Chapter 1

SCIENTIFIC IMBALANCES OF THE TWENTIETH CENTURY

1.1 THE SCIENTIFIC IMBALANCE CAUSED BY ANTIMATTER

1.1.1 Needs for a Classical Theory of Antimatter

The first large scientific imbalances of the 20-th century studied in this monograph is that caused by the treatment of *matter* at all possible levels, from Newtonian to quantum mechanics, while *antimatter* was solely treated at the level of *second quantization* [1].

Besides an evident lack of scientific democracy in the treatment of matter and antimatter, the lack of a consistent *classical* treatment of antimatter left open a number of fundamental problems, such as the inability to study whether a faraway galaxy or quasar is made up of matter or of antimatter, because such a study requires first a classical representation of the gravitational field of antimatter, as an evident pre-requisite for the quantum treatment (see Figure 1.1).

It should be indicated that classical studies of antimatter simply cannot be done by merely reversing the sign of the charge, because of inconsistencies due to the existence of only one quantization channel. In fact, the quantization of a classical antiparticle merely characterized by the reversed sign of the charge leads to a *particle* (rather than a charge conjugated antiparticle) with the wrong sign of the charge.

It then follows that the treatment of the gravitational field of suspected antimatter galaxies or quasars cannot be consistently done via the Riemannian geometry in which there is a simple change of the sign of the charge, as rather popularly done in the 20-th century, because such a treatment would be structurally inconsistent with the quantum formulation.

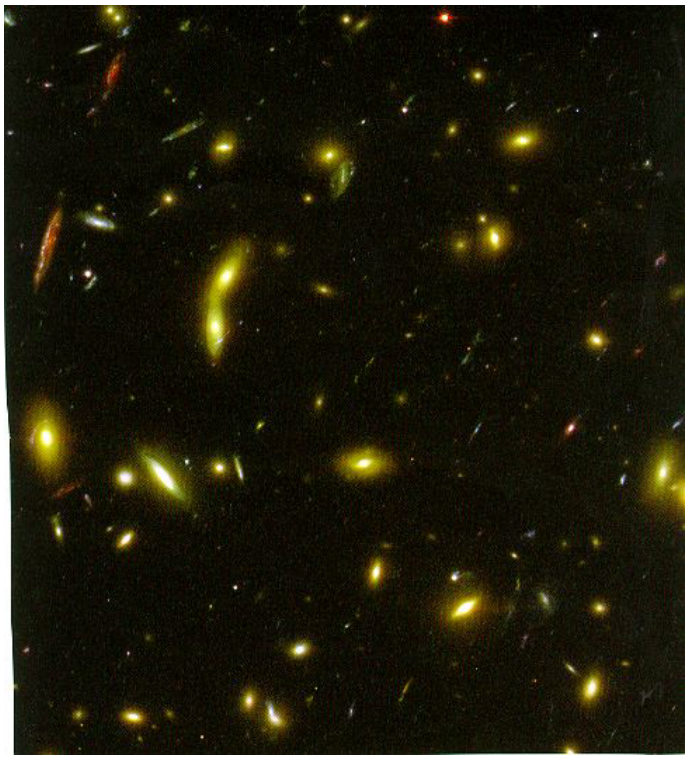

Figure 1.1. An illustration of the first major scientific imbalance of the 20-th century studied in this monograph, the inability to conduct classical quantitative studies as to whether faraway galaxies and quasars are made-up of matter or of antimatter. In depth studies have indicated that the imbalance was not due to insufficient physical information, but instead it was due to the lack of a mathematics permitting the classical treatment of antimatter in a form compatible with charge conjugation at the quantum level.

At any rate, the most interesting astrophysical bodies that can be made up of antimatter are *neutral.* In this case general relativity and its underlying Riemannian geometry can provide no difference at all between matter and antimatter stars due to the null total charge. The need for a suitable new theory of antimatter then becomes beyond credible doubt.

1.1.2 The Mathematical Origin of the Imbalance

The origin of this scientific imbalance was not of physical nature, because it was due to the *lack of a mathematics suitable for the classical treatment of antimatter in such a way as to be compatible with charge conjugation at the quantum level.*

Charge conjugation is an *anti-homomorphism.* Therefore, a necessary condition for a mathematics to be suitable for the classical treatment of antimatter is that of being anti-homomorphic, or, better, anti-isomorphic to conventional mathematics.

Therefore, the classical treatment of antimatter requires *numbers, fields, functional analysis, differential calculus, topology, geometries, algebras, groups, symmetries, etc. that are anti-isomorphic to their conventional formulations for matter.*

The absence in the 20-th century of such a mathematics is soon established by the lack of a formulation of trigonometric, differential and other elementary functions, let alone complex topological structures, that are anti-isomorphic to the conventional ones.

In the early 1980s, due to the absence of the needed mathematics, the author was left with no other alternative than its construction along the general guidelines of hadronic mechanics, namely, the construction of the needed mathematics from the physical reality of antimatter, rather than adapting antimatter to pre-existing insufficient mathematics.[1]

After considerable search, the needed new mathematics for antimatter resulted in being characterized by the most elementary and, therefore, most fundamental possible assumption, that of a *negative unit,*

$$-1, \tag{1.1.1}$$

and then the reconstruction of the entire mathematics and physical theories of matter in such a way as to admit -1 as the correct left and right unit at all levels.

In fact, such a mathematics resulted in being anti-isomorphic to that representing matter, applicable at all levels of study, and resulting in being equivalent to charge conjugation after quantization.[2]

[1]In the early 1980s, when the absence of a mathematics suitable for the classical treatment of antimatter was identified, the author was (as a theoretical physicist) a member of the Department of Mathematics at Harvard University. When seeing the skepticism of colleagues toward such an absence, the author used to suggest that colleagues should go to Harvard's advanced mathematics library, select any desired volume, and open any desired page at random. The author then predicted that the mathematics presented in that page resulted to be fundamentally inapplicable to the classical treatment of antimatter, as it did indeed result to be the case without exceptions. In reality, the entire content of advanced mathematical libraries of the early 1980s did not contain the mathematics needed for a consistent classical treatment of antimatter.

[2]In 1996, the author was invited to make a 20 minutes presentation at a mathematics meeting held in Sicily. The presentation initiated with a transparency solely containing the number -1 and the statement that such a number was assumed as the basic left and right unit of the mathematics to be presented. Unfortunately, this first transparency created quite a reaction by most participants who bombarded the author with questions advancing his presentation, questions often repeated with evident waste of precious time without the author having an opportunity to provide a technical answer. This behavior continued for the remaining of the time scheduled for the talk to such an

1.1.3 Outline of the Studies on Antimatter

Recall that "science" requires a mathematical treatment producing numerical values that can be confirmed by experiments. Along these lines, Chapter 2 is devoted, first, to the presentation of the new mathematics suggested by the author for the classical treatment of antimatter under the name of *isodual mathematics* with Eq. (1.1.1) as its fundamental *isodual left and right unit.*

Chapter 2 then presents the classical formalism, proposed under the name of *isodual classical mechanics* that begins with a necessary reformulation of Newton's equations and then passes to the needed analytic theory.

The operator formulation turned out to be *equivalent,* but not identical, to the quantum treatment of antiparticles, and was submitted under the name of *isodual quantum mechanics.*

Following these necessary foundational studies, Chapter 2 includes the detailed verification that the new *isodual theory of antimatter* does indeed verify *all* classical and particle experimental evidence.

In subsequent chapters we shall then study some of the predictions of the new isodual theory of antimatter, such as antigravity, a causal time machine, the isodual cosmology in which the universe has null total characteristics, and other predictsions that are so far reaching as to be at the true edge of imagination.

1.2 THE SCIENTIFIC IMBALANCE CAUSED BY NONLOCAL-INTEGRAL INTERACTIONS

1.2.1 Foundations of the Imbalance

The second large scientific imbalance of the 20-th century studied in this monograph is that caused by the reduction of *contact nonlocal-integral interactions* to pre-existing *action-at-a-distance local-differential theories* (see Figure 1.2).

It should be indicated that there exist numerous definitions of "nonlocality" in the literature, a number of which have been adapted to be compatible with pre-existing doctrines. The notion of nonlocality studied by hadronic mechanics is that specifically referred to *interactions of contact type not derivable from a potential and occurring in a surface, as for the case of resistive forces, or in a volume, as for the case of deep mutual penetration and overlapping of the wavepackets and/or charge distributions of particles.*

The imbalance was mandated by the fact (well known to experts to qualify as such) that *nonlocal-integral interactions are structurally incompatible with*

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extent that the author could not present the subsequent transparencies proving that numbers with a negative unit verify all axions of a field (see Chapter 2). The case illustrates that the conviction of absolute generality is so engraved among most mathematicians to prevent their minds from admitting the existence of *new* mathematics.

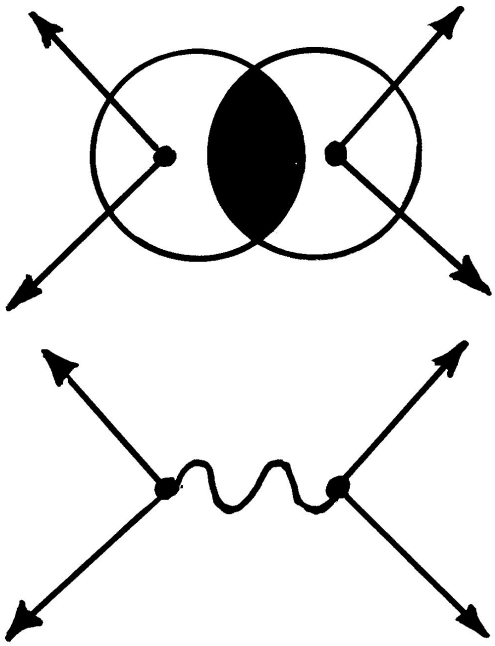

Figure 1.2. A first illustration of the second major scientific imbalance of the 20-th century studied in this monograph, the abstraction of extended hyperdense particles, such as protons and neutrons, to points, with consequential ignorance of the nonlocal and nonpotential effects caused by the the deep overlapping of hyperdense media. As we shall see, besides having major scientific implications, such as a necessary reformulation of Feynman's diagrams, the quantitative treatment of the nonlocal and nonpotential effects of this figure permit the prediction and industrial development of basically new, clean energies and fuels.

special relativity, because the interactions here considered cause the catastrophic collapse of the mathematics underlying special relativity, let alone the irreconcilable inapplicability of the physical laws.

In fact, the local-differential topology, calculus, geometries, symmetries, and other mathematical methods underlying special relativity permit the sole consistent description of *a finite number of point-like particles moving in vacuum (empty space).* Since points have no dimension and, consequently, cannot experience collisions or contact effects, the only possible interactions are at-a-distance, thus being derivable from a potential. The entire machinery of special relativity then follows. For systems of particles at large mutual dis-

tances for which the above setting is valid, such as for the structure of the hydrogen atom, special relativity is then *exactly valid.*

However, classical point-like particles do not exist; hadrons are notoriously extended; and even particles with *point-like charge,* such as the electron, do not have "point-like wavepackets". As we shall see, the representation of particles and/or their wavepackets as they really are in nature, that is, extended, generally nonspherical and deformable, cause the existence of contacts effects of nonlocal-integral as well as zero-range nonpotential type that are beyond any hope of quantitative treatment via special relativity.

This is the case for all systems of particles at short mutual distances, such as the structure of hadrons, nuclei and stars, for which special relativity is *inapplicable* (rather than "violated") because not conceived or intended for the latter systems. The understanding is that the *approximate character* remains beyond scientific doubt.

Well known organized academic interests on Einsteinian doctrines then mandated the abstraction of nonlocal-integral systems to point-like, local-differential forms as a necessary condition for the validity of special relativity. This occurrence caused a scientific distortion of simply historical proportions because, while the existence of systems for which special relativity is fully valid is beyond doubt, the assumption that all conditions in the universe verify Einsteinian doctrines is a scientific deception for personal gains.

In Section 1.1 and in Chapter 2, we show the structural inability of special relativity to permit a *classical* representation of antimatter in a form compatible with charge conjugation. In this section and in Chapter 3, we show the inability of special relativity to represent extended, nonspherical and deformable particles or antiparticles and/or their wavepackets under nonlocal-integral interactions at short distances.

In Section 1.3 and in Chapter 4, we show the irreconcilable inapplicability of special relativity for all possible, classical and operator irreversible systems of particles and antiparticles. The widely ignored theorems of catastrophic inconsistencies of Einstein's gravitation are studied in Section 1.4 and in Chapter 3.

A primary purpose of this monograph is to show that the political adaptation of everything existing in nature to special relativity, rather than constructing new relativities to properly represent nature, prevents the prediction and quantitative treatment of new clean energies and fuels so much needed by mankind. In fact, new clean energies are permitted precisely by contact, nonlocal-integral and nonpotential effects in hadrons, nuclei and stars that are beyond any dream of treatment via special relativity.

Therefore, *the identification of the limits of applicability of Einsteinian doctrines and the construction of new relativities are nowadays necessary for scientific accountability vis-a-vis society, let alone science.*

Needless to say, due to the complete symbiosis of special relativity and relativistic quantum mechanics, the inapplicability of the former implies that of the latter, and vice-versa. In fact, quantum mechanics will also emerge from our studies as being only *approximately valid* for system of particles at short mutual distances, such as for hadrons, nuclei and stars, for the same technical reasons implying the lack of exact validity of special relativity.

The resolution of the imbalance due to nonlocal interactions is studied in Chapter 3.

1.2.2 Exterior and Interior Dynamical Problems

The identification of the scientific imbalance here considered requires the knowledge of the following fundamental distinction:

DEFINITION 1.2.1: Dynamical systems can be classified into:

EXTERIOR DYNAMICAL SYSTEMS, consisting of particles at sufficiently large mutual distances to permit their point-like approximation under sole action-at-a-distance interactions, and

INTERIOR DYNAMICAL PROBLEMS, consisting of extended and deformable particles at mutual distances of the order of their size under action-at-a-distance interactions as well as contact nonpotential interactions.

Interior and exterior dynamical systems of antiparticles are defined accordingly.

Typical examples of exterior dynamical systems are given by planetary and atomic structures. Typical examples of interior dynamical systems are given by the structure of planets at the classical level and by the structure of hadrons, nuclei, and stars at the operator level.

The distinction of systems into exterior and interior forms dates back to Newton [2], but was analytically formulated by Lagrange [3], Hamilton [4], Jacobi[3][5] and others (see also Whittaker [6] and quoted references). the distinction was still assumed as fundamental at the beginning of the 20-th century, but thereafter the distinction was ignored.

For instance, Schwartzchild wrote two papers in gravitation, one of the *exterior gravitational problem* [7], and a second paper on the *interior gravitational problem* [8]. The former paper reached historical relevance and is presented in all subsequent treatises in gravitation of the 20-th century, but the same

[3]Contrary to popular belief, the celebrated Jacobi theorem was formulated precisely for the general analytic equations with external terms, while all reviews known to this author in treatises on mechanics of the 20-th century present the reduced version of the Jacobi theorem for the equations without external terms. Consequently, the reading of the original work by Jacobi [5] is strongly recommended over simplified versions.

treatises generally ignore the second paper and actually ignore the distinction into gravitational exterior and interior problems.

The reasons for ignoring the above distinction are numerous, and have yet to be studied by historians. A first reason is due to the widespread abstraction of particles as being point-like, in which case all distinctions between interior and exterior systems are lost since all systems are reduced to point-particles moving in vacuum.

An additional reason for ignoring interior dynamical systems is due to the great successes of the planetary and atomic structures, thus suggesting the reduction of all structures in the universe to exterior conditions.

In the author's view, the primary reason for ignoring interior dynamical systems is that they imply the inapplicability of the virtual totality of theories constructed during the 20-th century, including classical and quantum mechanics, special and general relativities, etc., as we shall see.

The most salient distinction between exterior and interior systems is the following. Newton wrote his celebrated equations for a system of n point-particle under an arbitrary force not necessarily derivable from a potential,

$$m_a \times \frac{dv_{ak}}{dt} = F_{ak}(t, r, v), \tag{1.2.1}$$

where: $k = 1, 2, 3$; $a = 1, 2, 3, ..., n$; t is the time of the observer; r and v represent the coordinates and velocities, respectively; and the conventional associative multiplication is denoted hereon with the symbol $\times$ to avoid confusion with numerous additional inequivalent multiplications we shall identify during our study.

Exterior dynamical systems occur when Newton's force F_{ak} is entirely derivable from a potential, in which case the system is entirely described by the sole knowledge of a Lagrangian or Hamiltonian and the *truncated Lagrange and Hamilton analytic equations, those without external terms*

$$\frac{d}{dt}\frac{\partial L(t, r, v)}{\partial v_a^k} - \frac{\partial L(t, r, v)}{\partial r_a^k} = 0, \tag{1.2.2a}$$

$$\frac{dr_a^k}{dt} = \frac{\partial H(t, r, p)}{\partial p_{ak}}, \quad \frac{dp_{ak}}{dt} = -\frac{\partial H(t, r, p)}{\partial r_a^k}, \tag{1.2.2b}$$

$$L = \frac{1}{2} \times m_a \times \mathbf{v}_a^2 - V(t, r, v), \tag{1.2.2c}$$

$$H = \frac{\mathbf{p}_a^2}{2 \times m_a} + V(t, r, p), \tag{1.2.2d}$$

$$V = U(t, r)_{ak} \times v_a^k + U_o(t, r); \tag{1.2.2e}$$

where: $\mathbf{v}$ and $\mathbf{p}$ represent three-vectors; and the convention of the sum of repeated indices is hereon assumed.

Interior dynamical systems when Newton's force F_{ak} is partially derivable from a potential and partially of contact, zero-range, nonpotential typem thus admitting additional interactions that simply cannot be represented with a Lagrangian or a Hamiltonian. For this reason, Lagrange, Hamilton, Jacobi and other founders of analytic dynamics presented their celebrated equations with *external terms representing precisely the contact, zero-range, nonpotential forces among extended particles.* Therefore, the treatment of interior systems requires the *true Lagrange and Hamilton analytic equations, those with external terms*

$$\frac{d}{dt}\frac{\partial L(t,r,v)}{\partial v_a^k} - \frac{\partial L(t,r,v)}{\partial r_a^k} = F_{ak}(t,r,v), \tag{1.2.3a}$$

$$\frac{dr_a^k}{dt} = \frac{\partial H(t,r,p)}{\partial p_{ak}}, \quad \frac{dp_{ak}}{dt} = -\frac{\partial H(t,r,p)}{\partial r_a^k} + F_{ak}(t,r,p), \tag{1.2.3b}$$

$$L = \frac{1}{2} \times m_a \times \mathbf{v}_a^2 - V(t,r,v), \tag{1.2.3c}$$

$$H = \frac{\mathbf{p}_a^2}{2 \times m_a} + V(t,r,p), \tag{1.2.3d}$$

$$V = U(t,r)_{ak} \times v_a^k + U_o(t,r), \tag{1.2.3e}$$

$$F(t,r,v) = F(t,r,p/m). \tag{1.2.3f}$$

Comprehensive studies were conducted by Santilli in monographs [9] (including a vast historical search) on the necessary and sufficient conditions for the existence of a Lagrangian or a Hamiltonian known as the *conditions of variational selfadjointness.* These studies permitted a rigorous separation of all acting forces into those derivable from a potential, or variationally selfadjoint (SA) forces, and those not derivable from a potential, or variationally nonselfadjoint (NSA) forces according to the expression

$$F_{ak} = F_{ak}^{SA}(t,r,v) + F_{ak}^{NSA}(t,r,v,a,...). \tag{1.2.4}$$

In particular, the reader should keep in mind that, while selfadjoint forces are of Newtonian type, *nonselfadjoint forces are generally non-Newtonian,* in the sense of having an unrestricted functional dependence, including that on accelerations a and other non-Newtonian forms. [4]

As we shall see, nonselfadjoint forces generally have a nonlocal-integral structure that is usually reduced to a local-differential form via power series expansions in the velocities.

[4]There are serious rumors that a famous physicist from a leading institution visited NASA in 1998 to propose a treatment of the trajectory of the space shuttle during re-entry via (the truncated) Hamiltonian mechanics, and that NASA engineers kindly pushed that physicist through the door.

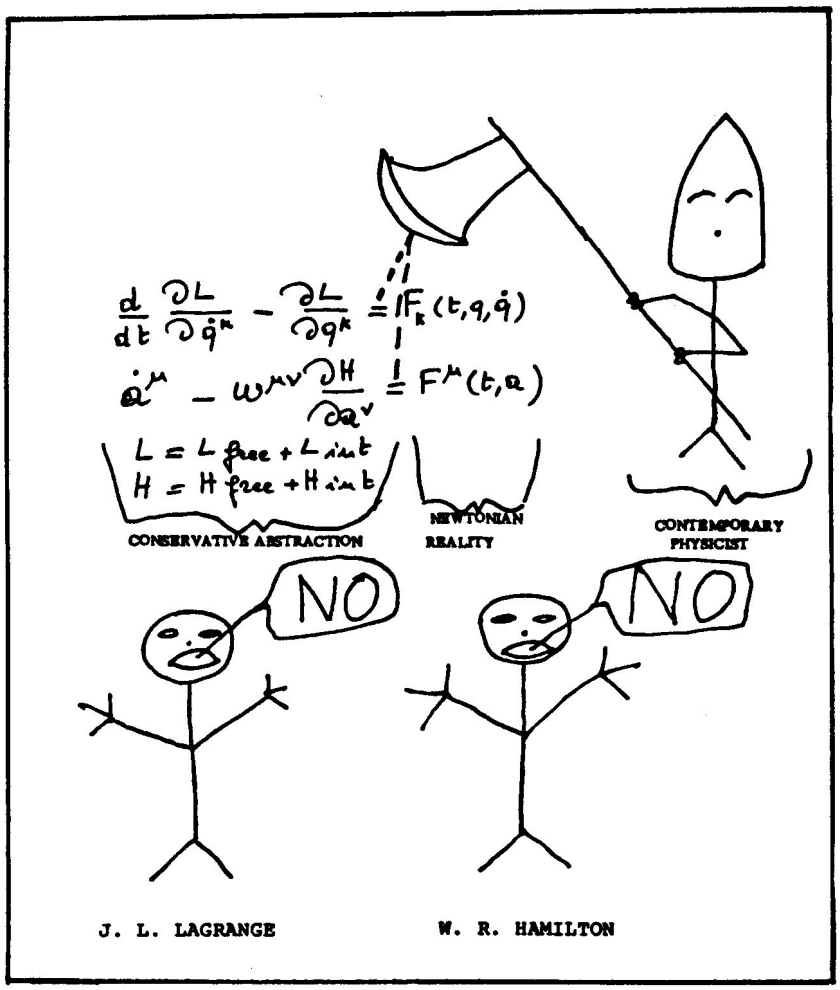

Figure 1.3. A reproduction of a "vignetta" presented by the author in 1978 to the colleagues at the Lyman Laboratory of Physics of Harvard University as part of his research under DOE support to denounce the truncation of the external terms in Lagrange's and Hamilton's equations that was dominating physical theories of the time. As studied in details in this monograph, the proper formulation of the true historical equations, those with external terms, permits the construction of covering theories that, being invariant, will indeed resist the test of time, while permitting the prediction and industrial development of new clean energies and fuels, thus establishing a societal, let alone scientific need for their serious study.

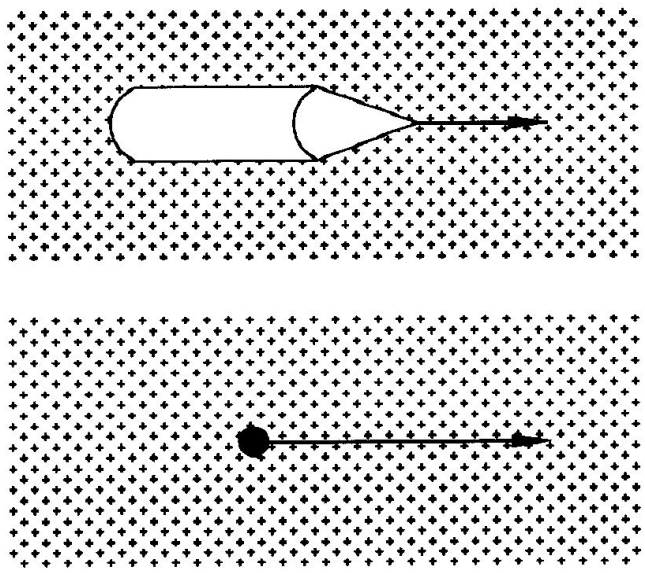

Figure 1.4. Another illustration of the major scientific imbalance studied in this monograph. The top view depicts a typical Newtonian system with nonlocal and nonpotential forces, such as a missile moving in atmosphere, while the bottom view depicts its reduction to point-like constituents conjectured throughout the 20-th century for the evident purpose of salvaging the validity of quantum mechanics and Einsteinian doctrines. However, the consistency of such a reduction has now been disproved by theorems, thus confirming the necessity of nonlocal and nonpotential interactions at the primitive elementary level of nature.

For instance, the contact, zero-range, resistive force experienced by a missile moving in our atmosphere is characterized by an integral over the surface of the missile and it is usually approximated by a power series in the velocities, e.g. $F^{NSA} = k_1 \times v + k_2 \times v^2 + k_3 \times v^3 + \ldots$ (see Figure 1.3).

Moreover, the studies of monographs [9] established that, for the general case in three dimensions, *Lagrange's and Hamilton's equations without external terms can only represent in the coordinates of the experimenter exterior dynamical systems, while the representation of interior dynamical systems in the given coordinates* (t, r) *of the experimenter require the necessary use of the true analytic equations with external terms.*

Whenever exposed to dynamical systems not entirely representable via the sole knowledge of a Lagrangian or a Hamiltonian, a rather general attitude is that of transforming them into an equivalent purely Lagrangian or Hamil-

tonian form. these transformations are indeed mathematically possible, but they are physically insidious.

It is known that, under sufficient continuity and regularity conditions and under the necessary reduction of nonlocal external terms to local approximations such as that in Eq. (1.2.4), the *Darboux's theorem* of the symplectic geometry or, equivalently, the *Lie-Koening theorem* of analytic mechanics assure the existence of coordinate transformations

$$\{r, p\} \rightarrow \{r'(r, p), p'(r, p)\}, \tag{1.2.5}$$

under which nonselfadjoint systems (1.2.2) can be turned into a selfadjoint form (1.2.1), thus eliminating the external terms.

However, coordinate transforms (1.2.5) are *necessarily nonlinear.* Consequently, the new reference frames are *necessarily noninertial.* Therefore, the elimination of the external nonselfadjoint forces via coordinate transforms cause the necessary loss of Galileo's and Einstein's relativities.

Moreover, it is evidently impossible to place measuring apparata in new coordinate systems of the type $r' = exp(k \times p)$, where k is a constant. For these reasons, the use of Darboux's theorem or of the Lie-Koening theorem was strictly prohibited in monographs [9,10,11]. Thus, to avoid misrepresentations, the following basic assumption is hereon adopted:

ASSUMPTION 1.2.1: The sole admitted analytic representations are those in the fixed references frame of the experimenter without the use of integrating factors, called direct analytic representations.

Only *after* direct representations have been identified, the use of the transformation theory may have physical relevance. Due to its importance, the above assumption will also be adopted throughout this monograph.

As an illustration, the admission of integrating factors within the fixed coordinates of the experimenter does indeed allow the achievement of an analytic representation without external terms of a restricted class of nonconservative systems, resulting in Hamiltonians of the type $H = e^{f(t,r,...)} \times p^2/2 \times m$. This Hamiltonian has a fully valid *canonical meaning* of representing the time evolution. However, this Hamiltonian loses its meaning as representing the energy of the system. The quantization of such a Hamiltonian then leads to a plethora of illusions, such as the belief that the uncertainty principle for energy and time is still valid while, for the example here considered, such a belief has no sense because H does not represent the energy (see Refs. [9b] for more details).

Under the strict adoption of Assumption 1.2.1, all these ambiguities are absent because H *will always represent the energy,* irrespective of whether

conserved or nonconserved, thus setting up solid foundations for correct physical interpretations.

1.2.3 General Inapplicability of Conventional Mathematical and Physical Methods for Interior Dynamical Systems

The impossibility of reducing interior dynamical systems to an exterior form within the fixed reference frame of the observer causes the loss for interior dynamical systems of all conventional mathematical and physical methods of the 20-th century.

To begin, the presence of irreducible nonselfadjoint external terms in the analytic equations causes the loss of their derivability from a variational principle. In turn, the lack of an action principle and related Hamilton-Jacobi equations causes the lack of any possible quantization, thus illustrating the reasons why the voluminous literature in quantum mechanics of the 20-th century carefully avoids the treatment of analytic equations with external terms.

By contrast, *one of the central objectives of this monograph is to review the studies that have permitted the achievement of a reformulation of Eqs. (1.2.3) fully derivable from a variational principle in conformity with Assumption 1.2.1, thus permitting a consistent operator version of Eqs. (1.2.3) as a covering of conventional quantum formulations.*

Recall that Lie algebras are at the foundations of all classical and quantum theories of the 20-th century. This is due to the fact that the brackets of the time evolution as characterized by Hamilton's equations,

$$\frac{dA}{dt} = \frac{\partial A}{\partial r_a^k} \times \frac{dr_a^k}{dt} + \frac{\partial A}{\partial p_{ak}} \times \frac{dp_{ak}}{dt} =$$

$$= \frac{\partial A}{\partial r_a^k} \times \frac{\partial H}{\partial p_{ak}} - \frac{\partial H}{\partial r_a^k} \times \frac{\partial A}{\partial p_{ak}} = [A, H], \tag{1.2.6}$$

firstly, verify the conditions to characterize an *algebra* as currently understood in mathematics, that is, the brackets $[A, H]$ verify the right and left scalar and distributive laws,

$$[n \times A, H] = n \times [A, H], \tag{1.2.7a}$$

$$[A, n \times H] = [A, H] \times n, \tag{1.2.7b}$$

$$[A \times B, H] = A \times [B, H] + [A, H] \times B, \tag{1.2.7c}$$

$$[A, H \times Z] = [A, H] \times Z + H \times [A, Z], \tag{1.2.7d}$$

and, secondly, the brackets $[A, H]$ verify the *Lie algebra axioms*

$$[A, B] = -[B, A], \tag{1.2.8a}$$

$$[[A,B],C]+[[B,C],A]+[[C,A],B]=0. \tag{1.2.8b}$$

The above properties then persist following quantization into the operator brackets $[A,B]=A\times B-B\times A$, as well known.

When adding external terms, the resulting new brackets,

$$\frac{dA}{dt}=\frac{\partial A}{\partial r_a^k}\times\frac{dr_a^k}{dt}+\frac{\partial A}{\partial p_{ak}}\times\frac{dp_{ak}}{dt}=$$

$$=\frac{\partial A}{\partial r_a^k}\times\frac{\partial H}{\partial p_{ak}}-\frac{\partial H}{\partial r_a^k}\times\frac{\partial A}{\partial p_{ak}}+\frac{\partial A}{\partial r_a^k}\times F_a^k=$$

$$=(A,H,F)=[A,H]+\frac{\partial A}{\partial r_a^k}\times F_a^k, \tag{1.2.9}$$

violate the right scalar law (1.2.7b) and the right distributive law (1.2.7d) and, therefore, the brackets (A,H,F) do not constitute any algebra at all, let alone violate the basic axioms of the Lie algebras [9b].

The loss of the Lie algebras in the brackets of the time evolution of interior dynamical systems in their historical treatment by Lagrange, Hamilton, Jacobi and other founders of analytic dynamics, causes the loss of all mathematical and physical formulations built in the 20-th century.

The loss of basic methods constitutes the main reason for the abandonment of the study of interior dynamical systems. In fact, external terms in the analytic equations were essentially ignored through the 20-th century, by therefore adapting the universe to analytic equations (1.2.2) today known as the *truncated analytic equations.*

By contrast, *another central objective of this monograph is to review the studies that have permitted the achievement of a reformulation of the historical analytic equations with external terms,that is not only derivable from an action principle as indicated earlier, but also characterizes brackets in the time evolution that, firstly, constitute an algebra and, secondly, that algebra results to be a covering of Lie algebras.*

1.2.4 Inapplicability of Special Relativity for Dynamical Systems with Resistive Forces

The scientific imbalance caused by the reduction of interior dynamical systems to systems of point-like particles moving in vacuum, is indeed of historical proportion because it implied the belief of the exact applicability of special relativity and quantum mechanics for all conditions of particles existing in the universe, thus implying their applicability under conditions for which these theories were not intended for.

A central scope of this monograph is to show that the imposition of said theories to interior dynamical systems causes the suppression of new clean

energies and fuels already in industrial, let alone scientific, development, thus raising serious problems of scientific ethics and accountability.

At the classical level, the "inapplicability" (rather then the "violation") of (the Galilean and) special relativities for the description of an interior system such as a missile in atmosphere (as depicted in Figure 1.4) is beyond credible doubt, as any expert should know to qualify as such, because said relativities can only describe systems with action-at-a-distance potential forces, while the force acting on a missile in atmosphere are of contact-zero-range nonpotential type.

Despite this clear evidence, the resiliency by organized academic interests on conventional relativities knows no boundaries. As indicated earlier, when faced with the above evidence, a rather general posture is, that the resistive forces are "illusory" because, when the missile in atmosphere is reduced to its elementary point-like constituents, all resistive forces "disappear".

Such a belief is easily proved to be nonscientific by the following property that can be proved by a first year graduate student in physics:

THEOREM 1.2.1 [9b]: A classical dissipative system cannot be consistently reduced to a finite number of quantum particles under sole potential forces and, vice-versa, no ensemble of a finite number of quantum particles with only potential forces can reproduce a dissipative classical system.

Note that the above property causes the inapplicability of conventional relativities for the description of the *individual constituents* of interior dynamical systems, let alone their description as a whole.

Rather than adapting nature to pre-existing organized interests on Einsteinian doctrines, the scope of this monograph is that of adapting the theories to nature, as requested by scientific ethics and accountability.

1.2.5 Inapplicability of Special Relativity for the Propagation of Light within Physical Media

Another case of manipulation of scientific evidence to serve organized academic interests on conventional relativities is the propagation of light within physical media, such as water.

As it is well known, light propagates in water at a speed C much smaller than the speed c in vacuum and approximately given by the value

$$C = \frac{c}{n} = \frac{2}{3} \times c << c, \quad n = \frac{3}{2} >> 1. \tag{1.2.10}$$

It is well known that electrons can propagate in water at speeds bigger than the local speed of light, and actually approaching the speed of light in vacuum. In fact, the propagation of electrons faster than the local speed of light is

responsible for the blueish light, called *Cerenkov light,* that can be seen in the pools of nuclear reactors.

It is well known that *special relativity was built to describe the propagation of light IN VACUUM, and certainly not within physical media.* In fact, the setting of a massive particle traveling faster than the local speed of light is in violation of the basic axioms of special relativity.

To salvage the principle of causality it is then often assumed that *the speed of light "in vacuum" is the maximal causal speed "within water".* However, in this case there is the violation of the axiom of relativistic addition of speeds, because *the sum of two speeds of light in water does not yield the speed of light,* as required by a fundamental axiom of special relativity,

$$V_{tot} = \frac{C + C}{1 + \frac{C^2}{c^2}} = \frac{12}{13} \times c \neq C. \tag{1.2.11}$$

Vice-versa, if one assumes that *the speed of light "in water" C is the maximal causal speed "in water",* the axiom of relativistic compositions of speeds is verified,

$$V_{tot} = \frac{C + C}{1 + \frac{C^2}{C^2}} = C, \tag{1.2.12}$$

but there is the violation of the principle of causality evidently due to the fact that ordinary massive particles such as the electron (and not hypothetical *tachyons*) can travel faster than the local causal speed.

Again, the resiliency by organized interests on established relativities has no boundaries. When faced with the above evidence, a general posture is that, *when light propagating in water is reduced to photons scattering among the atoms constituting water, all axioms of special relativities are recovered in full.* In fact, according to this belief, photons propagate in vacuum, thus recovering the conventional maximal causal speed c, while the reduction of the speed of light is due to the scattering of light among the atoms constituting water.

The nonscientific character of the above view is established by the following evidence known to experts to qualify as such:

1) Photons are neutral, thus having a high capability of penetration within electrons clouds, or, more technically, the scattering of photons on atomic electron clouds (called *Compton scattering*) is rather small. Explicit calculations (that can be done by a first year graduate student in physics via quantum electrodynamics) show that, in the most optimistic of the assumptions and corrections, said scattering can account for only 3% of the reduction of the speed of light in water, thus leaving about 30% of the reduction quantitatively unexplained. Note that the deviation from physical reality is of such a magnitude that it cannot be "resolved" via the usual arbitrary parameters "to make things fit."

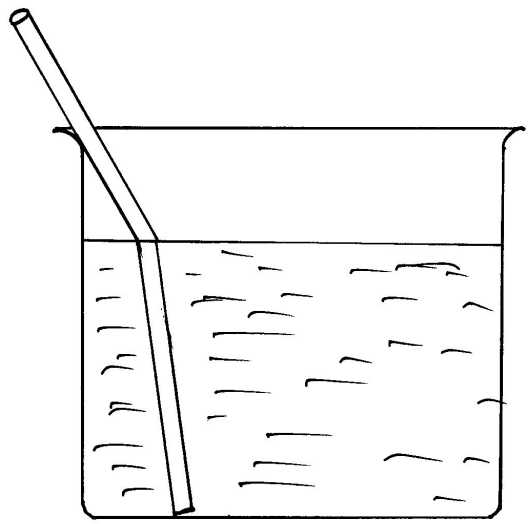

Figure 1.5. A further visual evidence of the lack of applicability of Einstein's doctrines within physical media, the refraction of light in water, due to the decrease of its speed contrary to the axiom of the "universal constancy of the speed of light". Organized academic interests on Einsteinian doctrines have claimed throughout the 20-th century that this effect is "illusory" because Einsteinian doctrines are recovered by reducing light to the scattering of photons among atoms. The political nature of the argument, particularly when proffered by experts, is established by numerous experimental evidence reviewed in the this section.

2) The reduction of speed occurs also for radio waves with one meter wavelength propagating within physical media, in which case the reduction to photons has no credibility due to the very large value of the wavelength compared to the size of atoms. The impossibility of a general reduction of electromagnetic waves to photon propagating within physical media is independently confirmed by the existence of vast experimental evidence on *non-Doppler's effects* reviewed in Chapter 9 indicating the existence of contributions outside the Doppler's law even when adjusted to the local speed.

3) There exist today a large volume of experimental evidence reviewed in Chapter 5 establishing that light propagates within hyperdense media, such as those in the interior of hadrons, nuclei and stars, at speed much bigger than the speed in vacuum,

$$C = \frac{c}{n} >> c, \quad n << 1. \tag{1.2.13}$$

in which case the reduction of light to photons scattering among atoms loses any physical sense (because such propagation can never reach the speed c, let alone speeds bigger than c).

In conclusion, experimental evidence beyond credible doubt has established that *the speed of light C is a local quantity dependent on the characteristics in which the propagation occurs, with speed $C = c$ in vacuum, speeds $C << c$ within physical media of low density and speeds $C >> c$ within media of very high density.*

The variable character of the speed of light then seals the lack of universal applicability of Einsteinian doctrines, since the latter are notoriously based on the philosophical assumption of "universal constancy of the speed of light".

1.2.6 Inapplicability of the Galilean and Poincaré symmetries for Interior Dynamical Systems

By remaining at the classical level, the inapplicability of Einsteinian doctrines within physical media is additionally established by the dramatic dynamical differences between the structure of a planetary system such as our Solar system, and the structure of a planet such as Jupiter.

The planetary system is a *Keplerian system,* that is, a systems in which the heaviest component is at the center (actually in one of the two foci of elliptical orbits) and the other constituents orbit around it without collisions. By contrast, planets absolutely do not constitute a Keplerian system, because they do not have a Keplerian center with lighter constituents orbiting around it (see Figure 1.6).

Moreover, for a planetary system isolated from the rest of the universe, the total conservation laws for the energy, linear momentum and angular momentum are verified for each individual constituent. For instance, the conservation of the intrinsic and orbital angular momentum of Jupiter is crucial for its stability. On the contrary, for the interior dynamical problem of Jupiter, conservation laws hold only globally, while no conservation law can be formulated for individual constituents.

For instance, in Jupiter's structure we can see in a telescope the existence in Jupiter's atmosphere of *interior vortices with variable angular momentum,* yet always in such a way to verify total conservation laws. We merely have internal exchanges of energy, linear and angular momentum but always in such a way that they cancel out globally resulting in total conservation laws.

In the transition to particles the situation remains the same as that at the classical level. For instance, *nuclei do not have nuclei* and, therefore, nuclei do not Keplerian systems.

Similarly, the Solar system is a Keplerian system, but the Sun is not. At any rate, any reduction of the structure of the Sun to a Keplerian system directly implies the belief in the perpetual motion within a physical medium,

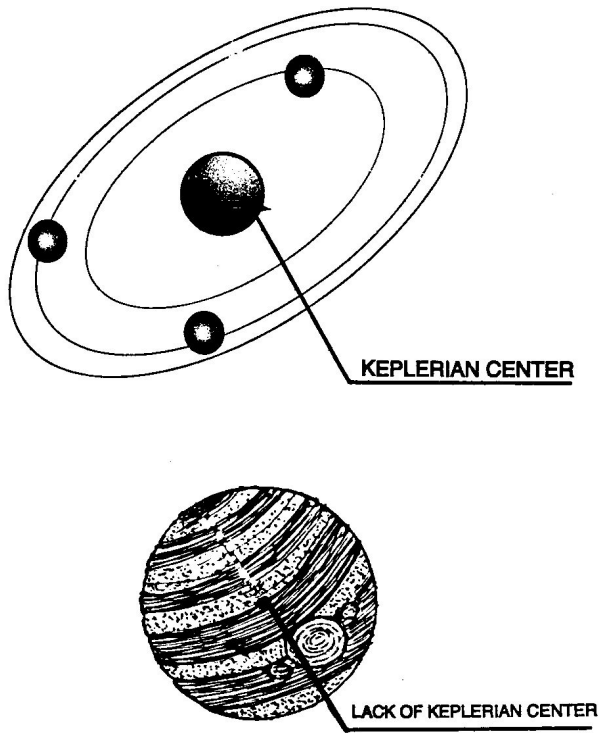

Figure 1.6. Another illustration of the second major scientific imbalance studied in this monograph, the dramatic structural differences between exterior and interior dynamical systems, here represented with the Solar system (top view) and the structure of Jupiter (bottom view). Planetary systems have a Keplerian structure with the exact validity of the Galilean and Poincaré symmetries. By contrast, interior systems such as planets (as well as hadrons, nuclei and stars) do not have a Keplerian structure because of the lack of the Keplerian center. Consequently, the Galilean and Poincaré symmetries cannot possibly be exact for interior systems in favor of covering symmetries and relativities studied in this monograph.

because electrons and protons could move in the hyperdense medium in the core of a star with conserved angular momenta, namely, a belief existing all boundaries of credibility, let alone of science.

The above evidence establishes beyond credible doubt the following:

THEOREM 1.2.2 [10b]: Galileo's and Poincaré symmetries are inapplicable for classical and operator interior dynamical systems due to the lack of Keplerian structure, the presence of contact, zero-range, non-potential interactions, and other reasons.

Note the use of the word "inapplicable", rather than "violated" or "broken". This is due to the fact that, as clearly stated by the originators of the basic spacetime symmetries (rather than their followers of the 20-th century), Galileo's and Poincaré symmetries were not built for interior dynamical conditions.

Perhaps the biggest scientific imbalance of the 20-th century has been the abstraction of hadronic constituents to point-like particles as a necessary condition to use conventional spacetime symmetries, relativities and quantum mechanics for interior conditions. In fact, such an abstraction is at the very origin of the conjecture that the undetectable *quarks* are the physical constituents of hadrons.

As repeatedly shown later on in this monograph, the unitary symmetries for the Mendeleev-type classification of hadrons into family has indeed a final character. However, the belief that the same unitary symmetries for the classification of hadrons can jointly provide the structure of each individual member of a unitary multiplet, is afflicted by a plethora of catastrophic inconsistencies that, after decades of attempts, have remained unresolved.

It is sufficient to recall at this point that*quarks cannot have any gravity at all,* because gravity can only be defined in spacetime while quarks can only be define on a unitary internal space without connection to our spacetime (due to O'Rafearthaigh's theorem[5]). Note that, under the conjecture that quarks are the constituents of nucleons, thus of nuclei, our bodies should float in the air because of the proven lack of gravity.

Also, *quark masses cannot have a credible inertia,* because to have inertial masses mast be defined in our spacetime, that is, masses must be the eigenvalues of the second order Casimir invariant of the Poincaré symmetry, while quarks cannot be characterized at all with such a spacetime symmetry. As a consequence, *quark masses are purely mathematical parameters solely definable in a purely mathematical complex-valued unitary space of the classification (and not the structure) of hadrons.* Additional catastrophic inconsistencies of quark conjectures will be pointed out later on. on.

Even assuming that quarks are physical particles, their structure for protons, neutrons and all baryons does not constitute a Keplerian system, under

[5]The author begs supersymmetry enthusiasts not to mention their theories at this point because, to achieve any credibility, they have first to prove the existence of an additional zoo of predicted particles none of which appears to be detected or detectable in reality.

which condition the use of nonrelativistic or relativistic quantum mechanics is more a religion than scientific truth.

Another main objective of this monograph is to show that the assumption of the unconfinable and undetectable quarks without gravity and inertia are the physical constituents of hadrons prevents any possible utilization of the immense reservoir or energy inside neutrons. On the contrary, if physical particles with proven gravity and inertial are assumed as the physical constituents of hadrons that can be expelled and detected under certain conditions, new clean energies are indeed possible, provided that special relativity and quantum mechanics are abandoned in favor of covering theories.

Irrespective of whether we consider quarks or other more credible particles, all particles have a wavepacket of the order of $1\,\mathrm{F} = 10^{-13}\,\mathrm{cm}$, that is, a wavepacket of the order of the size of all hadrons. Therefore, *the hyperdense medium in the interior of hadrons is composed of particles with extended wavepackets in conditions of total mutual penetration.* Under these conditions, the belief that Galileo's and Poincaré symmetries are *exactly* valid in the interior of hadrons implies the exiting from all boundaries of credibility, let alone of science.

The inapplicability of the fundamental spacetime symmetries then implies the inapplicability of Galilean and special relativities as well as of quantum nonrelativistic and relativistic mechanics. We can therefore conclude with the following:

COROLLARY 1.2.2A [10b]: Classical Hamiltonian mechanics and related Galilean and special relativities are not exactly valid for the treatment of interior classical systems such as the structure of Jupiter, while nonrelativistic and relativistic quantum mechanics and related Galilean and special relativities are not exactly valid for interior particle systems, such as the structure of hadrons, nuclei and stars.

Another important scope of this monograph is to show that the problem of the exact spacetime symmetries applicable to interior dynamical systems is not a mere academic issue, because it carries a direct societal; relevance. In fact, we shall show that broader spacetime symmetries specifically built for interior systems predict the existence of new clean energies and fuels that are prohibited by the spacetime symmetries of the exterior systems.

As we shall see, the assumption that the undetectable quarks are physical constituents of hadrons *prohibits* possible new energy based on processes occurring in the interior of hadrons (rather than in the interior of their ensembles such as nuclei). On the contrary, the assumption of hadronic constituents that can be fully defined in our spacetime and can be produced free under suitable conditions, directly implies new clean energies.

1.2.7 The Scientific Imbalance in Particle Physics

There is no doubt that quantum mechanics and special relativity permitted historical advances in particle physics. Yet, a widespread view expressed during the 20-th century is that "there exist no experimental data in particle physics disproving quantum mechanics and special relativity".

This statement has long lost scientific credibility because the agreement with experimental data was reached in numerous cases via the use of arbitrary parameters of unknown physical origin or motivation, while in reality these parameters constitute direct experimental evidence of *deviations* from the basic axioms of quantum mechanics and special relativity.

Among numerous cases existing in the literature, a representative one is that of the *Bose-Einstein correlation* in which protons and antiproton collide at high energy by annihilating each other and forming the so-called "fireball", that, in turn, emits a large number of unstable particles whose final product is a number of correlated mesons (see, e.g., review [7] and Figure 1.7).

The simplest possible case is that of the *two-points correlation function*

$$C_2 = \frac{P(p_1, p_2)}{P(p_1) \times P(p_2)}, \tag{1.2.14}$$

where p_1 and p_2 are the linear momenta of the two mesons and the P's represent their probabilities.

By working out the calculations via unadulterated axioms one of relativistic quantum mechanics one obtains expressions of the type

$$C_2 = 1 + A \times e^{-Q_{12}} - B \times e^{-Q_{12}}, \tag{1.2.15}$$

where A and B are normalization parameters and Q_{12} is the momentum transfer. This expression is dramatically far from representing experimental data, as shown in Chapter 5.

To resolve the problem, supporters of the universal validity of quantum mechanics and special relativity then introduce *four arbitrary parameters of unknown physical origin and motivation* called "chaoticity parameters" $c_\mu, \mu = 1, 2, 3, 4$, and expand expression (1.2.15) into the form

$$C_2 = 1 + A \times e^{-Q_{12}/c_1} + B \times e^{-Q_{12}/c_2} + C \times e^{-Q_{12}/c_3} - D \times e^{-Q_{12}/c_4}, \tag{1.2.16}$$

which expression does indeed fit the experimental data, as we shall see. However, the claim that quantum mechanics and special relativity are exactly valid is a scientific deception particularly when proffered by experts.

As we shall see in technical details in Chapter 5, the quantum axiom of expectation values (needed to compute the probabilities) solely permit expression (1.2.15), since it deals with Hermitean, thus diagonalized operators of the type

$$< \psi_\times \psi_2| \times P \times |\psi_1 \times \psi_2 >= P_{11} + P_{22}, \tag{1.2.17}$$

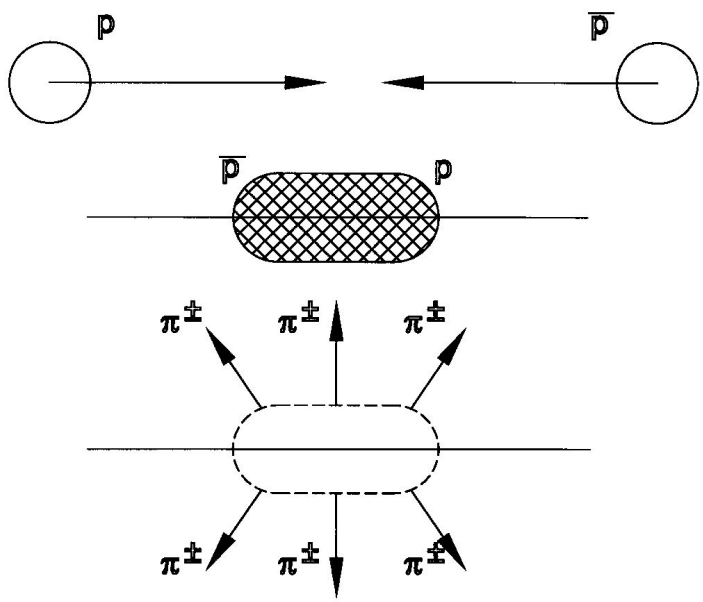

Figure 1.7. A schematic view of the Bose-Einstein correlation originating in proton-antiproton annihilations, for which the predictions of relativistic quantum mechanics are dramatically far from experimental data from unadulterated first principles. In order to salvage the theory and its underlying Einsteinian doctrines, organized interests introduce "four" ad hoc parameters deprived of any physical meaning or origin, and then claim the exact validity of said doctrines. The scientific truth is that these four arbitrary parameters are in reality a direct measurement of the deviation from the basic axioms of relativistic quantum mechanics and special relativity in particle physics.

while *the representation of a correlation between mesons 1 and 2 necessarily requires a structural generalization of the axiom of expectation value in such a form to admit off-diagonal elements for Hermitean operators,* for instance of the type

$$< \psi_{\times}\psi_2| \times T \times P \times T \times |\psi_1 \times \psi_2 >= P_{11} + P_{12} + P_{21} + P_{22}, \qquad (1.2.18)$$

where T is a 2×2-dimensional nonsingular matrix with off-diagonal elements (and P remains diagonal).

The scientific deception occurs because quantum mechanics and special relativity are claimed to be exactly valid for the Bose-Einstein correlation when experts, to qualify as such, know that the representation requires a structural modification of the basic axiom of expectation values as well as for numerous additional reasons, such as:

1) The Bose-Einstein correlation is necessarily due to contact, nonpotential, nonlocal-integral effects originating in the deep overlapping of the hyperdense charge distributions of protons and antiprotons inside the fireball;

2) The mathematical foundations of quantum mechanics (such as its topology), let alone its physical laws, are inapplicable for a meaningful representation of said nonlocal and nonpotential interactions as outlined in preceding sections; and

3) Special relativity is also inapplicable, e.g., because of the inapplicability of the basic Lorentz and Poincaré symmetries due to lack of a Keplerian structure,

the *approximate* validity of said theories remaining beyond scientific doubt.

Admittedly, there exist a number of semiphenomenological models in the literature (xxx) capable of a good agreement with the experimental data. Scientific deception occurs when these models are used to claim the exact validity of quantum mechanics and special relativity since the representation of experimental data requires necessary structural departures from basic quantum axioms.

Of course, the selection of the appropriate generalization of quantum mechanics and special relativity for an exact representation of the Bose-Einstein correlation is open to scientific debate. Scientific deception occurs when the need for such a generalization is denied for personal gains.

As we shall see, relativistic hadronic mechanics provides an *exact and invariant* representation of the experimental data of the Bose-Einstein correlation at high and low energies via unadulterated basic axioms, by providing in particular a direct representation of the shape of the $p-\bar{p}$ fireball and its density, while recovering the basic invariant under a broader realization of the Poincaré symmetry.

An in depth investigation of all applications of quantum mechanics and special relativity at large reveals that they have provided an *exact* and *invariant* representation *from unadulterated basic axioms* of *all* experimental data of the hydrogen atom, as well as of physical conditions in which the mutual distances of particles is much bigger than the size of the charge distribution (for hadrons) or of the wavepackets of particles (for the case of the electron).

1.2.8 The Scientific Imbalance in Nuclear Physics

There is no doubt that quantum mechanics and special relativity permitted historical advances in also nuclear physics during the 20-th century, as illustrated, for instance, by nuclear power plants. However, any claim that quantum mechanics and special relativity are *exactly* valid in nuclear physics is a scientific deception, particularly when proffered by experts, because of the well known inability of these theories to achieve an exact and invariant

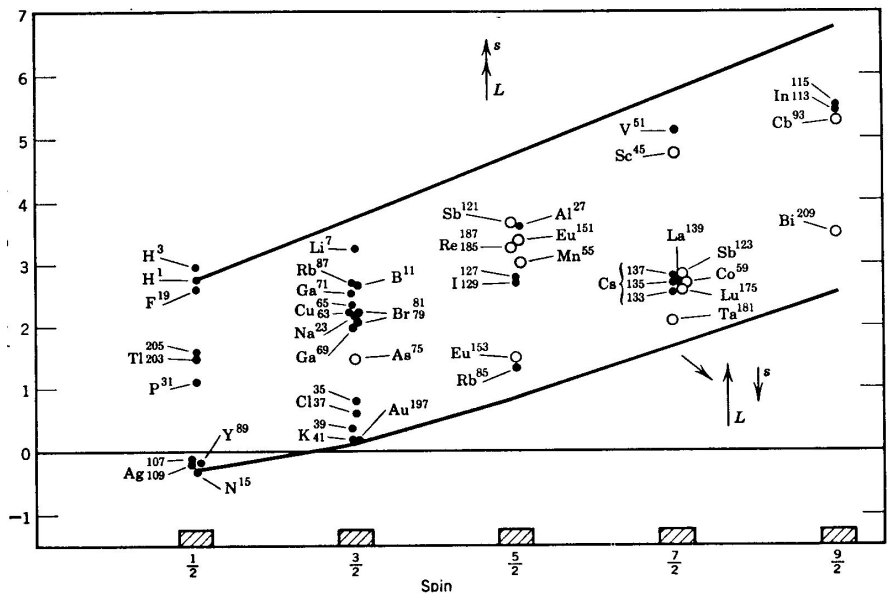

Figure 1.8. The first historical experimental evidence on the lack of exact validity of quantum mechanics in nuclear physics was given by data on nuclear magnetic moments that do not follow quantum mechanical predictions, and are instead comprised between certain minimal and maximal values, called the Schmidt Limits [13], without any possible quantum treatment. The additional suppression of the impossibility for the Galilean and Poincaré symmetries to be exact in nuclear physics due to the lack of a Keplerian center (see next figure), have essentially rendered nuclear physics a religion without a serious scientific process.

representation of numerous nuclear data despite one centuries of attempts and the expenditure of large public funds.

To resolve the insufficiencies, the use of arbitrary parameters of unknown physical origin and motivation was first attempted, semiphenomenological fits were reached and quantum mechanics and special relativity were again claimed to be exact in nuclear physics, while in the scientific reality the used parameters are a direct representation of *deviations* from the basic axioms of the theories as shown in detail in Chapter 5.

Subsequently, when the use of arbitrary parameters failed to achieve credible representations of nuclear data (such as nuclear magnetic moments as indicated below), organized academic interests claimed that "the deviations are resolved by deeper theories such as quark theories". At that point nuclear physics left the qualification of a true science to become a scientific religion.

Besides a plethora of intrinsic problematic aspects or sheer inconsistencies (such as the impossibility for quarks to have gravity mentioned earlier), quark theories failed to achieve any credible representation even of the spin of individual nucleons, let alone achieve exact representations of experimental data for their bound states.

Admittedly, the deviations here considered are at times small. Nevertheless, as we shall see in Chapter 6, small deviations directly imply new clean energies that cannot be even conceived, let alone treated, via quantum mechanics. Therefore, we have a societal duty to conduct serious investigations on broader mechanics specifically conceived for nuclear physics.

The first evidence on the lack of exact character of quantum mechanics in nuclear physics dates back to the birth of nuclear physics in the 1930s where it emerged that experimental values of nuclear magnetic moments could not be explained with quantum mechanics, because, starting with small deviations for small nuclei, the deviations then increased with mass, to reach deviations for large nuclei, such as the Zirconium so big to escape any use of unknown parameters "to fix things" (see Figure 1.8).

Subsequently, it became clear that quantum mechanics and special relativity could not explain the simplest possible nucleus, the deuteron, despite vast efforts. In fact, quantum mechanics missed about 1% of the deuteron magnetic moment despite all possible relativistic corrections, as well as the questionable assumptions that the ground state of the deuteron is a mixture of various states in a way manifestly against experimental evidence.

Next, quantum mechanics and special relativity were unable to represent the spin of the deuteron, an occurrence well known to experts in the field but carefully undisclosed. The axioms of quantum mechanics require that the ground state of two particles with spin 1/2 (such as the proton and the neutron) must have spin zero (*anti-parallel or singlet coupling*), while the case with spin 1 (*parallel spin or triplet coupling*) is unstable, as a first year graduate student in physics can prove.

By contrast, the deuteron has spin 1, thus remaining fundamentally unexplained by quantum mechanics and special relativity to this day.[6] Additionally, quantum mechanics has been unable to represent the stability of the neutron, its charge radius, and numerous other data.

Perhaps the most distressing, yet generally undisclosed, insufficiency of quantum mechanics and special relativity in nuclear physics has been the failure to understand and represent nuclear forces. Recall that a necessary condition for the applicability of quantum mechanics is that *all* interactions must be derivable from a potential.

[6] As we shall see in Chapter 6, the correct interpretation of the spin 1 of the deuteron has implications so deep to require a revision of the very notion of neutron.

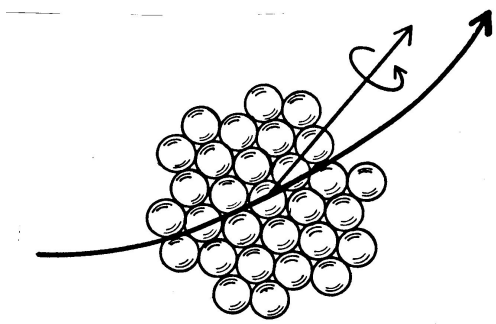

Figure 1.9. A visual evidence of the impossibility for quantum mechanics to be exactly valid in nuclear physics: the fact that "nuclei do not have nuclei." Consequently, the Galilean and Poincaré symmetries, as well as nonrelativistic and relativistic quantum mechanics, cannot possibly be exact for the nuclear structure structure since said symmetries demand the heaviest constituent at the center. The above occurrence establishes the validity of covering symmetries for interior systems without Keplerian centers, which symmetries are at the foundation of the covering hadronic mechanics.

The original concept that nuclear forces were of central type soon resulted to be disproved by nuclear reality, thus requiring the addition of non-central, yet still potential forces. The insufficiency of this addition requested the introduction of exchange, van der Waals, and numerous other potential forces. As of today, after about one century of adding new potentials to the Hamiltonian, we have reached the unreassuring representation of nuclear forces via some twenty or more different potentials in the Hamiltonian [13]

$$\begin{aligned} H = \Sigma_{k=1,2,\ldots,n} \frac{p_k^2}{2 \times m_k} + V_1 + V_2 + V_3 + V_4 + V_5 + V_6 + \\ + V_7 + V_8 + V_9 + V_{10} + V_{11} + V_{12} + V_{13} + V_{14} + \\ + V_{15} + V_{16} + V_{17} + V_{18} + V_{19} + V_{20} + \ldots\ldots\ldots \end{aligned} \tag{1.2.19}$$

and we still miss a credible understanding and representation of the nuclear force!

It is evident that this process cannot be kept indefinitely without risking a major condemnation by posterity. The time has long come to stop adding potentials to nuclear Hamiltonians and seek fundamentally new approaches and vistas.

In the final analysis, an inspection of nuclear volumes establishes that nuclei are generally composed of nucleons in conditions of partial mutual penetration,

as illustrated in Figure 1.9. By recalling that nucleons have the largest density measured in laboratory until now, the belief that all nuclear forces are of action-at-a-distance, potential type, as *necessary* to preserve the validity of quantum mechanics and special relativity, is pure academic politics deprived of scientific value.

As we shall see in Chapter 7, a central objective of hadronic mechanics is that of truncating the addition of potentials and re-examining instead the nuclear force from its analytic foundations, by first separating potential non-potential forces, and then examining in details each of them.

In summary, the lack of exact character of quantum mechanics and special relativity in nuclear physics is beyond scientific doubt. The open scientific issue is the selection of the appropriate generalization, but not its need.

As we shall see in Chapter 6, the covering hadronic mechanics and isospecial relativity resolve the fundamental open problems of nuclear physics by permitting the industrial development of new clean energies based on light natural and stable elements without the emission of dangerous radiations and without the release of radioactive waste.

1.2.9 The Scientific Imbalance in Superconductivity

The condition of superconductivity in the 20-th century can be compared to that of atomic physics prior to the representation of the structure of the atom.

Recall that individual electrons cannot achieve a superconducting state because their magnetic fields interferes with electromagnetic fields of atoms by creating in this way what we call *electric resistance.* Superconductivity is instead reached by deeply correlated-bonded pairs of electrons in singlet couplings, called *Cooper pairs.* In fact, these pairs have an essentially null total magnetic field (due to the opposite orientations of the two fields), resulting in a substantial decrease of electric resistance.

There is no doubt that quantum mechanics and special relativity have permitted the achievement of a good description of an "ensemble" of Cooper pairs, although each Cooper pair is necessarily abstracted as a point, the latter condition being necessary from the very structure of the theories.

However, it is equally well known that quantum mechanics and special relativity have been unable to reach a final understanding and representation of the structure of *one* Cooper pair, trivially, because electrons repel each other according to the fundamental Coulomb law.

The failure of basic axioms of quantum mechanics and special relativity to represent the *attractive* force between the two *identical* electrons of the Cooper pairs motivated the hypothesis that the attraction is caused by the exchange of a new particle called *phonon.* However, phonons certainly exist in sounds,

but they have found no verification at all in particle physics, thus remaining purely conjectural to this day.

In reality, as we shall see in Chapter 7, the interactions underlying the Cooper pairs are of purely contact, nonlocal and integral character due to the mutual penetration of the wavepackets of the electrons, as depicted in Figure 1.10. As such, they are very similar to the interactions responsible for Pauli's exclusion principle in atomic structures.

Under these conditions, the granting of a potential energy, as necessary to have phonon exchanges, is against physical evidence, as confirmed by the fact that any representation of Pauli's exclusion principle via potential interactions cause sizable deviations from spectral lines.

Therefore, the belief that quantum mechanics and special relativity provide a complete description of superconductivity is pure academic politics deprived of scientific content.

Superconductivity is yet another field in which the exact validity of quantum mechanics and special relativity has been stretched in the 20-th century well beyond its limit for known political reasons. At any rate, superconductivity has exhausted all its predictive capacities, while all advances are attempted via empirical trials and errors without a guiding theory.

As it was the case for particle and nuclear physics, the lack of exact character of quantum mechanics and special relativity in superconductivity is beyond doubt. Equally beyond doubt is the need for a deeper theory.

As we shall see in Chapter 7, the covering hadronic mechanics and isospecial relativity provide a quantitative representation of the structure of the Cooper pair in excellent agreement with experimental data, and with basically novel predictive capabilities, such as the industrial development of a new electric current, that characterized by correlated electron pairs in single coupling, rather than electrons.

1.2.10 The Scientific Imbalance in Chemistry

There is no doubt that quantum chemistry permitted the achievement of historical discoveries in the 20-th century. However, there is equally no doubt that the widespread assumption of the exact validity of quantum chemistry caused a large scientific imbalance with vast implications, particularly for the alarming environmental problems.

After about one century of attempts, quantum chemistry still misses a historical 2% of molecular binding energies when derived from axiomatic principles without *ad hoc* adulterations (see below). Also, the deviations for electric and magnetic moments are embarrassing not only for their numerical values, but also because they are wrong even in their sign [14], not to mention numerous other insufficiencies outlined below.

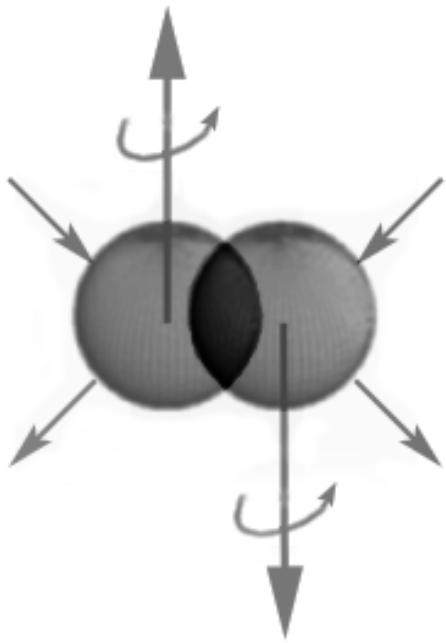

Figure 1.10. A schematic view of the fundamental conditions studied in this monograph, the deep overlapping of the extended wavepackets of electrons in valence bonds and Cooper pairs according to a singlet coupling as required by Pauli's principle. Recall that, for quantum mechanics and special relativity, electrons are points and, therefore, the conditions of this figure have no meaning at all. However, said point character can only be referred to the charge structure of the electron, since "point-like wavepackets" do not exist in nature. For the covering hadronic mechanics, superconductivity and chemistry, the point-like charge structure of the electrons remains, with the additional presence of the contact nonpotential interactions due to the overlapping of the extended wavepackets represented via a nonunitary structure. As shown in Chapter 8, the treatment of the latter interactions via hadronic mechanics and chemistry has permitted the achievement, for the first time in scientific history, of an "exact and invariant" representations of molecular data from first axioms without ad hoc adulterations.

It is easy to see that the reason preventing quantum chemistry from being exactly valid for molecular structures is given by contact, nonlocal-integral and nonpotential interactions due to deep wave-overlappings in valence bonds that, as such, are beyond any realistic treatment by local-differential-potential axioms, such as those of quantum chemistry (Figure 1.10).

Recall that quantum mechanics achieved an exact and invariant representation of all experimental data of *one* hydrogen atom. Nevertheless, quantum

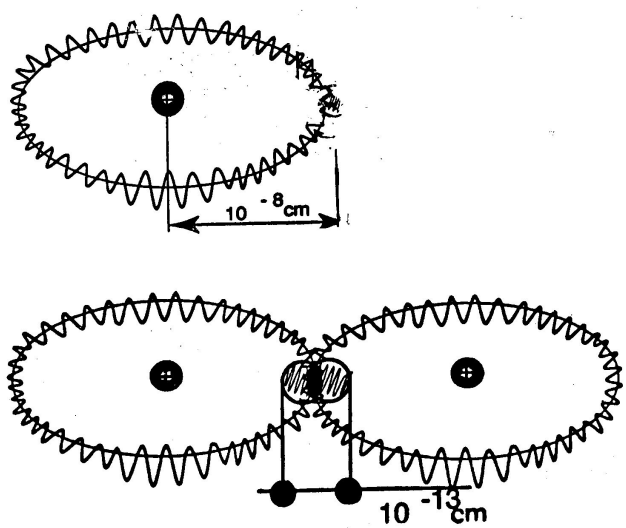

Figure 1.11. A first clear evidence of the lack of exact validity of quantum chemistry. The top view depicts one hydrogen atom for which quantum mechanics resulted to be exactly valid. The bottom view depicts two hydrogen atoms coupled into the H_2 molecule in which case quantum chemistry has historically missed a 2% of the binding energy when applied without adulteration of basic axioms "to fix things" (such as via the used of the screening of the Coulomb law and then claim that quantum chemistry is exact). Since nuclei do not participate in the molecular bond, the origin of the insufficiency of quantum mechanics and chemistry rests in the valence bond.

mechanics and chemistry miss 2% of the binding energy of *two* hydrogen atoms coupled into the hydrogen molecule (Figure 1.11).

The only possible explanation is that in the hydrogen atom all interactions are of action-at-a-distance potential type due to the large mutual distances of the constituents with respect to the size of their wavepackets. By contrast, in the hydrogen molecule we have the mutual penetration of the wavepackets of valence electrons with the indicated contact, nonlocal-integral and nonpotential interactions at short mutual distances that are absent in the structure of the hydrogen atom.

Alternatively and equivalently, the nuclei of the two hydrogen atoms of the H_2 molecule cannot possibly be responsible for said 2% deviation. Therefore, the deviation from basic axioms can only originate in the valence bond.

By no means the above insufficiencies are the only ones. Quantum chemistry is afflicted by a true litany of limitations, insufficiencies or sheer inconsistencies that constitute the best kept secret of the chemistry of the 20-th century

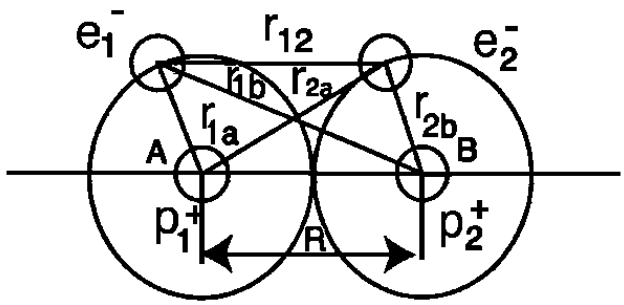

Figure 1.12. A schematic view of the fact that the total Coulomb force among the atoms of a molecular structure is identically null. As a consequence, conventional Coulomb interactions cannot provide credible grounds for molecular bonds. At the same time, existing chemical conjectures, such as the exchange and van der Waals forces, are weak, as known from nuclear physics. These facts establish that the chemistry of the 20-th century is like nuclear physics before the discovery of the strong interactions, because chemistry missed the identification of an attractive force sufficiently strong to represent molecular structure. As we shall see in Chapter 8, hadronic chemistry will indeed provide, for the first time in scientific history, the numerical identification of the missed "attractive strong attractive valence force" as being precisely of contact, nonlocal and nonpotential type. The achievement of and exact representation of molecular data is then be consequential.

because known to experts (since they have been published in refereed journals), but they remain generally ignored evidently for personal gains.

We outline below the insufficiencies of quantum chemistry for the simplest possible class of systems, those that are *isolated from the rest of the universe*, thus verifying conventional *conservation laws* of the total energy, total linear momentum, etc., and are *reversible* (namely, their time reversal image is as physical as the original system).

The most representative systems of the above class are given by *molecules,* here generically defined as aggregates of atoms under a valence bond. Despite undeniable achievements, quantum chemical models of molecular structures have the following fundamental insufficiencies studied in detail in monograph [11]:

1: Quantum chemistry lacks a sufficiently strong molecular binding force. After 150 years of research, chemistry has failed to identify to this day the *attractive force* needed for a credible representation of valence bonds. In the absence of such an attractive force, names such as "valence" are pure nomenclatures without quantitative meaning.

To begin, the average of all Coulomb forces among the atoms constituting a molecule is identically null. As an example, the currently used Schroedinger equation for the H_2 molecule is given by the familiar expression [15],

$$(-\frac{\hbar^2}{2\mu_1}\nabla_1^2-\frac{\hbar^2}{2\mu_2}\nabla_2^2-\frac{e^2}{r_{1a}}-\frac{e^2}{r_{2a}}-\frac{e^2}{r_{1b}}-\frac{e^2}{r_{2b}}+\frac{e^2}{R}+\frac{e^2}{r_{12}})|\psi>=E|\psi>, \quad (1.2.20)$$

which equation contains the Coulomb attraction of each electron by its own nucleus, the Coulomb attraction of each electron from the nucleus of the other atom, the Coulomb repulsion of the two electrons, and the Coulomb repulsion of the two protons.

It is easy to see that, in semiclassical average, the two attractive forces of each electron from the nucleus of the other atom are compensated by the average of the two repulsive forces between the electrons themselves and those between the protons, under which Eq. (1.2.20) reduces to two independent *neutral* hydrogen atoms *without* attractive interaction, as depicted in Fig. 1.2.12,

$$\left[\left(-\frac{\hbar^2}{2\mu_1}\nabla_1^2-\frac{e^2}{r_{1a}}\right)+\left(-\frac{\hbar^2}{2\mu_2}\nabla_2^2-\frac{e^2}{r_{2a}}\right)\right]|\psi\rangle=E|\psi\rangle. \quad (1.2.21)$$

In view of the above occurrence, quantum chemistry tries to represent molecular bonds via *exchange, van der Waals and other forces* [15]. However, the latter forces were historically introduced for *nuclear structures* in which they are known to be *very weak*, thus being insufficient to provide a true representation of molecular bonds.

It is now part of history that, due precisely to the insufficiencies of exchange, van der Waals and other forces, nuclear physicists were compelled to introduced the *strong nuclear force*. As an illustration, calculations show that, under the currently assumed molecular bonds, the molecules of a three leaf should be decomposed into individual atomic constituents by a weak wind of the order of 10 miles per hour.

To put it in a nutshell, after about one century of research, *quantum chemistry still misses in molecular structures the equivalent of the strong force in nuclear structures.*

As we shall see in Chapter 8, one of the objectives of hadronic chemistry is precisely to introduce the missing force, today known as the *strong valence force,* that is, firstly, ATTRACTIVE, secondly, sufficiently STRONG, and, thirdly, INVARIANT. The exact and invariant representation of molecular data will then be a mere consequence.

2: Quantum chemistry admits an arbitrary number of atoms in the hydrogen, water and other molecules. This inconsistency is proved beyond scientific doubt by the fact that the exchange, van der Waals, and other

forces used in current molecular models were conceived in nuclear physics for the primary purpose of admitting a large number of constituents.

When the same forces are used for molecular structures, they also admit an arbitrary number of constituents. As specific examples, when applied to the structure of the hydrogen or water molecule, any graduate student in chemistry can prove that, under exchange, van der Waals and other forces of nuclear type, the hydrogen, water and other molecules admit an *arbitrary* number of hydrogen atoms (see Figure 1.13).

Rather than explaining the reason why nature has selected the molecules H_2 and H_2O as the sole possible, current molecular models admit "molecules" of the type H_5, H_{23}, H_7O, H_2O_{121}, $H_{12}O_{15}$, etc., in dramatic disagreement with experimental evidence.

3: Quantum chemistry has been unable to explain the correlation of valence electrons solely into pairs. Experimental evidence clearly establishes that the valence correlations only occur between *electron pairs* in singlet coupling. By contrast, another known insufficiency of quantum chemistry is the intrinsic inability to restrict correlations to valence pairs.

This insufficiency is then passed to orbital theories, that work well at semi-empirical levels but remain afflicted by yet unresolved problems, eventually resulting in deviations of the prediction of the theory from experimental data that generally grow with the complexity of the molecule considered.

The inability to restrict correlations to valence pairs also provides an irrefutable additional confirmation that quantum chemistry predicts an arbitrary number of constituents in molecular structures.

As we shall see in Chapter 8, thanks to the advent of the new strong valence bond, the covering quantum chemistry does indeed restrict valence bonds strictly and solely to electron pairs. The resolution of inconsistency 2 will then be a mere consequence.

4: The use in quantum chemistry of "screened Coulomb potentials" violates basic quantum principles. The inability by quantum chemistry to achieve an exact representation of binding energies stimulated the adulteration of the basic Coulomb law into the so-called *screened Coulomb law* of the type

$$F = \pm f(r) \times \frac{e^2}{r}, \tag{1.2.22}$$

that did indeed improve the representation of experimental data.

However, the Coulomb law is a fundamental invariant of quantum mechanics, namely, the law remains invariant under all possible unitary transforms

$$F = \pm\frac{e^2}{r} \rightarrow U \times (\pm\frac{e^2}{r}) \times U^\dagger = \pm\frac{e^2}{r}, \tag{1.2.23a}$$

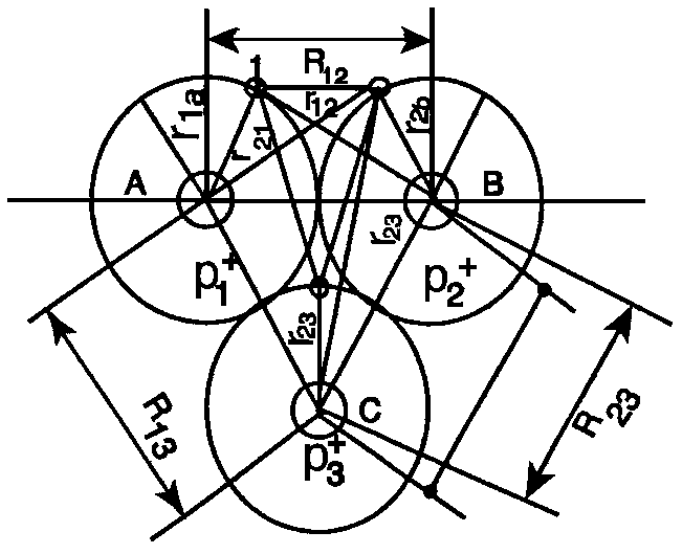

Figure 1.13. A schematic view of the fact that quantum chemistry predicts an arbitrary number of atoms in molecules because the exchange, van der Waals, and other bonding forces used in chemistry were identified in nuclear physics for an arbitrary number of constituents. Consequently, quantum chemistry is basically unable to explain the reasons nature has selected the molecules H_2, H_2O, CO_2, etc. as the sole possible molecular structures, and other structures such as H_5, H_{23}, H_7O, HO_{21}, $H_{12}O_{15}$, etc. cannot exist. As we shall see in Chapter 8, the "strong valence force" permitted by hadronic chemistry can only occur among "pairs" of valence electrons, thus resolving this historical problem in a quantitative way.

$$U \times U^{\dagger} = I, \tag{1.2.23b}$$

Therefore, any structural deviation from the Coulomb law implies deviations from the basic quantum axioms.

It then follows that the only possibility of achieving screened Coulomb laws is via the use of *nonunitary transforms* of the type

$$F = \pm\frac{e^2}{r} \rightarrow W \times (\pm\frac{e^2}{r}) \times W^{\dagger} = \pm e^{A\times r} \times \frac{e^2}{r}, \tag{1.2.24a}$$

$$W \times W^{\dagger} = e^{A\times r} \neq I. \tag{1.2.24b}$$

Therefore, by their very conception, *the use of screened Coulomb laws implies the existing from the class of equivalence of quantum chemistry.* Despite that, organized academic interests have continued to claim that screened Coulomb laws belong to quantum chemistry, thus exiting from the boundaries of science.

Irrespective from the above, a first year graduate student in chemistry can prove that *screened Coulomb laws cause the abandonment of the very notion of quantum in favor of the continuous emission or absorption of energy.* in fact, quantized emissions and absorptions of photons crucially depend on the existence of quantized orbits that, in turn, solely exist for unadulterated Coulomb potentials, as well known.

This insufficiency establishes the need to generalize quantum chemistry into a covering theory since the Coulomb law is indeed insufficient to represent molecular data. Rather than adapting a theory to adulterated basic axioms, it is scientifically more appropriate to build a new theory based on the needed broader axioms.

As we shall see in Chapter 8, the covering hadronic chemistry has been conceived to have a *nonunitary structure* as an evident necessary condition for novelty. In so doing, quantum chemistry naturally admits all infinitely possible screened Coulomb laws of type (1.2.22). However, such screenings are solely admitted in the nonlocal-integral region of deep wave-overlappings of valence electrons that are of the order of $1\,\mathrm{F} = 10^{-13}\,\mathrm{cm}$, while recovering the conventional Coulomb law automatically for all distances greater that $1\,\mathrm{F}$.

This conception permits the achievement of an exact representation of molecular binding energies while preserving in full the quantum structure of the individual atoms.

5: Quantum chemistry cannot provide a meaningful representation of thermodynamical reactions. The missing 2% in the representation of binding energies is misleadingly small, because it corresponds to about 1,000 Kcal/mole while an ordinary thermodynamical reaction (such as that of the water molecule) implies an average of 50 Kcal/mole. No scientific calculation can be conducted when the error is of about twenty times the quantity to be computed.[7]

As we shall see in Chapter 8, our covering hadronic chemistry does indeed permit exact thermochemical calculations because it has achieved exact representations of molecular characteristics.

6: Computer usage in quantum chemical calculations requires excessively long periods of time. This additional, well known insufficiency is notoriously due to the slow convergence of conventional quantum series,

[7]The author received a request from a U. S. public company to conduct paid research on certain thermochemical calculations. When discovering that the calculations had to be based on quantum chemistry due to political needs by the company to be aligned with organized academic interests, the author refused the research contract on grounds that it would constitute a fraud of public funds, due to the excessively large error of all thermochemical calculations when based on quantum chemistry.

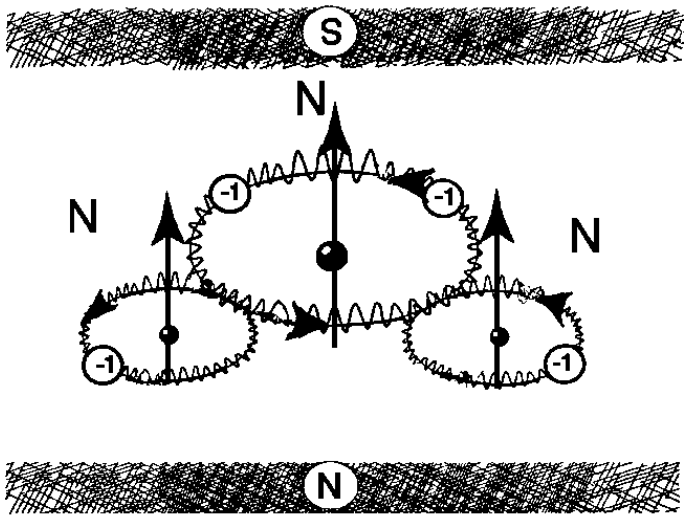

Figure 1.14. A schematic view of the prediction by quantum chemistry that water is paramagnetic, in dramatic disagreement with experimental evidence. In fact, quantum chemistry does not restrict the correlation of valence bonds to pairs. As a result, the individual valence electrons of the water molecule remain essentially independent. Quantum electrodynamics then demands the capability to polarize all valence electrons under an external magnetic field, resulting in the net magnetic polarity of this figure, and the consequential paramagnetic character of the water (as well as of all) molecules. As we shall see in Chapter 8, hadronic chemistry resolves this additional historical problem because our "strong valence force" deeply correlates valence electron pairs, thus permitting a global polarization of a molecule only in special cases, such as those with unbounded electrons.

an insufficiency that persists to this day despite the availability of powerful computers.

As we shall also see in Chapter 8, our covering hadronic chemistry will also resolve this additional insufficiency because he mechanism permitting the exact representation of molecular characteristics implies a fast convergent lifting of conventional slowly convergent series.

7: Quantum chemistry predicts that all molecules are paramagnetic. This inconsistency is a consequence of the most rigorous discipline of the 20-th century, quantum electrodynamics, establishing that, under an external magnetic field, the orbits of peripheral atomic electrons must be oriented in such a way to offer a magnetic polarity opposite to that of the external field (a polarization that generally occurs via the transition from a three-dimensional to a toroidal distribution of the orbitals).

According to quantum chemistry, atoms belonging to a molecule preserve their individuality. Consequently, quantum electrodynamics predicts that the peripheral atomic electrons of a molecule must acquire polarized orbits under an external magnetic field.

As a result, quantum chemistry predicts that the application of an external magnetic field, to hydrogen $H-H$, water $H-O-H$ and other molecules implies their acquisition of a net total, opposite polarity, $H_\uparrow - H_\uparrow$, $H_\uparrow - O_\uparrow - H_\uparrow$, etc., which polarization is in dramatic disagreement with experimental evidence.

The above inconsistency can also be derived from its inability to restrict the correlation solely to valence pairs. By contrast, the strong valence bond of the covering hadronic chemistry eliminates the independence of individual atoms in a molecular structure, by correctly representing the diamagnetic or paramagnetic character of substances.

No serious advance in chemistry can occur without, firstly, the admission of the above serious insufficiencies and/or inconsistencies, secondly, their detailed study, and, thirdly, their resolution via a covering theory.

Most importantly, we shall show in Chapter 10 that no resolution of the now alarming environmental problems is possible without a resolution of the above serious inconsistencies of quantum chemistry.

1.2.11 Catastrophic Inconsistencies of Quantum Mechanics, Superconductivity and Chemistry for Underwater Electric Arcs

Submerged electric arcs among carbon-base electrodes are known to permit the production of cost competitive and clean burning gaseous fuels via a highly efficient process since the primary source of energy is carbon combustion by the arc, the electric current used by the arc being a comparatively smaller energy. As such, submerged electric arcs have particular relevance for the main objectives of hadronic mechanics, as studied in Chapter 10 (see also monograph [11]).

An understanding of the motivations for the construction of hadronic mechanics, superconductivity and chemistry requires a knowledge of the fact that, contrary to popular beliefs, submerged electric arcs provide undeniable evidence of the following deviations from established doctrines:

1) When the liquid feedstock is distilled water and the electrodes are given by essentially pure graphite, quantum mechanics and chemistry predict that the produced gas is composed of 50% H_2 and 50% CO. But CO is combustible in atmosphere and its exhaust is given by CO_2. Therefore, in the event said prediction was correct, the combustion exhaust of the gas should contain about 42% of CO_2. Numerous measurements conducted by an EPA accredited automotive laboratory [11] have established that the combustion

exhaust contains about 4%-5% CO_2 without an appreciable percentage of unburned CO. Consequently, *the error of quantum mechanics and chemistry is of about ten times the measured value,* the error being in defect.

2) For the same type of gas produced from distilled water and carbon electrodes, quantum mechanics and chemistry predict that the thermochemical processes underlying the formation of the gas release about 2,250 British Thermal Units (BTU) per standard cubic feet (scf) (see Ref. [11]). In reality, systematic measurements have established that the heat produced is of the order of 250 BTU/scf. Therefore,*the error of quantum mechanics and chemistry is again of the order of ten times the measured quantity,* the error being this time in excess. Note that deviation 1) is fully compatible with deviation 2). In fact, the primary source of heat is the production of CO. Therefore, the production of 1/10-th of the heat predicted confirms that the CO is about 1/10-th the value predicted by quantum mechanics and chemistry.

3) Again for the case of the gas produced from distilled water and graphite electrodes, quantum mechanics and chemistry predict that no oxygen is present in the combustion exhaust, since the prediction is that, under the correct stochiometric ratio between atmospheric oxygen and the combustible gas, the exhaust is composed of 50% H_2O and 50% CO_2. In reality, independent measurements conducted by an EPA accredited automotive laboratory have established that, under the conditions here considered, the exhaust contains about 14% of breathable oxygen. Therefore, in this case the error of quantum mechanics and chemistry if about fourteen times the measured value.

4) Quantum mechanics and chemistry predict that the H_2 component of the above considered gas has the conventional specific weight of 2.016 atomic mass units (amu). Numerous measurements conducted in various independent laboratories have established instead that the hydrogen content of said gas has the specific weight of 14.56 amu, thus implying it a seven-fold deviation from the prediction of conventional theories.

5) Numerous additional deviations from the prediction of quantum mechanics and chemistry also exist, such as the fact that the gas has *a variable energy content, a variable specific weight, and a variable Avogadro number* as shown in Chapters 8 and 10, while conventional gases have *constant energy content, specific weight and Avogadro number,* as it is well known.

Above all *the most serious deviations in submerged electric arc occurs for Maxwell's electrodynamics,* to such an extent that any industrial or governmental research in the field based on Maxwell's electrodynamics is a misuse of corporate or public funds. At this introductory level we restrict ourselves to the indication of the axial attractive force between the electrodes and other features structurally incompatible with maxwell's electrodynamics.

needless to say, structural incompatibilities with maxwell's electrodynamics automatically imply structural incompatibilities with special relativity due to the complete symbiosis of the two theories.

Note the re-emergence of the distinction between exterior and interior problems also in regard to Maxwell's electrodynamics. In fact, an arc in vacuum constitutes an exterior problem, while an arc within a liquid constitutes an interior problem. The impossibility of conducting serious industrial research via Maxwell's electrodynamics for submerged electric arcs can then be derived from the inapplicability of special relativity in the conditions considered.

The departures also extend to quantum superconductivity because the initiation of submerged electric arcs causes the collapse of the electric resistance, from very high value (as it is the case for distilled water) down to fractional Ohms. As a consequence, a submerged electric arc has features reminiscent of superconductivity. But the arc occurs at about 10,000 times the maximal temperature predicted by quantum superconductivity. The limitations of the theory is then beyond credible doubt, the only open scientific issues being the selection of the appropriate generalization.

In summary, under the above deviations, any use of quantum mechanics, superconductivity and chemistry for the study of submerged electric arcs exits the boundaries of scientific ethics and accountability. The departures of experimental evidence from old doctrines are just too big to be removed via arbitrary parameters "to fix things", thus mandating the construction of suitable covering theories.

1.3 THE SCIENTIFIC IMBALANCE CAUSED BY IRREVERSIBILITY

1.3.1 The Scientific Imbalance in the Description of Natural Processes

Numerous basic events in nature, including particle decays, such as

$$n \to p^+ + e^- + \bar{\nu}, \tag{1.3.1}$$

nuclear transmutations, such as

$$C(6,12) + H(1,2) \to N(7,14), \tag{1.3.2}$$

chemical reactions, such as

$$H_2 + \frac{1}{2}\mathrm{O}_2 \to H_2\mathrm{O}, \tag{1.3.3}$$

and other processes are called *irreversible* when their images under time reversal, $t \to -t$, are prohibited by causality and other laws. Systems are instead called *reversible* when their time reversal images are as causal as the original

ones, as it is the case for planetary and atomic structures when considered isolated from the rest of the universe.

Yet another large scientific imbalance of the 20-th century has been the treatment of *irreversible* systems via the formulations developed for *reversible* systems, such as Lagrangians and Hamiltonian mechanics, quantum mechanics and chemistry and special relativity. In fact, all these formulations are strictly reversible, in the sense that all their basic axioms are fully reversible in time, by causing in this way limitations in virtually all branches of science.

The imbalance was compounded by use of the *truncated Lagrange and Hamilton equations* (see Section 1.2.2) based on conventional Lagrangians or Hamiltonians,

$$L = \Sigma_{k=1,2,\ldots,n} \frac{1}{2} \times m_k \times v_k^2 - V(r), \qquad (1.2.xxx)$$

$$H = \Sigma_{a=1,2,..,n} frac \mathbf{p}_a^2 2 \times m_a + V(r), \qquad (1.3.4)$$

under the full awareness that *all known potentials (such as those for electric, magnetic, gravitational and other interactions), and therefore, all known Hamiltonians, are reversible.*

This additional scientific imbalance was dismissed by academicians with vested interests in reversible theories with unsubstantiated statements, such as "irreversibility is a macroscopic occurrence that disappears when all bodies are reduced to their elementary constituents".

The underlying belief is that mathematical and physical theories that are so effective for the study of one electron in a reversible orbit around a proton are tacitly believed to be equally effective for the study of the same electron when in irreversible motion in the core of a star with the local *nonconservation* of energy, angular momentum, and other characteristics.

Along these lines a vast literature grew during the 20-th century on the dream of achieving compatibility of quantum mechanics with the evident irreversibility of nature at all levels, most of which studies were of manifestly political character due to the strictly reversibility of all methods used for the analysis.

These academic beliefs have been disproved by the following:

THEOREM 1.3.1 [10b]: A classical irreversible system cannot be consistently decomposed into a finite number of elementary constituents all in reversible conditions and, vice-versa, a finite collection of elementary constituents all in reversible conditions cannot yield an irreversible macroscopic ensemble.

The property established by the above theorems dismisses all nonscientific beliefs on irreversibility, and identify the real needs, the construction of formulations that are *structurally irreversible,* that is, irreversible for all known

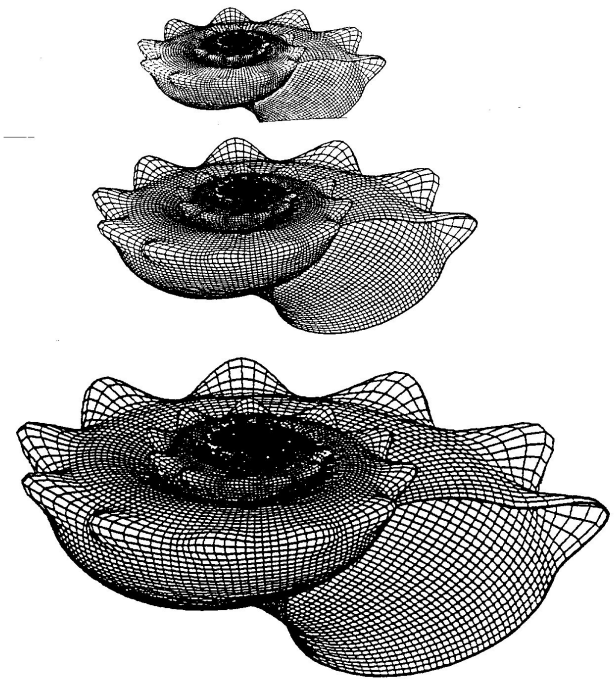

Figure 1.15. A pictorial view of the impossibility for quantum mechanics to be exactly valid in nature: the growth of a seashell. In fact, quantum mechanics is structurally irreversible, in the sense that all its axioms, geometries and symmetries, potentials, etc., are fully reversible in time, while the growth of a seashell is structurally irreversible. The need for an irreversible generalization of quantum mechanics is then beyond credible doubt, as studied in detail in Chapter 4.

reversible potentials, Lagrangians or Hamiltonians, and are applicable at all levels of study, from Newtonian mechanics to second quantization.

The historical origin of the above imbalance can be outlined as follows. One of the most important teaching in the history of science is that by Lagrange [2], Hamilton [3], and Jacobi [4] who pointed out that *irreversibility originates from contact nonpotential interactions not representable with a potential,* for which reason they formulated their equations with *external terms,* as in Eqs. (1.2.3).

In the planetary and atomic structures, there is no need for external terms, since all acting forces are of potential type. In fact, these systems admit an excellent approximation as being made-up of *massive points moving in vacuum*

without collisions (exterior dynamical problems). In these cases, the historical analytic equations were "truncated" with the removal of the external terms.

In view of the successes of the planetary and atomic models, the main scientific development of the 20-th century was restricted to the "truncated analytic equations", without any visible awareness that they are not the equations conceived by the founders of analytic mechanics.

Therefore, the origin of the scientific imbalance on irreversibility is the general dismissal by scientists of the 20-th century of the historical teaching by Lagrange, Hamilton and Jacobi, as well as academic interests on the truncated analytic equations, such as quantum mechanics and special relativity. In fact, as outlined earlier, the use of external terms in the basic analytic equations cause the the inapplicability of the mathematics underlying said theories.

It then follows that no serious scientific advance on irreversible processes can be achieved without first identifying a structurally irreversible mathematic and then the compatible generalizations of conventional theories, a task studied in details in Chapter 4.

As we shall see, contrary to popular beliefs, the origin of irreversibility results in being at the ultimate level of nature, that of elementary particles in interior conditions. irreversibility then propagates all the way to the macroscopic level so as to avoid the inconsistency of Theorem 1.3.1.

1.3.2 The Scientific Imbalance in Astrophysics and Cosmology

Astrophysics and cosmology are new branches of science that saw their birth in the 20-th century with a rapid expansion and majestic achievements. Yet, these new fields soon fell pray to organized interests in established doctrines with particular reference to quantum mechanics, special relativity and gravitation, resulting in yet another scientific imbalance of large proportions.

To begin, all interior planetary or astrophysical problems are *irreversible,* as shown by the very existence of *entropy,* and known thermodynamical laws studiously ignored by supporters of Einsteinian doctrines. this feature, alone, is sufficient to cause a scientific imbalance of historical proportions because, as stressed above, irreversible systems cannot be credibly treated with reversible theories.

Also, quantum mechanics has been shown in the preceding sections to be inapplicable to all interior astrophysical and gravitational problems for reasons other than irreversibility. Any reader with an independent mind can then see the limitations of astrophysical studies for the interior of stars, galaxies and quasars based on a theory that is intrinsically inapplicable for the problems considered.

The imposition of special relativity as a condition for virtually all relativistic astrophysical studies of the 20-th century caused an additional scientific

imbalance. To illustrate its dimensions and implications, it is sufficient to note that all calculations of astrophysical energies have been based on the relativistic mass-energy equivalence

$$E = m \times c^2, \tag{1.3.5}$$

namely, on the philosophical belief that the speed of light c is the same for all conditions existing in the universe (this is the well known "universal constancy of the speed of light").

As indicated earlier, this belief has been disproved by clear experimental evidence, particularly for the case of interior astrophysical media in which the maximal causal speed has resulted to be $C = c/n >> c$, $n << 1$, in which case the correct calculation of astrophysical energies is given by the equivalence principle of the isospecial relativity (see Chapter 3)

$$E = m \times C^2 = m \times c^2/n^2 >> m \times c^2, \ n << 1, \tag{1.3.6}$$

thus invalidating current view on the "missing mass", and others.

A further large scientific imbalance in astrophysics and cosmology was caused by the imposition of general relativity, namely, by one of the most controversial theories of the 20-th century because afflicted by problematic aspects and sheer inconsistencies so serious called catastrophic, as outlined in the next section.

It is hoped these preliminary comments are sufficient to illustrate the weakness of the scientific foundations of astrophysical studies of the 20-th century.

1.3.3 The Scientific Imbalance in Biology

By far one of the biggest scientific imbalances of the 20-th century occurred in biology because biological structures were treated via quantum mechanics in full awareness that the systems described by that discipline are dramatically different than biological structures.

To begin, quantum mechanics and chemistry are strictly *reversible,* while all biological structures and events are structurally *irreversible,* since biological structures such as a cell or a complete organism, admit a birth, then grow and then die.

Moreover, quantum mechanics and chemistry can only represent *perfectly rigid systems*, as well known from the fundamental rotational symmetry that can only describe "rigid bodies".

As a consequence, the representation of biological systems via quantum mechanics and chemistry implies that our body should be perfectly rigid, without any possibility of introducing deformable-elastic structures, because the latter would cause catastrophic inconsistencies with the basic axioms.

Moreover, another pillar of quantum mechanics and chemistry is the verification of total conservation laws, for which Heisenberg's equation of motion

became established. In fact, the quantum time evolution of an arbitrary quantity A is given by

$$i \times \frac{dA}{dt} = [A, H] = A \times H - H \times A, \tag{1.3.7}$$

under which expression we have the conservation law of the energy and otehr quantities, e.g.,

$$i\ dH/dt = H \times H - H \times H \equiv 0. \tag{1.3.8}$$

A basic need for a scientific representation of biological structures is instead the representation of *the time-rate-of-variations of biological characteristics*, such as size, weight, density, etc. This identifies another structural incompatibility between quantum mechanics and biological systems.

When passing to deeper studies, the insufficiencies of quantum mechanics and chemistry emerge even more forcefully. As an example, quantum theories can well represent the *shape* of sea shells, but not their *growth in time.*

In fact, computer visualizations [16] have shown that, when the geometric axioms of quantum mechanics and chemistry (those of the Euclidean geometry) are imposed as being *exactly* valid, sea shells first grow in a deformed way, and then crack during their growth.

Finally, the ideal systems described with full accuracy by quantum mechanics, such as an isolated hydrogen atom or a crystal, are *eternal.* Therefore, the description via quantum theories implies that biological systems are eternal.

These occurrences should not be surprising to inquisitive minds, because the birth and growth, e.g., of a seashell is strictly *irreversible and nonconservative,* while the geometric axioms of quantum theories are perfectly *reversible and conservative*, as indicated earlier, thus resulting in a structural incompatibility, this time, at the geometric level without any conceivable possibility of reconciliation, e.g., via the introduction of unknown parameters "to fix things".

Additional studies have established that the insufficiencies of quantum mechanics and chemistry in biology are much deeper than the above, and invest the *mathematics* underlying these disciplines. In fact, Illert [16] has shown that a minimally correct representation of the growth in time of sea shells requires the *doubling of the Euclidean axes.*

However, sea shells are perceived by the human mind (via our three Eustachian tubes) as growing in our *three-dimensional* Euclidean space. As we shall see in Chapter 8, that the only known resolution of such a dichotomy is that via *multi-valued irreversible mathematics*, that is, mathematics in which operations such as product, addition, etc., produce a *set of values*, rather than one single value as in quantum mechanics and chemistry.

At any rate, the belief that the simplistic mathematics underlying quantum mechanics and chemistry can explain the complexity of the DNA code, has

no scientific credibility, the only serious scientific issue being the search for broader mathematics.

In conclusion, science will never admit "final theories". No matter how valid any given theory may appear at any point in time, its structural broadening for the description of more complex conditions is only a matter of time.

This is the fate also of quantum mechanics and chemistry,as well as special and general relativities that cannot possibility be considered as "final theories" for all infinitely possible conditions existing in the universe.

After all, following only a few centuries of research, rather than having reached a "final stage", science is only at its infancy.

1.4 THE SCIENTIFIC IMBALANCE CAUSED BY GENERAL RELATIVITY AND QUANTUM GRAVITY

1.4.1 The Negative Impact of General Relativity on Antimatter, Interior Problems, and Grand Unifications

There is little doubt that *special relativity* has a majestic axiomatic structure with clear verifications in the field of its original conception (point particles and electromagnetic waves propagating in vacuum). By contrast, it is safe to state that *general relativity* (see, e.g., Ref. [17] and vast literature quoted therein) has been the most controversial theory of the 20-th century for an ever growing plethora of inconsistencies that have grown in time, rather than being addressed and resolved.

In this section we address some of the inconsistencies published by numerous scholars in refereed technical journals, yet generally ignored by organized interests on Einsteinian doctrines, which inconsistencies are so serious to be known nowadays as being "catastrophic". The apparent resolution of the inconsistencies will be presented in Chapters 3, 4, 5, 11, and 12.

Let us begin with the following basic requirement for any classical theory of gravitation to be consistent:

REQUIREMENT 1: Any consistent classical theory of antimatter must allow a consistent representation of the *gravitational field of antimatter.* General Relativity does not verify this first requirement because, in order to attempt a compatibility of classical and quantum formulations, antimatter requires negative-energies, while general relativity solely admit positive-definite energies, as well known.

Even assuming that this insufficiency is somewhat bypassed, general relativity can onlay represent antimatter via the reversal of the sign of the charge. But the most important astrophysical bodies expected to be made up of anti-

matter are neutral. this confirms the structural inability of general relativity to represent antimatter in a credible way.

REQUIREMENT 2: Any consistent classical theory of antimatter must be able to represent *interior gravitational problems.* General relativity fails to verify this second requirement for numerous reasons, such as the inability to represent the *density* of the body considered, its *irreversible* condition, e.g., due to the increase of entropy, the *locally varying speed of light,* etc.

REQUIREMENT 3: Any consistent classical theory of gravitation must permit a grand unifications with other interactions. It is safe to state that this requirement too is not met by general relativity since all attempts to achieve a grand unification have failed to date since Einstein times (see Chapter 12 for details).

REQUIREMENT 4: Any consistent classical theory of gravitation must permit a consistent operator formulation of gravity. This requirement too has not been met by general relativity, since its operator image, known as *quantum gravity* [18] is afflicted by additional independent inconsistencies mostly originating from its unitary structure as studied in the next section.

REQUIREMENT 5: Any consistent classical theory of gravitation must permit the representation of the *locally varying nature of the speed of light.* This requirement too is clearly violated by general relativity.

The above insufficiencies are not of marginal character because they caused serious imbalances in most branches of quantitative sciences.

As an illustration, the first insufficiency prevented any study whatever as to whether a far away galaxy or quasar is made up of matter or of antimatter. The second insufficiency created a form of religion related to the so-called "black holes", since before claiming their existence, gravitational singularities must evidently come out of *interior* gravitational problems and definitely not from theoretical abstractions solely dealing with exterior gravitation. The third insufficiency has been responsible for one of the longest list of failed attempts in grand unification without addressing the origin of the failures in the gravitational theory itself. the fourth insufficiency prevented throughout the entire 20-th century a consistent quantum formulation of gravity with large implications in particle physics. The fifth insufficiency cause cosmological models that can only be qualified as scientific beliefs, rather than quantitative theories based on sound physical foundations.

It is hoped that even the most representative members of organized interests on Einsteinian doctrines will admit that any additional support for said interests is now counterproductive, since it has already passed the mark for a severe condemnation by posterity.

It is time to provide a scientific identification of the basic insufficiencies of general relativity and initiate systematic studies for their resolution.

1.4.2 Catastrophic Inconsistencies of General Relativity due to Lack of Sources

There exist subtle distinctions between "general relativity", "Einstein's Gravitation", and "Riemannian" formulation of gravity. For our needs, we here define *Einstein's gravitation* as the reduction of exterior gravitation in vacuum to pure geometry, namely, gravitation is solely represented via curvature in a Riemannian space $\mathcal{R}(x, g, R)$ with spacetime coordinates $x = \{x^\mu\}$, $\mu = 1, 2, 3, 0$ and nowhere singular real-valued and symmetric metric $g(x)$ over the reals R, with field equations [19,20]

$$G_{\mu\nu} = R_{\mu\nu} - g_{\mu\nu} \times R/2 = 0, \tag{1.4.1}$$

in which, as a central condition to have Einstein's gravitation, *there are no sources for the exterior gravitational field in vacuum for a body with null total electromagnetic field (null total charge and magnetic moment).*

For our needs, we define as *general relativity* any description of gravity on a Riemannian space over the reals with Einstein-Hilbert field equations with a source due to the presence of electric and magnetic fields,

$$G_{\mu\nu} = R_{\mu\nu} - g_{\mu\nu} \times R/2 = k \times t_{\mu\nu}, \tag{1.4.2}$$

where k is a constant depending on the selected unit whose value is here irrelevant. For the scope of this section it is sufficient to assume that the *Riemannian description of gravity* coincides with general relativity according to the above definition.

In the following, we shall first study the inconsistencies of Einstein gravitation, that is, the inconsistencies in the entire reduction of gravity to curvature without source, and then study the inconsistency of general relativity, that is, the inconsistencies caused by curvature itself even in the presence of sources.

It should be stressed that a technical appraisal of the content of this section can only be reached following the study of the axiomatic inconsistencies of grand unified theories of electroweak and gravitational interactions whenever gravity is represented with curvature on a Riemannian space irrespective of whether with or without sources, as studied in Chapter 12.

THEOREM 1.4.1 [21]: Einstein's gravitation and general relativity at large are incompatible with the electromagnetic origin of mass established by quantum electrodynamics, thus being inconsistent with experimental evidence.

Proof. Quantum electrodynamics has established that the mass of all elementary particles, whether charged or neutral, has a primary electromagnetic

origin, that is, all masses have a first-order origin given by the volume integral of the 00-component of the energy-momentum tensor $t_{\mu\nu}$ of electromagnetic origin,

$$m = \int d^4x \times t_{oo}^{elm}. \tag{1.4.3a}$$

$$t_{\alpha\beta} = \frac{1}{4\pi}(F_\alpha^\mu F_{\mu\beta} + \frac{1}{4} g_{\alpha\beta} F_{\mu\nu} F^{\mu\nu}), \tag{1.4.3b}$$

where $t_{\alpha\beta}$ is the *electromagnetic tensor,* and $F_{\alpha\beta}$ is the *electromagnetic field* (see Ref. [11a] for explicit forms of the latter with retarded and advanced potentials).

Therefore, quantum electrodynamics requires the presence of a *first-order source tensor* in the *exterior field equations* in vacuum as in Eqs. (1.4.2). Such a source tensor is absent in Einstein's gravitation (1.4.1) by conception. Consequently, Einstein's gravitation is incompatible with quantum electrodynamics.

The incompatibility of general relativity with quantum electrodynamics is established by the fact that the source tensor in Eqs. (1.4.2) is of *higher order in magnitude*, thus being ignorable in first approximation with respect to the gravitational field, while according to quantum electrodynamics said source tensor is of first order, thus not being ignorable in first approximation.

The inconsistency of both Einstein's gravitation and general relativity is finally established by the fact that, for the case when the total charge and magnetic moment of the body considered are null, Einstein's gravitation and general relativity allows no source at all. By contrast, as illustrated in ref. [21], quantum electrodynamics requires a first-order source tensor even when the total charge and magnetic moments are null due to the charge structure of matter. **q.e.d.**

The first consequence of the above property can be expressed via the following:

COROLLARY 1.4.1A [21]: Einstein's reduction of gravitation in vacuum to pure curvature without source is incompatible with physical reality.

A few comments are now in order. As is well known, the mass of the electron is entirely of electromagnetic origin, as described by Eq. (3.3), therefore requiring a first-order source tensor in vacuum as in Eqs. (3.2). Therefore, Einstein's gravitation for the case of the electron is inconsistent with nature. Also, the electron has a point charge. Consequently, *the electron has no interior problem at all, in which case the gravitational and inertial masses coincide,*

$$m_{Electron}^{Grav.} \equiv m_{Electron}^{Iner}. \tag{1.4.4}$$

Next, Ref. [21] proved Theorem 1.4.1 for the case of a neutral particle by showing that the π^o meson also needs a first-order source tensor in the exterior gravitational problem in vacuum since its structure is composed of one charged particle and one charged antiparticle in high dynamical conditions.

In particular, the said source tensor has such a large value to account for the entire *gravitational mass* of the particle [21]

$$m_{\pi^o}^{Grav.} = \int d^4x \times t_{00}^{Elm}. \tag{1.4.5}$$

For the case of the interior problem of the π^o , we have the additional presence of short range weak and strong interactions representable with a new tensor $\tau_{\mu\nu}$. We, therefore, have the following

COROLLARY 1.4.1B [21]: In order to achieve compatibility with electromagnetic, weak and strong interactions, any gravitational theory must admit two source tensors, a traceless tensor for the representation of the electromagnetic origin of mass in the exterior gravitational problem, and a second tensor to represent the contribution to interior gravitation of the short range interactions according to the field equations

$$G_{\mu\nu}^{Int.} = R_{\mu\nu} - g_{\mu\nu} \times R/2 = k \times (t_{\mu\nu}^{Elm} + \tau_{\mu\nu}^{ShortRange}). \tag{1.4.6}$$

A main difference of the two source tensors is that the electromagnetic tensor $t_{\mu\nu}^{Elm}$ is notoriously traceless, while the second tensor $\tau_{\mu\nu}^{ShortRange}$ is not. A more rigorous definition of these two tensors will be given shortly.

It should be indicated that, for a possible solution of Eqs. (1.4.6), various explicit forms of the electromagnetic fields as well as of the short range fields originating the electromagnetic and short range energy momentum tensors are given in Ref. [21].

Since both source tensors are positive-definite, Ref. [21] concluded that the interior gravitational problem characterizes the *inertial mass* according to the expression

$$m^{Iner} = \int d^4x \times (t_{00}^{Elm} + \tau_{00}^{ShortRange}), \tag{1.4.7}$$

with consequential general law

$$m^{Inert.} \geq m^{Grav.}, \tag{1.4.8}$$

where the equality solely applies for the electron.

Finally, Ref. [21] proved Theorem 1.4.1 for the exterior gravitational problem of a neutral massive body, such as a star, by showing that the situation is essentially the same as that for the π^o. The sole difference is that the electromagnetic field requires the sum of the contributions from *all* elementary

constituents of the star,

$$m_{Star}^{Grav.} = \Sigma_{p=1,2,...} \int d^4x \times t_{p00}^{Elem.}. \tag{1.4.9}$$

In this case, Ref. [21] provided methods for the approximate evaluation of the sum that resulted to be of first-order also for stars with null total charge.

When studying a charged body, there is no need to alter equations (3.6) since that particular contribution is automatically contained in the indicated field equations.

Once the incompatibility of general relativity at large with quantum electrodynamics has been established, the interested reader can easily prove the incompatibility of general relativity with quantum field theory and quantum chromodynamics, as implicitly contained in Corollary 1.4.1B.

An important property apparently first reached in Ref. [11a] in 1974 is the following:

COROLLARY 1.4.1C [21]: The exterior gravitational field of a mass originates entirely from the total energy-momentum tensor (3.3b) of the electromagnetic field of all elementary constituents of said mass.

In different terms, a reason for the failure to achieve a "unification" of gravitational and electromagnetic interactions initiated by Einstein himself is that the said interactions can be "identified" with each other and, as such, they cannot be unified. In fact, in all unifications attempted until now, the gravitational and electromagnetic fields preserve their identity, and the unification is attempted via geometric and other means resulting in redundancies that eventually cause inconsistencies.

Note that conventional electromagnetism is represented with the tensor $F_{\mu\nu}$ and related Maxwell's equations. When electromagnetism is identified with exterior gravitation, it is represented with the energy-momentum tensor $t_{\mu\nu}$ and related equations (1.4.6).

In this way, *gravitation results as a mere additional manifestation of electromagnetism.* The important point is that, besides the transition from the field tensor $F_{\mu\nu}$ to the energy-momentum tensor $T_{\mu\nu}$, there is no need to introduce a new interaction to represent gravity.

Note finally the irreconcilable alternatives emerging from the studies herein considered:

ALTERNATIVE I: Einstein's gravitation is assumed as being correct, in which case quantum electrodynamics must be revised in such a way to avoid the electromagnetic origin of mass; or

ALTERNATIVE II: Quantum electrodynamics is assumed as being correct, in which case Einstein's gravitation must be irreconcilably abandoned in favor of a more adequate theory.

By remembering that quantum electrodynamics is one of the most solid and experimentally verified theories in scientific history, it is evident that the rather widespread assumption of Einstein's gravitation as having final and universal character is non-scientific.

THEOREM 1.3.2 [22,10b]: Einstein's gravitation (1.4.1) is incompatible with the Freud identity of the Riemannian geometry, thus being inconsistent on geometric grounds.

Proof. The Freud identity [11b] can be written

$$R^{\alpha}_{\beta} - \frac{1}{2} \times \delta^{\alpha}_{\beta} \times R - \frac{1}{2} \times \delta^{\alpha}_{\beta} \times \Theta \;=\; U^{\alpha}_{\beta} + \partial V^{\alpha\rho}_{\beta}/\partial x^{\rho} \;=\; k \times (t^{\alpha}_{\beta} + \tau^{\alpha}_{\beta}), \quad (1.4.10)$$

where

$$\Theta \;=\; g^{\alpha\beta} g^{\gamma\delta} (\Gamma_{\rho\alpha\beta}\Gamma^{\rho}_{\gamma\beta} - \Gamma_{\rho\alpha\beta}\Gamma^{\rho}_{\gamma\delta}), \quad (1.4.11a)$$

$$U^{\alpha}_{\beta} \;=\; -\frac{1}{2}\frac{\partial\Theta}{\partial g^{\rho\alpha}_{|\rho}} g^{\gamma\beta} \uparrow_{\gamma}, \quad (1.4.11b)$$

$$V^{\alpha\rho}_{\beta} \;=\; \frac{1}{2}[g^{\gamma\delta}(\delta^{\alpha}_{\beta}\Gamma^{\rho}_{\alpha\gamma\delta} - \delta^{\rho}_{\beta}\Gamma^{\rho}_{\alpha\delta}) +$$

$$+ (\delta^{\rho}_{\beta} g^{\alpha\gamma} - \delta^{\alpha}_{\beta} g^{\rho\gamma})\Gamma^{\delta}_{\gamma\delta} + g^{\rho\gamma}\Gamma^{\alpha}_{\beta\gamma} - g^{\alpha\gamma}\Gamma^{\rho}_{\beta\gamma}]. \quad (1.4.11c)$$

Therefore, the Freud identity requires two first order source tensors for the exterior gravitational problems in vacuum as in Eqs. (1.4.6) of Ref. [21]. These terms are absent in Einstein's gravitation (1.4.1) that, consequently, violates the Freud identity of the Riemannian geometry. **q.e.d.**

By noting that trace terms can be transferred from one tensor to the other in the r.h.s. of Eqs. (1.4.10), it is easy to prove the following:

COROLLARY 1.4.2A [10b]: Except for possible factorization of common terms, the t- and τ-tensors of Theorem 3.2 coincide with the electromagnetic and short range tensors, respectively, of Corollary 1.4.1B.

A few historical comments regarding the Freud identity are in order. It has been popularly believed throughout the 20-th century that the Riemannian geometry possesses only *four identities* (see, e.g., Ref. [17]). In reality, Freud [22] identified in 1939 a *fifth identity* that, unfortunately, was not aligned with Einstein's doctrines and, as such, the identity was ignored in virtually the

entire literature on gravitation of the 20-th century, as it was also the case for Schwartzschild's interior solution [8].

However, as repeatedly illustrated by scientific history, structural problems simply do not disappear with their suppression, and actually grow in time. In fact, the Freud identity did not escape Pauli who quoted it in a footnote of his celebrated book of 1958 [23]. Santilli became aware of the Freud identity via an accurate reading of Pauli's book (including its important footnotes) and assumed the Freud identity as the geometric foundation of the gravitational studies presented in Ref. [10b].

Subsequently, in his capacity as Editor in Chief of *Algebras, Groups and Geometries,* Santilli requested the mathematician Hanno Rund, a known authority in Riemannian geometry [24], to inspect the Freud identity for the scope of ascertaining whether the said identity was indeed a new identity. Rund kindly accepted Santilli's invitation and released paper [25] of 1991 (the last paper prior to his departure) in which Rund confirmed indeed the character of Eqs. (3.10) as a genuine, independent, fifth identity of the Riemannian geometry.

The Freud identity was also rediscovered by Yilmaz (see Ref. [26] and papers quoted therein) who used the identity for his own broadening of Einstein's gravitation via an external *stress-energy tensor* that is essentially equivalent to the source tensor with non-null trace of Ref. [11a], Eqs. 1.4.6).

Despite these efforts, the presentation of the Freud identity to various meetings and several personal mailings to colleagues in gravitation, the Freud identity continues to remain vastly ignored to this day, with very rare exceptions (the indication by colleagues of additional studies on the Freud identify not quoted herein would be gratefully appreciated.)

Theorems 1.4.1 and 1.4.2 complete our presentation on the catastrophic inconsistencies of Einstein's gravitation due to the lack of a first-order source in the exterior gravitational problem in vacuum. These theorems, by no means, exhaust all inconsistencies of Einstein's gravitation, and numerous additional inconsistencies do indeed exist.

For instance, Yilmaz [26] has proved that Einstein's gravitation explains the 43" of the precession of Mercury, but cannot explain the basic Newtonian contribution. This result can also be seen from Ref. [21] because the lack of source implies the impossibility of importing into the theory the basic Newtonian potential. Under these conditions the representation of the Newtonian contribution is reduced to a religious belief, rather than a serious scientific statement.

For these and numerous additional inconsistencies of general relativity we refer the reader to Yilmaz [26], Wilhelm [27-29], Santilli [30], Alfvén [31,32], Fock [34], Nordensen [35], and large literature quoted therein.

1.4.3 Catastrophic Inconsistencies of General Relativity due to Curvature

We now pass to the study of the structural inconsistencies of general relativity caused by the very use of the Riemannian *curvature*, irrespective of the selected field equations, including those fully compatible with the Freud identity.

THEOREM 1.4.3 [36]: Gravitational theories on a Riemannian space over a field of real numbers do not possess time invariant basic units and numerical predictions, thus having serious mathematical and physical inconsistencies.

Proof. The map from Minkowski to Riemannian spaces is known to be *noncanonical,*

$$\eta = Diag.(1,1,1,-1) \ \rightarrow \ g(x) = U(x) \times \eta \times U(x)^{\dagger}, \tag{1.4.12a}$$

$$U(x) \times U(x)^{\dagger} \neq I. \tag{1.4.12b}$$

Thus, the time evolution of Riemannian theories is necessarily noncanonical, with consequential lack of invariance in time of the basic units of the theory, such as

$$I_{t=0} = Diag.(1cm, 1cm, 1cm, 1sec) \rightarrow I'_{t>0} = U_t \times I \times U_t^{\dagger} \ \neq I_{t=0}. \tag{1.4.13}$$

The lack of invariance in time of numerical predictions then follows from the known "covariance", that is, lack of time invariance of the line element. **q.e.d.**

As an illustration, suppose that an experimentalist assumes at the initial time $t = 0$ the units 1 cm and 1 sec. Then, all Riemannian formulations of gravitation, including Einstein's gravitation, predict that at the later time $t > 0$ said units have a different numerical value.

Similarly, suppose that a Riemannian theory predicts a numerical value at the initial time $t = 0$, such as the 43" for the precession of the perihelion of Mercury. One can prove that the same prediction at a later time $t > 0$ is numerically different precisely in view of the "covariance", rather than invariance as intended in special relativity, thus preventing a serious application of the theory to physical reality. We therefore have the following:

COROLLARY 1.4.3A [36]: Riemannian theories of gravitation in general, and Einstein's gravitation in particular, can at best describe physical reality at a fixed value of time, without a consistent dynamical evolution.

Interested readers can independently prove the latter occurrence from the *lack of existence of a Hamiltonian in Einstein's gravitation.* It is known in

analytic mechanics (see, e.g., Refs. [17,24]) that Lagrangian theories not admitting an equivalent Hamiltonian counterpart, as is the case for Einstein's gravitation, are inconsistent under time evolution, unless there are suitable subsidiary constraints that are absent in general relativity.

It should be indicated that the inconsistencies are much deeper than that indicated above. For consistency, the Riemannian geometry must be defined on the field of numbers $R(n, +, \times)$ that, in turn, is fundamentally dependent on the basic unit I. But the Riemannian geometry does not leave time invariant the basic unit I due to its noncanonical character. The loss in time of the basic unit I then implies the consequential loss in time of the base field R, with consequential catastrophic collapse of the entire geometry [36].

In conclusion, not only is Einstein's reduction of gravity to pure curvature inconsistent with nature because of the lack of sources, but also the ultimate origin of the inconsistencies rests in the curvature itself when assumed for the representation of gravity, due to its inherent noncanonical character at the classical level with consequential nonunitary structure at the operator level.

Serious mathematical and physical inconsistencies are then unavoidable under these premises, thus establishing the impossibility of any credible use of general relativity, for instance, as an argument against the test on antigravity predicted for antimatter in the field of matter [5], as well as establishing the need for a profound revision of our current views on gravitation.

THEOREM 1.4.4: Einstein's gravitation is incompatible with experimental evidence because it predicts a bending of the speed of light that is double the experimental value.

Proof. Light carries energy, thus being subjected to a bending due to the conventional Newtonian gravitational attraction, while Einstein's gravitation predicts that the bending of light is due to curvature, thus resulting in a bending twice the experimentally measured value, the first being incompatible with the latter. **q.e.d.**

Without proof due to its evident nature, we also present the following:

THEOREM 1.4.5: The reduction of gravitation to curvature is incompatible with phyhsical reality because the free fall occurs along a straight radial line.

In fact, a consistent representation of the free fall of a mass along a straight radial line requires that the Newtonian attraction be represented the field equations necessarily without curvature, thus disproving the customary belief

needed to avoid Corollary 4.2.A that said Newtonian attraction emerges at the level of the PPN approximation of Eqs. (1.4.1).

THEOREM 1.4.6. Gravitational experimental measurements do not verify Einstein's gravitation uniquely.

Proof. All claimed "experimental verifications" of Einstein's gravitation are based on the PPN "expansion" (or linearization) of the field equations that, as such, is not unique. In fact, Eqs. (1.4.1) admit a variety of inequivalent expansions depending on the selected parameter, the selected expansion and the selected truncation. It is then easy to show that the selection of an expansion of the same equations (3.1) but different from the PPN approximation leads to dramatic departures from experimental values. **q.e.d.**

A comparison between special and general relativities is here in order. Special relativity can be safely claimed to be "verified by experiments" because the said experiments verify numerical values uniquely and unambiguously predicted by special relativity. By contrast, no such statement can be made for general relativity since the latter does not uniquely and unambiguously predict given numerical values due, again, to the variety of possible expansions and linearization.

The origin of such a drastic difference is due to the fact that *the numerical predictions of special relativity are rigorously controlled by the basic Poincaré "invariance". By contrast, one of the several drawbacks of the "covariance" of general relativity is precisely the impossibility of predicting numerical values in a unique and unambiguous way, thus preventing serious claims of true "experimental verifications" of general relativity.*

By no means the above analysis exhaust all inconsistencies of general relativity, and numerous additional ones do indeed exist, such as that expressed by the following:

THEOREM 1.4.7 [36]: Operator images of Riemannian formulations of gravitation are inconsistent on mathematical and physical grounds.

Proof. As established by Theorem 1.4.3, classical formulations of Riemannian gravitation are noncanonical. Consequently, all their operator counterparts must be nonunitary for evident reasons of compatibility. But nonunitary theories are known to be inconsistent on both mathematical and physical grounds [36]. In fact, on mathematical grounds, nonunitary theories of quantum gravity (see, e.g., Refs. [2j,2k]) do not preserve in time the basic units, fields and spaces, while, on physical grounds, the said theories do not possess time invariant numerical predictions, do not possess time invariant Hermiticity (thus having no acceptable observables), and violate causality. **q.e.d**

The reader should keep in mind the additional well known inconsistencies of quantum gravity, such as the historical incompatibility with quantum mechanics, the lack of a credible PCT theorem, etc.

By no means, the inconsistencies expressed by Theorems 1.4.1 throufg 1.4.7 constitute all inconsistencies of general relativity. In the author's opinion, additional deep inconsistencies are caused by the fact that *general relativity does not possess a well defined Minkowskian limit,* while the admission of the Minkowski space as a tangent space is basically insufficient on dynamical grounds (trivially, because on said tangent space gravitation is absent).

As an illustration, we should recall the controversy on conservation laws that raged during the 20-th century [11]. Special relativity has rigidly defined total conservation laws because they are the Casimir invariants of the fundamental Poincaré symmetry. By contrast, there exist several definitions of total conservation laws in a Riemannian representation of gravity due to various ambiguities evidently caused by the absence of a symmetry in favor of covariance.

Moreover, none of the gravitational conservation laws yields the conservation laws of special relativity in a clear and unambiguous way, precisely because of the lack of any limit of a Riemannian into the Minkowskian space. Under these conditions, the compatibility of general relativity with the special reduces to personal beliefs outside a rigorous scientific process.

To avoid raising issues of scientific ethics, all these inconsistencies establish beyond a scientific, or otherwise credible, doubt the need for a structural revision of the gravitational theories of the 20-th century for both matter and antimatter, a study that will be initiated from the next chapter on.

1.5 THE SCIENTIFIC IMBALANCE CAUSED BY NONCANONICAL AND NONUNITARY THEORIES

1.5.1 Introduction

When facing the limitations of special relativity and quantum mechanics for the representation of extended, nonspherical, deformable and hyperdense particles and antiparticles under linear and nonlinear, local and nonlocal as well as potential and nonpotential forces, a rather general attitude is that of attempting their generalization via the broadening into noncanonical and nonunitary structures, while preserving the mathematics of their original formulation.

Despite the widespread publication of papers on theories with noncanonical or nonunitary structures in refereed journals, including those of major physical societies, it is not generally known that these broader theories are afflicted by inconsistencies so serious to be also known as catastrophic.

Another basic objective of this monograph is the detailed identification of these inconsistencies because their only known resolution is that presented in the next chapters, that permitted by *new mathematics* specifically constructed from the physical conditions considered.

In fact, the broadening of special relativity and quantum mechanics into noncanonical and nonunitary forms, respectively, is necessary to exit form the class of equivalence of the conventional formulations. The resolution of the catastrophic inconsistencies of these broader formulations when treated via the mathematics of canonical and unitary theories, then leaves no other possibility than that of it broadening the basic mathematics.

To complete the presentation of the foundations of the covering hadronic mechanics, in the next two sections we shall review the inconsistencies of noncanonical and nonunitary theories. The remaining sections of this chapter are devoted to an outline of hadronic mechanics so as to allow the reader to enter in a progressive way into the advanced formulations presented in the next chapters.

1.5.2 Catastrophic Inconsistencies of Noncanonical Theories

As recalled in Section 1.2, the research in classical mechanics of the 20-th century has been dominated by *Hamiltonian systems,* that is, systems admitting their complete representation via the *truncated Hamilton equations* (1.2.2), namely, the historical equations proposed by Hamilton in which the external terms have been cut out.

For the scope of this section, it is best to rewrite Eqs. (1.2.2) in the following unified form (see monographs [9] for details)[8]

$$b = (b^\mu) = (r, p) = (r^k, p_k), \tag{1.5.1a}$$

$$\frac{db^\mu}{dt} = \omega^{\mu\nu} \times \frac{\partial H(t, b)}{\partial b^\nu}, \tag{1.5.1b}$$

$$H = K(p) + V(t, r, p), \tag{1.5.1c}$$

$$\mu = 1, 2, 3, ..., 6, \quad k = 1, 2, 3,$$

where H is the Hamtiltonian, K is the kinetic energy, V is the potential energy, $\omega^{\mu\nu}$ is the canonical Lie tensor with explicit form

$$\omega^{\mu\nu} = \begin{pmatrix} 0 & I_{3\times 3} \\ -I_{3\times 3} & 0 \end{pmatrix} \tag{1.5.2}$$

[8] We continue to denote the conventional associative multiplication of numbers, vector fields, operators, etc. with the notation $A \times B$ rather than the usual form AB, because the new mathematics necessary to resolve the catastrophic inconsistencies studied in this chapter is based on various different generalizations of the multiplication. As a consequence, the clear identification of the assumed multiplication will soon be crucial for the understanding of the equations of this monograph.

and $I_{3\times 3} = Diag(1,1,1)$ is the unit matrix.

In the above unified notation, the brackets of the time evolution can be written

$$\frac{dA}{dt} = [A, H] = \frac{\partial A}{\partial b^\mu} \times \omega^{\mu\nu} \times \frac{\partial H}{\partial b^\nu}, \tag{1.5.3}$$

and they characterize a *Lie algebra,* as well known.

The above equations have a *canonical structure,* namely, their time evolution characterizes a *canonical transformation*[9],

$$b^\mu \to b'^\mu(b), \tag{1.5.4a}$$

$$\omega^{\mu\nu} \to \frac{\partial b'^\mu}{\partial b^\rho} \times \omega^{\rho\sigma} \times \frac{\partial b'^\nu}{\partial b^\sigma} \equiv \omega^{\mu\nu}; \tag{1.5.4b}$$

and the theory possesses the crucial property of predicting the same numbers under the same conditions at different times, a property generically referred to as *invariance,* such as the invariance of the basic analytic equations under their own time evolution

$$\frac{db^\mu}{dt} - \omega^{\mu\nu} \times \frac{\partial H(t,b)}{\partial b^\nu} = 0 \to$$

$$\to \frac{db'^\mu}{dt} - \omega^{\mu\nu} \times \frac{\partial H(t',b')}{\partial b'^\nu} = 0. \tag{1.5.5}$$

where the invariance is expressed by the preservation of the Lie tensor $\omega^{\mu\nu}$ and of the Hamiltonian H.

It is easy to predict that future research in classical mechanics will be dominated by *non-Hamiltonian systems,* that is, systems that cannot be entirely described by the Hamiltonian and require at least a second quantity for their complete description.

Alternatively, we are referring to systems with internal forces that are partly of potential type, represented by V, and partly of nonpotential type, thus requiring new quantities for their representation.

We are also referring to the transition from *exterior dynamical systems* recalled in Section 1.3 (systems of point-like particles moving in vacuum without collisions under sole action-at-a-distance potential interactions) to *interior dynamical systems* (extended, nonspherical and deformable particles moving within a resistive medium with action-at-a-distance potential forces plus contact, nonpotential, nonlocal, and integral forces).

As also recalled in Section 1.2, exterior dynamical systems can be easily represented with the truncated Hamilton equations, while the first representation

[9]For several additional different but equivalent definitions of canonical transformations one may consult Ref. [54a] Pages 187-188.

of the broader non-Hamiltonian systems is given precisely by the historical analytic equations with external terms, Eqs. (1.3.2) that we now rewrite in the unified form

$$\frac{db^\mu}{dt} = \omega^{\mu\nu} \times \frac{\partial H(t,b)}{\partial b^\nu} + F^\mu(t,b,\dot{b},...), \tag{1.5.6a}$$

$$F^\mu = (0, F_k), \quad \mu = 1,2,...,6, \quad k = 1,2,3. \tag{1.5.6b}$$

Nevertheless, as also recalled in Section 1.3, the addition of the external terms creates serious structural problems since the brackets of the new time evolution

$$\frac{dA}{dt} = (A,H,F) = \frac{\partial A}{\partial b^\mu} \times \omega^{\mu\nu} \times \frac{\partial H}{\partial b^\nu} + \frac{\partial A}{\partial b^\mu} \times F^\mu, \tag{1.5.7}$$

violate the conditions to characterize an algebra (since they violate the right distributive and scalar laws), let alone violate all possible Lie algebras, thus prohibiting the studies of basic aspects, such as spacetime symmetries under nonpotential forces.

As experienced by the author, when facing the latter problems, a rather natural tendency is that of using coordinate transforms $b \to b'(b)$ to turn a systems that is non-Hamiltonian in the b-coordinates into a Hamiltonian form in the b'-coordinates,

$$\frac{db^\mu}{dt} - \omega^{\mu\nu} \times \frac{\partial H(t,b)}{\partial b^\nu} - F^\mu(t,b,\dot{b},...) = 0 \to$$

$$\to \frac{db'^\mu}{dt} - \omega^{\mu\nu} \times \frac{\partial H'(t,b')}{\partial b^\nu} = 0. \tag{1.5.8}$$

These transformations always exist under the necessary continuity and regularity conditions, as guaranteed by *Lie-Koening theorem* of analytic mechanics or the *Darboux Theorem* of the symplectic geometry) [9b].

This first attempt has no physical value because of excessive problems identified in Section 1.2, such as: the lack of physical meaning of quantum formulations in the b'-coordinates; the impossibility of placing a measuring apparatus in the transformed coordinates; the loss of all known relativities due to the necessarily nonlinear character of the transforms with consequential mapping of inertial into noninertial frames; and other problems.

The above problems force the restriction of analytic representations of non-Hamiltonian systems within the fixed coordinates of the experimenter, the so-called *direct analytic representations* of Assumption 1.2.1 [9].

Under the latter restriction, the second logical attempt for quantitative treatments of non-Hamiltonian systems is that of broadening conventional canonical theories into a noncanonical form at least admitting a consistent algebra in the brackets of the time evolution, even though the resulting time

evolution of the broader equations cannot characterize a canonical transformation.

As an illustration of these second lines of research, in 1978 the author wrote for Springer-Verlag his first volume of *Foundations of Theoretical Mechanics* [9a] devoted to the integrability conditions for the existence of a Hamiltonian representation (the so-called *Helmholtz's conditions of variational selfadjointness*). The evident scope was that of identifying the limits of applicability of the theory within the fixed coordinates of the experimenter.

A main result was the proof that *the truncated Hamilton equations admit a direct analytic representation in three space dimensions only of systems with potential (variationally selfadjoint) forces,*[10] thus representing only a small part of what are generally referred to as *Newtonian systems.*

In this way, monograph [9a] confirmed the need to enlarge conventional Hamiltonian mechanics within the fixed frame of the experimenter in such a way to admit a direct representation of all possible Newtonian systems verifying the needed regularity and continuity conditions.

Along the latter line of research, in 1982 the author published with Springer-Verlag his second volume of *Foundations of Theoretical Mechanics* [9b] for the specifically stated objective of broadening conventional Hamiltonian mechanics in such a way to achieve *direct universality,* that is, the capability of representing *all* Newtonian systems (universality) in the fixed frame of the experimenter (direct universality), while jointly preserving not only an algebra, but actually the *Lie algebra* in the brackets of the time evolution.

These efforts gave birth to a broader mechanics called by the author *Birkhoffian mechanics* in honor of the discoverer of the basic equations, G. D. Birkhoff [37], which equations can be written in the unified form

$$\frac{db^\mu}{dt} = \Omega^{\mu\nu}(b) \times \frac{\partial B(t,b)}{\partial b^\nu}, \tag{1.5.9}$$

where $B(t,b)$ is called the *Birkhoffian* in order to distinguish it from the Hamiltonian (since B does not generally represent the total energy), and $\Omega^{\mu\nu}$ is a *generalized Lie tensor,* in the sense that the new brackets

$$\frac{dA}{dt} = [A,B]^* = \frac{\partial A}{\partial b^\mu} \times \Omega^{\mu\nu} \times \frac{\partial B}{\partial b^\nu}, \tag{1.5.10}$$

still verify the Lie algebra axioms (see Ref. [9b] for details).

Stated in different terms, the main efforts of monograph [54b] were to show that, under the necessary continuity and regularity properties, the historical Hamilton's equations with external terms always admit a reformulation

[10]The truncated Hamilton equations admit analytic representations of nonconservative systems but only *in one dimension,* which systems are essentially irrelevant for serious physical applications.

within the fixed frame of the experimenter with a consistent Lie algebra in the brackets of the time evolution,

$$\frac{db^\mu}{dt} = \omega^{\mu\nu} \times \frac{\partial H(t,b)}{\partial b^\nu} + F^\mu(t,b,...) \equiv \Omega^{\mu\nu}(b) \times \frac{\partial B(t,b)}{\partial b^\nu}. \tag{1.5.11}$$

In this case, rather than being represented with H and F, non-Hamiltonian systems are represented with B and Ω.

Monograph [9b] achieved in full the intended objective with the proof that *Birkhoffian mechanics is indeed directly universal for all possible well behaved local-differential Newtonian systems,* and admits the following *generalized canonical transformations,*

$$\Omega^{\mu\nu}(b) \to \frac{\partial b'^\mu}{\partial b^\rho} \times \Omega^{\rho\sigma}(b(b')) \times \frac{\partial b'^\nu}{\partial b^\sigma} \equiv \Omega^{\mu\nu}(b'). \tag{1.5.12}$$

Monograph [9b] concluded with the indication of the apparent full equivalence of the Birkhoffian and Hamiltonian mechanics, since the latter is admitted as a particular case of the former (when the generalized Lie tensor acquires the canonical form), both theories are derivable from a variational principle, and both theories admit similar transformation properties.

Since the generalized Lie tensor $\Omega^{\mu\nu}$ and related brackets $[A,B]^*$ are antisymmetric, we evidently have conservation laws of the type

$$\frac{dB}{dt} = [B,B]^* \equiv 0, \tag{1.5.13}$$

Consequently, Birkhoffian mechanics was suggested in monograph [54b] for the representation of *closed-isolated non-Hamiltonian systems* (such as Jupiter).

The representation of *open-nonconservative non-Hamiltonian systems* required the identification of a yet broader mechanics with a consistent algebra in the brackets of the time evolution, yet such that the basic brackets are not antisymmetric. The solution was reached in monographs [38] via the *Birkhoffian-admissible mechanics* with basic analytic equations

$$\frac{db^\mu}{dt} = \omega^{\mu\nu} \times \frac{\partial H(t,b)}{\partial b^\nu} + F^\mu(t,b,...) \equiv S^{\mu\nu}(b) \times \frac{\partial B(t,b)}{\partial b^\nu}, \tag{1.5.14}$$

where the tensor $S^{\mu\nu}$ is *Lie-admissible* According to Santilli's [39] realization of Albert [40] abstract formulation, namely, in the sense that the generalized brackets of the time evolution

$$\frac{dA}{dt} = (A,B) = \frac{\partial A}{\partial b^\mu} \times S^{\mu\nu}(b) \times \frac{\partial B}{\partial b^\nu}, \tag{1.5.15}$$

verify all conditions to characterize an algebra, and their attached antisymmetric brackets

$$[A,B]^* = (A,B) - (B,A), \tag{1.5.16}$$

characterize a generalized Lie algebra as occurring in Birkhoffian mechanics.

The representation of the open-nonconservative character of the equations was then consequential, since the lack of antisymmetry of the brackets yields the correct *time rate of variation of the energy* $E = B$

$$\frac{dE}{dt} = (E, E) = F_k \times v^k, \tag{1.5.17}$$

and the same occurs for all other physical quantities.

Monographs [38] then proved the direct universality of Birkhoffian-admissible mechanics for all open-nonconservative systems, identified its transformation theory and provided the following elementary, yet universal realization of the Lie-admissible tensor S for $B = H$ representing the total *nonconserved* energy

$$S^{\mu\nu} = \begin{pmatrix} 0 & I \\ -I & F/(\partial H/\partial p) \end{pmatrix}. \tag{1.5.18}$$

Note that *the Birkhoffian-admissible mechanics is structurally irreversible,* in the sense of being irreversible for all possible energies and Birkhoffian functions since the basic Lie-admissible tensor is itself irreversible, $S(t, b) \neq S(-t, b)$, thus being particularly suited to represent irreversible systems.

However, studies conducted after the publication of monographs [9,38] revealed the following seemingly innocuous feature:

LEMMA 1.5.1 [11b]: *Birkhoffian and Birkhoffian-admissible mechanics are noncanonical theories, i.e., the generalized canonical transformations, are noncanonical,*

$$\omega^{\mu\nu} \rightarrow \frac{\partial b'^{\mu}}{\partial b^{\rho}} \times \omega^{\rho\sigma} \times \frac{\partial b'^{\nu}}{\partial b^{\sigma}} \equiv \Omega^{\mu\nu}(b') \neq \omega^{\mu\nu}. \tag{1.5.19}$$

It is important to understand that *Birkhoffian and Birkhoffian-admissible mechanics are mathematically attractive, but they are not recommended for physical applications, both classically as well as foundations of operator theories.*

The canonical Lie tensor has the well known explicit form (1.5.2). Therefore, the diagonal matrix $I_{3\times3}$ is left invariant by canonical transformations. But $I_{3\times3}$ is the *fundamental unit of the basic Euclidean geometry.* As such, it represents in an abstract and dimensionless form the basic units of measurement, such as

$$I_{3\times3} = Diag.(1\text{cm}, 1\text{cm}, 1\text{cm}). \tag{1.5.20}$$

By their very definition, noncanonical transformations do not preserve the basic unit, namely, they are transformations of the representative type (with

arbitrary new values)

$$I_{3\times 3} = Diag.(1\text{cm}, 1\text{cm}, 1\text{cm}) \rightarrow$$

$$\rightarrow U \times I_{3\times 3} \times U^t = Diag.(3.127 \text{ cm},\ e^{-212} \text{ cm},\ \log 45 \text{ cm}), \qquad (1.5.21a)$$

$$U \times U^t \neq I, \qquad (1.5.21b)$$

where t stands for transposed. We, therefore, have the following important:

THEOREM 1.5.1 [53]: *Whether Lie or lie-admissible, all classical noncanonical theories are afflicted by catastrophic mathematical and physical inconsistencies.*

Proof. Noncanonical theories do not leave invariant under time evolution the basic unit. This implies the loss under the time evolution of the base field on which the theory is defined. Still in turn, the loss in time of the base field implies catastrophic mathematical inconsistencies, such as the lack of preservation in time of metric spaces, geometries, symmetries, etc., since the latter are defined over the field of real numbers.

Similarly, noncanonical theories do not leave invariant under time evolution the basic units of measurements, thus being inapplicable for consistent measurements. The same noncanonical theories also do not possess time invariant numerical predictions, thus suffering catastrophic physical inconsistencies. **q.e.d.**

In conclusion, the regaining of a consistent algebra in the brackets of the time evolution, as it is the case for Birkhoffian and Birkhoffian-admissible mechanics, is not sufficient for consistent physical applications because the theories remain noncanonical. In order to achieve a physically consistent representation of non-Hamiltonian systems, it is necessary that

1) The analytic equations must be derivable from a first-order variational principle, as necessary for quantization;

2) The brackets of the time evolution must characterize a consistent algebra admitting exponentiation to a transformation group, as necessary to formulate symmetries; and

3) The resulting theory must be invariant, that is, must admit basic units and numerical predictions that are invariant in time, as necessary for physical value.

Despite the large work done in monographs [9,38], the achievement of all the above conditions required the author to resume classical studies from their foundations.

These third efforts finally gave rise to the new *Hamilton-Santilli iso-, geno- and hypermechanics* [10b] that do verify all conditions 1), 2) and 3), thus being

suitable classical foundations of hadronic mechanics, as reviewed in Chapter 3.

However, the joint achievement of conditions 1), 2) and 3) for non-Hamiltonian systems required the prior construction of *basically new mathematics,* [10a] today known as *Santilli's iso-, geno- and hyper-mathematics,* as also reviewed in Chapter 3.

This section would be grossly incomplete and potentially misleading without a study of requirement 1), with particular reference to the derivability of analytic equations from a "first-order" variational principle.

Classical studies of non-Hamiltonian systems are essential, not only to identify the basic methods for their treatment, but above all to identify quantization channels leading to unique and unambiguous operator formulations.

Conventional Hamiltonian mechanics provides a solid foundation of quantum mechanics because it is derivable from the variational principle that we write in the unified notation [9a]

$$\delta A^\circ = \delta \int [R^\circ_\mu(b) \times db^\mu - H \times dt] =$$

$$= \delta \int (p_k \times dr^k - H \times dt), \tag{1.5.22}$$

where the functions R°_μ have the canonical expression

$$(R^\circ_\mu) = (p_k, 0), \tag{1.5.23}$$

under which expression the canonical tensor assumes the realization

$$\omega_{\mu\nu} = \frac{\partial R^\circ_\nu}{\partial b^\mu} - \frac{\partial R^\circ_\mu}{\partial b^\nu}, \tag{1.5.24a}$$

$$(\omega_{\mu\nu}) = (\omega^{\alpha\beta})^{-1}. \tag{1.5.24b}$$

As it is well known, the foundations for quantization are given by the *Hamilton-Jacobi equations* here expressed inb the unified notation of Ref. [9a]

$$\frac{\partial A^\circ}{\partial t} = -H, \quad \frac{\partial A^\circ}{\partial b^\mu} = R^\circ_\mu, \tag{1.5.25}$$

that can be written explicitly in the familiar forms

$$\frac{\partial A^\circ}{\partial t} + H = 0, \tag{1.4.26a}$$

$$\frac{\partial A^\circ}{\partial r^k} - p_k = 0, \tag{1.5.26b}$$

$$\frac{\partial A^\circ}{\partial p_k} = 0, \tag{1.5.26c}$$

The use of the *naive quantization*

$$A^\circ \to -i \times \hbar \times \ell n\ \psi, \tag{1.5.27}$$

yields *Schroedinger's equations* in a unique and unambiguous way

$$\frac{\partial A^\circ}{\partial t} + H = 0 \to -i \times \bar{h}\frac{\partial \psi}{\partial t} - H \times \psi = 0, \tag{1.5.28a}$$

$$\frac{\partial A^\circ}{\partial r^k} = p_k \to -i \times \hbar \times \frac{\partial \psi}{\partial r^k} - p_k \times \psi = 0, \tag{1.5.28b}$$

$$\frac{\partial A^\circ}{\partial p_k} = 0 \to \frac{\partial \psi}{\partial p_k} = 0. \tag{1.4.28c}$$

The much more rigorous *symplectic quantization* yields exactly the same results and, as such, it is not necessary for these introductory notes.

A feature crucial for quantization is Eq. (1.5.26c) from which it follows that *the canonical action A° is independent from the linear momentum*, i.e.,

$$A^\circ = A^\circ(t, r). \tag{1.5.29}$$

an occurrence generally (but not universally) referred in the literature as characterizing a *first-order action functional.*

¿From the naive quantization it follows that, in the configuration representation, *the wave function originating from first-order action functionals is independent from the linear momentum* (and, vice-versa, in the momentum representation it is independent from the coordinates),

$$\psi = \psi(t, r), \tag{1.5.30}$$

which property is crucial for the axiomatic structure of quantum mechanics, e.g., for the correct formulation of Heisenberg's uncertainty principle, causality, Bell's inequalities, etc.

A serious knowledge of hadronic mechanics requires the understanding of the reason *Birkhoffian mechanics cannot be assumed as a suitable foundations for quantization.* Birkhoff's equations can indeed be derived from the variational principle (see monograph [9b] for details)

$$\delta A = \delta \int [R_\mu(b) \times db^\mu - B \times dt], \tag{1.5.31}$$

where the new functions $R_\mu(b)$ have the general expression

$$(R_\mu(b)) = (A_k(t, r, p), B^k(t, r, p)), \tag{1.5.32}$$

subject to the regularity condition that Det. $\Omega \neq 0$, under which Birkhoff's tensor assumes the realization

$$\Omega_{\mu\nu}(b) = \frac{\partial R_\nu}{\partial b^\mu} - \frac{\partial R_\mu}{\partial b^\nu}, \tag{1.5.33a}$$

$$(\Omega_{\mu\nu}) = (\Omega)^{\alpha\beta})^{-1}, \tag{1.5.33b}$$

with *Birkhoffian Hamilton-Jacobi equations* [9b]

$$\frac{\partial A}{\partial t} = -B, \quad \frac{\partial A}{\partial b^\mu} = R_\mu. \tag{1.5.34}$$

As one can see, Birkhoffian expressions (1.5.31)–(1.5.33) appear to be greatly similar to the corresponding Hamiltonian forms (1.4.22)–(1.4.26). Nevertheless, there is a fundamental structural difference between the two equations given by the fact that *the Birkhoffian action does indeed depend on the linear momenta,*

$$A = A(t, r, p), \tag{1.5.35}$$

a feature generally referred to as characterizing a *second-order action functional.*

As a consequence, *the "wavefunction" resulting from any quantization of Birkhoffian mechanics also depends on the linear momentum,*

$$\psi = \psi(t, r, p), \tag{1.5.36}$$

by characteriz9ing an operator mechanics that is beyond our current technical knowledge for quantitative treatment, since such a dependence would require a dramatic restructuring of all quantum axioms.

In fact, the use of a naive quantization,

$$A(t, r, p) \to -i \times \hbar \times \ell n\ \psi(t, r, p), \tag{1.5.37}$$

characterizes the following maps

$$\frac{\partial A}{\partial t} + B = 0 \to -i \times \bar{h}\frac{\partial \psi}{\partial t} - B \times \psi = 0, \tag{1.5.38a}$$

$$\frac{\partial A}{\partial b^\mu} - R_\mu = 0 \to -i \times \hbar \times \frac{\partial \psi}{\partial b^\mu} - R_\mu \times \psi = 0, \tag{1.5.38b}$$

A first problem is that the latter equations are generally nonlinear and, as such, they cannot be generally solved in the r- and p-operators. This causes the emergence of an operator mechanics in which it is impossible to define basic physical quantities, such as the linear momentum or the angular momentum, with consequential lack of currently known physical relevance at this moment.

On more technical grounds, in the lifting of Hamiltonian into Birkhoffian mechanics, there is the replacement of the r-coordinates with the R-functions. In fact, the Birkhoffian action has the explicit dependence on the R-functions, $A = A[t, R(b)] = A'(t, r, p)$. As such, the Birkhoffian action can indeed be interpreted as being of first-order, but in the R-functions, rather than in the r-coordinates.

Consequently, a correct operator image of the Birkhoffian mechanics is given by the expressions (first derived in Ref. [11b])

$$i \times \hbar \times \frac{\partial \psi[t, R(b)]}{\partial t} = B \times \psi[t, R(b)], \tag{1.5.39a}$$

$$-i \times \hbar \times \frac{\partial \psi[t, R(b)]}{\partial b^\mu} = R_\mu(b) \times \psi[t, R(b)]. \tag{1.5.39b}$$

As we shall see in Chapter 3, the above equations characterize a *covering of hadronic (rather than quantum) mechanics,* in the sense of being structurally more general, yet admitting hadronic mechanics as a particular case.

Even though mathematically impeccable, intriguing, and deserving further studies, the mechanics characterized by Eqs. (1.4.39) is excessively general for our needs, and its study will be left to the interested reader.

The above difficulties identify quite precisely the first basic problem for the achievement of a physically consistent and effective formulation of hadronic mechanics, consisting in the need of constructing a new mathematics capable of representing CLOSED (that is, isolated) non-Hamiltonian systems via a first-order variational principle (as required for consistent quantization), admitting antisymmetric brackets in the time evolution (as required by conservation laws), and possessing time invariant units and numerical predictions (as required for physical value).

The need to construct a new mathematics is evident from the fact that no pre-existing mathematics can fulfill the indicated needs. As we shall see in Chapter 3, *Santilli's isomathematics* [10a] has been constructed precisely for and does indeed solve these specific problems.

The impossibility of assuming the *Birkhoffian-admissible mechanics* as the foundation of operator formulation for OPEN (that is, nonconservative) non-Hamiltonian systems is clearly established by the fact that said mechanics *is not derivable from a variational principle.*[11]

The latter occurrence identifies a much more difficult task given by the *need to construct a yet broader mathematics capable of representing open non-Hamiltonian systems via a first-order variational principle (as required for consistent quantization), admitting non-antisymmetric brackets in the time evolution (as required by non-conservation laws), and possessing time invariant units and numerical predictions (as required by physical value).*

The lack of any pre-existing mathematics for the fulfillment of the latter tasks is beyond credible doubt. Rather than adapting nature to pre-existing mathematics, the author has constructed a yet broader mathematics, today

[11]Because conventional variations δ can only characterize antisymmetric tensors of type $\omega_{\mu\nu}$ or $\Omega_{\mu\nu}$ and cannot characterize non-antisymmetric tensors such as the Lie-admissible tensor $S_{\mu\nu}$.

known as *Santilli's genomathematics* [10a], that does indeed achieve all indicated objectives, as outlined in Chapter 4.

Readers interested in the depth of knowledge are suggested to meditate a moment on the implications of the above difficulties. In fact, these difficulties have caused the impossibility in the 20-th century to achieve a meaningful operator formulation of contact, nonconservative and nonpotential interactions.

A consequence has been the widespread belief that nonpotential interactions "do not exist" in the particle world, a view based on the lack of existence of their operator representation, with negative implications at all levels of knowledge, such as the impossibility of achieving a meaningful understanding of the origin of irreversibility.

As a consequence, the resolution of the difficulties in the quantization of nonpotential interactions achieved by hadronic mechanics implies a rather profound revision of most of the scientific views of the 20-th century, as we shall see in the subsequent chapters.

1.5.3 Catastrophic Inconsistencies of Nonunitary Theories

Once the limitations of quantum mechanics are understood (and admitted), another natural tendency is to exit from the class of equivalence of the theory via suitable generalizations, while keeping the mathematical methods used for quantum mechanics.

It is important for these studies to understand that these efforts are afflicted by catastrophic mathematical and physical inconsistencies equivalent to those suffered by classical noncanonical formulations based on the mathematics of canonical theories.

The author has dedicated his research life to the construction of axiomatically consistent and invariant generalizations of quantum mechanics for the treatment of nonlinear, nonlocal, and nonpotential effects because they are crucial for the prediction and treatment of new clean energies and fuels.

In this section we review the foundations of these studies with the identification, most importantly, of the failed attempts in the hope of assisting receptive colleagues in avoiding the waste of their time in the study of theories that are mathematically significant, yet cannot possibly have real physical value.

To begin, let us recall that a theory is said to be *equivalent to quantum mechanics* when it can be derived from the latter via any possible *unitary transform* on a conventional Hilbert space $\mathcal{H}$ over the field of complex numbers $C = C(c, +, \times)$,

$$U \times U^\dagger = U^\dagger \times U = I, \tag{1.5.40}$$

under certain conditions of topological smoothness and regularity hereon ignored for simplicity, where "$\times$" represents again the conventional associative product of numbers or matrices, $U \times U^\dagger \equiv UU^\dagger$.

As a consequence, *a necessary and sufficient condition for a theory to be inequivalent to quantum mechanics is that it must be outside its class of unitary equivalence,* that is, the new theory is connected to quantum mechanics via a *nonunitary transform*

$$U \times U^\dagger \neq I. \tag{1.5.41}$$

generally defined on a conventional Hilbert space $\mathcal{H}$ over C.

Therefore, true generalized theories must have a *nonunitary structure*, i.e., their time evolution must verify law (1.5.41), rather than (1.5.40).[12]

During his graduate studies in physics at the University of Torino, Italy, and as part of his Ph. D. thesis, Santilli [641-43] published in 1967 the following *parametric deformation of the Lie product* $A \times B - B \times A$, the first in scientific records

$$\begin{aligned}(A, B) = p \times A \times B - q \times H \times A = \\ = m \times (A \times B - B \times A) + n \times (A \times B + B \times A) = \\ = m \times [A, B] + n \times \{A, B\},\end{aligned} \tag{1.5.42}$$

where $p = m + n, q = n - m$ and $p \pm q$ are non-null parameters.

By remembering that the Lie product characterizes *Heisenberg's equations,* the above generalized product was submitted as part of the following *parametric generalization of Heisenberg's equations* in its finite and infinitesimal forms [41,42]

$$A(t) = U \times A(0) \times U^\dagger = e^{i \times H \times q \times t} \times A(0) \times e^{-i \times t \times p \times H}, \tag{1.5.43a}$$

$$i\ dA/dt = (A, H) = p \times A \times H - q \times H \times A, \tag{1.5.43b}$$

with classical counterpart studied in Ref. [43].

After an extensive research in European mathematics libraries (conducted prior to the publication of Ref. [41] with the results listed in the same publication), the brackets $(A, B) = p \times A \times B - q \times B \times A$ resulted to be *Lie-admissible* according to A. A. Albert [40], that is, the brackets are such that their attached antisymmetric product

$$[A \hat{,} B] = (A, B) - (B, A) = (p + q) \times [A, B], \tag{1.5.44}$$

characterizes a *Lie algebra.*

[12]The reader should be aware that there exist in the literature numerous claims of "generalizations of quantum mechanics" although they have a unitary time evolution and, consequently, do not constitute true generalizations. All these "generalizations" will be ignored in this monograph because they will not resist the test of time.

Jointly, brackets (A, B) are *Jordan admissible* also according to Albert, in the sense that their attached symmetric product,

$$\{A\hat{,}B\} = (A, B) + (B, A) = (p + q) \times \{A, B\}, \tag{1.5.45}$$

characterizes a *Jordan algebra.*

At that time (1967), only three articles on this subject had appeared in Lie- and Jordan-admissibility solely in the sole mathematical literature (see Ref. [41]).

In 1985, Biederharn [44] and MacFairlane [45] published their papers on the simpler q-deformations $A \times B - q \times B \times A$ without a quotation of the origination of the broader form $p \times A \times B - q \times B \times A$ by Santilli [41] in 1967.

Regrettably, Biedenharn and MacFairlane abstained from quoting Santilli's origination of twenty years earlier despite their documented knowledge of such an origination.

For instance, Biedenharn and Santilli had applied for a DOE grant precisely on the same deformations two years prior to Biedenharn's paper of 1985, and Santilli had personally informed MacFairlaine of said deformations years before his paper of 1985.

The lack of quotation of Santilli's origination of q-deformations resulted in a large number of subsequent papers by numerous other authors that also abstained from quoting said origination (see representative contributions [46-49]), for which reason Santilli has been often referred to as the "most plagiarized physicist of the 20-th century".

Ironically, at the time Biedenharn and MacFairlane published their paper on q-deformations, Santilli had already abandoned them because of their catastrophic mathematical and physical inconsistencies studied in this Section.

In 1978, when at Harvard University, Santilli proposed the following *operator deformation of the Lie product* [Ref. [50], Eqs. (4.15.34) and (4.18.11)],

$$\begin{aligned}(A\hat{,}B) &= A \lhd B - B \rhd A = \\ &= A \times P \times B - B \times Q \times A = \\ &= (A \times T \times B - B \times T \times A) + (A \times W \times B + B \times W \times A) = \\ &= [A\hat{,}B] + \{A\hat{,}B\},\end{aligned} \tag{1.5.46}$$

where $P = T + W, Q = W - T$ and $P \pm Q$ are, this time, fixed non-null matrices or operators.

Evidently, product (1.5.46) remains jointly Lie-admissible and Jordan-admissible because the attached antisymmetric and symmetric brackets,

$$[A\hat{,}B] = (A\hat{,}B) - (B\hat{,}A) = A \times T \times B - B \times T \times A, \tag{1.5.47a}$$

$$\{A\hat{,}B\} = (A\hat{,}B) + (B\hat{,}A) = A \times W \times B + B \times W \times A, \tag{1.5.47b}$$

characterizes a *Lie-Santilli and Jordan-Santilli isoalgebra* (see Chapter 4 for details).

The reader should be aware that the following alternative versions of product (1.5.46),

$$P \times A \times B - Q \times B \times A, \tag{1.5.48a}$$

$$A \times B \times P - B \times A \times Q, \tag{1.5.48b}$$

do not constitute an algebra since the former (latter) violates the left (right) distributive and scalar laws [50].

The above operator deformations of the Lie product was also submitted for the following broader *operator Lie-admissible and Jordan-admissible generalization of Heisenberg's equations* in its finite and infinitesimal forms [50]

$$A(t) = U \times A(0) \times U^\dagger = e^{i \times H \times Q \times t} \times A(0) \times e^{-i \times t \times P \times H}, \tag{1.5.49a}$$

$$i\ dA/dt = (A \hat{,} H) = A \lhd H - H \rhd A =$$
$$= A \times P \times H - H \times Q \times A, \tag{1.5.49b}$$
$$P = Q^\dagger, \tag{1.5.49c}$$

which equations, as we shall see in Chapter 4, are the fundamental equations of hadronic mechanics following proper mathematical treatment.

It is an instructive exercise for the reader interested in learning the foundation of hadronic mechanics to prove that:

1) Time evolutions (1.5.43) and (1.5.49) are *nonunitary,* thus being outside the class of unitary equivalence of quantum mechanics;

2) The application of a nonunitary transform $R \times R^\dagger \neq I$ to structure (1.5.43) yields precisely the broader structure (1.5.49) by essentially transforming the parameters p and q into the operators

$$P = p \times (R \times R^\dagger)^{-1}, Q = q \times (R \times R^\dagger)^{-1}; \tag{1.5.50}$$

3) The application of additional nonunitary transforms $S \times S^\dagger \neq I$ to structure (1.5.50) preserves its Lie-admissible and Jordan-admissible character, although with different expressions for the P and Q operators.

The above properties prove the following:

LEMMA 1.5.2 [36]: *General Lie-admissible and Jordan-admissible laws (1.5.49) are "directly universal" in the sense of containing as particular cases all infinitely possible nonunitary generalizations of quantum mechanical equations ("universality") directly in the frame of the observer ("direct universality"), while admitting a consistent algebra in their infinitesimal form.*

The above property can be equally proven by noting that the product $(A\hat{,}B)$ is the most general possible "product" of an "algebras" as commonly understood in mathematics (namely, a vector space with a bilinear composition law verifying the right and left distributive and scalars laws).

In fact, the product $(A\hat{,}B)$ constitutes the most general possible combination of Lie and Jordan products, thus admitting as particular cases *all* known algebras, such as associative algebras, Lie algebras, Jordan algebras, alternative algebras, supersymmetric algebras, Kac-Moody algebras, *etc.*

Despite their unquestionable mathematical beauty, theories (1.5.43) and (1.5.49) possess the following catastrophic physical and mathematical inconsistencies:

THEOREM 1.5.2 [36] *(see also Refs.* [51-58]*): All theories possessing a nonunitary time evolution formulated on conventional Hilbert spaces $\mathcal{H}$ over conventional fields of complex numbers $C(c, +, \times)$ do not admit consistent physical and mathematical applications because:*

1) They do not possess invariant units of time, space, energy, etc., thus lacking physically meaningful application to measurements;

2) They do not conserve Hermiticity in time, thus lacking physically meaningful observables;

3) They do not possess unique and invariant numerical predictions;

4) They generally violate probability and causality laws; and

5) They violate the basic axioms of Galileo's and Einstein's relativities.

Nonunitary theories are also afflicted by catastrophic mathematical inconsistencies.

The proof of the above theorem is essentially identical to that of Theorem 1.5,1 (see Ref. [36] for details). Again, the basic unit is not an abstract mathematical notion, because it embodies the most fundamental quantities, such as the units of space, energy, angular momentum, etc.

The nonunitary character of the theories here considered then causes the lack of conservation of the numerical values of such units with consequential catastrophic inapplicability of nonunitary theories to measurements.

Similarly, it is easy to prove that the condition of Hermiticity at the initial time,

$$(\langle\phi| \times H^\dagger) \times |\psi\rangle \equiv \langle\phi| \times (H \times |\psi\rangle), \quad H = H^\dagger, \tag{1.5.51}$$

is violated at subsequent times for theories with nonunitary time evolution when formulated on $\mathcal{H}$ over C. This additional catastrophic inconsistency (known as *Lopez's lemma* [52,53]), can be expressed by

$$[\langle\psi| \times U^\dagger \times (U \times U^\dagger)^{-1} \times U \times H \times U^\dagger] \times U|\psi\rangle =$$
$$= \langle\psi| \times U^\dagger \times [(U \times H \times U^\dagger) \times (U \times U^\dagger)^{-1} \times U|\psi\rangle] =$$

$$= (\langle\hat{\psi} \times T \times H'^{\dagger}) \times |\hat{\psi}\rangle = \langle\hat{\psi}| \times (\hat{H} \times T \times |\hat{\psi}\rangle), \tag{1.5.52a}$$

$$|\hat{\psi}\rangle = U \times |\psi\rangle, \;\; T = (U \times U^{\dagger})^{-1} = T^{\dagger}, \tag{1.5.52b}$$

$$H'^{\dagger} = T^{-1} \times \hat{H} \times T \neq H. \tag{1.5.52c}$$

As a result, nonunitary theories do not admit physically meaningful observables.

Assuming that the preceding inconsistencies can be by-passed with some manipulation, nonunitary theories still remain with additional catastrophic inconsistencies, such as the lack of invariance of numerical predictions.

To illustrate this additional inconsistency, suppose that the considered nonunitary theory is such that, at $t = 0$ sec, $U \times U^{\dagger}_{[t=0]} = 1$, at $t = 15$ sec, $U \times U^{\dagger}_{[t=15]} = 15$, and the theory predicts at time $t = 0$ sec, say, the eigenvalue of 2 eV,

$$H|_{t=0} \times |\psi >= 2\ eV \times |\psi > . \tag{1.5.53}$$

It is then easy to see that the same theory predicts under the same conditions the *different* eigenvalue 30 eV at $t = 15$ sec, thus having no physical value of any type. In fact, we have

$$U \times U^{\dagger}|_{t=0} = I, \;\; U \times U^{\dagger}|_{t=15} = 15, \tag{1.5.54a}$$

$$\begin{gathered} U \times H \times |\psi\rangle = (U \times H \times U^{\dagger}) \times (U \times U^{\dagger})^{-1} \times (U \times |\psi\rangle) = \\ = H' \times T \times |\hat{\psi}\rangle = U \times E \times |\psi\rangle = E \times (U \times |\psi\rangle) = E \times |\hat{\psi}\rangle, \\ H' = U \times H \times U^{\dagger}, \quad T = (U \times U^{\dagger})^{-1}, \end{gathered} \tag{1.5.54b}$$

$$H' \times |\hat{\psi}\rangle\ |_{t=0} = 2 \text{ eV} \times |\hat{\psi}\rangle\ |_{t=0}, \;\; T = 1\ |_{t=0}, \tag{1.4.54c}$$

$$\begin{gathered} H' \times |\hat{\psi}\rangle\ |_{t=15} = 2 \text{ eV} \times (U \times U^{\dagger}) \times |\hat{\psi}\rangle\ |_{t=15} = \\ = 30 \text{ eV} \times |\hat{\psi}\rangle\ |_{t=15}\ . \end{gathered} \tag{1.5.54d}$$

Probability and causality laws are notoriously based on the unitary character of the time evolution and the invariant decomposition of the unit.

Their violation for nonunitary theories is then evident. It is an instructive exercise for the reader interested in learning hadronic mechanics, superconductivity and chemistry to identify a specific example of nonunitary transforms for which the effect *precedes* the cause.

The violation by nonunitary theories of the basic axioms of Galileo's Einstein's relativities is so evident to require no comment.

An additional, most fundamental inconsistency of the theories considered is their *noninvariance*, that can be best illustrated with the lack of invariance of the general Lie-admissible and Jordan-admissible laws (1.5.49).

In fact, under nonunitary transforms, we have, e.g., the lack of invariance of the Lie-admissible and Jordan-admissible product,

$$U \times U^\dagger \neq I \tag{1.5.55a}$$

$$\begin{aligned} U\times(A\hat{,}B)\times U^\dagger &= U\times(A\lhd B - B\rhd A)\times U^\dagger = (U\times A\times U^\dagger)\times \\ &\times[(U\times U^{-1})\times(U\times P\times U^\dagger)\times(U\times U^\dagger)^{-1}]\times(U\times B\times U^\dagger)- \\ &-(U\times B\times U^\dagger)\times[(U\times U^{-1})\times(U\times Q\times U^\dagger)\times(U\times U^\dagger)^{-1}]\times \\ &\times(U\times A\times U^\dagger) = A'\times P'\times B' - B'\times Q'\times A' = \\ &= A'\lhd' B' - B'\rhd' A'. \end{aligned} \tag{1.5.55b}$$

The above rules confirm the preservation of a Lie-admissible structure under the most general possible transforms, thus confirming the direct universality of laws (1.4.49) as per Theorem 1.4.2. The point is that *the formulations are not invariant* because

$$P' = (U \times U^{-1}) \times (U \times Q \times U^\dagger) \times (U \times U^\dagger)^{-1} \neq P, \tag{1.5.56a}$$

$$Q' = (U \times U^{-1}) \times (U \times Q \times U^\dagger) \times (U \times U^\dagger)^{-1} \neq Q, \tag{1.5.56b}$$

that is, because *the product itself is not invariant.*

By comparison, the invariance of quantum mechanics follows from the fact that the associative product "$\times$" is not changed by unitary transforms

$$U \times U^\dagger = U^\dagger \times U = I, \tag{1.5.57a}$$

$$\begin{aligned} A \times B \to U \times (A \times B) \times U^\dagger &= \\ = (U \times A \times U^\dagger) \times (U \times U^\dagger)^{-1} \times (U \times B \times U^\dagger) &= A' \times B'. \end{aligned} \tag{1.5.57b}$$

Therefore, generalized Lie-admissible and Jordan-admissible theories (1.5.49) are not invariant because the generalized products "$\lhd$" and "$\rhd$" are changed by nonunitary transformations, including the time evolution of the theory itself. The same results also holds for other nonunitary theories, as the reader is encouraged to verify.

The mathematical inconsistencies of nonunitary theories are the same as those of noncanonical theories. Recall that mathematics is formulated over a given field of numbers. Whenever the theory is nonunitary, the first noninvariance is that of the basic unit of the field.

The lack of conservation of the unit then causes the loss of the basic field of numbers on which mathematics is constructed. It then follows that the entire axiomatic structure as formulated at the initial time, is no longer applicable at subsequent times.

For instance, the formulation of a nonunitary theory on a conventional Hilbert space has no mathematical sense because that space is defined over the field of complex numbers.

The loss of the latter property under nonunitary transforms then implies the loss of the former. The same result holds for metric spaces and other mathematics based on a field.

In short, the lack of invariance of the fundamental unit under nonunitary time evolutions causes the catastrophic collapse of the entire mathematical structure, without known exception.

The reader should be aware that the above physical and mathematical inconsistencies apply not only for Eqs. (1.5.49) but also for a large number of generalized theories, as expected from the direct universality of the former.

It is of the essence to identify in the following at least the most representative cases of physically inconsistent theories, to prevent their possible application (see Ref. [36] for details):

1) Dissipative nuclear theories [13] represented via an imaginary potential in non-Hermitean Hamiltonians,

$$H = H_0 = iV \neq H^\dagger \tag{1.5.58}$$

lose all algebras in the brackets of their time evolution (requiring a bilinear product) in favor of the triple system,

$$i \times \ dA/dt = A \times H - H^\dagger \times A = [A, H, H^\dagger] \tag{1.5.59}$$

This causes the loss of nuclear notions such as "protons and neutrons" as conventionally understood, e.g., because the definition of their spin mandates the presence of a consistent algebra in the brackets of the time evolution.

2) Statistical theories with an external collision term C (see Ref. [59] and literature quoted therein) and equation of the density

$$i \ d\rho/dt = \rho \odot H = [\rho, H] + C, \quad H = H^\dagger, \tag{1.5.60}$$

violate the conditions for the product $\rho \odot H$ to characterize any algebra, as well as the existence of exponentiation to a finite transform, let alone violating the conditions of unitarity.

3) The so-called "q-deformations" of the Lie product (see, e.g., [64,65,66–69] and very large literature quoted therein)

$$A \times B - q \times B \times A, \tag{1.5.61}$$

where q is a non-null scalar, that are a trivial particular case of Santilli's (p, q)-deformations (1.4.42).

4) The so-called "k-deformations" [60-63] that are a relativistic version of the q-deformations, thus also being a particular case of general structures (1.4.42).

5) The so-called "star deformations" [64] of the associative product

$$A \star B = A \times T \times B, \tag{1.5.62}$$

where T is fixed, and related generalized Lie product

$$A \star B - B \star A, \tag{1.5.63}$$

are manifestly nonunitary and *coincide* with Santilli's Lie-isotopic algebras [50].

6) Deformed creation-annihilation operators theories [65,66].

7) Nonunitary statistical theories [67].

8) Irreversible black holes dynamics [68] with Santilli's Lie-admissible structure (1.4.46) [103,104].

9) Noncanonical time theories [6971].

10) Supersymmetric theories [104] with product

$$(A, B) = [A, B] + \{A, B\} =$$

$$= (A \times B - B \times A) + (A \times B + B \times A), \tag{1.5.64}$$

are an evident particular case of Santilli's Lie-admissible product (1.4.46) with $T = W = I$.

11) String theories (see ref. [58] and literature quoted therein) generally have a noncanonical structure due to the inclusion of gravitation with additional catastrophic inconsistencies when including supersymmetries.

12) The so-called squeezed states theories [73,74] due to their manifest nonunitary character.

13) All quantum groups (see, e.g., refs. [75-77]) with a nonunitary structure.

14) Kac-Moody superalgebras [78] are also nonunitary and a particular case of Santilli's Lie-admissible algebra (1.4.46) with $T = I$ and W a phase factor.

Numerous additional theories are also afflicted by the catastrophic inconsistencies of Theorem 1.5.2, such as quantum groups, quantum gravity, and other theories the reader can easily identify from the *departures* of their time evolution from the unitary law.

All the above theories have a nonunitary structure formulated via conventional mathematics and, therefore, are afflicted by the catastrophic physical and mathematical inconsistencies of Theorem 1.5.2.

Additional generalized theories were attempted via *the relaxation of the linear character of quantum mechanics* [56]. These theories are essentially based on eigenvalue equations with the structure

$$H(t, r, p, |\psi\rangle) \times |\psi\rangle = E \times |\psi\rangle, \tag{1.5.65}$$

(i.e., H depends on the wavefunction).

Even though mathematically intriguing and possessing a seemingly unitary time evolution, these theories also possess rather serious physical drawbacks, such as: they violate the superposition principle necessary for composite systems such as a hadron; they violate the fundamental Mackay imprimitivity

theorem necessary for the applicability of Galileo's and Einstein's relativities and possess other drawbacks [36] so serious to prevent consistent applications.

Yet another type of broader theory is *Weinberg's nonlinear theory* [79] with brackets of the type

$$A \odot B - B \odot A = \\ = \frac{\partial A}{\partial \psi} \times \frac{\partial B}{\partial \psi^\dagger} - \frac{\partial B}{\partial \psi} \times \frac{\partial A}{\partial \psi^\dagger}, \tag{1.5.66}$$

where the product $A \odot B$ is *nonassociative.*

This theory violates Okubo's No-Quantization Theorem [70], prohibiting the use of nonassociative envelopes because of catastrophic physical consequences, such as the loss of equivalence between the Schrödinger and Heisenberg representations (the former remains associative, while the latter becomes nonassociative, thus resulting in inequivalence).

Weinberg's theory also suffers from the absence of any unit at all, with consequential inability to apply the theory to measurements, the loss of exponentiation to a finite transform (lack of Poincaré-Birkhoff-Witt theorem), and other inconsistencies studied in Ref. [55].

These inconsistencies are not resolved by the adaptation of Weinberg's theory proposed by Jordan [80] as readers seriously interested in avoiding the publication of theories known to be inconsistent *ab initio* are encouraged to verify.

Several authors also attempted *the relaxation of the local-differential character of quantum mechanics* via the addition of "integral potentials" in the Hamiltonian,

$$V = \int d\tau \Gamma(\tau, \dots). \tag{1.5.67}$$

These theories are structurally flawed on both mathematical and physical grounds.

In fact, the nonlocal extension is elaborated via the conventional mathematics of quantum mechanics which, beginning with its topology, is strictly local-differential, thus implying fundamental *mathematical* inconsistencies. Nonlocal interactions are in general of contact type, for which the notion of a potential has no physical meaning, thus resulting in rather serious *physical* inconsistencies.

In conclusion, by the early 1980's Santilli had identified classical and operator generalized theories [103,104] that are directly universal in their fields, with a plethora of simpler versions by various other authors.

However, all these theories subsequently resulted in being mathematically significant, but having no physical meaning because they are noninvariant when elaborated with conventional mathematics.

As we shall see in Chapter 3 and 4, thanks to the construction of new mathematics, hadronic mechanics does indeed solve all the above inconsistencies. The clear difficulties in the solutions then illustrate the value of the result.

1.5.4 The Birth of Isomathematics, Genomathematics and their Isoduals

As it is well known, the basic equations of quantum mechanics, *Heisenberg's time evolution* of a (Hermitean) operator A ($\hbar = 1$),

$$i \times \frac{dA}{dt} = A \times H - H \times A = [A, H], \tag{1.5.68a}$$

$$H = p^2/2 \times m + V(r), \tag{1.5.68b}$$

can only represent the *conservation* of the total energy H (and other quantities) under action-at-a-distance interactions derivable from a potential $V(r)$,

$$i \times \frac{dH}{dt} = [H, H] = H \times H - H \times H \equiv 0. \tag{1.5.69}$$

Consequently, the above equations are basically insufficient to provide an operator representation of *closed non-Hamiltonian systems,* namely, systems of extended particles verifying conventional total conservation laws yet possessing internal potential; and nonpotential interactions, as it is the case for all interior problems, such as the structure of hadron, nuclei and stars.

The central requirement for a meaningful representation of closed, classical or operator interior systems of *particles* with internal contact interactions is the achievement of a *generalization of Lie's theory* in such a way to admit broader brackets, hereon denoted $[A\hat{,}B]$, verifying the following conditions:

1) The new brackets $[A\hat{,}B]$ must verify the distributive and scalars laws (3.9) in order to characterize an algebra;

2) Besides the Hamiltonian, the new brackets should admit a new Hermitean operator, hereon denoted with $\hat{T} = \hat{T}^\dagger$, and we shall write $[A\hat{,}B]_{\hat{T}}$, as a necessary condition for the representation of all non-Hamiltonian forces and effects.

3) The new brackets must be anti-symmetric in order to allow the conservation of the total energy under contact nonpotential internal interactions

$$i \times \frac{dH}{dt} = [H\hat{,}H]_{\hat{T}} \equiv 0; \tag{1.5.70}$$

For the case of *open,* classical or operator irreversible interior systems of *particles* there is the need of a *second generalization of Lie's theory* characterizing broader brackets, hereon denoted $(A\hat{,}B)$ verifying the following conditions:

1') The broader brackets (A, B) must also verify the scalar and distributive laws (3.9) to characterize an algebra;

2') The broader brackets must include *two* non-Hermitean operators, hereon denoted $\hat{P}$ and $\hat{Q}, \hat{P} = \hat{Q}^\dagger$ to represent the two directions of time, and the new brackets, denoted ${}_{\hat{P}}(A\hat{,}B)_{\hat{Q}}$, must be neither antisymmetric nor symmetric to characterize the time rate of variation of the energy and other quantities,

$$i \times \frac{dH}{dt} \;=\; {}_{\hat{P}}(H\hat{,}H)_{\hat{Q}} \;\neq\; 0; \tag{1.5.71}$$

3') The broader brackets must admit the antisymmetric brackets $[A\hat{,}B]$ and $[A, B]$ as particular cases because conservation laws are particular cases of nonconservation laws.

For the case of closed and open interior systems of *antiparticles,* it is easy to see that the above generalizations of Lie's theory will not apply for the same reason that the conventional Lie theory cannot characterize exterior systems of point-like antiparticles at classical level studied in Section 1.1 (due to the existence of only one quantization channel, the operator image of classical treatments of antiparticles can only yield particles with the wrong sign of the charge, and certainly not their charge conjugate).

The above occurrence requires a *third generalization of Lie's theory* specifically conceived for the representation of closed or open interior systems of antiparticles at *all* levels of study, from Newton to second quantization. As we shall see, the latter generalization is provided by the isodual map.

In an attempt to resolve the scientific imbalances of the preceding section, when at the Department of Mathematics of Harvard University, Santilli [39,50] proposed in 1978 an axiom-preserving generalization of conventional mathematics verifying conditions 1), 2) and 3), that he subsequently studied in various works (see monographs [9,10,11,38] and quoted literature).

The new mathematics is today known as *Santilli's isotopic and genotopic mathematics* or *isomathematics and genomathematics* for short [81-86], where the word "isotopic" or the prefix "iso" are used in the Greek meaning of preserving the original axioms, and the word "geno" is used in the sense of inducing new axioms.

Proposal [39] for the new isomathematics was centered in the generalization (called *lifting*) of the conventional, N-dimensional unit, $I = Diag.(1, 1, ..., 1)$ into an $N \times N$-dimensional matrix $\hat{I}$ that is nowhere singular, Hermitean and positive-definite, but otherwise possesses an unrestricted functional dependence on local coordinates r, velocities v, accelerations a, dimension d, density μ, wavefunctions ψ, their derivatives $\partial\psi$ and any other needed quantity,

$$I = Diag.(1, 1, ..., 1) > 0 \rightarrow \hat{I}(r, v, a, d, \mu, \psi, \partial\psi, ...) = \hat{I}^\dagger = 1/\hat{T} > 0 \tag{1.5.72}$$

while jointly lifting the conventional associative product $A \times B$ among generic quantities A and B (numbers, vector fields, matrices, operators, etc.) into the

form

$$A \times B \rightarrow A \hat{\times} B = A \times \hat{T} \times B, \tag{1.5.73}$$

under which $\hat{I}$, rather than I, is the correct left and right unit,

$$I \times A = A \times I \equiv A \rightarrow \hat{I} \hat{\times} A = A \hat{\times} \hat{I} \equiv A, \tag{1.5.74}$$

for all A of the set considered, in which case $\hat{I}$ is called *Santilli's isounit,* and $\hat{T}$ is called the *isotopic element.*

Eqs. (1.5.72)–(1.5.74) illustrate the isotopic character of the lifting. In fact, $\hat{I}$ preserves all topological properties of I; the isoproduct $A \hat{\times} B$ remains as associative as the original product $A \times B$; and the same holds for the preservation of the axioms for a left and right identity.

More generally, the lifting of the basic unit required, for evident reasons of consistency, a corresponding compatible lifting of *all* mathematics used by special relativity and quantum mechanics, with no exception known to this author, thus resulting in the new *isonumbers*, isospaces, isofunctional analysis, isodifferential calculus, isotopologies, isogeometries, etc. (for mathematical works see Refs. [10,11,38]).

Via the use of the above liftings, Santilli presented in the original proposal [39] a step-by-step isotopic (that is, axiom-preserving) lifting of all main branches of Lie's theory, including the isotopic generalization of universal enveloping associative algebras, Lie algebras, Lie groups and the representation theory. The new theory was then studied in various works and it is today known as the *Lie-Santilli isotheory* [81-86]. Predictably. from Eqs. (1.5.73) one can see that the new isobrackets have the form

$$[A \hat{,} B]_{\hat{T}} = A \hat{\times} B - B \hat{\times} A =$$

$$= A \times \hat{T} \times B - B \times \hat{T} \times A = [A \hat{,} B], \tag{1.5.75}$$

where the subscript $\hat{T}$ shall be dropped hereon, whose verification of conditions 1), 2), 3) is evident.

The point important for these introductory lines is that *isomathematics does allow a consistent representation of extended, nonspherical, deformable and hyperdense particles under local and nonlocal, linear and nonlinear, and potential as well as nonpotential interactions.*

In fact, all conventional linear, local and potential interactions can be represented with a conventional Hamiltonian, while the shape and density of the particles and their nonlinear, nonlocal and nonpotential interactions can be represented with Santilli's isounits via realizations of the type

$$\hat{I} = \Pi_{k=1,2,\ldots,n} Diag(n_{k1}^2, n_{k2}^2, n_{k3}^2, n_{k4}^2) \times e^{\Gamma(\psi,\psi^\dagger) \times \int d^3 r \psi^\dagger(r)_k \times \psi(r)_k}, \tag{1.5.76}$$

where: the $n_{k1}^2, n_{k2}^2, n_{k3}^2$ allow to represent, for the first time, the actual, extended, nonspherical and deformable shapes of the particles considered (normalized to the values $n_k = 1$ for the perfect sphere); n_{k4}^2 allows to represent, also for the first time, the density of the interior medium (normalized to the value $n_4 = 1$ for empty space); the function $\Gamma(\psi, \psi^\dagger)$ represents the nonlinear character of the interactions; and the integral $\int d^3 r \psi^\dagger(r)_k \times \psi(r)_k$ represents nonlocal interactions due to the overlapping of particles or of their wave packets.

When the mutual distances of the particles are much greater than 10^{-13}cm = 1 F, the integral in Eq. (1.5.76) is identically null, and all nonlinear and nonlocal effects are null. When, in addition, the particles considered are reduced to points moving in vacuum, all the n-quantities are equal to 1, generalized unit (1.3.22) recovers the trivial unit, and isomathematics recovers conventional mathematics identically, uniquely and unambiguously.

In the same memoir [39], in order to represent irreversibility, Santilli proposed a broader genomathematics based on the following differentiation of the product to the right and to the left with corresponding generalized units

$$A > B = A \times \hat{P} \times B, \quad \hat{I}^> = 1/\hat{P}; \tag{1.5.77a}$$

$$A < B = A \times \hat{Q} \times B, \quad {}^<\hat{I} = 1/\hat{Q}, \tag{1.5.77b}$$

$$\hat{I}^> = {}^< \hat{I}^\dagger, \tag{1.5.77c}$$

where evidently the product to the right, $A > B$, represents motion forward in time and that to the left, $A < B$, represents motion backward in time. Since $A > B \neq A < B$, the latter mathematics represents irreversibility from the most elemental possible axioms.

The latter mathematics was proposed under a broader lifting called "genotopy" in the Greek meaning of inducing new axioms, and it is known today as *Santilli genotopic mathematics,* pr *genomathematics* for short [81-86].

It is evident that genoliftings (1.5.77) require a step by step generalization of all aspects of isomathematics, resulting in *genonumbers, genofields, genospaces, genoalgebras, genogeometries, genotopologies, etc.* [9b,10b,11,38a].

Via the use of the latter mathematics, Santilli proposed also in the original memoir [39] a genotopy of the main branches of Lie's theory, including a genotopic broadening of universal enveloping isoassociative algebras, Lie-Santilli isoalgebras, Lie-Santilli isogroup, isorepresentation theory, etc. and the resulting theory is today known as the *Lie-Santilli genotheory* with basic brackets

$$\begin{aligned} {}_{\hat{P}}(A\hat{,}B)_{\hat{Q}} &= A < B - B > A = \\ &= A \times P \times B - B \times Q \times B = (A\hat{,}B), \end{aligned} \tag{1.5.78}$$

where the subscripts $\hat{P}$ and $\hat{Q}$ shall be dropped from now on.

It should be noted that the main proposal of memoir [39] is genomathematics, while isomathematics is presented as a particular case for

$$(A\hat{,}B)_{\hat{P}=\hat{Q}=\hat{T}} = [A\hat{,}B]. \tag{1.5.79}$$

as we shall see in Chapters 3 and 4, the *isodual isomathematics* and *isodual genomathematics* for the treatment of antiparticles are given by the isodual image (1.1.6) of the above iso- and geno-mathematics, respectively.

1.5.5 Hadronic Mechanics

Thanks to the prior discovery of isomathematics and genomathematics, in memoir [50] also of 1978 Santilli proposed a generalization of quantum mechanics for closed and open interior systems, respectively, under the name of *hadronic mechanics,* because hyperdense hadrons, such as protons and neutrons, constitute the most representative (and most difficult) cases of interior dynamical systems.

For the case of closed interior systems of particles, hadronic mechanics is based on the following *isotopic generalization of Heisenberg's equations* (Ref. [50], Eqs. (4.15.34) and (4.18.11))

$$i \times \frac{dA}{dt} = [A\hat{,}H] = A\hat{\times}H - H\hat{\times}A. \tag{1.5.80}$$

while for the broader case of open interior systems hadronic mechanics is based on the following *genotopic generalization of Heisenberg's equations* (Ref. [50], Eqs. (4.18.16))

$$i \times \frac{dA}{dt} = (A\hat{,}H) = A < H - H > A =$$
$$= A \times P \times H - H \times Q \times A. \tag{1.5.81}$$

The isodual images of Eqs. (1.5.80) and (1.5.81) for antiparticles as we as their multivalued hyperformulations significant for biological studies, were added more recently [88].

A rather intense scientific activity followed the original proposal [50], including five *Workshops on Lie-admissible Formulations* held at Harvard University from 1978 to 1982, fifteen *Workshops on Hadronic Mechanics*, and several formal conferences held in various countries, plus a rather large number of research papers and monographs written by various mathematicians, theoreticians and experimentalists, for an estimated total of some 15,000 pages of research published refereed journals (see the *General References on Hadronic Mechanics* at the end of this volume).

It shpould be indicated that, following the original proposal of 1978 [50], maturity on the basic new numbers of hadronic mechanics, the *iso-, geno-*

and hyper-numbers and their isoduals was reached only in 1993 [87]; a correct mathematical formulation was reached only in 1996 [88] due to problems that had remained unsolbved for years; and a fully invariant physical formulation was reached only in 1997 for invariant Lie-isotopic theories [89] and invariant Lie-admissible theories [89] 9see also memoir [91] for a recent review).

The lapse of time between the original proposal of 1978 and the achievement of mathematical and physical maturity illustrates the difficulties to be resolved.

As a result of all these efforts, hadronic mechanics is today a rather diversified discipline conceived and constructed for quantitative treatments of all classical and operator systems of particles according to Definition 1.3.1 with corresponding isodual formulations for antiparticles.

It is evident that in the nfollowing chapters we can review only the most salient foundations of hadronic mechanics and have to defer the interested reader to the technical literature for brevity.

As of today, hadronic mechanics has experimental verifications and applications in particle physics, nuclear physics, atomic physics, superconductivity, chemistry, biology, astrophysics and cosmology, including numerous industrial applications outlined in monograph [92].

Hadronic mechanics can be classified into bf sixteen different branches, including: four branches of classical treatment of particles with corresponding four branches of operator treatment also of particles, and eight corresponding (classical and operator) treatments of antiparticles.

An effective classification of hadronic mechanics is that done via the main topological features of the assumed basic unit, since the latter characterizes all branches according to:

$I = 1 > 0$:
HAMILTONIAN AND QUANTUM MECHANICS
Used for the description of closed and reversible systems of point-like particles in exterior conditions in vacuum;

$I^d = -1 < 0$:
ISODUAL HAMILTONIAN AND ISODUAL QUANTUM MECHANICS
Used for the description of closed and reversible systems of point-like antiparticles in exterior conditions in vacuum;

$\hat{I}(r, v, ...) = \hat{I}^\dagger > 0$:
CLASSICAL AND OPERATOR ISOMECHANICS
Used for the description of closed and reversible systems of extended particles in interior conditions;

$\hat{I}^d(r^d, v^d, ...) = \hat{I}^{d\dagger} < 0$:
ISODUAL CLASSICAL AND OPERATOR ISOMECHANICS

HADRONIC MECHANICS

MECHANICS AND THEIR ISODUALS

Newtonian Mechanics	Isodual Newtonian Mechanics
Hamiltonian mechanics	Isodual Hamiltonian Mechanics
Quantization	Isodual Quantization
Quantum mechanics	Isodual Quantum Mechanics
Special Relativity	Isodual Special Relativity

REPRESENTATION: isolated systems of point-like particles (mechanics) and antiparticles (isodual mechanics) under local, linear and potential forces.

ISOMECHANICS AND THEIR ISODUALS

Iso-Newtonian Mechanics	Isodual iso-Newtonian Mech.
Iso-Hamiltonian mechanics	Isodual iso-Hamiltonian Mech.
Isoquantization	Isodual Isoquantization
Isohadronic mechanics	Isodual isohadronic Mech.
Isospecial Relativity	Isodual Special Relativity

REPRESENTATION: Isolated, reversible and single-valued systems of extended particles (isomechanics) and antiparticles (isodual isomechanics) under internal, local and nonlocal, linear and nonlinear, potential and nonpotential forces.

GENOMECHANICS AND THEIR ISODUALS

Geno-Newtonian Mechanics	Isodual Geno-Newtonian Mech.
Geno-Hamiltonian mechanics	Isodual Geno-Hamiltonian Mech.
Genoquantization	Isodual Genoquantization
Genohadronic mechanics	Isodual Genohadronic Mechanics
Genospecial Relativity	Isodual Genospecial Relativity

REPRESENTATION: open, irreversible and single-valued systems of extended particles (genomechanics) and antiparticles (isodual genomechanics) under external, local and nonlocal, linear and nonlinear, potential and nonpotential forces.

HYPERMECHANICS AND THEIR ISODUALS

Hyper-Newtonian Mechanics	Isodual Hyper-Newtonian Mech.
Hyper-Hamiltonian mechanics	Isodual Hyper-Hamiltonian Mech.
Hyperquantization	Isodual Hyperquantization
Hyperhadronic mechanics	Isodual Hyperhadronic Mech.
Hyperspecial Relativity	Isodual Hyperspecial Relativity

REPRESENTATION: open, irreversible and multi--valued systems of extended particles (hypermechanics) and antiparticles (isodual hypermechanics) under external, local and nonlocal, linear and nonlinear, potential and nonpotential forces.

Figure 1.16. The structure of hadronic mechanics.

Used for the description of closed and reversible systems of extended antiparticles in interior conditions;

$\hat{I}^{>}(r^{>}, v^{>}, ...) = ({}^{<}\hat{I})^{\dagger}$:
CLASSICAL AND OPERATOR GENOMECHANICS
Used for the description of open and irreversible systems of extended particles in interior conditions;

$\hat{I}^{d>}(r^{d>}, v^{dv}, ...\} = ({}^{<}\hat{I})^{d\dagger}$:
ISODUAL CLASSICAL AND OPERATOR GENOMECHANICS
Used for the description of open and irreversible systems of extended particles in interior conditions;

$\hat{I}^{>} = (\hat{I}_1^{>}, \hat{I}_2^{>}, ...) = ({}^{<}\hat{I})^{\dagger}$:
CLASSICAL AND OPERATOR HYPERMECHANICS
Used for the description of multivalued open and irreversible systems of extended particles in interior conditions;

$\hat{I}^{d>} = \{\hat{I}_1^{>}, \hat{I}_2^{>}, ...\} = ({}^{<}\hat{I})^{\dagger}$:
ISODUAL CLASSICAL AND OPERATOR HYPERMECHANICS
Used for the description of multivalued open and irreversible systems of extended antiparticles in interior conditions.

In summary, a serious study of antiparticles requires its study beginning at the classical level and then following at all subsequent levels, exactly as it is the case for particles.

In so doing, the mathematical and physical treatments of antiparticles emerge as being deeply linked to that of particles since, as we shall see, the former are an anti-isomorphic image of the latter.

Above all, a serious study of antiparticles requires the admission of their existence in physical conditions of progressively increasing complexity, that consequently require mathematical and physical methods with an equally increasing complexity, resulting in the various branches depicted in Figure 5.

All in all, young minds of any age will agree that, rather than having reached a terminal character, our knowledge of nature is still at its first infancy and so much remains to be discovered.

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