron-positron pair, magnetostatic space still is being used by the part of each decoupled particle's energy that remains in oscillation through the tri-spatial junction.

We also saw previously that up and down quarks mandatorily permanently maintain more than half of their oscillating energy within magnetostatic space while their corresponding oscillating presence diminishes in the same proportion within electrostatic space, that is, a presence in electrostatic space that corresponds for a down quark to a stabilization at a distance of 1/3 of the electron unit charge relative to the electrostatic Y-z axis, and to a distance of 2/3 of the positron unit charge for the up quark.

One thing is certain, the total magnetic field of a neutron is much more powerful than that of an electron, being made up of the already more intense magnetic fields of the up and down quarks and of the three magnetic fields of a higher order of intensity of the three quarks carrier-photons ([5], Section IV). It is not at all illogical at this point to suspect that this powerful composite magnetic field could become a destabilizing factor when the neutron is isolated.

This obviously is not the case for isolated protons however, since they are known for their total stability. But there nevertheless exists special nuclear configurations that apparently succeed in causing a proton to spontaneously convert to neutron state with emission of a positron, in a process that would be the reverse of the one that we are going to analyse for the neutron, for example, the β^+ decay of 7-N-13 into stable 6-C-13.

Considering that magnetic fields produced by permanent magnets (also termed magnetostatic fields) are caused by the fusion of the individual magnetic fields of forced parallel spin-aligned unpaired electrons in the material of magnets into a single larger magnetic field (See separate papers [5] and [18] for a complete analysis of elementary particles magnetic fields), and the non-differentiated nature of the kinetic energy making up magnetic fields, it is quite logical that the magnetic fields associated with up and down quarks in nucleons, as well as the magnetic fields of their carrier-photons will fuse in a similar manner in magnetostatic space as completely as their respective frequencies will allow ([5], Sections X and XII), on account of proximity of the particles and the two associated tri-spatial junctions.

I. Neutron Instability and Decay

For reasons that remain to be determined, and through a mechanics that remains to be minutely explored, in an average time of approximately 16.88 minutes, something extraordinary occurs in isolated neutrons. Part of this magnetic substance shared in common, seems to successfully return to electrostatic space through one of the junctions located on the coplanar electrostatic Y-z axis, which then allows it to interact with the closest down quark as if they were the two halves of the same complete photon.

It goes without saying, considering that the energy of the down quark involved is much larger than 1.022 MeV, that this newly transferred quantity of kinetic energy and the closest down quark will have no other choice but to instantly behave with respect to each other as if they were an electron/positron pair, on account of the strongly destabilizing vertiginous rotating motion of the two other farther away elements of the triad.

The newly returned quantity will logically become the positron of the newly formed pair and will naturally enter into rotation close to the up quark of the triad, at a distance determined by the combined action of the homostatic repulsion between itself and the previously existing up quark and the resulting inertia of the rotation speed of the triad in normal space.

The down quark involved, which now possesses very little energy, most of it having been transferred to the positron as the latter stabilizes as a new up quark, will be ejected as a free electron in a direction related to the orientation of the rotation of the neutron, recovering in the process its unit charge as the stress due to the tight triad closed orbit fades to zero as the particle moves away ([13]). And we now have a proton, possessing slightly less energy than the original neutron, with a measurable effective mass at sea level of 938,271998 MeV/c^2.

The issue of the "disappearing energy" associated with neutrinos during β- decay of neutrons as they convert into a proton and an electron is addressed in a separate paper ([23]).

J. The Internal Structure of the Proton

If we compare the new configuration now available for the proton (**Fig.5**) with the mental image that we previously built for the neutron (**Fig.3**), we can see that we are also dealing here with an approximately equilateral triangle, but instead of appearing to us with its tip pointing "upward", this one appears to us with its tip relatively pointing "downward", metaphorically speaking, if we continue to visualize the electrostatic Y-z axis as being horizontal, and the normal space X-x axis pointing out, perpendicularly with respect to the surface delimited by the three quarks.

The remaining down quark from the original neutron is now by itself under the electrostatic axis and has no choice but to remain at the same distance from the electrostatic axis that it had when it was part of the neutron since we know from experimental evidence that its charge in the proton remains at 1/3 of the electron unit charge.

In this new configuration, the tri-spatial junctions have thus no choice but to remain located at the same level as in the neutron, as witnessed by the charges associated with the quarks, that is, at one third of the distance between the down quark and the two up quarks, starting from the down quark ($\mathbf{r'_u}$ and $\mathbf{r'_d}$).

1) Drifting of the normal axis half way towards the up quarks: We can also observe that contrary to the neutron triad, in which both normal and electrostatic axis intersect at the centre of the triad, these two axes do not intersect in the proton. The X-x axis of normal space has now drifted upward to a new location halfway between the Y-z electrostatic axis and a line that would link both up quarks, and is now located at the exact center of this new triangular formation!

2) Total stability of the dynamic structure of the proton: Could this separation of both rotation and translation axes be the reason for the proton stability? Quite possibly! But advanced dynamic simulations will be required for confirmation.

We can observe that the two up quarks are circulating twice further away from the coplanar axis as does the single down quark. We can well imagine that such a configuration is very stable since we now have two inertial masses rotating far from the coplanar axis, in relation with a single down quark whose mass is approximately double that of the sum of both up quarks and rotating close to the coplanar axis.

We have just explored the structure of a proton produced by this hypothetical mechanics of β- decay in a neutron, but it goes without saying that in this expanded geometry of space, a proton could as easily have been directly created from two positrons plus one electron interacting with too little energy to escape mutual capture, as we just analyzed for the neutron creation.

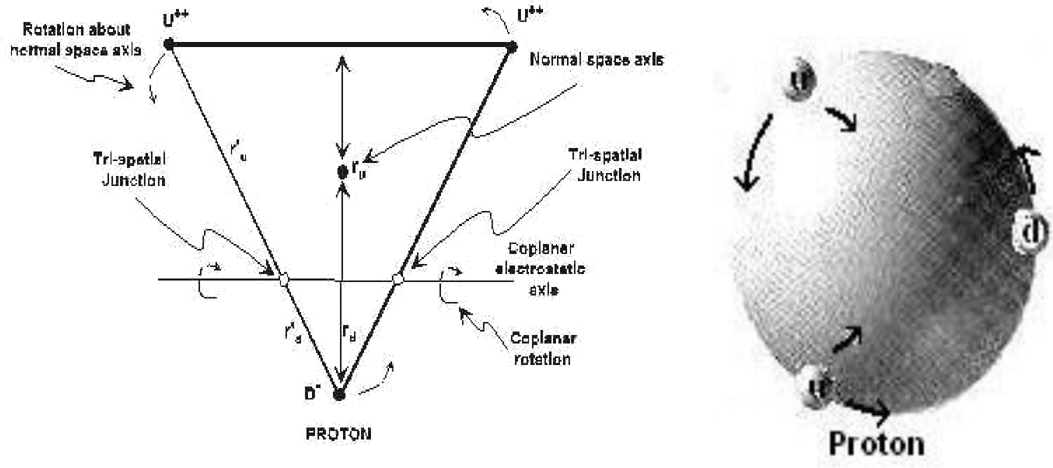

Fig.5: The Internal dynamic structure of the proton.

Consequently, it can be posed that in this expanded geometry of space, when triads of a mix of electrons and positrons are forced into a volume of space of diameter 2.116708996 x 10^{-10} meter or less, with insufficient energy to escape mutual Coulomb interaction, we can logically expect the following outcome:

$$2e^{+} + e^{-} \Rightarrow p + 3e^{-} + 3e^{+} \tag{48}$$

and

$$2e^{-} + e^{+} \Rightarrow n + 3e^{-} + 3e^{+} \Rightarrow p + 4e^{-} + 3e^{+} \tag{49}$$

K. Antiprotons and antineutrons

But to remain coherent with the logic of triad formation proposed here, it could certainly be argued that the main end product of equation (48) should be an anti-neutron instead of a proton, and that it would logically suffer the same instability as the neutron, eventually decaying into an anti-proton and a positron.

Let us recall however that the only verified cases of existence of anti-neutrons or anti-protons, very fleeting it must be said, have occurred only in exceptional and extreme circumstances in high energy accelerators, or as extremely fleeting by-products of cosmic radiation, and that all of the known stable matter of the Universe is made up exclusively of neutrons, protons and electrons.

Considering however the statistically equal probability of production of anti-neutrons and neutrons in this model, the question certainly arises as to why we don't routinely find such anti-particles in nature. An analysis carried out in a separate paper will shed conclusive light on the reason why neutrons are the most likely initial product of nucleogenesis from combinations of triads made up electrons and positrons ([17]).

XXXI. EXPERIMENTAL VERIFICATION

L. Detection in high energy accelerators

It can certainly be argued that if it was so easy to create protons and neutrons merely by forcing thermal electrons and positrons close to one another, the phenomenon would have been observed long ago.

Indeed, for the past 50 years, physicists have been bombarding and colliding particles in a number of ever more powerful particles accelerators. It seems quite improbable that even accidentally, the right combination of circumstances would not have occurred, even considering the very small cross-sections involved. What if it had occurred a number of times, but without being recognized for what it was, if these occurrences were assigned other causes, or discarded as parasitic by-products of the effects being searched for?

It has been well established that $\boldsymbol{\pi}$ mesons (made up of up and down quarks) are routinely created from head-on collisions of streams of electrons ([19]), and that baryons (protons and neutrons) also are a customary by-product of such head-on electron beams scattering ([4]), which more than strongly support the possible validity of the second stage generation process that Haïssinsky's description suggests ([3], p. 33).

Which means theoretically that:

$$e^{-} + 2e^{+} \rightarrow p + 3\gamma \rightarrow p + n\pi^{o} + n\pi^{\pm} \tag{50}$$

and

$$2e^{-} + e^{+} \rightarrow n + 3\gamma \rightarrow n + n\pi^{o} + n\pi^{\pm} \tag{51}$$

It was often observed in high energy accelerators that when streams of electrons and positrons are collided head-on with sufficient energy, a variety of more massive particles materialize as a function of the quantity of energy liberated during such scattering events, and that the following set is more specifically cited:

$$2e^{-} + \text{Kinetic Energy} \rightarrow p + 4e^{-} + 2e^{+} + n\pi^{o} + n\pi^{\pm} + \text{other particles} \tag{52}$$

Given the homostatic repulsion between electrons, it obviously is required for them to be accelerated to extreme velocities in opposite directions for precise head-on collisions to occur.

When such a precise head-on collision occurs between two electrons, a brutal slowing down to a practical momentary stop of both particles necessarily takes place on the final leg of their intersecting trajectories, which cannot fail to result in the liberation of all of the kinetic energy of both electrons in the form of two intense bremmsstrahlung photons.

Since the total amount of energy that will be carried away by these photons will exactly match the energy that had to be imparted to the electrons to successfully force them into such a head-on collision, these photons will obviously be way more energetic than the 1.022 MeV threshold while the two electrons stand close together at a practical dead stop with respect to each other.

It can thus be expected that local circumstances may be reunited for the interaction between the two very closely packed electrons and the half-photons of at least one of the photons that just appeared, to force the conversion of this photon (possibly of both photons) into a new pair of electron/positron.

M. Confirmation of pair production via photons interaction

Or much more probable, it could involve interaction between the two hyper energetic bremmsstrahlung photons that just appeared in extreme close proximity that would force both photons to immediately convert to two new electron/positron pairs, a process the existence of which was confirmed by an experiment led in 1997 by Kirk McDonald at the Stanford Linear Accelerator (SLAC).

Indeed, by converging two sufficiently concentrated photons beams towards a single point in space, one made up of photons exceeding the 1.022 MeV threshold, electron/positron pairs appeared without any massive atom nucleus being close by.

This sets the 1.022 MeV energy level as the threshold starting from which massless photons become highly sensitive to be destabilized into converting to pairs of massive particles.

Moreover, given the hellish quantity of energy that will be localized at this point in space, it is not improbable that a neutron being produced according to the mechanics proposed in this analysis would immediately destabilize and convert to a proton.

Presently, we could tentatively dissect the transformation in the following manner:

$$\begin{gathered}
2e^- + \text{Kinetic Energy} \rightarrow \quad 2e^- + 2\,\gamma \rightarrow \\
(2e^- + e^+) + e^- + 1\,\gamma \rightarrow \quad (n + 3\gamma) + e^- + 1\,\gamma \rightarrow \\
(n + 3e^- + 3e^+) + e^- + 1\,\gamma \rightarrow \quad (p + 4e^- + 3e^+) + e^- + 1\,\gamma \rightarrow \\
p + 4e^- + 2e^+ + (e^+ + e^-) + 1\,\gamma \rightarrow \quad p + 4e^- + 2e^+ + 2\,\gamma \rightarrow \\
p + 4e^- + 2e^+ + n\pi^0 + n\pi^\pm + \text{other particles}
\end{gathered} \qquad (53)$$

which is exactly what is apparently deemed to have been observed.

Moreover, following the same logic, what would occur if two positrons were directly collided in the same manner in a high energy accelerator could possibly be extrapolated. Such an experiment should be relatively easy to set up, that would confirm the reality of this mechanics of conversion:

$$\begin{gathered}
2e^+ + \text{Kinetic Energy} \rightarrow \quad 2e^+ + 2\,\gamma \rightarrow \\
(2e^+ + e^-) + e^+ + 1\,\gamma \rightarrow \quad (p + 3\gamma) + e^+ + 1\,\gamma \rightarrow \\
(p + 3e^- + 3e^+) + e^+ + 1\,\gamma \rightarrow \quad p + 2e^- + 3e^+ + (e^- + e^+) + 1\,\gamma \rightarrow \\
p + 2e^- + 3e^+ + 2\,\gamma \rightarrow \\
p + 2e^- + 3e^+ + n\pi^0 + n\pi^\pm + \text{other particles}
\end{gathered} \qquad (54)$$

But of course, the experimental confirmation of such a prediction remains to be made.

These considerations concern only manmade experiments however, but what about possibly verifiable natural occurrences of such nucleogenesis?

Shouldn't the telltale of such possibly natural occurrences be hitherto unexplained and extreme emissions of high energy gamma photons somewhere in the environment such as would be mandatorily emitted when the three high energy bremmsstrahlung photons are released as each nucleon is being formed in such a process?

After all, photons of energy 1.022 MeV and more are quite common occurrences coming from the Sun ([20], p. 42), likely to create innumerable thermal pairs of electrons and positrons as they graze free moving massive particles in the so-called "vacuum" of space. These issues are explored in separate papers ([11]) and ([17]).

XXXII. CONCLUSION

From this analysis can be drawn the conclusion that the greater part of protons and neutrons masses, which constitute the greater part of the mass of matter, can only be relativistic in nature, and that it is impossible that their rest mass would not vary with the density of surrounding matter on account of the universal inverse square interaction with distance of all charged scatterable particles making them up with the charged scatterable particles making up the surrounding matter.

The more atoms will be regrouped, the more intense the inverse square Coulombian interaction will be between the charged quarks of the local set, causing a slackening of the structure of each triad involved, lessening the energy of the quarks carrier-photons, which ultimately will cause a lessening of the relativistic masses to be added to those of the quarks proper.

The effective masses of protons and neutrons as determined at the surface of the Earth can then only be less than those that would be measurable in deep space, far from any large accumulation of matter such as planets. Similarly, the effective masses of protons and neutrons located at the centre of the Earth can only be less than that of those located at the surface of the Earth.

Also, a seamless series of clearly defined interaction sequences now provides an uninterrupted path of causality from 1) the unquantized quantities of unidirectional kinetic energy induced in particles by natural acceleration through Coulomb or gravitational interaction as analyzed in Section VIII; 2) to the quantization in the form of free-moving photons of any quantity of this energy in excess of the precise amount required by the local stable or metastable electromagnetic equilibrium, also analyzed in Section VIII; 3) to the creation of electron-positron pairs from the destabilization of photons of energy 1.022 MeV or more as analyzed in ([8]); 4) to the creation of protons and neutrons from the interaction of electrons and positrons forced into groups of three including both types in sufficiently small volumes of space with insufficient energy to escape mutual capture as analyzed in this paper; 5) to the final shedding in the form of neutrino energy of momentary metastable excess mass (different from momentary relativistic mass increase due to velocity) as overexcited newly created massive elementary particles (electrons, muons and tau particles) are forced by local electromagnetic equilibrium into reaching their lowest possible rest mass as analyzed in ([23]).

REFERENCES

[1]. Breidenbach M. et al. (1969) **Observed Behavior of Highly Inelastic Electron-Proton Scattering**, Phys. Rev. Let., Vol. 23, No. 16, 935-939.

[2]. Walter Greiner & Joachim Reinhardt, **Quantum Electrodynamics**, Second Edition, Springer Verlag New York Berlin Heidelberg, 1994.

[3]. M. Haïssinsky. **La chimie nucléaire et ses applications**, France, Masson et Cie, Éditeurs, 1957.

[4]. Hanson, G, Agrams G.S. et al. (1975). **Evidence for Jet Structure in Hadron Production by e+ e- Annihilation.** Phys. Rev. Let., Vol. 35, No. 24, 1609-1612.

[5]. André Michaud. **On The Magnetostatic Inverse Cube Law and Magnetic Monopoles**. International Journal of Engineering Research and Development e-ISSN: 2278-067X, p-ISSN: 2278-800X, www.ijerd.com. Volume 7, Issue 5 (June 2013), PP.50-66. (http://www.ijerd.com/paper/vol7-issue5/H0705050066.pdf).

[6]. Robert Resnick & David Halliday. **Physics**. John Wyley & Sons, New York, 1967.

[7]. André Michaud. **Expanded Maxwellian Geometry of Space**, 4th edition, SRP Books, 2004. Available in various eBook formats at: https://www.smashwords.com/books/view/163704.

[8]. André Michaud. **The Mechanics of Electron-Positron Pair Creation in the 3-Spaces Model**. International Journal of Engineering Research and Development, e-ISSN: 2278-067X, p-ISSN: 2278-800X, www.ijerd.com Volume 6, Issue 10 (April 2013), PP. 36-49. (http://ijerd.com/paper/vol6-issue10/F06103649.pdf).

[9]. André Michaud. **Field Equations for Localized Individual Photons and Relativistic Field Equations for Localized Moving Massive Particles**. International IFNA-ANS Journal, No. 2 (28), Vol. 13, 2007, p. 123-140, Kazan State University, Kazan, Russia. (Also available online at http://www.gsjournal.net/Science-Journals/Essays/View/2257).

[10]. Particle Data Group. **Review of Particle Physics,** Volume 15 – Number 10-4.2000.

[11]. André Michaud. **The Corona Effect.** The General Science Journal. 2009. http://www.gsjournal.net/Science-Journals/Essays/View/2262.

[12]. Yvette Cauchois. **Atomes, Spectres, Matière**. Éditions Albin Michel, Paris, 1952.

[13]. André Michaud. **On the Electron Magnetic Moment Anomaly**. International Journal of Engineering Research and Development. e-ISSN: 2278-067X, p-ISSN: 2278-800X, www.ijerd.com. Volume 7, Issue 3 (May 2013), PP. 21-25. (http://ijerd.com/paper/vol7-issue3/E0703021025.pdf).

[14]. André Michaud. **The Expanded Maxwellian Space Geometry and the Photon Fundamental LC Equation**, International Journal of Engineering Research and Development, e-ISSN: 2278-067X, p-ISSN: 2278-800X, www.ijerd.com, Volume 6, Issue 8 (April 2013), PP. 31-45. (http://ijerd.com/paper/vol6-issue8/G06083145.pdf).

[15]. André Michaud. **Deriving ε_0 and μ_0 from First Principles and Defining the Fundamental Electromagnetic Equations Set**. International Journal of Engineering Research and Development. e-ISSN: 2278-067X, p-ISSN: 2278-800X, www.ijerd.com. Volume 7, Issue 4 (May 2013), PP. 32-39. (http://ijerd.com/paper/vol7-issue4/G0704032039.pdf).

[16]. David R. Lide, Editor-in-chief. **CRC Handbook of Chemistry and Physics**. 84th Edition 2003-2004, CRC Press, New York. 2003.

[17]. André Michaud. **Inside planets and stars masses.** The General Science Journal. 2009. http://www.gsjournal.net/Science-Journals/Essays/View/2263.

[18]. André Michaud. **On the Einstein-de Haas and Barnett Effects**. International Journal of Engineering Research and Development. e-ISSN: 2278-067X, p-ISSN: 2278-800X, www.ijerd.com Volume 6, Issue 12 (May 2013), PP. 07-11. (http://ijerd.com/paper/vol6-issue12/B06120711.pdf).

[19]. G. Goldhaber et al, **Observation in e+ e- Annihilation of a Narrow State at 1865 MeV/c^2 Decaying to Kπ and K$\pi\pi\pi$**, Phys. Rev. Let. Vol. 37 No.5, 255 (1976).

[20]. Markus Aschwanden. **Physics of the Solar Corona,** Springer, (2006).

[21]. Maurice Duquesne. **Matière et Antimatière.** Collection Que sais-je #767, Presses Universitaires de France, 1968.

[22]. André Michaud. **From Classical to Relativistic Mechanics via Maxwell**. International Journal of Engineering Research and Development, e-ISSN: 2278-067X, p-ISSN: 2278-800X, www.ijerd.com. Volume 6, Issue 4 (March 2013), PP. 01-10. (http://ijerd.com/paper/vol6-issue4/A06040110.swf).

[23]. André Michaud. **The Mechanics of Neutrinos Creation in the 3-Spaces Model**. International Journal of Engineering Research and Development. **e-**ISSN: 2278-067X, **p-**ISSN: 2278-800X, www.ijerd.com. Volume 7, Issue 7 (June 2013), PP. 01-08. (http://www.ijerd.com/paper/vol7-issue7/A07070108.pdf).