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THE ETHERINO AND/OR THE NEUTRINO HYPOTHESIS

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By using a language as accessible to as broad an audience as possible, in this paper we identify serious insufficiencies of the neutrino and quark hypotheses for the synthesis of the neutrons from protons and electrons inside stars according to the familiar reaction $p^+ + \bar{\nu} + e^- \rightarrow n$. We introduce, apparently for the first time, the hypothesis that the energy and spin needed for the synthesis of the neutron originate either from the environment or from the ether conceived as a universal medium with very high energy density via an entity here called *etherino,* denoted with the letter "a" (from the Latin aether), carrying mass and charge 0, spin $\frac{1}{2}$ and 0.78 MeV energy according to the synthesis $p^+ + a + e^- \rightarrow n$. We identify the compatibility $p^+ + a + e^- \rightarrow n \rightarrow p^+ + e^- + \bar{\nu}$ and the incompatibility condition $p^+ + a + e^- \rightarrow n \rightarrow p^+ + e^- + \bar{a}$ of the neutrino and etherino hypotheses, the latter representing the possible return of missing features to the ether, without being necessarily in conflict with neutrino experiments. We review the new structure model of the neutron and hadrons at large with massive physical constituents produced free in the spontaneous decays as permitted by the covering hadronic mechanics. We show its compatibility with the standard model when interpreted as only providing the final Mendeleev-type classification of hadrons. We point out basically new clean energies predicted by the new model. We indicate new experiments confirming the above studies although in a preliminary form. Finally, we conclude with the proposal of new experiments suggested for the much needed search of new clean energies.

1. HISTORICAL NOTES

In 1920, Rutherford [1a] submitted the hypothesis that hydrogen atoms in the core of stars are compressed into new particles having the size of the proton that he called *neutrons,* according to the synthesis

$$p^+ + e^- \rightarrow n. \tag{1.1}$$

The existence of the neutron was confirmed in 1932 by Chadwick [1b]. However, Pauli [1c] noted that the spin 1/2 of the neutron cannot be represented via a quantum state of two particles each having spin 1/2, and conjectured the possible emission of a new neutral massless particle with spin 1/2. Fermi [1d] adopted Pauli's conjecture, coined the name *neutrino* (meaning in Italian "little neutron") with symbol ν for the particle and $\bar{\nu}$ for the antiparticle, and developed the theory of *weak interactions* according to which the synthesis of the neutron is given by

$$p^+ + e^- \to n + \nu, \tag{1.2}$$

with inverse reaction, the spontaneous decay of the neutron,

$$n \to p^+ + e^- + \bar{\nu}. \tag{1.3}$$

where we have assumed isolated neutrons.

The above hypothesis was more recently incorporated into the so-called *standard model* (see, e.g., [1e]) in which the original neutrino was extended to three different particles, the *electron, muon and tau neutrinos* and their antiparticles. Neutrinos were then assumed to have masses, then to have different masses derived from the fit of experimental data, and then to "oscillate" (namely, to change "flavor" or transform one type into the other).

2. INSUFFICIENCIES OF NEUTRINO HYPOTHESIS

Despite historical advances, the neutrino hypothesis has remained afflicted by a number of basic, although generally unspoken insufficiencies, that can be summarized as follows:

1) According to the standard model, a neutral particle carrying mass and energy in our spacetime is predicted to cross very large hyperdense media, such as those inside stars, without any collision. Such a view is outside scientific reason because already questionable when the neutrinos were assumed to be massless. The recent use of massive neutrinos has rendered the view beyond the limit of plausibility because a massive particle carrying energy in our spacetime simply cannot propagate within hyperdense media inside large collections of hadrons without any collision. The general belief that this is due to the very low value of the cross section between neutrinos and other particles casts shadows on the theory rather than resolving the conceptual uneasiness here considered.

2) The fundamental reaction for the production of the (electron) neutrino, Eq. (1.2), violates the principle of conservation of the energy, unless the proton and the electron have kinetic energy of at least 0.78 MeV, in which case there is no energy available for the neutrino. In fact, the sum of the rest energies of the proton and the electron (938.78 MeV) is 0.78 MeV *smaller* than the neutron rest energy (939.56 MeV).

3) As reported in nuclear physics textbooks, the energy measured as being carried by the electron in beta decays follows a bell-shaped curve with a maximum value of the order of 0.782 MeV (depending on nuclear data). The "missing energy" (as the difference between $0.78MeV$ and the electron energy) has been assumed throughout the 20-th century to be carried by the hypothetical neutrino. However, in view of the strongly attractive Coulomb interactions between the nucleus and the electron, the energy carried by the electron is expected to depends on the direction of emission, with maximal value for radial emission and minimal value for tangential emission (Figure 1). Despite a laborious search, the author has been unable to identify in the literature much needed calculations of this aspect because if the "missing energy" is entirely absorbed by the nucleus, then there is, again, no energy left for the neutrino.

4) The claims of "experimental detection" of neutrinos are perhaps more controversial than the theoretical aspects because of numerous reasons, such as: the lack of established validity of the scattering theory (se Figure 2); the elaboration of the data via a theory centrally dependent on the

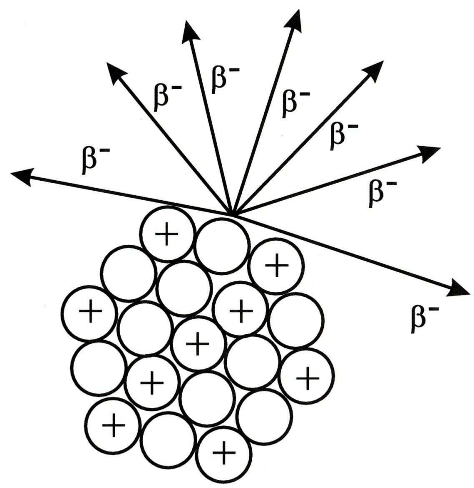

Figure 1: *A conceptual illustration of the expected dependence of the kinetic energy of the electron in nuclear beta decays on the direction of emission due to the strongly attractive Coulomb interaction between the positively charged nucleus and the negatively charged electron.*

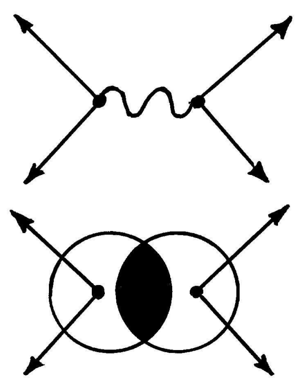

Figure 2: *A schematic illustration of the lack of established validity of the conventional (quantum) scattering theory in the elaboration of neutrino experiments due to the abstraction of all particles as massive points (top view), while particles used in neutrino experiments are extended with hyperdense medium resulting in deep overlappings and mutual penetrations (bottom view). The latter conditions require a broader scattering theory including nonlocal, nonlinear and non-Hamiltonian effects under which the claimed experimental results are not expected to remain necessarily valid.*

neutrino hypotheses; the presence in recent "neutrino detectors" of radioactive sources that could themselves account for the extremely few events over an enormous number of total events; the lack of uniqueness of the neutrino interpretation of experimental data due to the existence of alternative interpretations without the neutrino hypothesis; and other aspects.

5) Numerous additional insufficiencies exist, such as the absence of well identified physical differentiations between the electron, muon and tau neutrino; the theory contains an excessive number of parameters essentially capable to achiever any desired fit, and other problems studied in Section 4.

For additional studies on the insufficiencies of the neutrino hypothesis, one may consult Bagge [2a] and Franklin [2b] for an alternative theories without the neutrino hypothesis; Wilhelm [2c] for additional problematic aspects; Mössbauer [2d] for problems in neutrino oscillations; Fanchi [2e] for apparent serious biases in "neutrino experiments"; and literature quoted therein.

3. INSUFFICIENCIES OF QUARK HYPOTHESIS

The view expressed by the author since the birth of quark theories (see memoir [3a] of 1981) is that SU(3) color theories and more recently the standard model have provided the final Mendeleev-type, classification of particles into families. Quarks are necessary for the elaboration of the theory. However, on ground of strict scientific rigor, quarks should be solely defined as purely mathematical representations of a purely mathematical internal symmetry solely definable on a purely mathematical, complex-valued unitary space. By contrast, numerous unresolved (and generally unspoken) insufficiencies emerge whenever quarks are assumed as physical particles existing in our spacetime, such as:

1) According to the standard model [1e], at the time of the synthesis of the neutron according to Eq. (1.2), the proton and the electron literally "disappear" from the universe to be replaced by hypothetical quarks as neutron constituents. Moreover, at the time of the neutron spontaneous decay, Eq. (1.3), the proton and the electron literally "reappear" again into our spacetime. This view is beyond scientific reason, because the proton and the electron are the only *permanently stable* massive particles clearly established so far and, as such, they simply cannot "disappear" from our universe and then "reappear" just because so desired by quark supporters. The *only* plausible hypothesis under Eqs. (1.2) and (1.3) is that the proton and the electron are actual physical constituents of the neutron as originally conjectured by Rutherford, although the latter view requires the adaptation of our theories to physical reality, rather than the opposite attitude implemented by quark theories of adapting physical reality to preferred theories.

2) When interpreted as physical particles in our spacetime, irrespective of whether we refer to mass or energy, *quarks cannot experience any gravity.* As clearly stated by Albert Einstein in his limpid writings, gravity can only be defined in spacetime, while quarks can only be defined in the mathematical, internal, complex valued unitary space with no known connection to our spacetime. In particular, O'Rafearthaigh's theorem prohibits the validity for quarks of our spacetime symmetries. Consequently, physicists who support the hypothesis that quarks are the physical constituents of protons and neutrons, thus of all nuclei, should see their body levitate due to the absence of gravity.

3) When, again, interpreted as physical particles in our spacetime, *quarks cannot have any inertia.* In fact, inertia can only be rigorously admitted for the eigenvalues of the second order Casimir invariant of the Poincaré symmetry, while quarks cannot be defined via such a basic

spacetime symmetry, as expected to be known by experts to qualify as such. Consequently, "quark masses" are purely mathematical parameters deprived of technical characterization as masses in our spacetime, thus being mere *ad hoc* parameter to reach pre-set fits.

4) Even assuming that, with unknown scientific manipulations, the above insufficiencies are resolved, it is known by experts that quark theories at the level of first quantization have failed to achieve a representation of *all* characteristics of hadrons, with catastrophic insufficiencies in the representation of spin, magnetic moment, mean lives, charge radii and other basic features of hadrons. Of course QCD and gauge theories have provided deeper insights, but not a resolution of the controversies due to the inability to reach exact solutions of nonlinear partial differential equations.

5) It is also known by experts that the application of quark conjectures to the structure of nuclei has multiplied the controversies, while resolving none of them. As an example, the assumption that quarks are the physical constituents of protons and neutrons in nuclei has failed to achieve a representation of the main characteristics of the simplest possible nucleus, the deuteron. In fact, quark conjectures as physical particles in our spacetime are unable to represent the spin 1 of the deuteron (since they predict spin zero in the ground state of two particles each having spin $\frac{1}{2}$); quark conjectures are unable to represent the anomalous magnetic moment of the deuteron despite all possible relativistic corrections attempted for decades (because the presumed quark orbits are too small to fit data following polarizations or deformations); quark conjectures are unable to represent the stability of the neutron when a deuteron constituent; quark conjectures are unable to represent the charge radius of the deuteron, and when passing to larger nuclei, such as the zirconium, the catastrophic inconsistencies of quark conjectures can only be defined as being embarrassing.

For additional references, one may consult Ref. [3a] on historical reasons preventing quarks to be physical particles in our spacetime; Ref. [3b] on a technical treatment of the impossibility for quarks to have gravity or inertia; Ref. [3c] on a more detailed presentation on the topic of this section; and Refs. [7,9g,9h] for general studies.

The implications of the above insufficiencies are rather serious. In fact, they imply that the identification of the hadronic constituents with physical particles truly existing in our spacetime is more open than ever and carries ever increasing societal implications since the assumption that quarks are physical constituents of hadrons prevents due scientific process on alternative models admitting new clean energies so much needed by mankind, as illustrated later on.

Alternatively, we can say that the above insufficiencies of quark conjectures as physical particles in our spacetime render the current status of hadron physics essentially equivalent to our knowledge of atoms at the beginning of the 20-th century, namely, prior to the discovery of their structure. We did have at that time the Mendeleev-classification of atoms into families, but we had yet to initiate the study of the structure of individual atoms. Similarly, at this writing SU(3) color theories and the standard model have indeed provided the final classification of hadrons into family. However, on serious scientific ground the structure of individual hadrons of a given SU(3)-multiplet must be indicated as being unknown.

Needless to say, all alternative structure models, including those without neutrino and quark conjectures must achieve full compatibility with the unitary models of classification, in essentially the same way according to which quantum structures of atoms achieved full compatibility with their Mendeleev classification.

On historical grounds, the classification of nuclei, atoms and molecules required *two different models,* one for the classification into families and a separate model for the structure of the individual elements of a given family. Quark theories depart from this historical teaching because of their original conception of attempting to represent with one single theory both the classification and the structure of hadrons. Admittedly, in recent times quarks are differentiated whether characterizing classification and structure, but the problematic aspect persists because caused by the belief that one single theory can represent the totality of the phenomenology of particles .

The view advocated in this paper is that, quite likely, history will repeat itself. The transition from the Mendeleev classification of atoms to the atomic structure required a basically new theory, quantum mechanics, due to the large differences existing in the classification and structure of atoms. Similarly, the transition from the Mendeleev-type classification of hadrons to the structure of individual hadrons will require a broadening of the basic theory, this time a generalization of quantum mechanics due to the truly dramatic differences of the dynamics of particles moving in vacuum, as in the atomic structure, to the dynamics of particles moving within hyperdense media as in the hadronic structure.

4. INAPPLICABILITY OF QUANTUM MECHANICS FOR THE SYNTHESIS AND STRUCTURE OF THE NEUTRON AND OF HADRONS AT LARGE

The author has repeatedly stated in his works that quantum mechanics has a majestic axiomatic structure and impressive verifications for the conditions of its original conception. Hence, in this section we are certainly not expressing doubt on the validity of quantum mechanics, but rather on its applicability for conditions dramatically different than those of its original conception.

To the author's best knowledge following studies in the field during the past three decades, the representation of the synthesis of the neutron according to quantum mechanics according to either the familiar reaction

$$p^+ + e^- \rightarrow n + \nu, \tag{4.1}$$

or the complementary reaction

$$p^+ + \bar{\nu} + e^- \rightarrow n, \tag{4.2}$$

is impossible for the following reasons:

1) Synthesis (4.1) generally violates the principle of conservation of the energy unless it is explicitly stated that the l.h.s. carries $0.78MeV$ kinetic energy, in which case there is no energy left for the neutrino. This is due to the fact that the sum of the masses of the proton and of the electron,

$$m_p + m_e = 938.272\,\mathrm{MeV} + 0.511\,\mathrm{MeV} = 938.783\,\mathrm{MeV}, \tag{4.3}$$

is *smaller* than the mass of the neutron, $m_n = 939.565$ MeV, with "positive" mass defect

$$m_n - (m_p + m_e) = 939.565 - (938.272 + 0.511)\,\mathrm{MeV} = 0.782\,\mathrm{MeV}. \tag{4.4}$$

2) Assuming that the proton and the electron have a relative kinetic energy of (at least) $0.78MeV$, synthesis (4.1) remains impossible according to quantum mechanics because, at that value of the energy, the proton-electron cross section is excessively small (about $10^{-20} barns$).

3) Assuming that the relative kinetic energy of protons and electrons is sufficiently small to allow a meaningful value of their cross section, synthesis (4.1) would require a *positive* binding-like energy, in which case quantum equations become physically inconsistent in the sense that mathematical solutions are indeed admitted, but the indicial equation of Schrödinger's equation no longer admits

the representation of the total energy and other physical quantities with real numbers. In fact, as well known, all quantum bound states, such as those for nuclei, atoms and molecules, have a *negative* binding energy that results in "negative" mass defect (readers seriously interested in studying the synthesis of the neutron as well as of hadrons at large are suggested to attempt the solution of any quantum bound state in which the conventional negative binding energy is turned into a positive value).

4) Assuming that the above problems are somewhat resolved via a manipulation of Schrödinger equation, it is impossible for quantum mechanics to achieve a meaningful representation of: the meanlife of the neutron of $15'$ (since quantum mechanics would predict a meanlife of the order of $10^{-19}s$); the anomalous magnetic moment of the neutron $\mu_n = -1.913\mu_N$ (that, when computed from the magnetic moments of the proton $\mu_p = 2.792\mu_N$ and of the electron $\mu_e = 1.001\mu_B$ would be wrong even in the sign); and of the neutron charge radius $R = 10^{-13}cm$ (since Bohr's radius $R = 10^{-8}cm$ is the smallest radius permitted by quantum mechanics for a "stable" bound state of a proton and an electron).

5) The impossibility for quantum mechanics to reach meaningful representation of the synthesis of the neutron is multiplied, rather than resolved, by complementary synthesis (4.2) because, being an antiparticle, the antineutrino carries a *negative* energy, rather than the needed positive energy and, in any case, the cross section of antineutrinos on protons and/or electrons must be assumed as being null for any serious study.

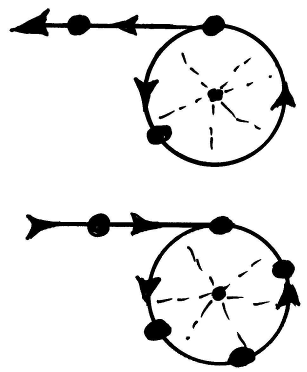

Figure 3: *A schematic view of the transformation of linear into angular motion and vice-versa that could play a crucial role in the synthesis of the neutron and its stimulated decay. Note that such a transformation is outside the capabilities of the Poincaré symmetry due to its sole validity for Keplerian systems, that is, for massive points orbiting around a heavier nucleus without collisions. By comparison, the transformation of this figure requires the presence of subsidiary constraints altering the conservation laws, thus altering the very structure of the applicable symmetry.*

It should be noted that the above insufficiencies of quantum mechanics generally apply for the synthesis of all hadrons, beginning with that for the neutral pion

$$e^+ + e^- \rightarrow \pi^o, \tag{4.5}$$

where the "positive binding energy" is now of 133.95 MeV.

The view advocated by the author since 1978 (see later on Ref. [5a]) is that, rather than avoiding the study of the synthesis of the neutron and of hadrons at large just because not permitted by quantum mechanics (as done throughout most of the 20-th century), a covering mechanics should be build in such a way to permit quantitative studies of said syntheses.

The most visible evidence indicating the lack of exact character of quantum mechanics for the synthesis and structure of hadrons is that, unlike atoms, *hadrons do not have nuclei.* Consequently, a mechanics that is exact for the atomic structure *cannot* be exact for the hadronic structure due to the lack of a Keplerian structure that, in turn, requires the necessary breaking of the fundamental Galilean and Lorentzian symmetries.

Quantum mechanics was conceived and constructed for the representation of the trajectories of electrons moving in vacuum in atomic orbits (this is the so-called *exterior dynamical problems*), in which case the theory received historical verifications. The same mechanics cannot possibly be exact for the description of the dramatically different physical conditions of the same electron moving within the hyperdense medium inside a proton (this is the so-called *interior dynamical problems*). Such an assumption literally implies the belief in the perpetual motion within a physical medium since it implies that an electron must orbit in the core of a star with a locally conserved angular momentum, as requested by the quantum axiom of the rotational symmetry and angular momentum conservation law.

In the final analysis it has been established by scientific history that the validity of any given theory within given conditions is set by the results. Quantum mechanics has represented *all* features of the hydrogen atom in a majestic way and, therefore, the theory is exactly valid for the indicated conditions.

By contrast, when extended to the structure of particles, quantum mechanics has only produced an interlocked chain of individually implausible and unverifiable conjectures on neutrinos and quarks while having dramatic insufficiencies in the representation of particle data, besides failing to achieve final results in various other branches of sciences, such as in nuclear physics, superconductivity, chemistry, biology and astrophysics.

After all these controversies protracted for such a long period of time under the use of very large public funds, there comes a time in which the serious conduction of serious science requires a re-examination of the foundational theories.

5. THE ETHERINO HYPOTHESIS

As clearly shown by the preceding analysis, the synthesis of the neutron according to Rutherford [1a] not only misses spin $\frac{1}{2}$ as historically pointed out by Pauli [1c] and Fermi [1d], but also misses 0.78 MeV energy. Moreover, these quantities must be *acquired* by the proton and electron for the synthesis to exist, rather than being "released" as in Eq. (4.1), while complementary reaction (4.2) is unacceptable for the reasons indicated in the preceding section.

Consequently, a central open problem in the synthesis of the neutron (as well as of hadrons at large) is the identification of "where" these quantities originate. The first evident answer is that the missing quantities originate from the environment in the interior of stars in which the neutron is synthesized. In fact, there is no doubt that the interior of stars can indeed supply spin $\frac{1}{2}$ and (at least) 0.78 MeV energy.

However, due to the fundamental character of the neutron synthesis for the entire universe, serious studies should not be solely restricted to the most obvious possibility, and should consider instead all plausible alternatives no matter how speculative they may appear at this time, for subsequent selection of the appropriate solution via direct experiments.

Along the latter lines, we recall the hypothesis of the continuous creation of matter in the universe that has been voiced repeatedly during the 20-th century. In this paper we point out, apparently for the first time, that the best possible mechanism for continuous creation is precisely the synthesis of neutrons inside stars under the assumption that the missing energy and spin originates from the ether conceived as a universal medium with an extremely large energy density.

Far from being farfetched, the hypothesis is supported by predictably insufficient, yet significant evidence, such as the fact that stars initiate their lives as being solely composed of hydrogen atoms that miss the energy and spin needed for the first synthesis, that of the neutron, after which all conventional nuclear syntheses follow.

Additionally, explicit calculations indicate that the immense energy needed for a supernova explosion simply cannot be explained via the sole use of conventional nuclear syntheses, particularly in view of the fact that supernova explosions occur at the end of the life of stars, thus suggesting again the possible existence of a mechanism extracting energy from the ether and transforming it into a form existing in our spacetime. The explanation of supernova explosions via gravitational collapse is perhaps more controversial than the nuclear one due to known problematic aspects of gravitational theories on a curved space. such as their verification of the "theorems of catastrophic inconsistencies" of noncanonical theories [5f.5g,7a].

It is important to point out that the notion of ether as a universal substratum appears to be necessary not only for the characterization and propagation of electromagnetic waves, but also for the characterization and propagation of all elementary particles and, therefore, for all matter existing in the universe.

The need for a universal medium for the characterization and propagation of electromagnetic "waves" is so strong to require no study here, e.g., for waves with 1-m wavelength for which the reduction of waves to photons for the purpose of eliminating the ether loses credibility.

The same notion of ether appears necessary also for the characterization and propagation of the electron, due to its structure as a "pure oscillation" of the ether, namely, an oscillation of one of its points without any oscillating mass as conventionally understood. Similar structures are expected for all other truly elementary particles.

It should be indicate that the above conception implies that, contrary to our sensory perception, *matter is totally empty as a conventionally perceives "solid" and space is totally full as a medium,* with the former being mere excitations of the latter, as suggested by the author since his high school studies [4a]. This conception was submitted to illustrate the lack of existence of the "ethereal wind" [4b] that delayed studies on the ether for at least one century, since motion of matter would merely require the transfer of the characteristic oscillations from given points of the ether to others. Mass is then characterized by the known equivalence of the energy of the characteristic oscillations, and inertia is the resistance provided by the ether against changes of motion [4a]. For additional recent views on the ether we refer interested readers to Ref. [4c].

In order to conduct quantitative studies of the above alternatives, in this paper we submit apparently for the first time the hypothesis that the synthesis of the neutron from protons and electrons occurs via the *absorption* either from the environment inside stars or from the ether of an "entity", here called *etherino* (meaning in Italian "little ether") and represented with the symbol "a" (from the Latin aether) having mass and charge 0, spin $\frac{1}{2}$ and a minimum of 0.78 MeV energy. We reach in this way the following

Etherino hypothesis on the neutron synthesis:

$$p^+ + a_n + e^- \rightarrow n, \tag{5.1}$$

where a_n denotes the *neutron etherino* (see below for other cases), and the energy 0.78 MeV is assumed to be "minimal" because of the presence of conventional "negative" binding energy due to the attractive Coulomb interactions between the proton and the electron at short distances. Hypothesis (5.1) is submitted in lieu of reaction

$$p^+ + \hat{\nu} + e^- \to n \tag{5.2}$$

due to the insufficiencies of the latter identified in Section 4.

In the author view, a compelling aspect supporting the etherino hypothesis is the fact that the synthesis of the neutron has the highest probability when the proton and the electron are at relative rest, while the same probability becomes essentially null when the proton and the electron have the (relative) missing energy of 0.78 MeV because, as indicated in Section 4, in that case their cross section becomes very small.

Another argument supporting the etherino over the antineutrino hypothesis is that the former permits quantitative studies on the synthesis of the neutron as we shall see in subsequent sections, while the latter provides none, as shown in the preceding section.

Still another supporting argument is that the etherino hypothesis eliminates the implausible belief that massive particles carrying energy in our spacetime can traverse enormous hyperdense media without collisions since the corresponding etherino event could occur via propagation of impulses through the ether as a universal substratum.

We are here referring to a possible directional event in the ether as a medium triggered by the decay of the neutron, its propagation through the ether as a longitudinal wave, and its possible detection via the triggering of particle events currently interpreted as caused by neutrino scattering.

In order to prevent the invention of additional hypothetical particles over an already excessive number of directly undetectable particles existing in contemporary physics, the author would like to stress that *the etherino is not intended to be a conventional particle, but an entity representing the transfer of the missing quantities from the environment or the ether to the neutron.* The lack of characterization as a conventional physical particle will be made mathematically clear in the next sections.

It is evident that the etherino hypothesis requires a reinspection of the spontaneous decay of the neutron. To conduct a true scientific analysis, rather than adopt a scientific religion, it is necessary to identify all plausible alternatives, and then reach a final selection via experiments. We reach in this way the following *three* possible alternatives:

First hypothesis on the neutron decay:

$$p^+ + a_n + e^- \to n \to p^+ + e^- + \bar{\nu}, \tag{5.3}$$

namely, the etherino hypothesis for the neutron "synthesis" could be fully compatible with the neutrino hypothesis for the neutron "decay";

Second hypothesis on the neutron decay:

$$p^+ + a_n + e^- \to n \to p^+ + e^- + a_n, \tag{5.4}$$

namely, the missing energy and spin could be returned to the environment or the ether, a process here symbolically represented with a_n; and

Third hypothesis on the neutron decay:

$$p^+ + a_n + e^- \to n \to p^+ + e^-, \tag{5.5}$$

namely, no neutrino or etherino is released in the neutron decay, all energy being absorbed by the emitted protons and electrons.

Note that the latter case is strictly prohibited by quantum mechanics because of known symmetries. However, the latter case should not be dismissed superficially without due stuidy because it is indeed admitted by the covering hadronic mechanics via the conversion of the orbital into the kinetic motion as in Fig. 3.

Note also that *the continuous creation of matter is only possible for case* (5.3 because, by conception, such a creation requires first the transfer of energy from the ether to our spacetime, here represented with the etherino hypothesis on the neutron synthesis, Eq. (5.1), and then the permanence in our spacetime of the acquired energy, here represented with Eq. (5.3). These two conditions are absent in all other possibilities.

By recalling the impossibility for antineutrino to participate in the neutron synthesis proved in Section 4, we can say that, rather than being in conflict with each other, *the etherino hypothesis may well turn out to be in strong support of the existence of neutrinos in neutron decays,* as illustrated in Section 9 on available experimental data. This intriguing occurrence, when combined with the other possibilities, illustrate the title selected for this paper "The etherino and/or the neutrino hypothesis."

In summary, it should be stressed that *the etherino hypothesis does not imply the necessary abandonment of the neutrino hypothesis.* However, after studying the synthesis of the neutron for decades, *the author is aware of no theoretical and/or experimental evidence that either excludes or establishes the existence of the neutrino in a final form,* and this illustrate the complexity of the problem.

The synthesis of the antineutron in the interior of antimatter stars is evidently given by

$$p^- + \bar{a}_{\bar{n}} + e^+ \rightarrow \bar{n}. \tag{5.6}$$

where $\bar{a}_{\bar{n}}$ is the *antineutron antietherino,* namely an entity carrying negative energy as apparently necessary for antimatter [5,7c]. This would imply that the ether is constituted by a superposition of very large but equal densities of positive and negative energies existing in different yet coexisting spacetimes, a concept permitted by the isodual representation of antimatter [7c] with even deeper cosmological and epistemological implications since their total null value would avoid discontinuities at creation.

For the synthesis of the neutral pion we have the hypothesis

$$e^+ + a_{\pi^o} + e^- \rightarrow \pi^o, \tag{5.7}$$

where a_{π^o} is the π^o*-etherino,* namely, an entity carrying mass, charge and spin 0 and minimal energy of 133.95 MeV transferred from the ether to our spacetime. Numerous similar additional forms of etherinos can be formulated depending on the hadron synthesis at hand.

The understanding of synthesis (5.7) requires advanced knowledge of modern classical and operator theories of antimatter (see monograph [7c]) because a_{π^o} must be *iso-self-dual,* namely, it must coincide with its antiparticle as it is the case for the π^o. In more understandable terms, a_{π^o} represents an equal amount of positive and negative energy, since only the former (latter) can be acquired by the electron (positron), the sign of the total energy for isoselfdual states being that of the observer [*loc. cit.*].

Intriguingly, the etherino hypothesis for the neutron *decay,* Eq. (5.4), is not necessarily in conflict with available data on neutrino experiments, because said hypothesis could provide their mere re-interpretation as a new form of communication through the ether. Moreover, in the event the propagation of the latter event results to be longitudinal as expected, its speed is predicted to be a large multiple of the speed of conventional (transversal) electromagnetic waves.

In the final analysis, the reader should not forget that, when inspected at interstellar or intergalactic distances, communications via electromagnetic waves should be compared to the communications by the American Indians with smoke signals. The search for basically new communications much faster than those via electromagnetic waves is then mandatory for serious astrophysical advances at interstellar distances. In turn, such a search can be best done via longitudinal signals propagating through the ether. Then, the possibility of new communications being triggered by the etherino reinterpretation of neutrino experiments should not be aprioristically dismissed without serious study.

6. RUDIMENTS OF THE COVERING HADRONIC MECHANICS

When at the Department of Physics of Harvard University in the late 1970s, R. M. Santilli [5a] proposed the construction of a new broader realization of the axioms of quantum mechanics under the name of *hadronic mechanics* that was intended for the solution of the insufficiencies of conventional theories outlined in the preceding sections. The name "hadronic mechanics" was selected to emphasize the primary applicability of the new mechanics at the range of the strong interactions, since the validity of quantum mechanics for bigger distances was assumed *a priori.*

The central problem was to identify a broadening-generalization of quantum mechanics in such a way to represent linear, local and potential interactions, as well as additional, contact, nonlinear, nonlocal-integral and nonpotential interactions, as expected in the neutron synthesis. as well as in deep mutual penetration and overlapping of hadrons (Figure 2) under the following:

CONDITION I; The covering mechanics must exist from the class of unitary equivalence of quantum mechanics, that is, its time evolution must violate the unitary condition on a conventional Hilbert space, as a necessary condition to set the premises for a quantitative treatment of the synthesis of the neutron and hadrons at large due to the insufficiency of unitary time evolutions indicated in preceding sections;

CONDITION 2: Since systems entirely represented by a conventional Hermitean Hamiltonian characterize linear, local and potential interactions with unitary time evolution, the covering mechanics must identify a second quantity capable of representing contact, nonlinear, nonlocal and nonpotential interactions that, by conception, are outside the capability of a Hamiltonian and, hence, of quantum mechanics.

CONDITION 3: The covering mechanics must verify the same *time invariance* as possessed by quantum mechanics, namely, the broader mechanics has to predict the same numerical values under the same conditions at different times.

It was evident that a solution verifying the above conditions required *new mathematics, i.e. new numbers, new spaces, new geometries, new symmetries, etc.* A detailed search in advanced mathematical libraries of the Cantabridgean area revealed that the needed new mathematics simply did not exist and, therefore, had to be built.

Following a number of (unpublished) trials and errors, Santilli [5a] proposed the solution consisting in the representation of contact, nonlinear, nonlocal and nonpotential interactions via a *generalization (called lifting) of the basic unit* $\hbar = +1$ of quantum mechanics into a function, a matrix or an operator $\hat{I}$ that is positive-definite like +1, but otherwise has an arbitrary functional dependence on all needed quantities, such as time t, coordinates r, momenta p, density μ, frequency ω, wavefunctions ψ, their derivatives $\partial\psi$, etc.

$$\hbar = +1 > 0 \quad \rightarrow \quad \hat{I}(t,\, r,\, p,\, \mu,\, \omega,\, \psi,\, \partial\psi,\, ...) = \hat{I}^\dagger = 1/\hat{T} > 0, \tag{6.1}$$

while jointly lifting the conventional associative product $\times$ between two generic quantities A, B (numbers, vector fields, matrices, operators, etc.) into the form admitting $\hat{I}$, and *no longer* $+1$, as the correct left and right unit

$$A \times B \quad \rightarrow \quad A \hat{\times} B = A \times \hat{T} \times B, \tag{6.2a}$$

$$1 \times A = A \times 1 = A \quad \rightarrow \quad \hat{I} \hat{\times} A = A \hat{\times} \hat{I} = A, \tag{6.2b}$$

for all elements A, B of the set considered.

The representation of non-Hamiltonian effects with a generalization of the basic unit resulted to be unique for the verification of the above three conditions. As an illustration, whether generalized or not, the unit is the basic invariant of any theory. The representation of non-Hamiltonian interactions with the basic unit permitted the crucial by-passing of the theorems of catastrophic inconsistencies of nonunitary theories [5f,5g,7a]. Since the unit is the ultimate pillar of all mathematical and physical formulations, liftings (6.1) and (6.2) required a corresponding compatible lifting of the *totality* of the mathematical and physical formulations used by quantum mechanics, resulting indeed into new numbers, new fields, new spaces, new algebras, new geometries, new symmetries, etc. [5b,5c]. Mathematical maturity in the formulation of the new numbers was reached only in memoir [5b] of 1993 and general mathematical maturity was reached in memoir [5c] of 1996. Physical maturity was then quickly achieved in papers [5d–5g].

These studies provided a form of "completion" of quantum mechanics essentially along the EPR argument in the sense of extending the *realization* of abstract quantum axioms to admit nonunitary theories or, equivalently, non-Hamiltonian interactions and effects, but without any alteration of the axioms themselves, as we shall see.

The fundamental dynamical equations of hadronic mechanics were submitted by Santilli in the original proposal [5a], are today called *Heisenberg-Santilli isoequations,* and can be written in the finite form

$$\hat{A}(\hat{t}) = \hat{U}(\hat{t}) \hat{\times} \hat{A}(\hat{0}) \hat{\times} \hat{U}^\dagger(\hat{t}) = (\hat{e}^{\hat{H} \hat{\times} \hat{t} \hat{\times} \hat{i}}) \hat{\times} \hat{A}(\hat{0}) \hat{\times} (\hat{e}^{-\hat{i} \hat{\times} \hat{t} \hat{\times} \hat{H}}) =$$
$$= [(e^{H \times \hat{T} \times t \times i}) \times \hat{I}] \times \hat{T} \times A(0) \times \hat{T} \times [\hat{I} \times (e^{-i \times t \times \hat{T} \times H})] =$$
$$= (e^{H \times \hat{T} \times t \times i}) \times \hat{A}(\hat{0}) \times (e^{-i \times t \times \hat{T} \times H}), \tag{6.3a}$$

$$\hat{U} = \hat{e}^{i \times H \times t}, \quad \hat{U}^\dagger = \hat{e}^{-i \times t \times \times H}, \quad \hat{U} \hat{\times} \hat{U}^\dagger = \hat{U} \hat{\times} \hat{U} = \hat{I} \neq 1, \quad [H, \hat{T}] \neq 0, \tag{6.3b}$$

and infinitesimal form

$$\hat{i} \hat{\times} \frac{\hat{d}\hat{A}}{\hat{d}\hat{t}} = i \times \hat{I}_t \times \frac{d\hat{A}}{d\hat{t}} = [\hat{A} \hat{,} \hat{H}] = \hat{A} \hat{\times} \hat{H} \hat{-} \hat{H} \hat{\times} \hat{A} =$$
$$= \hat{A} \times \hat{T}(\hat{t},\, \hat{r},\, \hat{p},\, \hat{\psi},\, \hat{\partial}\hat{\psi},\, ...) \times \hat{H} - \hat{H} \times \hat{T}(\hat{t},\, \hat{r},\, \hat{p},\, \hat{\psi},\, \hat{\partial}\hat{\psi},\, ...) \times \hat{A}, \tag{6.4}$$

where Eq. (6.3b) represents the crucial *nonunitarity-isounitary property,* namely, the violation of unitarity on conventional Hilbert spaces over a field, and its reconstruction on *iso-Hilbert spaces* over *isofields* with inner product $< \hat{\psi} | \hat{\times} | \hat{\psi} >$; we have used in Eqs. (6.3a) the notion of *isoexponentiation,* see Eq. (6.14d); all quantities with a "hat" are formulated on isospaces over isofields with isocomplex numbers $\hat{c} = c \times \hat{I}$, $c \in C$; and one should note the *isodifferential calculus* with expressions of the type $\hat{d}/\hat{d}\hat{t} = \hat{I}_t \times d/d\hat{t}$ first achieved in memoir [5c].

The equivalent lifting of Schrödinger's equation was suggested by Santilli and other authors over conventional fields, thus violating the condition of time invariance (see [7a] for historical notes and quotations). The final version was reached by Santilli in memoir [5c] following the construction of the *isodifferential calculus* and can be written

$$\hat{i}\hat{\times}\frac{\hat{\partial}}{\hat{\partial}\hat{t}}|\hat{\psi}>= i \times \hat{I}_t \times \frac{\partial}{\partial \hat{t}}|\hat{\psi}>= \hat{H}\hat{\times}|\hat{\psi}>=$$

$$= \hat{H}(\hat{t},\, \hat{r},\, \hat{p}) \times \hat{T}(\hat{r},\, \hat{p},\, \hat{\psi},\, \hat{\partial}\hat{\psi},\, ...) \times |\hat{\psi}>= \hat{E}\hat{\times}|\hat{\psi}>= E \times |\hat{\psi}>, \tag{6.5a}$$

$$\hat{p}_k\hat{\times}|\hat{\psi}>= -\hat{i}\hat{\times}\hat{\partial}_k|\hat{\psi}>= -i \times \hat{I}^i_k \times \partial_i|\hat{\psi}>, \tag{6.5b}$$

with *isocanonical commutation rules*

$$[\hat{r}^i \hat{,} \hat{p}_j] = \hat{i}\hat{\times}\hat{\delta}^i_j = i \times \delta^i_j \times \hat{I}, [\hat{r}^i, \hat{r}^j] = [\hat{p}_i, \hat{p}_j] = 0, \tag{6.6}$$

isoexpectation values

$$< \hat{A} >= \frac{< \hat{\psi}|\hat{\times}\hat{A}\hat{\times}|\hat{\psi} >}{< \hat{\psi}|\hat{\times}|\hat{\psi} >}, \tag{6.7}$$

and basic properties

$$\frac{< \hat{\psi}|\hat{\times}\hat{I}\hat{\times}|\hat{\psi} >}{< \hat{\psi}|\hat{\times}|\hat{\psi} >} = \hat{I}, \quad \hat{I}\hat{\times}|\hat{\psi} >= |\hat{\psi} >, \quad \hat{I}^{\hat{n}} = \hat{I}\hat{\times}\hat{I}\hat{\times}...\hat{I} \equiv \hat{I}, \quad \hat{I}^{\hat{1/2}} = \hat{I}, \tag{6.8}$$

the latter confirming that $\hat{I}$ is indeed the isounit of hadronic mechanics (where the isoquotient $\hat{/} = / \times \hat{I}$ has been tacitly used [5c]).

A few comments are now in order. In honor of Einstein's vision on the lack of completion of quantum mechanics, Santilli submitted the original Eqs. (6.1)–(6.8) under the name of *isotopies*, a word used in the Greek meaning of "preserving the original axioms." In fact, $\hat{I}$ preserves all topological properties of $+1$, $A\hat{\times}B$ is as associative as the conventional product $A \times B$ and the preservation of the original axioms holds at all subsequent levels to such an extent that, in the event any original axiom is not preserved, the lifting is not isotopic. Nowadays, the resulting new mathematics is known as *Santilli isomathematics*, $\hat{I}$ is called *Santilli's isounit*, $A\hat{\times}B$ is called the *isoproduct,* etc. (see the General Bibliography of Ref. [7a] and monograph [8]).

Note the identity of Hermiticity and its isotopic image, $(< \hat{\psi}|\hat{\times}\hat{H}^{\hat{\dagger}})\hat{\times}|\hat{\psi} >\equiv< \hat{\psi}|\hat{\times}(\hat{H}\hat{\times}|\hat{\psi} >)$, $\hat{H}^{\hat{\dagger}} \equiv \hat{H}^{\dagger}$, thus implying that all quantities that are observable for quantum mechanics remain observable for hadronic mechanics; the new mechanics is indeed isounitary, thus avoiding the theorems of catastrophic inconsistencies of nonunitary theories; hadronic mechanics preserves all conventional quantum laws, such as Heisenberg's uncertainties, Pauli's exclusion principle, etc.; dynamical equations (6.3)–(6.8) have been proved to be "directly universal" for all possible theories with conserved total energy, that is, capable of representing all infinitely possible systems of the class admitted (universality) directly in the frame of the observer without the use of transformations (direct universality); and numerous other features one can study in Refs. [6–8].

Also, one should note that *hadronic mechanics verifies the abstract axioms of quantum mechanics to such an extent that the two mechanics coincide at the abstract, realization-free level.* In reality, hadronic mechanics provides an explicit and concrete realization of the theory of "hidden variables" λ, as one can see from the abstract identity of the isoeigenvalue equation $\hat{H}\hat{\times}|\hat{\psi}>=\hat{E}\hat{\times}|\hat{\psi}>$ and the conventional equation $H \times |\psi>= E \times |\psi>$, by providing in this way an *operator* realization of hidden variables $\lambda = \hat{T}$ (for detailed studies on these aspects, including the *inapplicability* of Bell's inequality, see Ref. [6g]).

We should also indicate that the birth of hadronic mechanics can be seen in the following *new isosymmetry,* here expressed via a constant K for simplicity,

$$< \psi| \times |\psi > \times 1 \equiv < \psi| \times K^{-1} \times |\psi > \times (K \times 1) = < \psi|\hat{\times}|\psi > \times \hat{I}. \tag{6.9}$$

The reader should not be surprised that the above isosymmetry remained unknown throughout the 20-th century. In fact, its identification required the prior discovery of *new numbers,* Santilli's isonumbers with arbitrary units [5b].

Compatibility between hadronic and quantum mechanics is reached via the condition

$$\mathrm{Lim}_{r>>10^{-13}\,\mathrm{cm}}\hat{I} \equiv \hbar = 1, \tag{6.10}$$

under which hadronic mechanics recovers quantum mechanics uniquely and identically at all levels. Therefore, hadronic mechanics coincides with quantum mechanics everywhere except in the interior of the so-called *hadronic horizon* (a sphere of radius $1\,\mathrm{F} = 10^{-13}$ cm) in which the new mechanics admits a non-Hamiltonian realization of strong interactions.

The latter representation is significant because, if seeded within a constructive scientific environment, allows a realistic possibility to achieve a the first known or otherwise possible *convergent perturbation theory for strong interactions.* This is due to a theorem [7a] essentially stating that, *under sufficient smoothness and other topological conditions, for any given divergent quantum perturbative series for strong interactions*

$$A(k) = A(0) + k \times (A \times H - H \times A)/1! + ... \to \infty, \tag{6.11}$$

there always exists a realization of the isounit $|\hat{I}| = |1/\hat{T}| >> w$ *and a numerical value* N *bounded from above for which the above series becomes strongly convergent,*

$$A(k) = A(0) + k \times (A \times \hat{T} \times H - H \times \hat{T} \times A)/1! + ... \to N << \infty, |\hat{T}| << w. \tag{6.12}$$

Intriguingly, all realizations of Santilli's isounits identified so far verify this crucial condition.

The physical interpretation of the mathematical lifting of the unit $\hbar \to \hat{I}$ is straightforward: the abandonment of Planck's *constant* in favor of an *integrodifferential operator* represents the abandonment of the quantum of energy. In fact, the quantization of the orbits of the electron in the hydrogen atom is now part of history, but the assumption that the same electron must have similarly quantized orbits when within the hyperdense medium inside the proton is repugnant to scientific reason.

A simple method has been identified in Refs. [5d] for the construction of hadronic mechanics and all its underlying new mathematics consisting of:

(i) Representing all conventional interactions with a Hamiltonian H and all non-Hamiltonian interactions and effects with the isounit $\hat{I}$;

(ii) Identifying the latter interactions with a nonunitary transform

$$U \times U^{\dagger} = \hat{I} \neq I; \tag{6.13}$$

(iii) Subjecting the *totality* of conventional mathematical, physical and chemical quantities and all their operations to the above nonunitary transform, resulting in expressions of the type

$$I \to \hat{I} = U \times I \times U^\dagger = 1/\hat{T}, \tag{6.14a}$$

$$a \to \hat{a} = U \times a \times U^\dagger = a \times \hat{I}, \tag{6.14b}$$

$$a \times b \to U \times (a \times b) \times U^\dagger =$$

$$= (U \times a \times U^\dagger) \times (U \times U^\dagger)^{-1} \times (U \times b \times U^\dagger) = \hat{a} \hat{\times} \hat{b}, \tag{6.14c}$$

$$e^A \to U \times e^A \times U^\dagger = \hat{I} \times e^{\hat{T} \times \hat{A}} = (e^{\hat{A} \times \hat{T}}) \times \hat{I}, \tag{6.14d}$$

$$[X_i, X_j] \to U \times [X_i X_j] \times U^\dagger =$$

$$= [\hat{X}_i \hat{,} \hat{X}_j] = U \times (C^k_{oj} \times X_k) \times U^\dagger = \hat{C}^k_{ij} \hat{\times} \hat{X}_k == C^k_{ij} \times \hat{X}_k, \tag{6.14e}$$

$$< \psi| \times |\psi > \to U \times < \psi| \times |\psi > \times U^\dagger =$$

$$=< \psi| \times U^\dagger \times (U \times U^\dagger)^{-1} \times U \times |\psi > \times (U \times U^\dagger) =< \hat{\psi}| \hat{\times} |\hat{\psi} > \times \hat{I}, \tag{6.14f}$$

$$H \times |\psi > \to U \times (H \times |\psi >) = (U \times H \times U^\dagger) \times (U \times U^\dagger)^{-1} \times (U \times |\psi >) =$$

$$= \hat{H} \hat{\times} |\hat{\psi} >, \text{ etc.} \tag{6.14g}$$

Note that *catastrophic inconsistencies emerge in the event even one single quantity or operation is not subjected to isotopies.* In the absence of comprehensive liftings, we would have a situation equivalent to the elaboration of the quantum spectral data of the hydrogen atom with isomathematics, resulting of dramatic deviations from reality.

It is easy to see that the application of an additional nonunitary transform to expressions (6.12) causes the *lack of invariance,* e.g.,

$$W \times W^\dagger \neq I, \quad I \to \hat{I}' = W \times \hat{I} \times W^\dagger \neq \hat{I}, \tag{6.15}$$

with consequential activation of the theorems of catastrophic inconsistencies [5f,5g,7a]. However, any given nonunitary transform can be identically rewritten in the isounitary form,

$$W \times W^\dagger = \hat{I}, \quad W = \hat{W} \times \hat{T}^{1/2}, \tag{6.16a}$$

$$W \times W^\dagger = \hat{W} \hat{\times} \hat{W}^\dagger = \hat{W}^\dagger \hat{\times} \hat{W} = \hat{I}, \tag{6.16b}$$

under which hadronic mechanics is indeed isoinvariant

$$\hat{I} \to \hat{I}' = \hat{W} \hat{\times} \hat{I} \hat{\times} \hat{W}^\dagger = \hat{I}, \tag{6.17a}$$

$$\hat{A} \hat{\times} \hat{B} \to \hat{W} \hat{\times} (\hat{A} \hat{\times} \hat{B}) \hat{\times} \hat{W}^\dagger =$$

$$= (\hat{W} \times \hat{T} \times A \times \hat{T} \times \hat{W}^\dagger) \times (\hat{T} \times \hat{W}^\dagger)^{-1} \times \hat{T} \times (\hat{W} \times$$

$$\times \hat{T})^{-1} \times (\hat{W} \times \hat{T} \times \hat{B} \times \hat{T} \times \hat{W}^\dagger) =$$

$$= \hat{A}' \times (\hat{W}^\dagger \times \hat{T} \times \hat{W})^{-1} \times \hat{B}' = \hat{A}' \times \hat{T} \times \hat{B}' = \hat{A}' \hat{\times} \hat{B}', \text{ etc.} \tag{6.17b}$$

Note that the invariance is ensured by the *numerically invariant values of the isounit and of the isotopic element under nonunitary-isounitary transforms,* $\hat{I} \to \hat{I}' \equiv \hat{I}$, $A \hat{\times} B \to A' \hat{\times}' b' \equiv A' \hat{\times} B'$, in a way fully equivalent to the invariance of quantum mechanics, as expected to be necessarily the case due to the preservation of the abstract axioms under isotopies. The resolution of the catastrophic inconsistencies for noninvariant theories is then consequential.

Hadronic mechanics has nowadays clear experimental consistency in particle physics, nuclear physics, superconductivity, chemistry, astrophysics, cosmology and biology (see monographs [7,8,9h] for details), which verifications cannot possibly be reviewed here. We merely mention for subsequent need the following realization of the isounit for two particles in conditions of mutual penetration

$$\hat{I} = Diag.(n_{11}^2, n_{12}^2, n_{13}^2, n_{14}^2) \times Diag.(9n_{21}^2, n_{22}^2, n_{23}^2, n_{24}^2) \times \\ \times e^{N \times (\hat{\psi}/\psi) \times \int d^3 r \times \psi_{\downarrow}^{\dagger}(r) \times \psi_{\uparrow}(r)}, \tag{6.18}$$

where n_{ak}^2, $a = 1, 2$, $k = 1, 2, 3$ are the semiaxes of the ellipsoids representing the two particles, n_{a4}, $a = 1, 2$ represents their density, $\hat{\psi}$ represents the isowavefunction, ψ represents the conventional wavefunction (that for $\hat{I} = 1$), and N is a positive constant. Note the clearly nonlinear, nonlocal-integral and nonpotential character of the interactions represented by isounit (6.18).

The use f the above isounit permitted R. M. Santilli and D. D. Shillady to reach the first exact and invariant representation of the main characteristics of the hydrogen, water and other molecules, said representation being achieved directly from first axiomatic principles without *ad hoc* parameters, or adulterations via the screenings of the Coulomb law under which the notion of quantum loses any physical or mathematical meaning, thus rendering questionable the very name of "quantum chemistry" (see [7b] for details). In reality, due to its nonunitary structure, *hadronic chemistry* contains as particular cases all infinitely possible screenings of the Coulomb laws.

To understand these results, one should note that quantum mechanics is indeed exact for the structure of *one* hydrogen atom, but the same mechanics is no longer exact for *two* hydrogen atoms combined into the hydrogen molecule due to the historical inability to represent the last 2% of the binding energy as well as due to other insufficiencies. The resolution of these insufficiencies was achieved by hadronic chemistry [7b] precisely via isounit (6.16), namely, via the time invariant representation of the nonlinear, nonlocal and nonpotential interactions occurring in the deep overlapping of the wavepackets of electrons in valence bonds. The new structure models of hadrons presented below is essentially an application in particle physics of these advances achieved in chemistry.

Note that isounit (6.18) verifies the crucial condition $|\hat{I}| = |1/\hat{T}| >> 1$ for the isoconvergence (6.12) of divergent perturbative series (6.11), thus rendering plausible the construction of a convergent perturbative theory of strong interactions. The understanding of these new vistas in particle physics, as well as the content of the remaining sections, requires at least a rudimentary knowledge of the advances permitted in chemistry by the Santilli-Shillady strongly attractive valence bond originating from isounit (6.18), including the reduction of computer time in molecular calculations at least 1000-fold [7b].

7. THE NEW STRUCTURE MODEL OF HADRONS WITH MASSIVE PHYSICAL CONSTITUENTS PRODUCED FREE IN SPONTANEOUS DECAYS

As it is well known, nuclear, atomic and molecular sciences have made historical contribution to mankind. By comparison, contemporary hadron physics has no possibility of even predicting, let alone permitting conceivable practical applications. This so visible a disparity is due to the fact that the constituents of nuclei, atoms and molecules can be produced free, while quarks cannot be produced free due to their lack of existence in our spacetime and other reasons discussed in Section 3.

The view advocated by the author since 1978 [5a] is that the complete absence of practical value of contemporary hadron physics is due to the belief of the exact validity of quantum mechanics within the hyperdense media in the interior of hadrons, namely, for conditions dramatically different than those of the original conception of the theory, while the construction of a covering mechanics specifically intended for the conditions here considered does indeed permit quantitative predictions of new, experimentally verifiable practical applications.

In this and in the following section we show that the use of the covering hadronic mechanics for the synthesis, structure and decay of (unstable) hadrons allows their constituents to be ordinary massive physical particles that can indeed be produced free in spontaneous decays. In turn, the capability of producing free hadronic constituents allows the predictions of basically new and clean energies so much needed by society.

The neutron is, by far, the biggest reservoir of clean energy available to mankind since it decays spontaneously (when isolated) by releasing a highly energetic electron that can be easily trapped with a metal shield, plus the neutrino that is innocuous to the environment (if it exists). As we shall see, the covering hadronic mechanics does indeed allow the numerically exact and time invariant representation of *all* characteristics of the neutron as a new bound state of a proton and an electron. In this case stimulated decays of the neutron become conceivable and experimentally verifiable, resulting in the indicated new clean energy of *hadronic,* and not nuclear type, in the sense of originating in the interior of individual hadrons, rather than in their collection.

By recall;ing the increasingly cataclysmic climactic events facing our planet, while continuing research along orthodox lines, we have the duty to conduct serious theoretical and experimental studies of these new possibilities on ground of scientific ethics and accountability, particularly in view of the large public funds currently used by hadron physics.

The central mathematical and physical problem is the following. Recall that the conventional Schrödinger equation is physically inconsistent for the "positive" binding-like minimal $0.78MeV$ energy needed for the synthesis of the neutron, Eq. (4.1). Hence, rather than adapting [physical reality to a preferred theory, we modify the theory in such a way to permit the representation of reality. Once this scientific attitude is set, a solution is readily possible and was actually reached in the original proposal [5a] to build hadronic mechanics.

The case of interest here is the lifting of the Schrödinger equation for a conventional two-body bound state (such as the positronium or the hydrogen atom) via isounit (6.18) where both particles are assumed to be spheres of radius 1 F for simplicity. Hence, we consider the simple lifting of quantum bound states characterized by the following simplified isounit (see [7a) for details and references following ['5a])

$$\hbar = 1 \rightarrow \hat{I} = U \times U^{\dagger} = e^{k \times (\psi / \hat{\psi}) \times \int dr^3 \times \psi_{\downarrow}^{\dagger}(r) \times \psi_{\uparrow}(r)}, \tag{7.1}$$

where ψ is the wavefunction of the quantum state and $\hat{\psi}$ is that of the corresponding hadronic state. Note that the above isounit verifies the basic requirement of recovering the conventional unit for all mutual distances of particles bigger than 1 F, thus restricting the applicability of hadronic mechanics within the hadronic horizon, as desired, and recovering quantum mechanics identically and uniquely in the outside.

As it is well known, outside the hadronic mechanics particles can be equally coupled in single and triplet, trivially, because they are assumed to be point-=like. In the interior of the hadronic horizon the situation is different because particles and/or their wavepackets are assumed as extended. It then follows that triplet couplings inside the hadronic horizon cause very strong *repulsive* forces, while singlet couplings produces very strong *attractive* forces [5a].

In fact, the lifting of the conventional Schrödinger equation for the positronium or the hydrogen atom always yields a strong attractive *Hulthen potential* that, as well known, behaves at short distances like the Coulomb potential, resulting in the expressions achieved in the original proposal [5a] (see [7a,7b,9g] for detailed reviews)

$$U \times [\left(\frac{1}{2 \times m_1} p_1^2 + \frac{1}{2 \times m_2} p_2^2 - V_{Coul}(r_{12})\right) \times |\psi\rangle] \times U^\dagger \approx$$

$$\approx \left(-\frac{1}{2 \times \bar{m}_1} \times \nabla_1^2 - \frac{1}{2 \times \bar{m}_2} \times \nabla_2^2 - V_o \times \frac{e^{-r_{12} \times b}}{1 - e^{-r_{12} \times b}}\right) \times |\hat{\psi}\rangle, \tag{7.2a}$$

$$\frac{\hbar^2}{2 \times m_k} \rightarrow \frac{|\hat{I} \hat{\times} \hat{I}|}{2 \times m_k} = \frac{|\hat{I}|}{2 \times m_k} \approx \frac{1}{2 \times \hat{m}_k}, \quad k = 1, 2, \tag{7.2b}$$

where the original Coulomb interaction has been "absorbed" by the Hulthen potential and Eqs. (7.2b) illustrates the mechanism of liftings $m_k \rightarrow \bar{m}_k,\ k = 1,\ 2$, characterizing a new *mass isorenormalizations* (also called *mutation* [5a]), that is, renormalizations caused by non-Hamiltonian (or non-Lagrangian) interactions, the symbol $|\hat{I}|$ representing in this case a numerical average of the deviation of the isounit from Planck's constant inside the hadronic horizon. Needless to say, the isorenormalization of the mass implies that of the remaining intrinsic characteristics of particles. These features assures the departure from quantum mechanics as necessary for the problem at hand.

Detailed studies have shown that the constituents of a bound state described by hadronic mechanics are no longer irreducible representations of the conventional Poincaré symmetry (a necessary departure due to the lack of a Keplerian structure indicated earlier), and are characterized instead by irreducible isorepresentations of the *Poincaré-Santilli isosymmetry* [6]. For this reason they are called *isoparticles* and are denoted with conventional symbols plus a "hat"/ Hence, in this notation (now universally adopted in the literature of hadronic mechanics), the symbols $e^\pm,\ p^\pm$ represent ordinary quantum particles characterized by the Poincaré symmetry, while the symbols as $\hat{e}^\pm,\ \hat{\pi}^\pm, \hat{p}^\pm$ represent the corresponding isoparticles characterized by the covering Poincaré-Santilli isosymmetry.

The mechanism permitting physically consistent equations for two-body bound states requiring a "positive" binding-like energy, as it is the case for the neutron and the π^o, is due to the mass isorenormalization since it achieves such an increased value under which a negative Hulthen binding energy admits physical solutions.

For the case of the π^o according to synthesis (7.2) the isorenormalized masses of the individual isoelectrons become of the order of 70 MeV, while for the case of the synthesis of the neutron according to Eq. (7.2), the isonormalized mass of the electron (assuming that the proton is unmutated and at rest) acquires a value of the order of 1.39 MeV, thus allowing a negative binding energy in both cases.

Via the use of hadronic mechanics, the original proposal [5a] achieved already in 1978 a *new structure model of π^o meson as a compressed positronium, thus identifying the physical constituents with ordinary electron and positrons although in an mutated state caused by their condition of* *total mutual penetration.* This permitted the numerical, exact and invariant representation of *all* characteristics of the π^o via the following single structural equation

$$\pi^o = (\hat{e}^-, \hat{e}^)_{HM}, \tag{7.3a}$$

$$U \times H_{positr} \times U^\dagger \approx \left(-\frac{1}{2 \times \bar{m}_e} \times \nabla_1^2 - \frac{1}{2 \times \bar{m}_e} \times \nabla_2^2 - V_{Hult} \times \frac{e^{-r_{12} \times b}}{1 - e^{-r_{12} \times b}} \right) \times |\hat{\psi}\rangle = E \times |\hat{\psi}\rangle, \tag{7.3b}$$

$$m_e = 0.511\,\text{MeV},\ ,\ E = 134.97\,\text{MeV},\ \tau = 8.4 \times 10^{-17}\,\text{s},\ R = b^{-1} = 10^{-13}\,\text{cm}. \tag{7.3c}$$

where the latter expressions are *subsidiary constraints* (see [7a,7b,9g] for reviews).

The above results were extended in the original proposal (Ref. [5a], Sect. 5) to all mesons resulting in this way in a structure model of all mesons with massive physical constituents that can be produced free in the spontaneous decays, generally those with the lowest mode, and we shall write

$$\pi^o = (\hat{e}^+, \hat{e}^-)_{HM}, \quad \pi^\pm = (\hat{\pi}^o, \hat{e}^\pm)_{HM} = (\hat{e}^+, \hat{e}^\pm, \hat{e}^-)_{HM}, \quad K^o = (\hat{\pi}^+, \hat{\pi}^-)_{HM}, \text{ etc.}, \tag{7.4}$$

where, again, e, π, K, etc. represent conventional *particles* as detected in laboratory and $\hat{e}, \hat{\pi}, \hat{K}$, etc. represent *isoparticles*, namely, the mutation of their intrinsic characteristics caused by their deep mutual penetration inside the hadronic horizon.

A few comments are now in order. Firstly, we should note the dramatic departures of the above structure models from conventional trends views in the standard model in its conventional interpretation of providing both the classification and the structure of hadrons. To begin, when dealing with classification the emphasis is in searching for "mass spectra." On the contrary, structure model of type (7.4) are known to be *spectra suppressing*, a notion also introduced since the original proposal [5a].

In essence, the Hulthen potential is known to admit only a finite spectrum of energy levels. When all conditions (7.3c) are imposed, the energy levels reduce to only one, that specifically and solely for the meson considered. Needless to say, excited states do exist, but are of *quantum* type, that is, whenever the constituents are excited, they exit from the hadronic horizon because isounit (7.1) reduces to 1, and quantum mechanics is recovered identically. Consequently, *the excited states of structure model (7.3) for the π^o are given by the infinite energy levels of the positronium.*

An additional dramatic departure from the standard model is given by the number of constituents. According to the standard model, in the transition from one hadron to another of a given family (such as in the transition from π^o to $\pi^\pm$) the number of quark constituents remain the same. On the contrary, *according to hadronic mechanics, the number of constituents necessarily increases with the increase of the mass,* exactly as it is the case for nuclear, atomic and molecular structures.

The model also achieved in Ref. [5a] a representation of the spontaneous decays with the lowest mode, such as

$$\pi^o = (\hat{e}^+, \hat{e}^-)_{HM} \rightarrow e^+ + e^-, \tag{7.5}$$

that is generally interpreted as a tunnel effect of the constituents through the hadronic horizon (rather than the particles being "created" at the time of the decay as requested by the standard model). The remaining decay are the results of rather complex events under non-Hamiltonian interactions still under investigation at this writing.

The representation of Rutherford's synthesis of the neutron, Eq. (1.1), required considerable additional studies on the isotopies of angular momentum [6a], spin [6b], Lorentz symmetry [6c], Poincaré symmetry [6d], the spinorial covering of the Poincaré symmetry [6e], the Minkowskian geometry [6f] and their implications for local realism and all that [6g].

Upon completion of these efforts, Santilli achieved in Ref. [9a] of 1990 the first known, numerically exact and time invariant nonrelativistic representation of *all* characteristics of the neutron as a hadronic bound state of a proton assumed to be un-mutated and a mutated electron (or isoelectron) via the following single structural equation representing the compression of the hydrogen atoms below to the hadronic horizon exactly as originally conceived by Rutherford

$$n = (p^{+}, \hat{e}^{-})_{HM}, \tag{7.6a}$$

$$U \times H_{hydr} \times U^{\dagger} \approx \left(-\frac{\hbar^2}{2 \times \hat{m}_p} \times \nabla_1^2 - \frac{\hbar^2}{2 \times \bar{m}_e} \times \nabla_2^2 - V_{Hult} \times \frac{e^{-r_{12} \times b}}{1 - e^{-r_{12} \times b}} \right) \times |\hat{\psi}\rangle = E \times |\hat{\psi}\rangle, \tag{7.6b}$$

$$m_e = 0.511\,\mathrm{MeV}, \quad m_p = 938.27\,\mathrm{MeV}, \quad E = 939.56\,\mathrm{MeV}, \quad \tau = 886\,\mathrm{s}, \quad R = 10^{-13}\,\mathrm{cm}. \tag{7.6c}$$

The relativistic extension of the above model was reached in Ref. [9b] of 1993 (see also [6e]) via the isotopies of Dirac's equation, and cannot be reviewed here to avoid a prohibitive length.

Remarkably, despite the disparities between Eqs. (7.3) and (7.6), the Hulten potential admitted again one single energy level, that of the neutron. Under excitation, the isoelectron exits the hadronic horizon (again, because the integral in Eq. (7.1) becomes null) and one recovers the quantum description. Consequently, according to structure model (7.6), *the excited states of the neutron are the infinite energy levels of the hydrogen atom.*

The representation of the spin $\frac{1}{2}$ of the neutron turned out to be simpler than expected, as outlined in Figure 4. In particular, *the hadronic representation of the synthesis of the neutron does not necessarily require any neutrino at all, exactly as originally conceived by Rutherford,* of course, not at the quantum level, but at the covering hadronic level.

This issue refers to the problem *whether or not the etherino represent the transfer of spin* $\frac{1}{2}$ discussed in Section 5. As we shall see, the alternative merely refers as to whether the etherino hypothesis on the neutron synthesis, Eq. (5.3), is studied via *quantum mechanics,* in which case the etherino must carry spin $\frac{1}{2}$, or via *hadronic mechanics,* in which case there is no need for the etherino to carry spin $\frac{1}{2}$ since the transfer of spin is represented by the lifting of the Hilbert space, thus being embedded in the very structure of the theory. *

With reference to Fig. 4, once compressed inside the hadronic horizon, that is, inside the proton, in order to have an attractive bond, the electron is constrained to have its spin antiparallel to that of the proton and, in order to achieve a stable state, the electron orbital momentum is constrained to coincide with the spin $\frac{1}{2}$ of the proton, otherwise the electron must move inside the proton and *against* its hyperdense medium. These simple conditions yield the following representation of the spin of the neutron

$$s_n^{spin} = s_p^{spin} + \hat{s}_{\hat{e}}^{spin} + \hat{s}_{\hat{e}}^{orb} = \frac{1}{2} - \frac{1}{2} + \frac{1}{2}, \tag{7.7}$$

where $\hat{s}$ indicates the use of the Lie-Santilli isotopic SU(2). Consequently, it the total angular momentum of the isoelectron is null,

$$s_{\hat{e}}^{tot} = s_{\hat{e}}^{spin} + s_{\hat{e}}^{orb} = 0, \tag{7.8}$$

and *the spin of the neutron coincides with that of the proton.*

It should be recalled that a fractional value of the angular momentum is anathema for quantum mechanics, namely, when the angular momentum is defined over a conventional Hilbert space $\mathcal{H}$

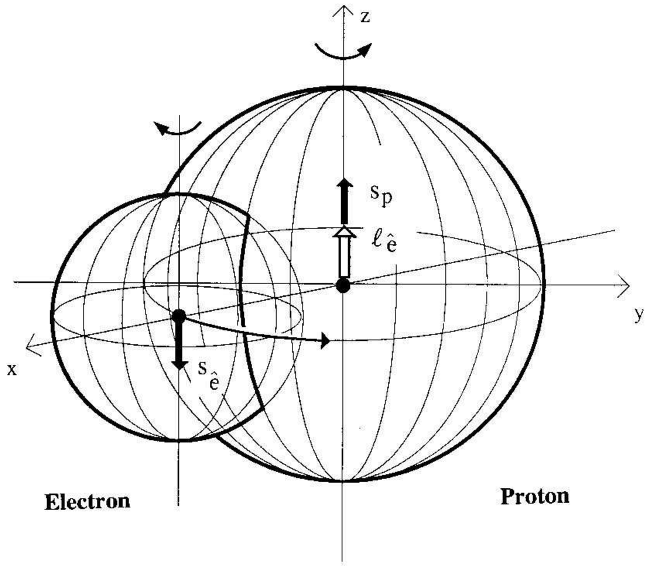

Figure 4: *A schematic view of the intrinsic and orbital angular momenta in Rutherford's synthesis of the neutron according to hadronic mechanics.*

over the field of complex numbers C (because it causes a departure from its nonunitary structure with a host of problems). By comparison, fractional values of the angular momentum are fully admissible for hadronic mechanics, namely when defined on an iso-Hilbert space $\hat{\mathcal{H}}$ over an isofield $\hat{\mathcal{C}}$ in view of its isounitary structure.

As a simple example, under the isounit and isotopic elements $\hat{I} = \frac{1}{2}, \hat{T} = 2$ and isonormalization $< \hat{\psi}|\times\hat{T}\times|\hat{\psi} >= 1$ the half-off-integer angular momentum $\hat{J}_3 = \frac{1}{2}$ admits the isoexpectation value 1,

$$< \hat{J}_3 >= \frac{< \hat{\psi}|\hat{\times}\hat{J}_3\hat{\times}|\hat{\psi} >}{< \hat{\psi}|\hat{\times}|\hat{\psi} >} = 1. \quad (7.9)$$

The above occurrence should not be surprising for the reader familiar with hadronic mechanics. In fact, the sole admission of conventional values of the angular momentum would imply the admission of the perpetual motion for, say, an electron orbiting in the core of a star. In the transition from motion in a quantized orbit in vacuum to motion within the core of a star, the angular momentum assumes an arbitrary, locally varying value. The only reason for the orbital value $\frac{1}{2}$ for the neutron is the existence of the constraint restricting the angular momentum of the isoelectron to coincide with the spin of the proton (Figure 4).

In summary, the lifting $\mathcal{H} \rightarrow \hat{\mathcal{H}}$ implicitly represents the absorption of the needed spin and energy from the ether or from the environment (such as the interior of a star), thus clarifying that, unlike the neutrino, the etherino *is not* a physical particle in our spacetime, but merely represents the indicate *transfer* of features. Hence, we therefore have the following equivalence

$$n = (p^+, a^o, e^-)_{QM} \approx (\hat{p}^+, \hat{e}^-)_{HM}, \quad (7.110)$$

with the understanding that the Schrödinger equation is physically inconsistent for the QM formulation, while its isotopic image is fully consistent.

We can therefore say that *hadronic mechanics is the first and only theory known to the author for quantitative invariant studies of the interplay between matter and the background medium, whether the ether or the hyperdense medium inside hadrons.*

The nonrelativistic, exact and invariant representation of the anomalous magnetic moment of the neutron ($-1.913m_N$) fin structure model (7.6) was also achieved for the first time by R. M. Santilli in Ref. [9a] of 1990.

The magnetic moment of Rutherford's neutron is characterized by *three* contributions, the magnetic moment of the proton, that of the isoelectron, and that caused by the orbital motion of the isoelectron. Note that for quantum mechanics the third contribution is completely missing because all particles are considered as points, in which case the electron cannot rotate inside the proton. Note that the inability by quantum mechanics to treat the orbital motion of the electron inside the proton (due to its point-like character) was the very origin of the conjecture of the neutrino.

With reference to the orientation of Figure 4, and by keeping in mind that a change of the sign of the charge implies a reversal of the sign of the magnetic moment, the representation of Ref. [9a] is based on the identity

$$\mu_n = \mu_p + \hat{\mu}_{\hat{e}-intrinsic} - \hat{\mu}_{\hat{e}-orbital} = -1.9123\mu_N, \tag{7.11}$$

Since the spin of the proton and of the electron can be assumed to be conventional in first approximation, we can assume that their intrinsic magnetic moments are conventional, i.e.,

$$\mu_p = +2.793m_N, \quad \hat{\mu}_{\hat{e}-intrinsic} = \mu_e = -1.001\mu_B = -1,837.987\mu_N, \tag{7.12}$$

consequently

$$\mu_p + \mu_e = 1,835\mu_N. \tag{7.13}$$

It is then evident that the anomalous magnetic moment of the neutron originates from the magnetic moment of the orbital motion of the isoelectron inside the proton, namely, a contribution that has been ignored since Rutherford's time until treated in Ref. [9a].

It is then easy to see that the desired exact and invariant representation of the anomalous magnetic moment of the neutron is characterized by the following numerical values

$$\hat{\mu}_{\hat{e}-orbital} = +1.004\mu_B, \quad \hat{\mu}_{\hat{e}-total} = 3 \times 10^{-3}\mu_B, \quad \mu_n = -1.9123\mu_N, \tag{7.14}$$

and this completes our nonrelativistic review. Note that the small value of the total magnetic moment of the isoelectron is fully in line with the small value of its total angular momentum (that is null in first approximation due to the assumed lack of mutation of the proton).

We regret to be unable to review the numerically exact and time invariant *relativistic* representation of the anomalous magnetic moment of the neutron [6e,9b] because it provides much deeper insights than the preceding one. In particular, it provides a full illustration of the physical implications of the *density* of hadrons, n_4^2, in isounit (6.18), that is completely absent in conventional hadron physics and the standard model at large. In fact, the numerical value of n_4 obtained from the fit of the data on the fireball of the Bose-Einstein correlation permits the exact representation of the neutron anomalous magnetic moment without any additional quantity or unknown parameters usually introduced to 'fit data.

The spontaneous decay of the neutron is given by the two alternatives

$$n = (p^+, \hat{e}^-)_{HM} \rightarrow p^+ + e^- + \bar{\nu}, \tag{7.15a}$$

$$n = (p^+, \hat{e}^-)_{HM} \rightarrow p^+ + e^- + \bar{a}_n, \tag{7.15b}$$

in which the proton and the electron are released as a mere tunnel effect of the massive constituents through the hadronic horizon, after which particles reacquire their conventional quantum characteristics.

Note that, under the etherino hypothesis, the behavior of the angular momentum for reaction (7.15) can be interpreted at the level of hadronic mechanics and related Poincaré-Santilli isosymmetry via the transformation of the orbital into linear motions without any need for the neutrino, in the same way as no neutrino is needed for the neutron synthesis.

The extension of the model to all baryons was conducted in Ref. [5d] resulting in models of the type

$$n = (\hat{p}^+, \hat{e}^-)_{HM} \approx (p^+, \hat{e}^-)_{HM}, \quad \Lambda = (\hat{p}^+, \hat{\pi}^-)_{HM} \approx (\hat{n}, \hat{\pi}^o)_{HM}, \tag{7.16a}$$

$$\Sigma^+ = (\hat{p}^+, \hat{\pi}^o)_{HM} \approx (\hat{\hat{n}}, \hat{\pi}^+)_{HM}, \, \Sigma^o = (\hat{\Lambda}, \hat{e}^+, \hat{e}^-)_{HM}, \, \Sigma^- = (\hat{n}, \hat{\pi}^-)_{HM} \approx (\hat{\bar{p}}^-, \hat{\pi}^o)_{HM}, \text{ etc.} \tag{7.16b}$$

where one should note the equivalence of seemingly different structure models under the indicated mutation of the constituents.

Compatibility of the hadronic structure models with the SU(3)-color Mendeleev-type classification was also first suggested in Ref. [5d] and resulted to be possible in a variety of ways, such as, via a *multivalued hyperunit* [5d,7a] consisting of a set of isounits each characterizing the structure of one individual hadrons in a given unitary multiplet

$$\hat{I} = Diag.(\hat{I}_{\pi^o}, \hat{I}_{\pi^+}, \hat{I}_{\pi^-}, \hat{I}_{K^o_S}, ...) = U \times U^\dagger > 0. \tag{7.17}$$

The lifting of SU(3)-color symmetries under the above hyperunit is isomorphic to the conventional symmetry due to the positive-definiteness of the hyperunit,

$$U \times SU(3) \times U^\dagger \approx SU(3), \tag{7.18}$$

thus ensuring the preservation of all numerical results of the Mendeleev-type classifications due to the preservation of the structure constants, Eqs. (6.14e).

We can therefore conclude by saying that *hadronic mechanics permits indeed nonrelativistic and relativistic, numerically exact and time invariant representations of "all" characteristics of unstable hadrons as generalized bound states of conventional massive particles that can be produced free in the spontaneous decays, generally those with the lowest mode, said representation occurring in a way compatible with the standard model when assumed as solely providing the final Mendeleev-type classification.*

8. NEW CLEAN ENERGIES PERMITTED BY THE ABSENCE OF NEUTRINOS AND QUARKS

Hadronic mechanics was proposed since its inception [5a] for the prediction and quantitative time invariant treatment of new clean energies and fuels that cannot be even conceived, let alone treated via quantum mechanics. Some of the new energies and fuels predicted by hadronic mechanics have already seen industrial development following rather large investments by the industry, such as:

1) The *PlasmaArcFlow Reactors* for a new, much cleaner and more and efficient carbon combustion via submerged electric arcs departing from the predictions of quantum mechanics by a large numerical factor, but fully treatable via the covering hadronic mechanics;

2) The new *magnecular fuels,* namely, fuels with the new chemical structure of *magnecules* (rather than molecules) characterized by a new non-valence bond weaker than the valence to allow for the first time full combustion, which new fuels cannot be even conceived with quantum chemistry, but are fully treatable via the covering hadronic chemistry;
and other novel applications (see [7b] for technical presentations and website [9i] for industrial aspects).

In this section we we outline another form of new, clean energy currently under study that is solely predicted by hadronic mechanics and known under the name of *hadronic energy,* to denote energy originating from mechanisms in the interior of hadrons such as the neutron, rather than in their collection, such as the conventional nuclear energies. As we shall see, the new hadronic energy is possible if and only if the hadronic constituents are massive physical particles that can be produced free, namely, if and only if quarks do not exist as physical particles in our spacetime. The possible absence of neutrinos creates new intriguing possibilities not related to the hadronic energy

The reader should be aware that numerous additional possibilities for new clean energies are predicted by hadronic mechanics at the nuclear, atomic and molecular levels thanks to the admission of a contact, *non-Hamiltonian* component of the bonding forces whose judicious use permits new separations and other mechanisms simply unthinkable with quantum mechanics due to its purely *Hamiltonian* character (see [9g] and website [9h]).

Physics has ignored throughout the 20-th century that *the neutron is the biggest reservoir of clean energy available to mankind* because: 1) The neutron is naturally unstable; 2) When decaying it releases a large amount of energy carried by the electron; and 3) Such energy can be easily trapped with a thin metal shield, thus being clean. In this section we study the possibility of tapping such energy via mechanisms occurring in the interior of individual neutrons, thus being a hadronic energy according to the above definition.

Moreover, this type of new energy is two-fold because, when the decay of individual neutrons occurs in a conductor, the latter acquires a positive charge while the shield trapping the electron acquires a negative charge, resulting in a new clean production of continuous current originating in the structure of the neutron. This type of hadronic energy was first proposed by Santilli in Ref. [9c] and today known as *hadronic battery* [8]. The second source of energy is thermal and it is given by the heat acquired by the shield trapping the emitted electrons.

Recall that, unlike the proton,*the neutron is naturally unstable.* Consequently, it must admit a *stimulated decay,* of course, under suitable conditions and verification of all conservation laws. Hadronic mechanics predicts a number of possibilities to stimulate the decay of the neutron. We here study the study the proposal by Santilli i [9c] of 1994 to stimulate the decay of the neutron in a selected number of nuclear isotopes (called *hadronic fuels*) with hard photons γ_{res} having energy (frequency) suitable to excite the isoelectron within the neutron, thus causing its expulsion with consequential decay.

By recalling that the proton can be assumed in first approximation as being un-mutated and that the isoelectron is predicted to have isorenormalized rest energy, the resonating energy (frequency) can be first defined quite simply as a submultiple of the difference of energy between the neutron and the proton

$$\Delta E = m_n - m_p = 1.293\,\text{MeV} = h \times \nu_{reson}, \tag{8.1a}$$

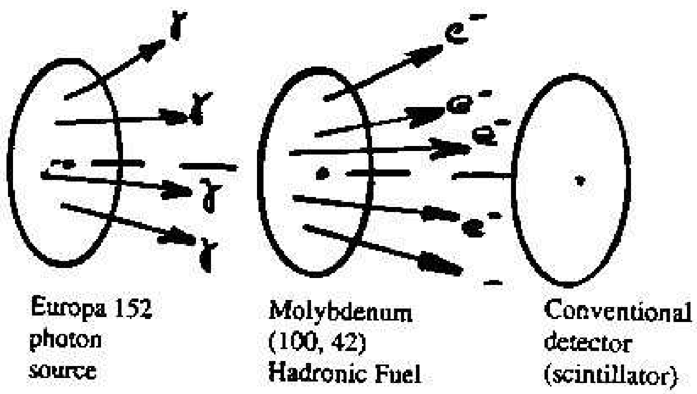

Figure 5: *The view illustrates a "hadronic fuel", the Mo(100,42), that, when hit by a neutron resonating frequency, is predicted to experience a stimulated decay into an unstable isotope (Tc(100, 43) that, in turn, decays spontaneous into the final stable isotope Ru(100, 44) with the total emission of two highly energetic electrons. Note that the molybdenum is a conductor. hence, the predicted energy is two fold, of electric and thermal nature.*

$$E_{res} = \frac{1.294}{n}\,\text{MeV},\ n = 1,\ 2,\ 3,\ ..., \tag{8.1b}$$

under which the isoelectron is predicted to be excited and consequently cross the 1 F hadronic horizon, resulting in the stimulated decay

$$\gamma_{res} + n \rightarrow p^+ + e^- + \bar{\nu}_e \ \ (or \ \ \bar{a}_n), \tag{8.2}$$

If the above stimulated decay is confirmed, the energy gain is beyond scientific doubt, because the use of 1/10-th of the exact resonating frequency (8.1b) could produce energy up to 100-times the original value, depending on the energy of the released betas. Note that the energy of photons not causing stimulated decay is not lost, because absorbed by the hadronic fuel, thus being part of the heat balance.

One among numerous cases of hadronic energy proposed for test in Ref. [9c] is given by

$$\gamma_{res} + Mo(100,42) \rightarrow Tc(100,43) + \beta^-, \tag{8.3a}$$

$$Tc(100,43) \rightarrow Ru(100,44) + \beta^-, \tag{8.3b}$$

where the first beta decay is stimulated while the second is natural and occurs in 18 sec. A conventional (quantum) study of the double beta decay of Mo(100,42) can be found in Ref. [9j] and papers quoted therein.

Note that conventional nuclear energy is based on the disintegration of *large and heavy nuclei,* thus producing well known dangerous radiations and leaving dangerous radioactive waste. By comparison, the above case of hadronic energy is *conceived* for the use of *light nuclei* as in the case of Eqs. (8.3), thus being clean because releasing no harmful radiation and leaving no harmful waste. In fact, both the original nucleus Mo(100, 42) and the final one Ru(100,44) are light, natural, and stable elements (for additional studies, see [9g]).

To illustrate the environmental implications of the above studies, Ref. [9d] proposed the use of the above stimulated decay of the neutron to stimulated decay of radioactive nuclear waste.

The proposal is to use a coherent beam of resonating photons to create a local excess of peripheral protons in combination with other processes, such as high intensity electric fields causing ellipsoidal deformations of large unstable nuclei whose decay is then inevitable under said excess of peripheral protons. The related equipment is predicted to be sufficiently small for use by nuclear power plants in their existing pools, thus rendering conventional nuclear energy more environmentally acceptable.

The reader should be aware that hadronic mechanics predicts other means for the recycling of highly radioactive nuclear waste, such as those via the disruption of the contact non-Hamiltonian component of the nuclear force originating from the mutual penetration of protons and neutrons in any nuclear structure as predicted by hadronic mechanics [9k] but unthinkable via quantum mechanics.

9. THE MUCH NEEDED EXPERIMENTAL RESOLUTIONS

The physics community has spent to date in neutrino and quark conjectures well in excess of ten billion dollars of public funds originating from various countries, while multiplying, rather than resolving the controversies, as indicated in Sections 2 and 3. It is evident that the physics community simply cannot continue this trend without risking a historical condemnation by posterity.

With the understanding that the impossibility for quarks to be physical particles in our space-time is proved beyond scientific doubt (Section 3), it is the duty of the physics community for scientific ethics and accountability to resolve experimentally whether or not the neutrino exists as a physical particle (Sections 2 and 5) and confirm or deny the existence of the new clean energies predicted by hadronic mechanics (Sections 6, 7,. 8), in which case the joint continuation experiments along preferred orthodox lines would be ethically sound.

There is no credible doubt that the experiments dwarfing by comparison at this writing any other particle experiment on scientific as well as societal grounds are those on the synthesis and decay of the neutron, from which experiments on the new hadronic energy can be readily derived. Along these prioritarian lines, in this paper we suggest the following experiments:

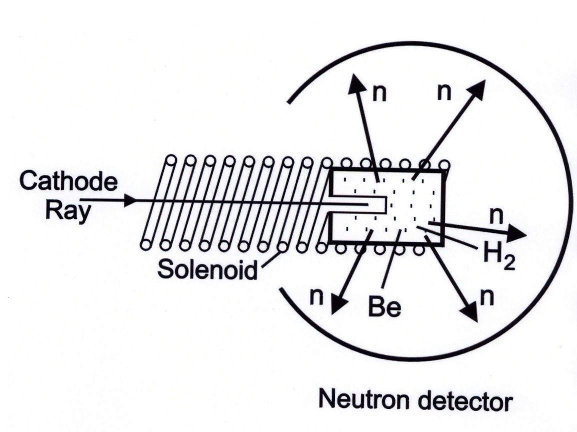

Figure 6: *A schematic view of the proposed laboratory synthesis of the neutron from protons and electrons to identify the needed energy.*

Proposed experiments on the laboratory synthesis of the neutron. The first attempt at synthesizing the neutron in laboratory known to this author was conducted with positive outcome in Brazil by the Italian priest-physicist Don Carlo Borghi and his associates [9e] (see [9g] for a review). The synthesis was recently confirmed by the author [9l] with the understanding that numerous experimental and theoretical issues remain open.

In addition to the finalization of the neutron synthesis according to tests [9e,9l], there is the need to work out basically new tests capable of measuring the energy needed for the neutron synthesis, since that aspect is outside the scope of said tests.

The latter information can be obtained nowadays in a variety of ways. That recommended in this note, consists in sending a coherent electron beam against a beryllium mass saturated with hydrogen and kept at low temperature (so that the protons of the hydrogen atoms can be approximately considered to be at rest). A necessary condition for credibility is that said protons and electrons be polarized to have antiparallel spins (singlet couplings), because large repulsions are predicted for triplet couplings at very short distances for particles with spin, as it is the case for the coupling of ordinary gears. Since the proton and the electron have opposite charges, said polarization can be achieved with the same magnetic field as illustrated in Fig. 6.

Under the above geometry, protons and electrons are expected to reach short distances of the order of $1F$ due to the mutual attraction not only of the opposite charges, but also of the opposite magnetic polarities in singlet coupling. In the event this geometry is insufficient, experimentalists should consider the addition of a "trigger" [7a,7b,7c] simulating the high pressure inside stars,*e.g.,* via impulses of electric and/or magnetic fields, thus facilitating the synthesis.

Neutrons that can possibly be synthesized in this way will escape from the beryllium mass and can be detected with standard means, of course, under the proper handling of the background that should be ignorable for the case of neutrons.

. The detection of neutrons synthesized from electrons with the threshold energy of $0.78 MeV$ would deny both the neutrino and the etherino hypotheses, while the detection of neutrons synthesized with electron energy *less* than 0.78 MeV would establish the etherino hypothesis due to the impossibility of the neutron synthesis via antineutrino established earlier.

Note that the latter possibility would not provide final evidence on the lack of existence of neutrinos because the possible experimental results here considered, those for on the neutron *synthesis,* cannot be credibly claimed to apply necessarily for the neutron *decay.* In fact, the continuous creation of matter via the neutron synthesis would confirm the lack of participation of antineutrinos in said synthesis, but would *require* the existence of neutrinos for the neutron decay as a necessary condition for the very permanence of the transfer of energy from the ether to our spacetime.

Proposed experiments on the neutron decay. The first direct measurements of electron energies in the decay of *isolated* neutrons (rather than nuclei) known to this author is that conducted by A. Garcia *et al.* [9j] in 1986 and thereafter ignored. The experimental results consist of systematic measurements of electron energy essentially at the threshold of the background energy of the set up consisting of $0.20 MeV$ with rapidly decaying bigger detected energies of the electrons, and virtually insignificant counts at the maximal expected energy of $0.78 MeV$ (see Fig. 2 of Ref. [9m]).

These results clearly indicate the existence of a mechanism carrying the "missing energy" in neutron decays, although the results cannot distinguish whether such a missing energy is carried by the neutrino or the etherino.

In fact, by recalling again the impossibility for antineutrinos to participate in the neutron synthesis proved in Section 4, under the assumption that neutrinos exist in neutron decays, tests [9m] could acquire the potentially historical value of having first shown the existence of continuous creation of matter in the universe via its transfer from the ether to our spacetime, as in Eq. (5.3).

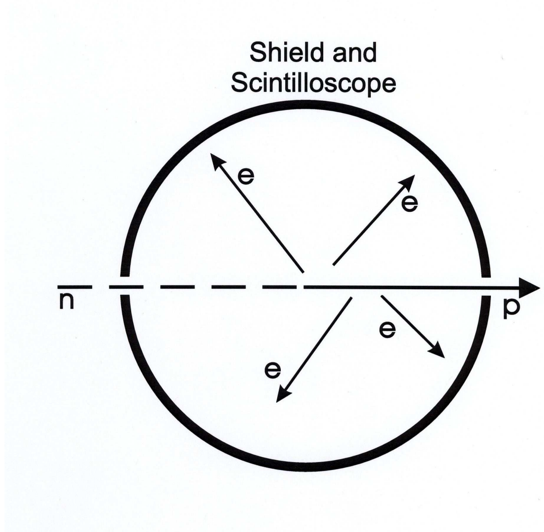

Figure 7: *A schematic view of the proposed measurement of the energy of the electron in spontaneous neutron decays to ascertain whether there is any energy left for the neutrino.*

Alternatively, in the event neutrinos do not exist for both the n eutron synthesis and decay, we could have the transfer of energy from the ether to our spacetime for the neutron synthesis, Eq. (5.1), and then the return of the same energy to the ether in the neutron decay, Eq. (5.4). The latter case could also have far reaching implications, such as possible new longitudinal communications through the ether at a large multiple of the speed of light indicated in Section 5.

Despite its undeniable accuracy, measurements [9m] do not appear to be conclusive on the energy of the electron for various reasons, such as seemingly insufficient measurements on the energy of the resulting protons that cannot be assumed to be the same as that of the original neutrons due to recoils and other conceivable effects in neutron decay.

Hence, we recommend the repetition of test [9m] via accurate measurements of: 1) the energy of the original neutrons; 2) the energy of the resulting protons; and 3) the energy of the emitted electrons. As a complement to the experimental set up depicted in Fig. 1 of Ref. [9m], in Figure 7 we present a schematic view of a possible set up showing means for the measurement of the energy of the emitted electrons, but means for the measurement of the energy of incoming neutrons and exiting protons are not depicted for simplicity.

Note that the conduction of the proposed test with "high energy" neutrons would not be resolutory because the *variation* of the electron energy expected to be absorbed by the neutrino would be excessively smaller than the electron energy.

The conduction of the test via nuclear beta decays is strongly discouraged due to the indicated expected dependence of the electron energy from the direction of beta emission (Figure 1), which dependence is negligible for the decay of individual neutrons.

Proposed experiments on the stimulated decay of the neutron. The test of the stimulated decay of the neutron proposed in Ref. [9c], Eqs. (8.3), was successfully conducted by N. Tsagas and his associates [9f] (see Ref. [9g] for a review and upgrading). As illustrated in Fig. 5, the latter experiment was conducted via a disk of Europa-152 (emitting photons precisely with the needed resonating frequency) coupled to a disc of a commercially available molybdenum, the pair being contained inside a scintilloscope for the detection of the expected electrons, the experimental set up being suitably shielded, as customary.

The test was successful because it detected electrons solely emitted by the indicated pair with energy much bigger than 1 MeV, since electrons from the Compton scattering of photons and atomic electrons can at most have 1 MeV, and the same high energy electrons were absent in the background as well as for the Europa-152 alone and the molybdenum alone.

The same test can be repeated in a variety of way with different hadronic fuels (see [9c] for alternatives). Most important is the repetition of the tests, specifically, with a disc of the isotope Mo(100, 42) that is contained only in 6% in commercially available molybdenum, since all other isotopes of the molybdenum do not admit the stimulated decay of the neutron for various reasons [9c,9g].

As one can see, despite the efforts conducted to far, the available experimental information on the synthesis, natural decay and stimulated decay of the neutron is grossly insufficient. Rather than being reason for dismissal, the insufficiency establishes instead the need for the finalization of the proposed basic experiments, also in view of their rather large scientific and societal relevance.

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