Igor S. Makarov

Introduction to
Theoretical Astrophysics

Ether
Particles
Atoms
Systems Theory

Reform Science Center

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Content

Preface

When our research works in physics[1] and humanities[2] were published, the necessity to start teaching those disciplines based on a radically new ideology became clear, and it was decided to write this textbook. This textbook is designed primarily for students of universities, postgraduate students and physicists. As the textbook contains a description of a new scientific method leading to the reform of modern science in general, scientists of all the other fields of science, including philosophers, may also find it interesting and useful.

Author would be grateful for any remarks and comments concerning the content and the format of the book.

Haifa, January 2014

1. Igor S. Makarov. *A Theory of Ether, Particles and Atoms. Second Edition*. Open University Press, 2010. ISBN-13: 9 781441 478412 (www.amazon.com).
2. Igor S. Makarov. *Reform of Modern Science. Politics. Economics.* Reform Science Center, 2012. ISBN-13: 9781469985770 (www.amazon.com).

INTRODUCTION

As the reader knows, modern theoretical physics is based on a number of fundamental theories, methods and interpretations of the vast collection of experimental data. Maxwell's electromagnetic theory, quantum mechanics and the theory of relativity seem to be most fundamental for modern physics. However these theories have proved unable to solve the most cardinal problems of physics, such as the origin of matter, the nature of the medium supporting the propagation of light, the nature of nuclear interaction, the structure of the atom, etc.

To overcome the above crisis, there have appeared some extravagant theories, such as quantum chromodynamics, the string theory, the Big Bang theory and the like, having a very vague and illusory connection to reality and only contributing to the present theoretical confusion. Although experimentalists, with their ever sophisticated and expensive technology, have been succeeding sometimes in discovering new phenomena, their contribution to theoretical physics, concerning its above cardinal problems, was insignificant.

Fortunately, the solution to the crisis has recently been suggested by philosophy. It became clear that physics is a theoretical science, a thoughtful cognizance of the nature; its language is mathematics, its philosophy is *that of the nature itself – the dialectical logic,* the logic described and presented in the most completed form in Hegel's *Encyclopedia of Philosophical Sciences*.

This textbook offers university students a new course on theoretical astrophysics based on the author's research which seems to have initiated the reform of modern physics, providing moreover the true philosophy and methodology of science in general.

The reader is supposed to have knowledge in physics and mathematics within the respective university courses. It is also recommended to get acquainted with the literature for FURTHER READING listed at the end of Chapter 8.

CHAPTER 1

THEORY OF ETHER

Introduction

The existence of ether, a thin omnipresent substance, the physical medium supporting the propagation of light, was hypothesized as far as by Aristotle and had been taken for granted by all physicists until the first decade of the 20th century.

It is known that Maxwell's theory of electromagnetic waves and his hypothesis to the effect that the velocity of light might depend on the velocity of ether, which he considered a kind of fluid filling all space, prompted physicists to undertake decisive experiments to verify that hypothesis. However, the famous experiment conducted by the American physicists Albert Michelson and Edward Morley (1887) failed to detect an ether and confirm the hypothesis.

Trying to explain the negative result of that experiment, the Irish physicist George Fitzgerald proposed (1893) the idea of a relative contraction of dimensions of solid bodies moving through ether. That suggestion was later developed into a full-scale theory by the Dutch physicist H. A. Lorentz and the French mathematician Henri Poincaré (1904). The latter, in fact, formulated a new principle of physics, *the principle of relativity*, which asserted that no experiment could detect an observer's motion through the ether.

That development showed that the classical model of ether, as an absolute stationary medium independent of time, was absolutely untenable and should be replaced by a more sophi-

sticated model. However, the theory of relativity, developed soon after that by Albert Einstein (1905), though not refuting the conception of ether as such, managed to do without it, replacing it with the conception of field, after which the whole idea of ether came to seem obsolete and was almost abandoned by modern physics. That was certainly a kind of self-deception, because any field is merely an excitation of the underlying physical medium and cannot exist without it.

It is therefore only natural that the further development of physics discovered vacuum to be no empty space but, on the contrary, an arena of intense physical processes. There have been observed such effects as vacuum polarization and vacuum fluctuations, the birth and vanish of virtual particles in it, and its interaction with particles; there have been introduced such terms as 'the physical vacuum' and 'the structure of vacuum'. All that proves vacuum to be indeed a physical medium, an ether. Thus, the ether has clearly manifested its reality and cannot be ignored any longer by theoretical physics.

The theory stated in this book is based on the method of systematic intuition which reveals the existence of ether, its composition and its essential characteristic. To start reading this chapter, the reader must put in doubt what he knows from other courses, follow the logic of the new theory and correct his former knowledge with new results.

In the beginning of this physical theory, we are supposed to know nothing true scientific about the physical world, and should start with an open-minded speculation about this allegedly new object.

1.1 The physical world

A. The physical world is an integral whole; it is integral only to the extent it *knows* itself as such: it is *knowledge* about itself; so the world is what it knows about itself. In the beginning the world knows nothing

about itself, there is neither space nor time; so the origin of the world is a *simple* integral whole, *a fundamental particle,* say *an electron*, with no physical properties - *a fundamental contradiction.* Drawing on the well-known experimental facts, general intuition and common sense, suggesting *the wave-corpuscular dualism* to be the principal, fundamental contradiction in the physical world, we conclude that, as such a contradiction in itself, the above electron is *a carrier* of the wave-corpuscular dualism: it is both a pure indefinite wave and a simple indefinite particle.

B. The electron described above is a *virtual* one, an abstraction unable to become a reality on its own. But the duality of the virtual electron implies the existence of its dual partner, a *virtual positron.* The latter is like the electron and likewise abstract. They differ in their primary feature: the electron being primarily wave, the positron corpuscular; thus the virtual electron is a *wave-particle*, while the virtual positron is a *particle-wave*.

C. Since the above electron and positron are the dual images of each other and can mutually replace each other, they do replace each other and produce a unity – a *virtual positronium.* The latter is the *primary interaction* in which the virtual electron and positron merge and turn into each other. As such an interaction, the virtual positronium is characterized by some quality, *energy E,* and therefore is *real.*

Comments:

(1) The above original particles deserve perhaps new terms, *'electrino'* and '*positrino'*, for example, because the terms 'virtual electron' and 'virtual positron' seem to be used in a different sense.

(2) Note that it is due to the interaction of the virtual electron and positron that energy emerges here; therefore, these virtual particles taken separately have no energy of their own.

1.2 The virtual positronium

A. The virtual positronium first is a *pair, corpuscular* interaction of the virtual electron and positron, the embodiment of their corpuscular properties; as such, this interaction is characterized by energy E_m which may be called *a corpuscular* or *a mass energy.*

B. The pair interaction of the electron and positron is the overcoming of their singularity, that is corpuscularity, and therefore the corpuscular interaction itself. As a result, the positronium spontaneously annihilates emitting *photons.* The photon is primarily the manifestation of the electron and positron's wave properties. However, the photon inherits its ancestors' wave-corpuscular dualism and therefore has hidden corpuscular properties as well. Therefore photons tend to turn into their opposition and do turn into it, colliding with each other and giving birth to electron-positron pairs. The latter generate likewise other pairs and the original pair, in particular. Thus the original pair is re-established as a result of the photon exchange, or *the exchange interaction* of virtual positroniums. This interaction is the embodiment of the electron and positron's wave properties and is characterized by energy E_p which may be called *an exchange* or *a momentum energy.*

C. The pair and exchange interactions are inseparable and produce a unity which we shall call *a complex positronium,* or *composium,* for short. The latter comprises both the phase of pair interaction and that of exchange interaction and is an infinite alternation of these two phases. So the composium is *the state* of an infinite series of virtual positroniums and is characterized by its *full energy E*, its components E_m and E_p corresponding to the above dual phases. Mathematically, such a duality is expressed by complex numbers, so the full energy is

$$E = E_m \pm iE_p \tag{1.1}$$

where the signs '+' and '–' refer to the equally probable *conjugate states* with energies E and $\tilde{E}$, respectively.

Comments:

Expression (1.1) is actually the true definition of the term *energy:* the latter is the *measure of interaction,* and as such it is a complex number, with its real and imaginary parts being both algebraic numbers.

1.3 The complex positronium

A. One composium suggests the existence of an unlimited number of composiums interacting with, and regenerating, each other. Because

of their corpuscularity, composiums are isolated, that is there takes place mutual *repulsion.* This results in every state being unique, corresponding to one composium only. The quantitative measure of the repulsion is the constant ε_o , the so-called *permittivity of a vacuum.*

B. Because of the composium's wave property, all its states are identical and convertible to each other**;** therefore, there takes place mutual *attraction*. This results in every state being occupied. The quantitative measure of the attraction is the constant μ_o , the so-called *permeability of a vacuum.*

C. The repulsion and attraction of composiums are inseparable and produce a unity which is *ether.* The latter, therefore, is an infinite number of composiums. Ether is the primary physical medium characterized by the constant

$$c=\frac{1}{\sqrt{\varepsilon_o \mu_o}} \tag{1.2}$$

the so-called *velocity of light in a vacuum.*

Comments:

Making use of (1.2), let us introduce the quantities

$$m=-\frac{E_m}{c^2} \tag{1.3}$$

and

$$p=\frac{E_p}{c} \tag{1.4}$$

which, in accordance with modern terminology, should be called *the mass* and *the momentum* of the composium, respectively; the negative sign in (1.3) being due to the fact that, as shown in Sec.1.4, here $E_m<0.$ So we present (1.1) as

$$E=-mc^2 \pm ipc \tag{1.5}$$

and therefore

$$|E|^2 = m^2 c^4 + p^2 c^2 \qquad (1.6)$$

which coincides with the known relativity theory formula for the energy $|E|$ of a material particle of mass m and momentum p.

The formulas (1.3) and (1.4) expose the physical meaning of such notions as mass and momentum. Indeed, as follows from (1.3), the mass of the composium emerges as a result of the pair interaction of the virtual electron and positron and is proportional to that interaction energy. Similarly, as follows from (1.4), the momentum of the composium emerges as a result of the photon exchange interaction and is proportional to the latter's energy. Therefore, neither electron nor positron, as virtual particles, have mass or momentum of their own.

1.4 Ether

A. Ether is a infinite multitude of composiums. Due to their isolation and mutual repulsion, that multitude is *discrete*; due to their identity and attraction, that multitude is *continuous*. As a sequence of transitions from one state of the composium to another, that multitude is *space* measured by *distance r.* As a sequence of the cycles of resurrection of states, which as such are identical to each other, that multitude is *time t.* As the transition from one state to another is also the cycle of state resurrection, time and space in ether are identical, which is described by the well-known identity

$$r = c\,t \qquad (1.7)$$

Thus space and time in ether are identical and inseparable.

B. Like the whole multitude, each composium is also both discrete and continuous. It is discrete as one composium and continuous as identical to other composiums. As a discrete element of the multitude, the composium is characterized by the constant *h, Planck's constant;* as a continuous element, the composium is the center of some circle of composiums and is characterized by the constant π, the ratio of the circumference of the circle to its diameter. Therefore, the composium combines the features of both continuity and discreteness, and, with its energy *E,* is characterized by the value

$$\chi = \frac{2\pi E}{h c} \tag{1.8}$$

which may be called *a complex wave number.*

C. Due to the above continuity, the definiteness and discreteness of one state continuously transit to those of the contiguous states. Therefore, each composium is the center of some *coherent multitude* of composiums. The coherent multitude contains an infinite number of composiums coherently connected with the given original composium. Thus the coherent multitude combines the features of both the whole multitude, ether, and its element, the composium. Since the coherency is a relative connection of two composiums, moving away from the center results in diminishing both the connection with the center and, to the same extent, the rate of this diminishing, too. Therefore, the coherent multitude is characterized by some fading exponential *function of coherency,*

$$\varphi_\chi(s) = \mathrm{e}^{\chi s}, \quad \Re\,\chi < 0 \tag{1.9}$$

where s is a space ($s = r$) or time ($s = ct$) interval. Function (1.9) determines the degree of coherency of composiums separated in space or time.

Comments

(1) This section displays the stage where ether exposes itself as a space-time medium, which makes it possible to specify the physical sense of such notions as space and time. These notions prove to be identical and inseparable in ether, because in the ‘clear' ether there are neither independent ‘landmarks’ for identifying direction, nor a ’clock’ for gauging time. Therefore, in ether space is time-like, that is half-dimensional, arithmetical, which is expressed by (1.7).

(2) As follows from (1.9), $E_m < 0$, which corresponds to the annihilating nature of the virtual positronium.

(3) Formulas (1.8) and (1.9) may be considered generalized expressions for the real wave number and the wave function of a free particle, respectively, used in quantum mechanics.

1.5 The coherent multitude of composiums

A. The coherent multitude first is a cumulative coherent amount of composiums, the amount coherently connected with the center – *the coherent multitude proper.* As such, the coherent multitude is characterized by its *massiveness,* or its *internal measure* A_χ.

B. Each element of a given coherent multitude belongs also to all the other coherent multitudes, and each element of any other coherent multitude belongs to the given multitude, too. Thus the given coherent multitude correlates with the infinite number of other coherent multitudes as with its own *boundary* and, in this correlation, returns to itself, that is contains its boundary within itself. Therefore, the coherent multitude may be characterized by *the elasticity of the boundary,* or its *external measure* B_χ.

C. Any coherent multitude proper and its boundary condition, transit to, and complement each other and, as a result, produce a unity – *a bounded multitude* of composiums characterized by *a complex measure*

$$C_\chi = A_\chi \pm i\, B_\chi \qquad (1.10)$$

The symmetry of conjugate states and that of conjugate coherent multitudes result in the same symmetry of the latter's complex measure, that is

$$C_{\tilde{\chi}} = \tilde{C}_\chi \qquad (1.11)$$

1.6 The bounded multitude of composiums

A. The bounded multitude, with its elastic boundary, is its own boundary. It is characterized by the integral measure C_χ manifesting the unity of its center with the boundary of the bounded multitude.

B. The center of the bounded multitude is also its own boundary, a unity with its own boundary, *a movement along an infinitesimal circle* in the plane of the complex parameter χ, the circle differing from its center by an infinitesimal quantity $d\chi$ and an infinitesimal measure dC_χ. The ratio of these quantities,

$$S(\chi)=\frac{dC_\chi}{d\chi} \quad , \tag{1.12}$$

determines *a complex measure density.* The function $S(\chi)$ is the *complex energy spectrum* of composiums in ether; it determines the relative intensity of the respective bounded multitudes, thereby setting up some *correlation* between them. As follows from (1.11) and (1.12),

$$S(\tilde{\chi})=\tilde{S}(\chi) \tag{1.13}$$

The correlation of bounded multitudes makes sense only in the half-plane $\Re\chi<0$ bounded by the axis $\Re\chi=0,$ *the boundary of correlation.*

C. Thus the center of the bounded multitude is both the center of coherency and that of correlation. But coherency is at the same time correlation as well, which implies their unity, *a correlative coherency*, characterized, similar to the integral measure C_χ, also by some integral characteristic, establishing accordingly a unity of the center with its new boundary; the latter suggesting *an integral movement of the center along the boundary of correlation*. The bounded multitude, looked upon as such a unity of its center, characterized by its respective measure $S(\chi)d\chi$ and the function of coherency $e^{\chi s}$, with the movement of the center along the boundary of correlation is *the correlation domain of ether* characterized by the function

$$g(s)=\frac{1}{2\pi i}\int_L S(\chi)e^{\chi s}d\chi\,; \quad \Re\chi\geq 0 \tag{1.14}$$

which, due to the relation (1.13), is real. The curve *L* envelops the half-plane $\Re\chi<0$ and may coincide with the axis $\Re\chi=0.$ The correlation domain embodies the unity of coherency and correlation, that is, the coherency of composiums in the bounded multitude and the correlation of bounded multitudes. The function *g*(*s*) determines the correlation of processes separated by a space ($s = r$) or time ($s = c\,t$) interval, and may be called the *correlation function of ether.*

In the correlation domain, the definiteness inherent in bounded

multitudes and their spectral relation vanish, and ether arrives at a simple relation towards itself, turning into a *correlative space-time* and thereby completing its development as a 'clear' ether. This completeness manifests itself in the realness of the function $g(s)$ which is a comprehensive, essential characteristic of ether.

***Comments*:**

(1) When reviewing the evolution the original concept of ether has undergone, we see that in the beginning ether, as an infinite number of composiums, is still a simple immediateness having no support in itself; but after conditioning itself by the coherent and bounded multitudes, ether turns into a self-supported immediateness, becomes identical to itself. Thus ether has been shown here in the process of its self-affirmation, which, according to the philosophy underlying our metod, is a necessary attribute of any respectable theory.

(2) Ether per se is an *arithmetical* space and therefore differs drastically from its earlier four-dimensional models.

(3) Note that the transform inverse to (1.14):

$$S(\chi)=\int_0^\infty g(s)\mathrm{e}^{-\chi s}\,ds \tag{1.15}$$

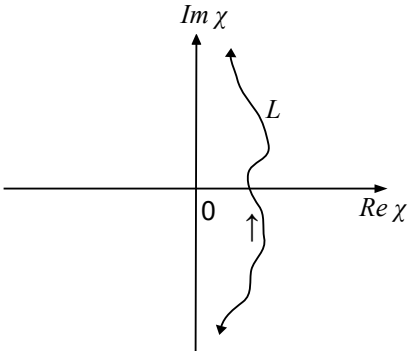

Fig.1.1 Position of line *L* on the χ-plane

is the Laplace transform of $g(s)$, which is known to be analytic in the half-plane $\Re\chi>0$. Therefore, the expression (1.14) makes sense only if the curve L lies in the half-plane $\Re\chi\geq 0$, the motion along it being anti-clockwise, as shown in Fig.1.1. In case $\Re\chi=0$, expression (1.14) still holds turning into the Fourier integral.

(4) In the context of the above theory, the so-called Cosmic Microwave Background Radiation seems to be a natural thermal radiation of ether with its natural black body radiation spectrum.

Conclusion

1. There are only two fundamental particles: the virtual electron and the virtual positron.
2. There exists ether, the primary physical medium, consisting of virtual positroniums exchanging photons.
3. The clear ether is an arithmetical space-time where space and time are identical and inseparable.
4. Energy of particles in ether is a complex number.
5. The correlation domain of ether is its essence.
6. The correlation function of ether is its comprehensive characteristic.

Questions for speculation and discussion

1. Can the virtual electron and positron have hidden properties?
2. Is the composium a particle?
3. Why is the energy of the composium a complex value?
4. Is it possible to prove the existence of ether experimentally?
5. Is ether the so-called *dark matter*?

CHAPTER 2

SUBATOMIC PARTICLES

Introduction

This chapter deals with the origin, properties and description of subatomic particles, the mesons and the neutron, thus giving the proper explanation to the origin of matter in the universe.

The chapter is based on the same method used in the preceding chapter and therefore starts with a speculation about the correlation domain of ether.

2.1 The correlation domain of ether

A. The correlation domain of ether (Sec.1.6), is a stable, self-consistent pattern of correlation, the indication of the self-consistency of ether itself, owing to which ether is a steady medium identical to itself. The correlation function $g(s)$ of ether determines connection between the processes in composiums separated by a space ($s = r$) or time ($s = ct$) interval. That connection is formed through photon exchange. In that process, one composium emits a photon which is absorbed and re-emitted by another composium. If the re-emitted photon retains the parameters of the original photon, there takes place *free propagation* of photons indicating correlation of the states of the respective composiums. Otherwise, there takes place *scattering* of photons indicating independence of the states of the composiums.

The second composium, too, emits photons which are absorbed, in particular, by the first one. Therefore, the first composium is correlated with the second one to the same extent as the second with the first. Thus there takes place correlation of correlation, *self-correlation,* the square

of correlation, which is depicted by the function $g^2(r)$. The latter determines the density of correlated composiums, *the density of correlation*, in the vicinity of some *center.*

The center suggests motion about it and therefore *division of space and time*; that division has actually happened before when we had to introduce the opposite motions of photons, using, of necessity, the space symbol r instead of s. The center suggests localization of space about it and makes it possible to introduce *a spatial frame of reference* with the center as its *origin*. So let us introduce the Cartesian frame of reference XYZ, in which the spatial position q means the totality of its coordinates $\{x,y,z,\}$; then the length of the radius-vector is

$$r=|q|=\sqrt{x^2+y^2+z^2} \tag{2.1}$$

and the element of space $dq = dx\,dy\,dz$.

B. After the division of space and time, with space localized about the center, the latter becomes the singular carrier of time, *a time gauge, the singularity* of ether. The form of the center is characterized by some *singularity distribution function* $\varphi_o(q)$, a continuous positive function satisfying the conditions

$$\varphi_o(q)=\varphi_o(|q|) \tag{2.2}$$

$$\int \varphi_o\,dq=1 \tag{2.3}$$

where the integral is taken over all space. The function $\varphi_o(q)$ defines *the uncertainty sphere* of the center, *the density of singularity.*

C. The photons emitted by the center are absorbed by its vicinity distributed with the density $g^2(r)$. Although that distribution is continuous, the act of the absorption of photon at some point q_1 is singular and should be described by the density of singularity, which in this case takes the form $\varphi_o(q-q_1)$. Thus the singularity permeates the entire vicinity of the center, thereby making its every point similar to the

center. As the motion about any point of singularity within the correlation domain should be correlated with that about the center, the entire vicinity of the center starts moving as a whole, that is, unites and merges with the center. This merging of self-consistency and singularity is the creation of a self-consistent singularity, a *self-consistent cloud.* The latter manifests *the re-unification of space and time*, represented by the functions g^2 and, φ_o, respectively; it is space localized and *rotating* as time about the center. The adequate mathematical expression for such merging of space and time, in which time unites with space at every point q_1 and therefore should be represented there by the function $\varphi_o(q-q_1)$, is the operation of *convolution* of the above two functions,

$$w(q)=g^2\otimes\varphi_o=\int g^2(|q_1|)\,\varphi_o(q-q_1)\,dq_1 \qquad (2.4)$$

As such a re-unification of space and time, the self-consistent cloud is *a material particle,* the function $w(q)$ being proportional to its *matter density.*

Comments:

The above analysis shows the re-unification of space and time to be the principal cause underlying the creation of matter. The logical conclusion about such origin of matter was made first by Hegel who stated in his "Encyclopedia of Philosophical Sciences" that *'space and time twist themselves into matter'*.

2.2 The self-consistent cloud

A. The function $w(q)$ defines the *inner boundary* of the self-consistent cloud dividing the domains of composiums correlated and non-correlated with the center. Therefore, the self-consistent cloud restricts the domain of free motion of photons, which results in that motion, as well as the states of the respective composiums, acquiring the nature of *reflection*, *a standing wave*. In that process, the opposite motions unite leading to the unity of conjugate states and the creation of *self-conjugate composiums.* The reflection is characterized by a *wave function,* $\psi(q,t)$, determining the distribution of reflection in space and its change

in time, on the one hand, and by a *reflection energy,* E_{ref}, determining the intensity of reflection, on the other hand. Owing to the self-conjugation of composium states in the reflection, E_{ref} is real. Taking into account that the linear transformation (2.4) is the most general description of the process of the self-consistent cloud, we should determine the relation between ψ and E_{ref}, most generally, in the form of a linear functional

$$E_{ref}=(\psi\,,\hat{E}_{ref}\psi) \tag{2.5}$$

where $\hat{E}_{ref}$ is a linear operator,

$$(f_1\,,f_2)=\int \tilde{f}_1 f_2\,dq \tag{2.6}$$

the *tilde* sign over character being the symbol of complex conjugation.

B. Propagating free in the domain of composiums correlated with the center, photons penetrate into the domain of non-correlated composiums and undergo scattering. The latter leads to the *degradation of reflection* and the respective time change of the wave function. The degradation of reflection depends on the density of non-correlated composiums and therefore should be proportional to the function

$$W(q)=w_{max}-w(q) \tag{2.7}$$

determining the extent of non-correlation; it being evident that $W\geq 0$.

As the time change of the reflection is characterized by the function $\frac{\partial\psi}{\partial t}$, the intensity of reflection degradation is proportional to the functional

$$P=\frac{1}{c}\left(\frac{\partial\psi}{\partial t}\,,W\frac{\partial\psi}{\partial t}\right) \tag{2.8}$$

The scattering of photons provides *the exchange interaction* of the self-consistent cloud with ether, the value P being proportional to the *power* of that interaction.

C. The inner boundary of the self-consistent cloud divides the domains of reflection and scattering, the latter providing the exchange interaction with ether. That boundary is self-conjugate in a sense: not only does it scatter centrifugal photons, but, due to the exchange interaction with ether, produces, with the same probability, centripetal photons, thereby creating the effect of photon reflection from the boundary. Therefore, the reflection in the self-consistent cloud exists due to the exchange interaction with ether. In its turn, the exchange interaction with ether exists due to the above reflection which, degrading through the scattering of photons, gives rise to the above interaction. Thus the reflection of composiums in the self-consistent cloud and its exchange interaction with ether depend on, and turn into, each other, due to which they fall into unity and produce a balance of reflection and exchange interaction, creating *a balanced cloud.* In the latter, the power of exchange interaction with ether is balanced with the rate of the reflection degradation energy, which, taking into account (2.5) and (2.8), corresponds to the relation

$$\frac{\partial(\psi, \hat{E}_{ref}\psi)}{\partial t} = -\frac{1}{c}\left(\frac{\partial\psi}{\partial t}, W\frac{\partial\psi}{\partial t}\right) \qquad (2.9)$$

Comments:

The process underlying the creation of the balanced cloud seems to be a new, higher stage of the space-time re-unification. Indeed, space and time, separated by the processes of the space reflection and its time change, are re-united due to the balancing of those processes in the balanced cloud.

2.3 The balanced cloud

A. The reflection of composiums in the balanced cloud first, as suggested by (1.3), is the reflection of pair interaction – the formation of the mass of the self-conjugate composiums; it is a coordinate pair interaction of virtual electrons and positrons in two bound conjugate states of composiums, some closed in itself, cyclic, time-forming process – *a*

time reflection. As it is the time change of the wave function that is essential for this reflection, the latter's energy, to within a constant factor, is

$$E_t = \frac{1}{2c^2}\left(\frac{\partial \psi}{\partial t}, \frac{\partial \psi}{\partial t}\right) \tag{2.10}$$

where c is the velocity of light in free space.

B. The reflection of composiums is also the reflection of exchange interaction inside the balanced cloud – the formation of the pair of momenta of the self-conjugate composiums; it is a co-ordinate exchange interaction in two bound conjugate states of composiums – *a space reflection.* As it is the spatial change of the wave function that is essential for the space reflection, the latter's energy, taking into account the proportionality between time and space intervals in the free propagation of photons, to within the same constant factor as in (2.10), is

$$E_s = -\frac{1}{2}(\psi, \Delta\psi) \tag{2.11}$$

where

$$\Delta = \frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2} + \frac{\partial^2}{\partial z^2} \tag{2.12}$$

C. Thus there are two kinds of reflection in the balance cloud: the time reflection, due to the pair interaction of virtual electrons and positrons, and the space reflection, due to the photon exchange interaction. However, the connection between these two processes is not immediate, as is the case in clear ether, but is mediated by the exchange interaction with ether. So when a change of time reflection occurs, it gives rise to the respective change of space reflection and its penetration through the boundary; but the latter *bounds* that change, preventing it from happening, *controlling* it. Thus there arises the effect of *self-control.*

The balanced cloud in which the time and space reflections form a united self-controlled space-time reflection is *a self-controlled cloud.* In the latter, the process of self-control is described by the equality

$E_{ref} = E_s + E_t$, which, taking into account (2.8), (2.10) and (2.11), takes the form

$$\partial\{\frac{1}{c^2}(\frac{\partial\psi}{\partial t},\frac{\partial\psi}{\partial t})-(\psi,\Delta\psi)\}/\partial t=-\frac{2}{c}(\frac{\partial\psi}{\partial t},W\frac{\partial\psi}{\partial t}) \qquad (2.13)$$

Taking into account the relations

$$\frac{\partial}{\partial t}(\frac{\partial\psi}{\partial t},\frac{\partial\psi}{\partial t})=2(\frac{\partial\psi}{\partial t},\frac{\partial^2\psi}{\partial t^2}) \qquad (2.13')$$

and

$$\frac{\partial}{\partial t}(\psi,\Delta\psi)=2(\frac{\partial\psi}{\partial t},\Delta\psi) \qquad (2.13'')$$

we can transform (2.13) into the equation

$$\frac{1}{c^2}\frac{\partial^2\psi}{\partial t^2}-\Delta\psi+\frac{W}{c}\frac{\partial\psi}{\partial t}=0 \qquad (2.14)$$

The latter is known in optics as the equation of *internal reflection.*

Comments:

(1) The physics of the self-control effect may be explained in other words as follows. The process of the balanced cloud corresponds to an ideal balance between the whole energy of the cloud and the power of its interaction with ether. But the separate consideration of the processes of pair and exchange interactions inside the balanced cloud exposes their different connections with ether: the first being connected indirectly through the photon exchange inside the cloud, the second directly through the boundary. It is this difference that results in the emergence of the self-control effect.

(2) The self-controlled cloud presents a new higher stage of space-time re-unification, in this case through maintaining the balance between the space and time reflections inside the cloud.

2.4 The self-controlled cloud

A. The effect of self-control in the self-controlled cloud gives rise to preferential forms of reflection and therefore leads to the discretization of the previously continuous spectrum of states. To determine these discrete states, it is necessary to solve the equation (2.14). To this end, let us represent (2.14) as

$$\frac{\partial u}{\partial t} + H u = 0 \tag{2.15}$$

where $u = u(q,t)$ is a two-component wave function,

$$u = \begin{pmatrix} \dfrac{\partial \psi}{\partial t} \\ \psi \end{pmatrix} \tag{2.16}$$

H is the matrix operator,

$$H = \begin{pmatrix} cW & -c^2\Delta \\ -I & 0 \end{pmatrix} \tag{2.17}$$

I is the unit operator.

The partial solution of (2.15) is known to be

$$u = U\,\mathrm{e}^{\lambda t}, \tag{2.18}$$

where $U = U(q)$ is a two-component spatial wave function satisfying the equation

$$\lambda U + H U = 0 \tag{2.19}$$

The solution of (2.19) is a set of complex-conjugate numbers $\{\lambda_k\},\{\tilde{\lambda}_k\}$ and their wave functions $\{U_k\},\{\tilde{U}_k\}$. These wave functions determine *bound* states satisfying the condition $(U, U) < \infty$. The equation (2.19) has a finite number of bound solutions. Indeed, substituting (2.18) into (2.15) and assuming $|\lambda_k| \to \infty$, we arrive at the equation

$$\lambda^2 U - c^2 \Delta U = 0 \qquad (2.20)$$

which has no bound solutions in the open space. Therefore, one must assume that $|\lambda_k| < \infty$ and $k < \infty$. However, the solutions of (2.19) are abstract because they depend on the indefinite quantity

$$A = \int g^2 dq \qquad (2.21)$$

B. As the reflection intensity grows in the bound states, it achieves its extreme value. The extreme state separates the domain of bound states from that of free states and therefore is both bound and free, a bound state of free conjugate composiums, *a free self-conjugate state*, *the state of rest.* In the latter, the reflection is determined only by the self-conjugation and concentrated in the minimal sphere corresponding to the uncertainty sphere determined by the function φ_o. In the state of rest, therefore, it is necessary to put $w = w_o$, $w_0 = B\varphi_o$. Under this condition, the wave function of the state of rest satisfies the equation

$$\lambda U + H_o U = 0, \qquad (2.22)$$

where $H \to H_o$ when $w \to w_o$.

As a bound state, the state of rest is a stable state; and as a free state, it is a single state isolated from other bound states, the most stable single state. Therefore, when solving (2.22), it is necessary to choose the value B in such a way that would ensure the existence of the most stable single bound solution. To this end, changing B from zero up, one should find values B_1 and B_2 corresponding to the emergence of the first and the second bound solutions, respectively. So the value B is selected between B_1 and B_2 and admits some variation. When selected, it would corresponds to a definite critical value of $\lambda = \lambda_0$. So solving simultaneously equations (2.19) and (2,22) with a slight variation of numbers A and B, it would be possible to achieve both a stable solution for the state of rest and the set of solutions for bound states of self-conjugate composiums within the self-controlled cloud satisfying the condition

$$\lambda_n = \lambda_0 \qquad (2.23)$$

Thus, the two different characteristics of vacuum, represented by the functions g and φ_o, prove agreed with each other.

C. In their evolution, the bound states have turned into a free self-conjugate state, but the latter has also proved to be bound. That mutual transition of boundness and free self-conjugation suggests the existence of their unity – a multitude of *free and bound* self-conjugate states, corresponding, apparently, to the joint solution of (2.19) and (2.23). Physically, this means that in the self-controlled cloud conjugate states unite into *bound self-conjugate* states thus making themselves free within the cloud. Formally, we have the multitude of complex-conjugate numbers $\{\lambda_k\},\{\tilde{\lambda}_k\}$ and the corresponding wave functions $\{U_k\},\{\tilde{U}_k\}$, k = 1,2,…,n, which, unlike the previous solutions, are definite, not abstract.

As the time factor of (2.18) coincides with the function of coherency of ether (see Chapter 1), it should be assumed that

$$\lambda=\frac{E}{\hbar}, \quad \hbar=\frac{h}{2\pi} \tag{2.24}$$

Then the energy of the self-conjugate composium in the k-state is determined by the pair of the complex-conjugate numbers

$$\begin{aligned} E_k&=-m_k c^2+i\, p_k c \\ \tilde{E}_k&=-m_k c^2-i\, p_k c \end{aligned} \tag{2.25}$$

where $E_k = \hbar\,\lambda_k$, that is

$$m_k=\frac{\hbar}{c^2}|\Re\,\lambda_k| \tag{2.26}$$

$$p_k=\frac{\hbar}{c}\Im\,\lambda_k \tag{2.27}$$

m_k being its mass and $\{p_k, -p_k\}$ its pair of momenta.

The creation of free and bound self-conjugate states completes the formation of self-conjugate composiums, which, as shown in Sec.2.2,

started as far back as in the self-consistent cloud. On completing the formation of self-conjugate composiums, the self-controlled cloud turns into *a self-conjugate cloud.* The latter is characterized by a set of self-conjugate wave functions

$$u_k(q,t)=U_k e^{\lambda_k t}+\tilde{U}_k e^{\tilde{\lambda}_k t}, k=1,2,\dots,n \qquad (2.28)$$

Comments:

The self-conjugate cloud is again a new stage of space-time re-unification. Indeed, the above analysis shows the spatial reflection in bound states described by the functions $\{U_k\}$, proves initially to be separated from the time reflection determined by the functions $e^{\lambda_k t}$. As the state of rest is a self-supporting cycling process controlled by the function $\varphi_{o,}$, a time gadget of sort combining the processes of both space and time reflection, the creation of bound self-conjugate states in the same manner is a kind of re-unification of space and time.

2.5 The self-conjugate cloud

A. Having acquired definiteness in the self-conjugate cloud, the reflection of composiums, defined by functions (2.28), establishes, within each particular state of reflection, its proper, *particular correlation* of processes, and that of the rate of those processes, at different points of the vicinity of the center. However, the above reflection is mediated by the exchange interaction with ether where the correlation of processes is different.

B. In ether, the correlation of processes is characterized by its correlation function *g(r);* the latter characterizing also the correlation of the rate of those processes. Thus we have *a two-component correlation function of ether*

$$G=\begin{pmatrix} g \\ g \end{pmatrix} \qquad (2.29)$$

for the processes and their rates.

C. Under the influence of exchange interaction with ether, its

mode of correlation penetrates the self-conjugate cloud, impelling it to conform its totality of independent particular modes of correlation with that of ether. As a result, the whole totality of reflections in the self-conjugate cloud undergoes the process of organization, during which there forms a collective, *organized reflection*, represented by a *linear combination* of spatial wave functions,

$$F=\sum_{k=1}^{n} C_k U_k+\tilde{C}_k \tilde{U}_k \tag{2.30}$$

approximating the function G; the coefficients $\{C_k\}$ being naturally formed according to the expressions

$$C_k=\frac{(V_k, G)}{(V_k, U_k)}, \qquad \tilde{C}_k=\frac{(\tilde{V}_k, G)}{(\tilde{V}_k, \tilde{U}_k)} \tag{2.31}$$

where the functions $\{V_k\}$ are the solutions of the equation

$$\lambda V+\bar{H} V=0 \tag{2.32}$$

$\bar{H}$ being the matrix transposed to H; the relationship of orthogonality,

$$(V_i, U_j)=0, \quad i\neq j \tag{2.33}$$

taking place.

Thus a spatial consistency with ether is achieved, which results in the self-conjugate cloud turning into *a consistent cloud.* The latter has an organized totality of modes of reflection characterized by a 4n-component self-conjugate function,

$$f(q, t)=\sum_{k=1}^{n} C_k U_k e^{\lambda_k t}+\tilde{C}_k \tilde{U}_k e^{\tilde{\lambda}_k t} \tag{2.34}$$

which describes the correlation of processes in the consistent cloud and therefore can be called its *correlation function.*

2.6 The mesons and the neutron

1. As follows from the above development, the first four creatures – the self-consistent, balanced, self-controlled, and self-conjugate clouds – depend on the correlation function of ether, which has been introduced from outside and is alien to them. Contrary to them, the consistent cloud itself models that function and therefore stands, as it were, on its own feet, affirms itself, which suggests that it is much more stable. This means that the consistent cloud is *the neutron,* the most stable subatomic particle, while the four earlier creatures, not consistent with ether, correspond to the much less stable particles – *the muon, the π-meson, the K-meson,* and *the η-meson*, respectively; these particles prove to be the intermediate stages of the synthesis of the neutron and, clearly, are not elementary. Thus in ether there takes place spontaneous generation of mesons and neutrons because that process, as shown above, is logical, consistent and therefore inevitable.

2. The inherent logic of the above particles and their mathematical description suggest the following features of their structure:

(a) the muon is a primitive material particle, a drop of matter, having no structure and characterized by its matter density proportional to the function (2.4);

(b) the π-meson is a particle with a primitive *inarticulate structure* described by the wave function $\psi(q,t)$ satisfying the equation (2.9);

(c) the K-meson is a particle with a primitive *discrete structure* characterized by a number of states satisfying the equation (2.14)**;**

(d) the η-meson is a particle with *a self-conjugate structure* characterized by a number of self-conjugate wave functions (2.28);

(e) the neutron is a particle with a *consistent structur*e characterized by its correlation function (2.34); logically, as the structure of any higher-order particle contains the structures of all lower-order particles, the structure of the neutron contains the structures of all above mesons.

3. The birth of neutrons in ether is the materialization of its essence, its correlation domain modeled by the structure of the neutron. That result confirms the well-known dialectical thesis holding that *"the essence must appear"*. Thus the aspiration for evolution and self-expression, common for the nature in general, is inherent in ether as well.

4. The conclusion about the process of spontaneous generation of

mesons and neutrons in ether is confirmed by the existence in outer space of cosmic rays and hydrogen gas, in particular, being created supposedly during, and as a result of, the above process. So this result provides a new explanation of the origin of matter in the universe.

5. The equation (2.14) is not so-called relativistically invariant, as it should have been to conform with some earlier theories. What is the matter? The answer is that one should distinguish between a mathematical approach and a physical one. Mathematically, it is admissible to choose arbitrarily any frames of reference moving relative to each other at any velocity. Physically, it is, strictly speaking, inadmissible because, in physics, any frame of reference is some material body which interacts with the object of investigation and should be united with it into a single system. It is such an interaction with the frame of reference that is essential for the above theory.

6. The above results shed light on the nature and structure of *the real electron*. Indeed, as (2.18) suggests, the self-conjugate composium in the extreme *n*-state is the basis of the real electron to be created after the neutron decay; that becomes more clear if we interpret the pair of momenta of that composium as *the spin* of the electron and the real and imaginary parts of the factors C_n and $\tilde{C}_n$ as *the electric charge* and *the magnetic moment* of the electron, respectively.

7. The above theory enables us to explain some peculiarities of the muon. Thus the extremely weak interaction of the latter with matter can be explained as follows. The muon is the simplest self-consistent group of composiums and, as mentioned above, has no material structure. But any material particle is also, first of all, a self-consistent creature that contains the self-consistent cloud as its basis. Therefore, the muon interacts with the nuclei of matter not as with anything alien, but as with its like. For that reason, the interaction of the muon with matter takes the form of successive replacements of the self-consistent clouds underlying the nuclei by the self-consistent cloud of the muon, with the last replaced cloud, due to the conservation laws, leaving the matter with parameters close to those of the original muon.

The fact that one of the products of the muon decay is the electron is accounted for by the result that it is in the self-consistent cloud, that is, the muon, that the formation of the self-conjugate composiums starts; one of them, that in the extreme state, completes, supposedly, its forma-

tion and transformation into the electron during the muon decay.

Conclusion

1. In ether there takes place spontaneous generation of particles.
2. Subatomic particles have hierarchical structures, from a non-structure of the muon to an organized structure of the neutron.
3. The high stability of the neutron is accounted for by its spatial consistency with ether.
4. The structure of the electron is similar to those of the constituents of the mesons. Its energy is characterized by a pair of conjugate complex numbers, which accounts for the origin of its spin.

Questions for speculation and discussion

1. What is the structure of the mesons?
2. What is the structure of the electron?
3. What is the origin of its mass, charge, magnetic moment and spin?
4. Why does the neutron have high stability?
5. What effect does underlie the origin of matter?

CHAPTER 3

THE NEUTRON BECOMING THE ATOM

Introduction

This chapter, a direct continuation of Chapter 2 with the same logic, expounds a new theory of the neutron decay first considered to be the result of the so-called 'weak interaction'. So we proceed with analyzing the last particle revealed by the theory, the consistent cloud.

3.1 The consistent cloud

A. The consistent cloud, that is the neutron, as shown in Chapter 2, is an organized system of reflection consistent with ether; it is characterized by its 4*n*-component correlation function,

$$f(q,t)=\sum_{k=-n}^{n} C_k U_k e^{\lambda_k t}$$
$$a_{-k}=\tilde{a}_k, \quad C_0=0 \tag{3.1}$$

This function consists of n terms such as

$$f_k(q,t)=C_k U_k e^{\lambda_k t}+\tilde{C}_k \tilde{U}_k e^{\tilde{\lambda}_k t} \tag{3.2}$$

where the spatial functions $U_k(q)$ and $\tilde{U}_k(q)$ describe the form of reflection, *a standing wave*. In this reflection, every element of space dq carries oscillation with the infinitesimal amplitude $C_k U_k dq$ and the complex frequency λ_k. Thus function (3.2) describes oscillation of a damped harmonic oscillator with *continuously distributed parameters*;

its *mode of oscillation* defined by the function $e^{\lambda_k t}$.

The functions $U_k(q)$ and $\tilde{U}_k(q)$ are solutions of the equation (2.19) with the operator *H* described by the matrix (2.17). This operator is of a strange kind: it is not a completely structured and articulated matrix operator. Therefore, the structure of the consistent cloud is, in a sense, underdeveloped.

B. As to the mode of oscillation, $\varphi_k(t)=e^{\lambda_k t}$, it has a definite frequency λ_k and, taken directly, corresponds to the oscillation of a damped harmonic oscillator with *lumped parameters* described by the equation

$$\alpha_k \frac{d^2\varphi_k}{dt^2}+\beta_k \frac{d\varphi_k}{dt}+\gamma_k \varphi_k=0 \qquad (3.3)$$

where $\alpha_k, \beta_k, \gamma_k$ are positive coefficients.

As a whole, there is a set of n oscillation modes $\{e^{\lambda_k t}\}$ corresponding, as it were, to the set of n independent oscillators with lumped parameters. However, their independence is abstract, because their frequencies are intimately connected and organized by the whole structure of the consistent cloud determined by the operator *H*.

C. As follows from above, the consistent cloud is, on the one hand, a linear system with continuously distributed parameters, and, on the other hand, as it were, a set of independent oscillators with lumped parameters constituting no integral system. Thus the structure of the consistent cloud is internally contradictory: the continuous spatial distribution of its parameters contradicts the discrete character of its oscillation modes. At the same time, as we have seen, these contradictory features mutually suggest, and are intimately connected with, each other, which implies the existence of their unity with the above contradiction settled.

So under the influence of the above contradiction and the exchange interaction with ether, the structure of the consistent cloud undergoes restructuring: there takes place a process of concentrating the continuously distributed parameters into lumped parameters, like churning milk into grains of butter. As a result, the consistent cloud completes its process of self-organization and becomes an organized system of interdependent oscillators with lumped parameters, an *organized cloud.*

The latter is, apparently, *the hydrogen atom,* the simplest and most spread one in the universe. The orbiting electron is exactly the manifestation of the discrete character of the atom's internal structure.

With the identity of space and time in ether and the space-time symmetry of its correlation function, the transformation of the neutron into the H-atom, with the spatially distributed parameters of the former turning into the lumped parameters of the latter, is accompanied by the transformation of the space consistency of the neutron into the time consistency of the H-atom.

Through the exchange interaction with ether, the organized cloud continuously reproduces itself and therefore retains the traces of all the previous entities – the muon, the mesons, and the neutron – being the completion of their evolution, on the one hand, and a primitive discrete model of ether, on the other. For that reason, the organized cloud is immune to the destructive influence of ether and hence absolutely stable.

3.2 The organized cloud

The process of the organized cloud is described by a system of linear differential equations

$$\begin{aligned} &\delta_{11}\varphi_1+\delta_{12}\varphi_2+...+\delta_{1n}\varphi_n=0\\ &\delta_{21}\varphi_1+\delta_{22}\varphi_2+...+\delta_{2n}\varphi_n=0\\ &----------\\ &\delta_{n1}\varphi_1+\delta_{n2}\varphi_2+...+\delta_{nn}\varphi_n=0 \end{aligned} \tag{3.4}$$

where

$$\delta_{ik}=\alpha_{ik}\frac{d^2}{dt^2}+\beta_{ik}\frac{d}{dt}+\gamma_{ik} \tag{3.5}$$

$\alpha_{ik}, \beta_{ik}, \gamma_{ik}$ are real constants. Making use of the matrices,

$$A=(a_{ik})=\begin{pmatrix} \alpha_{11} & \alpha_{12} & ... & \alpha_{1n}\\ \alpha_{21} & \alpha_{22} & ... & \alpha_{2n}\\ ..... & ..... & ... & ....\\ \alpha_{n1} & \alpha_{n2} & ... & \alpha_{nn} \end{pmatrix},\quad B=(\beta_{ik}),\ \Gamma=(\gamma_{ik}) \tag{3.6}$$

and the n-vector function

$$\boldsymbol{\Phi} = \begin{pmatrix} \varphi_1 \\ \varphi_2 \\ \dots \\ \varphi_n \end{pmatrix} \tag{3.7}$$

we rewrite (3.4) as

$$A\frac{d^2\boldsymbol{\Phi}}{dt^2} + B\frac{d\boldsymbol{\Phi}}{dt} + \Gamma\boldsymbol{\Phi} = 0 \tag{3.8}$$

Now we introduce a two-component function

$$\boldsymbol{u} = \begin{pmatrix} \dfrac{d\Phi}{dt} \\ \Phi \end{pmatrix} \tag{3.9}$$

and re-write (3.8) as

$$\frac{d\boldsymbol{u}}{dt} + \hat{H}\boldsymbol{u} = 0 \tag{3.10}$$

where

$$\hat{H} = \begin{pmatrix} A^{-1}B & A^{-1}\Gamma \\ -I & 0 \end{pmatrix} \tag{3.11}$$

The partial solution of (3.10) is known to be

$$\boldsymbol{u} = \boldsymbol{U}\,\mathrm{e}^{\lambda t} \tag{3.12}$$

where $\boldsymbol{U}$ is a $4n$-eigenvector satisfying the equation

$$\lambda\boldsymbol{U} + \hat{H}\boldsymbol{U} = 0 \tag{3.13}$$

where the complex eigenfrequency λ is determined by the characteristic equation

$$det\,|\lambda I + \hat{H}| = 0 \tag{3.14}$$

Supposing the solutions of (3.13) to be simple and complex-conjugate

– otherwise they would make no physical sense – we arrive at the general solution of (3.10),

$$\boldsymbol{u}(t)=\sum_{k=-n}^{n} T_k \boldsymbol{U}_k \mathrm{e}^{\lambda_k t}, \qquad a_{-k}=\tilde{a}_k \tag{3.15}$$

where the complex coefficients $\{T_k\}$ are, in general, different from the coefficients $\{C_k\}$ in (2.31) determined by the consistency of the consistent cloud with ether.

The vector function ***u(t)*** characterizes the structure of the organized cloud and may be called its *structural function.* Its *k*-term,

$$\boldsymbol{u}_k(t)=T_k \boldsymbol{U}_k \mathrm{e}^{\lambda_k t}+\tilde{T}_k \tilde{\boldsymbol{U}}_k \mathrm{e}^{\tilde{\lambda}_k t} \tag{3.16}$$

is a vector describing the oscillation with the complex frequency λ_k ; the vectors

$$\boldsymbol{U}_k=\begin{pmatrix} U_{k1} \\ U_{k2} \\ \dots \\ U_{kn} \end{pmatrix}, \quad \tilde{\boldsymbol{U}}_k=\begin{pmatrix} \tilde{U}_{k1} \\ \tilde{U}_{k2} \\ \dots \\ \tilde{U}_{kn} \end{pmatrix} \tag{3.17}$$

defining the form of oscillation: their components, $\{U_{ki}\}$, $\{\tilde{U}_{ki}\}$, oscillate with the same complex frequency λ_k , but have different amplitudes and initial phases.

3.3 The subsystems

The organized cloud has a completely developed organization of its internal and external processes, that is, the pair and the exchange interactions of virtual electrons and positrons inside the cloud, and its exchange interaction with ether. The organization of these processes has achieved the level of three *autonomous subsystems* implementing these processes, on the one hand, and the appropriate *agents* for them, on the other hand. This conclusion is confirmed by the possibility of describing the organized cloud with the equation (3.8), where the real, symmetric matrices *A, B, Γ* correspond, apparently, to the above subsystems, while the vectors

$$\frac{d^2\boldsymbol{\Phi}}{dt^2}, \frac{d\boldsymbol{\Phi}}{dt}, \boldsymbol{\Phi} \qquad (3.17')$$

correspond to their respective agents. These subsystems and agents may be called, in a generalized sense, those of *inertia, dissipation, and elasticity,* respectively. The existence in the hydrogen atom of such subsystems and their agents, called *quarks* and *gluons*, respectively, has been established experimentally.

The neutron, which is also an organized system, should also have similar subsystems and agents, which, indeed, has been confirmed experimentally; however, they are not developed to the same extent as in the atom and cannot be described by matrices and vectors, except only symbolically.

Quarks and gluons have also been found inside the π-meson, the K-meson, and the η-meson, two quarks in each; these quarks being described as relative combinations of the quarks found in the nucleons. In the context of the above theory, this fact may be commented as follows. The structures of the above mesons are much less developed than those of the neutron and the hydrogen atom and, unlike them, are not consistent with ether. For that reason, their *internal organs* are not developed to the level of three autonomous subsystems, but only to the level of their two relative combinations, which may be symbolically described by the ratios of the above three matrices: *A/B, A/Г, B/A, B/Г, Г/A, Г/B.* These quarks implement the simplest operations, those of the conservation of energy and exchange interaction with ether, and may be called, accordingly, *the quarks of conservation* and *exchange.*

Conclusion

1. A structural contradiction is the true cause of the neutron transforming into the H-atom; they both having linear structures with continuously distributed and lumped parameters respectively.
2. Quarks and gluons are actually the internal organs of the atom and their agents, respectively; the first being described by real symmetric matrices, the second by vector-functions and their time derivatives.

Questions for speculation and discussion

1. What is the main cause of the high stability of the H-atom?
2. How can its time consistency with ether be explained?
3. Why does the orbiting electron emerge?
4. Why does the orbiting electron have only a negative charge?
5. Is a symmetric world having atoms with orbiting positrons possible?
6. Is the reverse transformation of the H-atom into the neutron possible?
7. How do the neutron and the H-atom interact with ether?
8. Why is the neutron characterized by its magnetic field, while the H-atom by an electric one?
9. What are the nature and function of the quarks and gluons?
10. Are the neutron and the H-atom dual partners, particle and anti-particle?

CHAPTER 4

NUCLEAR STRUCTURE OF THE LIGHT ATOMS

Introduction

This chapter deals with such fundamental problems of modern physics as the nature of nuclear interaction and the nuclear structure of the most fundamental atoms, the atoms of hydrogen (H-atom), deuterium (D-atom) and helium (He-atom).

In modern theory the D-atom is considered simply a hydrogen isotope, with its nucleus consisting of a proton and a neutron bound together by some binding force. The nature of this force is still considered unclear, although, as we have already mentioned, the meson theory of nuclear forces makes it possible to calculate and formally explain some experimental results. However at present such a theory cannot be considered satisfactory.

In this chapter the theory stated in the previous chapters is developed with a new logic revealing the structure of light atoms and the essence of nuclear interaction.

4.1 The H-atom

4.1.1 Interaction with ether

As shown in Chapter 3, the process of the H-atom (the organized cloud) is characterized by its structural function, the 4n-component vector function of time,

$$\boldsymbol{f}(t)=\sum_{k=-n}^{n} T_k \boldsymbol{U}_{\boldsymbol{k}} \exp(\lambda_k t), \qquad a_{-k}=\tilde{a}_k \tag{4.1}$$

This function looks like a response of the atom to some standard excitation, an excitation by photons, a pulse excitation. Judging by this function, the H-atom is a linear system with n degrees of freedom. So let us now investigate what kind of system it is.

It seems from (4.1) that the structure of the H-atom consists of two major parts: a deterministic part corresponding to the set of vectors $\{\mathbf{U_k}\}$ and a stochastic part corresponding to the set of coefficients $\{T_k\}$. The latter are formed through the process of the neutron (the consistent cloud) which is therefore implicitly present in the process of the H-atom. This structural duality manifests itself in the H-atom consisting explicitly of two parts: *a proton* and *an electron,* the first being a deterministic part, the second a stochastic one, an agent of interaction with ether.

Owing to its dual structure, the H-atom responds to ether excitations in two ways: by scattering incident photons, and by absorbing and assimilating them thus reproducing its own structure and rejecting the surplus of energy, in accordance with its own organized structure, in the form of organized groups of photons – *neutrinos;* the latter may be called *electric neutrinos,* as shown below.

4.1.2 The rough model

The structure of the H-atom is expressed by function (4.1) only implicitly and cannot be modeled directly from it. Thus the H-atom, with such an abstract structure, is a *thing-in-itself*, still to be determined and exposed, *a purpose-in-itself*. As such a purposeful system, the H-atom is also *a means* for it own realization, *an electric device* consisting explicitly of a positively charged nucleus and a negatively charged stochastic shell, a storage of electric energy, *an electric capacitor* of some capacitance C_o. The process of its interaction with ether, that is essentially the process of receiving and radiating electromagnetic waves,

can simply be represented by some *wave impedance* R_o.

The above reasoning suggests that the H-atom can be represented by an electric RC-circuit as shown in Fig.4.1, where e(t) is a generator of electromotive force (emf) modeling electric excitations generated by ether. With this representation, the process of the H-atom is characterized by the time change of the charge q(t) of the capacitor, which satisfies the equation

$$R_o \frac{dq(t)}{dt} + \frac{1}{C_o} q(t) = e(t) \tag{4.2}$$

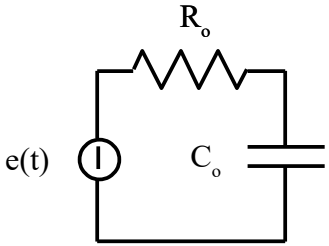

Fig. 4.1 The rough model of H-atom

Assuming zero initial conditions and e(t) = δ(t), where δ(t) is the delta-function, and taking the Laplace transform, $L\{\ \}$, of both sides in (4.2), we obtain the equation

$$pR_o Q(p) + \frac{1}{C_o} Q(p) = 1 \tag{4.3}$$

where

$$Q(p) = L\{q(t)\} = \int_0^\infty q(t) \exp(-pt)\, dt \tag{4.4}$$

which gives

$$Q(p) = \frac{C_o}{p\tau_C + 1}, \qquad \tau_C = R_o C_o \tag{4.5}$$

and, up to a constant factor,

$$q(t)=L^{-1}\{Q(p)\} \;\propto\; \exp\left(-\frac{t}{\tau_C}\right) \tag{4.6}$$

Function (4.6) determines correlation between two states of the atom separated by time *t* and may be called its *correlation function,* the time constant τ_C being the mean interval between excitation and emission.

To analyze function (4.6) from the spectral point of view, let us put p = iω and $x = \omega\,\tau_C$ in (4.5) and consider the square of its absolute value. Up to a constant factor, we have

$$\left|Q(ix/\tau_C)\right|^2 \;\propto\; \frac{1}{1+x^2} \tag{4.7}$$

This function is *the normalized energy spectrum of the H-atom* and is evaluated below.

4.1.3 The exact model

In the above model of the H-atom, its response (4.6) to the excitation turns up immediately, which cannot occur in reality, because it takes some time for the excitation to be processed by the atom. To amend this defect of the rough model, we should take into account the magnetic properties of the electron. Indeed, due to its own magnetic moment, the electron presents *an inductor* of some *inductance* L_1, which, for the above reason, should be connected in series with R_o and C_o .With this addition, the exact model of the H-atom looks as shown in Fig.4.2. Its process is depicted by the equation

$$L_1\frac{d^2q}{dt^2}+R_o\frac{dq}{dt}+\frac{q}{C_o}=e(t) \tag{4.8}$$

Repeating the above procedure, with e(t) = δ(t), we find

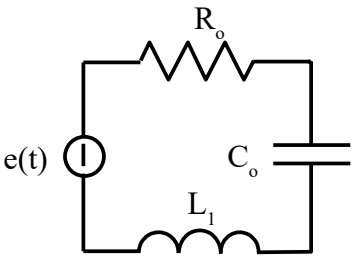

Fig. 4.2 The exact model of H-atom

$$Q(p)=\frac{1}{L_1(p-p_1)(p-p_2)} \tag{4.9}$$

where

$$p_{1,2}=-\frac{R_o}{2L_1}\pm\sqrt{\frac{R_o^2}{4L_1^2}-\frac{1}{L_1C_o}} \tag{4.10}$$

Up to a constant factor,

$$Q(p)\ \propto\ \left(\frac{1}{p-p_1}-\frac{1}{p-p_2}\right) \tag{4.11}$$

which gives

$$q(t)\ \propto\ \exp(p_1t)-\exp(p_2t) \tag{4.12}$$

This is the exact pulse response, the correlation function of the H-atom, its initial value q(0) = 0.

Introducing $\gamma=p_2/p_1$, $\gamma\approx19.7$, and finding the square of the absolute value of (4.11), we have approximately

$$\left|Q(i\omega_o x)\right|^2\ \propto\ \frac{1}{(1+x^2)(\gamma^2+x^2)} \tag{4.13}$$

which is the normalized energy spectrum of the H-atom in its exact representation.

4.1.4 Magnetic deficiency

The H-atom stores energy primarily in the form of electric field and therefore cannot respond adequately to the dual electromagnetic excitations generated by ether. With this magnetic deficiency, under the pressure of ether excitations, the H-atom tends to develop its magnetic capability and transform its structure accordingly.

4.2 The Neutron

4.2.1 Interaction with ether

The neutron, as shown in Chapter 2, is characterized by the 4n-component space-time correlation function,

$$f(q,t)=\sum_{k=-n}^{n} C_k U_k(q)\exp(\lambda_k t) \qquad (4.14)$$

Its continuously distributed structure manifests itself by its intrinsic magnetic field generated by some internal currents. It is through its magnetic field and magnetic perceptivity protruding far outside its structure, that the neutron interacts with ether. In that interaction, it scatters, absorbs and assimilates incident photons and ejects the surplus of energy in the form of neutrinos which, unlike the above-mentioned electric neutrinos, may be called *magnetic neutrinos.*

4.2.2 The rough model

Taken directly, the neutron is a storage of magnetic energy, an elementary *electric inductor* of some inductance L_o. Owing to the mutual correspondence of the structures of the H-atom and the neutron, called further H-structure and n-structure, respectively, and their dual consistency with ether, the interaction of the neutron with ether should be represented by the same wave impedance R_o. Accordingly, the neutron can be represented in rough by an electric circuit shown in Fig.4.3 and

consisting of inductor L_o and resistor R_o. The circuit is excited by a generator of electric current i(t) modeling the magnetic field excitation supplied by ether. The parallel structure of the circuit is exactly due to the magnetic character of the interaction.

In this model, the process of the neutron is characterized by the time change of the current $i_L(t)$ in the inductor in accordance with the equation

$$\tau_L \frac{di_L}{dt} + i_L = i(t) \tag{4.15}$$

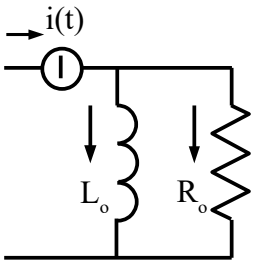

Fig. 4.3 The rough model of neutron

where $\tau_L = L_o/R_o$; this equation is similar to (4.2).

Assuming zero initial conditions, substituting $i(t) = \delta(t)$ and finding the Laplace transform of (4.15), we have

$$I_L(p) = \frac{1}{1 + p\,\tau_L} \tag{4.16}$$

which, up to a constant factor, gives

$$i_L(t) \;\propto\; \exp\left(-\frac{t}{\tau_L}\right) \tag{4.17}$$

Function (4.17) determines correlation of processes in states separated by the time t, the time constant τ_L being the mean interval between

excitation and emission. Owing to the kinship and the interdependency of the H-structure and the n-structure, $\tau_L = \tau_C$. Due to the identity of functions (4.6) and (4.17), the normalized energy spectrum of the neutron is similar to that of the H-atom.

Comments:
Taking into account their origin, the above mentioned electric and magnetic neutrinos seem to correspond in modern terms to the so-called electronic and muonic neutrinos, ν_e and ν_μ , respectively.

4.2.3 The exact model

The above analysis suggests that the H-atom and the neutron have dual structures with a thoroughly developed duality owing to the dual electromagnetic excitations supplied by ether. Therefore, similar to the H-atom which has major electric properties and minor magnetic properties, we should assume that the neutron, apart from its major magnetic properties, has also minor electric properties. Indeed, the existence of such properties has been established experimentally. These minor electric properties of the neutron can be simply represented by a capacitor of some capacitance C_1. With this amendment, the process of the neutron interacting with ether can be modeled by the electric circuit in Fig.4.4.

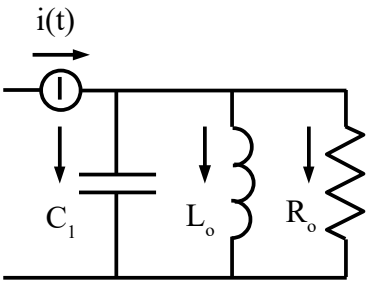

Fig. 4.4 The exact model of neutron

According to Kirchhoff's law,

$$i_L + i_R + i_C = i(t) \tag{4.18}$$

Making use of the Laplace transforms of the respective currents, $I_L(p)$, $I_R(p)$, $I_C(p)$ and $I(p)$, with $i(t) = \delta(t)$, and assuming zero initial conditions, (4.18) is replaced by $I_L + I_R + I_C = I$ which gives the following:

$$I_L = \frac{R_o}{pL_o} I_R, \quad I_C = pR_o C_1 I_R \tag{4.19}$$

$$I_R(p) = \frac{pL_o}{p^2 R_o L_o C_1 + pL_o + R_o} \tag{4.20}$$

While for the H-atom, the storage of mainly electric energy, it was essential to find its response in the form of the electric charge on the capacitor C_o, for the neutron, the storage of mainly magnetic energy, it is essential to find its response in the form of the electric current in the inductor L_o. Thus, substituting (4.20) in (4.19), we have

$$I_L(p) \propto \frac{1}{p^2 R_o L_o C_1 + pL_o + R_o} \tag{4.21}$$

Now, following the principle of dual symmetry of the H-structure and the n-structure, and taking into account their mutual consistency and consistency with ether, we should assume the following identities:

$$\frac{L_o}{C_o} = \frac{L_1}{C_1} = R_o^2 \tag{4.22}$$

With this assumption, (4.21) becomes identical, up to a constant factor, to (4.11). Thus the H-atom and the neutron have identical pulse responses to electric and magnetic excitations, respectively.

4.2.4 Electric deficiency

The neutron stores energy primarily in the form of magnetic field and therefore cannot respond adequately to the dual electromagnetic excitations generated by ether. With this electric deficiency, under the pressure of ether excitations, the neutron tends to develop its electric capability and transform its structure correspondingly.

4.3 The D-atom

4.3.1 Nuclear interaction

The eventual transformation of the neutron into the H-atom, accompanied by the transformation of its magnetic energy into electric energy, implies the possibility of their reverse transformation. Moreover, the duality of their above models, with electric deficiency on the one side and magnetic deficiency on the other, suggests the neutron and the H-atom to be the dual parts of some integral electromagnetic entity. So it is natural that in stars, where there exist proper conditions, neutrons and H-atoms are drawn to each other and unite into the atoms of deuterium, D-atoms. The D-atom is the simplest case of *nuclear interaction*, its bare manifestation, *the embryo* of the atom.

4.3.2 The rough model

Following the above development, the process of the D-atom should be represented by the synthesis of the above H- and n-models. In the rough representation of the D-atom by electric circuits, we allow only for the major parameters of its constituents, that is R_o and C_o for the H-atom and R_o and L_o for the neutron. Their synthesis may be of two kinds, shown in Fig.4.5a and Fig.4.5b, corresponding to electric and magnetic excitations, respectively. This means that the process of the D-atom

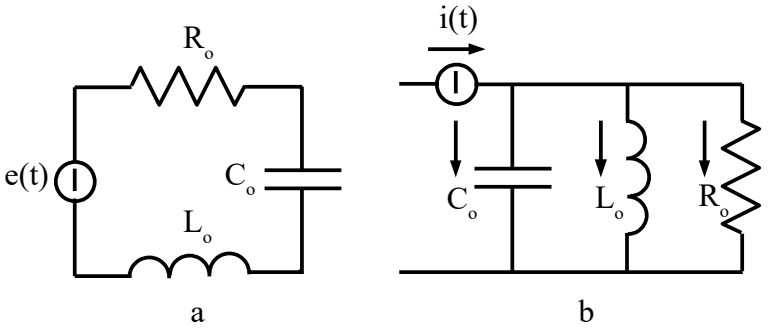

Fig.4.5 The rough models of the D-atom:
(a) electric excitation, (b) magnetic excitation

exists only in one phase, either electric or magnetic, corresponding to the respective types of excitation. Noteworthy, these models contain only three components each, instead of four components in total in the separate models of the H-atom and the neutron, which implies a higher structural efficiency of the D-atom, as compared with that of its constituents.

Before defining the characteristics of these models, we should determine first what type of characteristics (the charge in the capacitor, the current in the inductor or the potential difference of the resistor) is essential for these models. The answer is suggested by the models themselves: it is the common current i(t) for the series circuit in Fig.4.5a and the common potential difference V(t) for the parallel circuit in Fig.4.5b. The fact that the above circuits, when excited by emf or current, respectively, respond with current and potential difference, respectively, means that the D-atom converts the type of field from electric to magnetic and vice versa – the effect of *field conversion.*

4.3.3 Characteristics

(a) The pulse response. Making use of the procedures stated above, we find the Laplace transform of the current i(t) in Fig.4.5a and the common potential difference V(t) in Fig.4.5b, as follows:

$$I(p)=\frac{pC_o}{p^2 L_o C_o+pR_o C_o+1} \tag{4.23}$$

$$V(p)=\frac{pL_o}{p^2 L_o C_o+pL_o R_o^{-1}+1} \tag{4.24}$$

Taking into account equality (4.22), we find the above characteristics to be identical up to a constant factor.

After simple operations, we can rewrite (4.23) as

$$I(p)=\frac{pC_o}{(p-p_1)(p-p_2)} \tag{4.25}$$

where

$$p_{1,2}=-\alpha\pm i\omega_1;\ \ \alpha=\frac{R_o}{2L_o}$$
$$\omega_1=\sqrt{\omega_o^2-\alpha^2};\ \ \omega_o^2=\frac{1}{L_oC_o} \qquad (4.25')$$

that is $\omega_o=2\alpha$. Expressing (4.25) in terms of partial functions, we have

$$I(p)=pC_o\left(\frac{A}{p-p_1}+\frac{B}{p-p_2}\right) \qquad (4.26)$$

where $A=\frac{p_1}{p_1-p_2}$, $B=-\frac{p_2}{p_1-p_2}$, which, up to a constant factor, gives

$$i(t)\ \propto\ e^{-\alpha t}\left(\cos\sqrt{3}\,\alpha t-\frac{1}{\sqrt{3}}\sin\sqrt{3}\,\alpha t\right) \qquad (4.27)$$

Remarkably, the damping exponent factor , $\alpha=\frac{R_o}{2L_o}$, in (4.27) is half those for the separate H-atom and neutron, $\frac{1}{R_oC_o}$ and $\frac{R_o}{L_o}$ in (4.6) and (4.17), respectively, which implies a more efficient mode of energy conservation in the D-atom as compared with its constituents. Thus it is this already mentioned structural efficiency of the D-atom that prompts the H-atom and the neutron to unite, being the source of their binding energy.

(b) The normalized energy spectrum. Assuming p=iω in (4.26), we find

$$|I(i\omega)|^2=\frac{C_o^2\omega^2}{[\alpha^2+(\omega-\sqrt{3}\,\alpha)^2][\alpha^2+(\omega+\sqrt{3}\,\alpha)^2]} \qquad (4.28)$$

After some rearrangement, with $x=\frac{\omega}{\omega_o}$, we have

$$\left|I\left(i\omega_o x\right)\right|^2 \propto \frac{x^2}{x^4 - x^2 + 1} \tag{4.29}$$

This is the normalized energy spectrum of the D-atom.

4.3.4 The exact model

In the exact representation, we should allow also for the minor parameters of the above models, that is L_1 for the H-model and C_1 for the n-model. Then the models for the electric and magnetic phases of the D-atom look as shown in Fig.4.6a and Fig.4.6b, respectively.

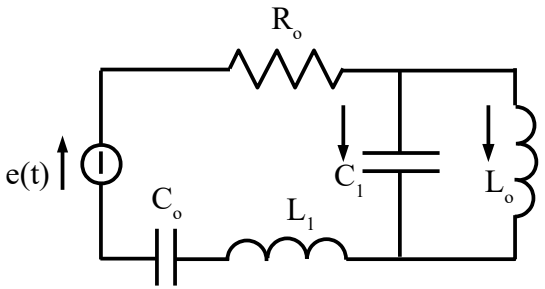

Fig.4.6a Exact model of D-atom for electric excitation

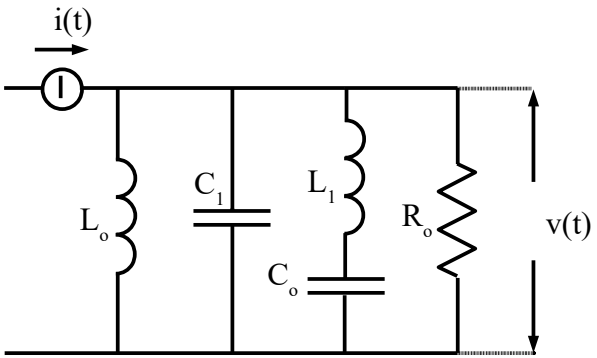

Fig. 4.6b Exact model of D-atom for magnetic excitation

Although the mathematical analysis of these circuits is simple, in principle, it is rather cumbersome, and we shall confine ourselves here to the above analysis of the rough models of the D-atom.

4.3.5 Interaction with ether

The D-atom is thus a kind of electromagnetic resonator generated by ether, consistent with it, and *living* in it. Excited sporadically by ether photons and neutrinos, it absorbs and assimilates them, thus reproducing its own structure. In doing so, it transforms its internal energy alternately from electric form to magnetic one and vice versa, while radiating the surplus of energy in the form of neutrinos. When excited by photons, the D-atom responds with electric or magnetic neutrinos, depending on the kind of excitation. When excited by neutrinos, the D-atom, in accordance with its internal logic, seems to transform electric neutrinos to magnetic ones and vice versa.

In the above context, the D-atom, whose process is characterized by nuclear interaction, is the first *real* atom, while the H-atom is not a real atom but rather its *egg*.

4.4. The He-atom

4.4.1. From the D-atom to the He-atom

The above electromagnetic models of the D-atom suggest that the state of the gas of D-atoms cannot be stable indefinitely. Indeed, according to those models, the process of the D-atom is one-sided: it is either in the electric phase or in the magnetic one, which contradicts the electromagnetic duality of ether. Besides, owing to the above-mentioned effect of field conversion, separate D-atoms, unlike ether, are not transparent. So separate D-atoms cannot adequately respond to excitations and are prompted to unite. As a result, under proper conditions, D-atoms collide and unite in pairs giving birth to the He-atoms.

Because of its dual structure, the He-atom responds adequately to the dual electromagnetic excitations supplied by ether. This makes the He-atom transparent, to a significant extent, to both photon and neutrino

excitations and therefore more consistent with ether. This explains the great abundance of the He-atom, as compared with that of the D-atom, and its role as the foundation in all the more complex atoms.

4.4.2 The rough model

In the above context, the He-atom should be represented by two united LCR-circuits. This unification may be either magnetic, with a double inductance, as shown in Fig.4.7a, or electric, with a double capacitance, as shown in Fig.4.7b. The second version seems to be more probable,

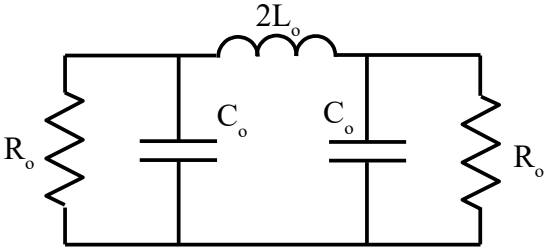

Fig. 4.7a The model of the magnetic unification of two D-atoms

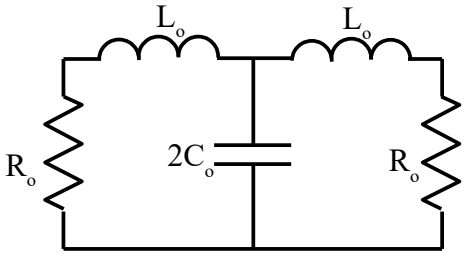

Fig.4.7b The model of the electric unification of two D-atoms

because it contains only two meshes and therefore is more simple, and, what is more important, it has a distributed magnetic structure and a concentrated electric one, which is more consistent with the nature of its

components – neutrons, with their distributed magnetic structure, and H-atoms, with their concentrated electric one. So we take the circuit in Fig.4.7b as the rough model of the He-atom.

As compared with its constituents, D-atoms, the model of the He-atom, a T-shape low-pass filter, has an important feature of symmetry which imparts it the above-mentioned property of transparency, making it a rough physical model of ether. To calculate the characteristics of this model, we should include in it the generator of emf (as shown in Fig.4.8) or current modeling excitations supplied by ether.

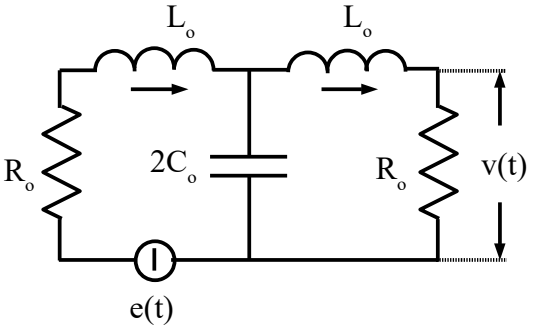

Fig. 4.8 The rough model of the He-atom

Making use of the above-mentioned operational method based on the Laplace transformation, assuming $L\{e(t)\}=1$ and zero initial conditions, we write Kirchhoff's equations for the circuit as follows:

$$\begin{aligned} Z\ I_1 - Z_{12} I_2 &= 1 \\ -Z_{12} I_1 + Z\ I_2 &= 0 \end{aligned} \qquad (4.30)$$

where $Z = pL_o + Z_{12} + R_o$, $Z_{12} = \dfrac{1}{2pC_o}$, I_1 and I_2 are the transforms of the loop currents in the left and right meshes, respectively.

4.4.3 The pulse response

From equations (4.30) we find the following expression for the transform of the potential difference v(t):

$$V(p)=I_2 R=\frac{RZ_{12}}{Z^2-Z_{12}^2} \tag{4.31}$$

Replacing Z and Z_{12} in (4.31) by their above expressions, making use of the relations (4.22) and (4.25'), we find:

$$V(p)=\frac{\omega_o^3}{2(p+\omega_o)(p^2+p\omega_o+\omega_o^2)} \tag{4.32}$$

This function has three poles:

$$p_1=-\omega_o,\quad p_{2,3}=-\frac{\omega_o}{2}\pm\frac{i\sqrt{3}\omega_o}{2} \tag{4.33}$$

and its inverse Laplace transform, up to a constant factor, is

$$v(t)\ \propto\ e^{-2\alpha t}+e^{-\alpha t}\left(\frac{1}{\sqrt{3}}\sin\sqrt{3}\alpha t-\cos\sqrt{3}\alpha t\right) \tag{4.34}$$

where $\alpha=\frac{\omega_o}{2.}$. This is *the correlation function* of the He-atom.

4.4.4 The spectral transparency

To analyze the process of the He-atom from the spectral point of view, let us put $p=i\omega$ in (4.32), then, introducing $x=\omega/\omega_o$, we have

$$V(i\omega_o x)=\frac{1}{2(1+ix)(1-x^2+ix)} \tag{4.35}$$

from which we find, up to a constant factor,

$$\left|V(i\omega_o x)\right|^2\ \propto\ \frac{1}{1+x^6} \tag{4.36}$$

Function (4.36) may be called the *spectral transparency* of the He-atom.

4.4.5 The exact model

To upgrade the rough model of the He-atom to the exact model, we should allow for the minor parameters: the capacitors C_1 shunting the inductors L_o and the inductors L_1 connecting the main capacitance with the resistors R_o, as shown in Fig.4.9. As the mathematical analysis of this circuit would be cumbersome, we confine ourselves here to the above analysis of the rough model.

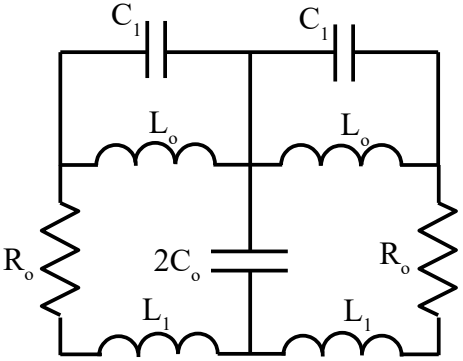

Fig. 4.9 Exact model of He-atom

4.4.6 The essence of nuclear interaction

As follows from the above, the essence of nuclear interaction is the conservation of energy by means of alternate transformation of electric energy to magnetic one and vice versa in the D-atom. There is another important aspect of this process: with the neutron embodying space consistency with ether and the H-atom implying time consistency, space and time are separated, and it is only through nuclear interaction that the space-time reunification is achieved.

Conclusion

1. The essence of nuclear interaction is the conservation of energy through electromagnetic interaction of H-atoms and neutrons.
2. The D-atom is the nest of nuclear interaction.
3. The nuclear structure of the light atoms is described by their electromagnetic models.
4. Excited by photons, the atoms respond with neutrinos.

Questions for discussion and speculation

1. Is the H-atom a real atom?
2. What is the essence of nuclear interaction?
3. What is the source of the binding energy?
4. Why is the He-atom the foundation of the nuclear structure?
5. What is the origin of neutrinos?
6. How do the light atoms respond to excitations?

CHAPTER 5

EVOLUTION OF THE NUCLEAR STRUCTURE

Introduction

This chapter develops a new shell theory of the nuclear structure based on the theory of nuclear interaction stated in the previous chapter.

5.1 The center

The He-atom is a system of two bound D-atoms rotating about their common center and creating in space a simple system of *central symmetry,* a *center;* it is a space-time center, the center of space and the origin of time, *beginning*, *here and now.* With its primitive transparency, it is the most simple and fundamental physical model of ether and makes the center (2-shell) of the nuclear structure in general.

The shortage of this simplest model of ether is that, while the D-atom consists mainly of three *nuclear quarks*, represented by the components L, C, and R, interaction between two D-atoms in the He-atom, represented in Fig.5.8 by two meshes, is performed only through the C-quark. So, under the pressure of the stellar environment, the He-atom tends to upgrade itself to a more sophisticated structure containing, to begin with, a *tetrahedral shell* of four D-atoms (4-shell).

5.2 The tetrahedral shell

This type of shell is realized in the atom of carbon and accounts for its great abundance and unique properties. The process of nuclear interac-

tion in the 4-shell can be represented by an electric LCR-circuit consisting, in the rough representation, of six components located along the ridges of a tetrahedron and connected at its vertices, as shown in Fig.5.1; each of its four meshes adjoins the other three, so that all the D-atoms represented by these meshes interact with each other. Composing Kirchhoff's equations for this network and making use of Laplace transforms, we obtain the following matrix for the 4-shell

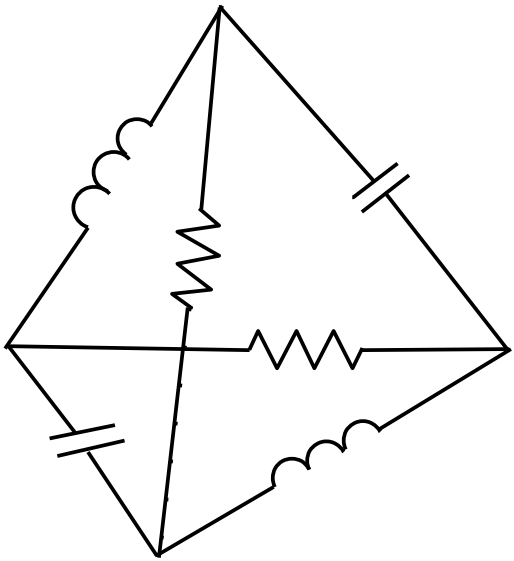

Fig.5.1 The model of the tetrahedral shell

$$(Z_{4\times4})=\begin{pmatrix} Z & -R & -Z_C & -Z_L \\ -R & Z & -Z_L & -Z_C \\ -Z_C & -Z_L & Z & -R \\ -Z_L & -Z_C & -R & Z \end{pmatrix} \tag{5.1}$$

where $Z_L = pL$, $Z_C = \frac{1}{pC}$, $Z = Z_L + Z_C + R$, p is the variable

of the Laplace transform.

For the exact representation of the atom, it is necessary to take into account also the minor parameters of the D-atom, its minor inductances and capacitance. To this end, in every mesh of the electric model, the minor inductance should be connected in series with the resistance, while the minor capacitance should be connected in parallel with the major inductance, as shown, for example, in Fig.5.9.

The atom of carbon is an integral whole and its two shells cannot be independent. However, the symmetries of these two shells are incompatible, and their interaction deprives the C-atom of its central symmetry, thereby prompting it to develop into a more complex structure. So, under proper conditions, the tetrahedral shell rises to the *octahedral shell* (8-shell).

5.3 The octahedral shell

This type of symmetry is realized first in the Ne-atom, with its outer shell consisting of eight D-atoms. The symmetry of this 8-shell is compatible with that of the central shell and together they open the *internal space* of the atom.

In a rough representation, nuclear interaction in the 8-shell is represented by an octahedral electric network with its 12 components placed along the ridges of an octahedron and connected at its vertices, as shown in Fig.5.2. This network is specified by a 8 X 8 matrix of impedances. Interaction of this shell with the central one results in the latter's axis being oriented along one of the axes of the octahedron, thus creating a more complex system of central symmetry. This symmetry suggests the idea of rotation about the center - *spherical symmetry.* This suggestion leads to the *icosahedral shell* (18-shell), because the dodecahedral symmetry, with its pentagonal faces, does not suit the atomic structure based on the interaction of three types of components.

5.4 The icosahedral shell

This kind of shell containing 18 D-atoms is materialized, in particular, in the atom of krypton, with its four shells of 2, 8, 18 and 8 D-atoms, respectively. Nuclear interaction in the 18-shell is represented, in the rough representation, by an electric network with 30 components placed

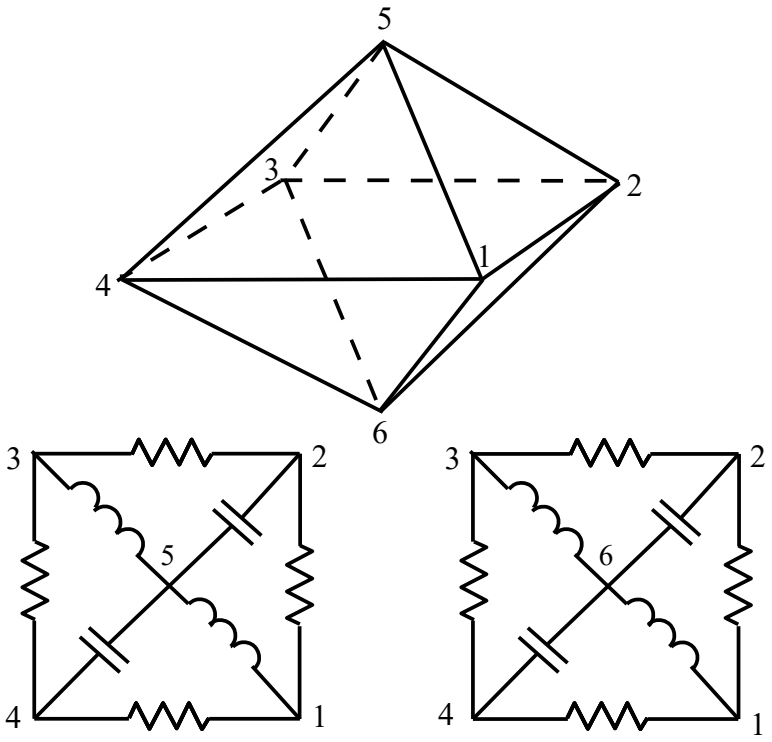

Fig.5.2 The model of the octahedral shell

along the ridges of an icosahedron and connected at its vertices, as is shown by the map-like image of the network in Fig.5.3, where the outer circle represents the vertex opposite that in the center of the map. This model has central symmetry which means the same symmetry of the 18-shell. Thus the latter proves compatible with the center of the atom. The network has 20 meshes, each with three different components except two meshes marked in Fig.5.3 by asterisks; these two meshes, having only two different components each, serve to close the sphere and cannot represent D-atoms. Thus the icosahedral shell has only 18 D-atoms and is characterized by an 18X18 matrix of impedances.

The spherical likeness of the 18-shell suggests restriction of space, its division into internal and external spaces separated by some *border*. This

suggested border should belong both to the internal space and the external one and therefore should be of a double structure. So it is quite natural that the idea of the border is materialized in a *double-icosahedral shell* (36-shell).

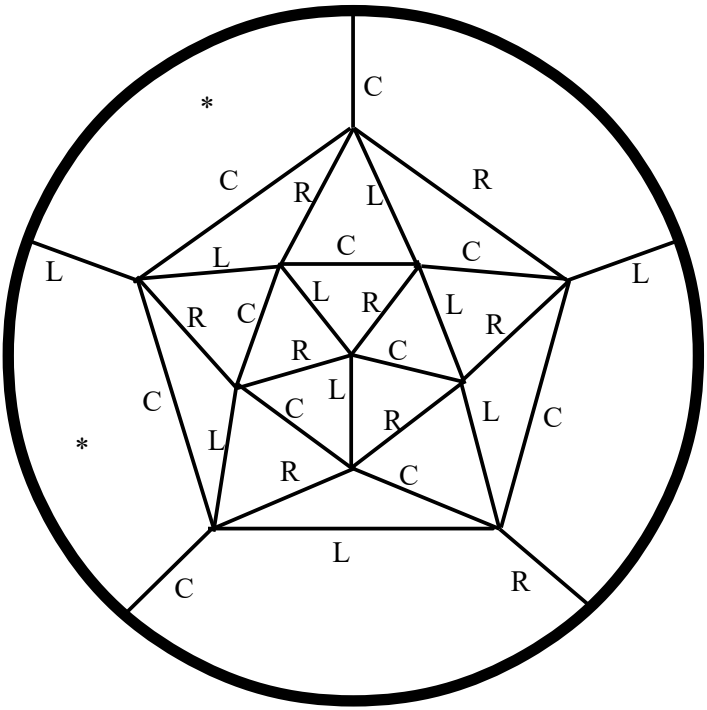

Fig.5.3 The model of the icosahedral shell

5.5 The double-icosahedral shell

This shell contains two close 18-shells interacting with one another. To maintain symmetry, the pairs of interacting D-atoms should cling to their common radii. When considering the electric model of the 36-shell, which should contain two interacting networks, we find the only way of interaction to be through mutual inductance of two respective inductors

in each of the 18 pairs of meshes. In physical terms, this means interaction by exchanging neutrons, with their magnetic capacity, between respective D-atoms.

The 36-shell is realized in full in the U-atom and in part in atoms with less atomic numbers as, for example, in the Rn-atom, with its six shells of 2, 8, 18, 32, 18 and 8 D-atoms manifesting themselves by the respective electronic shells. The incompleteness of the 36-shell in the Rn-atom is most likely due to the incompleteness of its external shells and the necessity, for that reason, of additional transparency and versat
ility of the border-shell.

The double shell suggests *inverse symmetry* between its two icosahedral shells relative to some middle sphere; this in turn suggests the full inverse symmetry between the internal space and the external space of the atom, the necessity for *inverse shells*.

5.6 The inverse shells

There are three inverse shells with 18, 8 and 2 D-atoms, respectively. The inverse 18-shell, opening the *external space* of the atom, is realized first in the atom of platinum and accounts for its unique physical properties. The inverse 8-shell, symbolizing the *external space proper,* is realized first in the atom of radon already mentioned. The inverse 2-shell is realized first in the atom of radium and symbolizes *interaction with, and transition to, ether, infinity.*

With the above three inverse shells implemented, there begins completion of the 32-shell until it rises to the 36-shell in the U-atom. The system of inverse symmetry is thus implemented in full in the last natural element of the periodic table, the U-atom, with its seven shells of 2, 8, 18, 36, 18, 8 and 2 D-atoms, respectively, 92 in total. The perfection of its structure manifests itself, in particular, by the great stability of the U-atom: its half-life being 4.5×10^9 years as compared with those of its preceding Pa-atom, 32 480 years, and its succeeding, artificial Np-atom, 2.2×10^6 years, and Pu-atom, 24 400 years.

5.7 Intershell interaction

In atoms with a developed shell symmetry, the shells able to form joint symmetrical patterns interact to achieve the highest degree of symmetry and stability. This interaction, as suggested above, is performed by addi-

tional neutrons alternating between shells, which, in terms of electric representation, is equivalent to creating magnetic links between the shells. The U-atom is the best illustration of this.

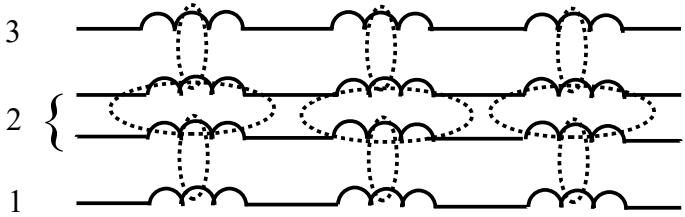

Fig.5.4 The model of interaction of the 18-shells:
1- the internal 18-shell; 2- the central 36-shell;
3 – the external 18-shell.

In the U-atom, there are essentially four 18-shells to be coordinated and bound into a single icosahedral structure, as shown in Fig.5.4. This coordination is implemented by three groups of additional neutrons, 18 in each, carrying out interaction between the respective D-atoms of adjacent 18-shells and thereby raising the atomic weight of the U-atom to 238. Clearly, interaction between the two middle shells is much stronger than their interaction with the other two shells. As a whole, these four bound 18-shells of the U-atom, accounting for over 83 percent of its atomic weight, constitute *a middle (icosahedral) substructure* dominating the structure of the atom. Depriving this substructure of its three neutrons moving along the same radius reduces the U-atom to its isotope U235 with a drastically weakened stability. The other four shells of the U-atom seem to interact with the middle substructure by means of its respective internal and external neutrons piercing at random all the respective internal and external shells and thus coordinating them with the middle substructure.

5.8 Ether, stars and atoms

5.8.1 The star

The star is formed in ether, interacts with it and therefore is thoroughly consistent with it. As the components of the star are quite different from those of ether, the consistency with ether means that the stellar matter simulates the conditions characteristic of ether, which results in its separate atoms becoming models of ether in their own manner. This is achieved through the adaptability of the D-atoms as shown below.

5.8.2 The D-atom

Nuclear interaction in the D-atom, the interaction of its structurally dual and mutually transformable components, H-atom and neutron, means their alternate mutual transition into one another with the respective transformation of their structure and energy. In that process, the neutron adapts itself to the environment and *continuously* passes the results of that adaptation, in the form of the set $\{C_k\}$ of its structural function (2.34), to the H-atom, where they transform into generally different set of coefficients $\{T_k\}$, as shown in (3.15), and enable the H-atom to achieve and maintain its time consistency with the stellar environment. Thus the D-atom achieves its consistency with the stellar environment both in space and time. As the stellar environment simulates ether, the D-atom proves consistent with ether.

5.8.3 The *m*-atom

(a) The electric model. The atom with an atomic number m, the m-atom, is a system of m interacting D-atoms. It adapts itself to the stellar environment through nuclear interaction in its D-atoms, thus achieving its consistency, *m-consistency,* both with the stellar environment and ether and becoming their *m-model*. The m-atom responses to vacuum excitations by emitting its specific *m-neutrinos* with its characteristic spectrum of radiation.

The nuclear structure of the m-atom, including its m electrons, is represented by an electric LCR- network with m degrees of freedom. The process of the network is described by a homogeneous vector differential equation,

$$\boldsymbol{L}\frac{d^2\boldsymbol{Q}}{dt^2}+\boldsymbol{R}\frac{d\boldsymbol{Q}}{dt}+\boldsymbol{D}\boldsymbol{Q}=0 \qquad (5.2)$$

where $\boldsymbol{L}$, $\boldsymbol{R}$ and $\boldsymbol{D}$ are the matrices of mutual inductances, resistances and elastances, respectively, that is

$$\boldsymbol{L}=\left(L_{ik}\right),\quad \boldsymbol{R}=\left(R_{ik}\right),\quad \boldsymbol{D}=\left(D_{ik}\right) \qquad (5.3)$$

where

$$D_{ik}=\frac{1}{C_{ik}},\quad L_{ik},\quad R_{ik},\quad C_{ik}$$

are the mutual inductance, resistance and capacitance, respectively, of the ik-branch separating the i-mesh and k-mesh of the network; $\boldsymbol{Q}$ is the vector of charges circulating in the meshes,

$$\boldsymbol{Q}=\begin{pmatrix} Q_1 \\ Q_2 \\ \dots \\ Q_m \end{pmatrix} \qquad (5.4)$$

Q_k being a charge, $I_k=\dfrac{dQ_k}{dt}$ a loop current in the k-mesh.

(b) The pulse response. The pulse response of such a network is a 4m-component vector function,

$$\boldsymbol{f_m}(t)=\sum_{k=-m}^{m} F_{mk}\,\boldsymbol{A_k}\exp\left(\lambda_k t\right) \qquad (5.5)$$

$\{F_{\mathrm{mk}}\}$ being the set of coefficients providing consistency of the m-atom with ether, with the relation

$$\sum_{k=-m}^{m} F_{mk}\,\boldsymbol{A_k}=0 \qquad (5.6)$$

necessary to satisfy the equality $\boldsymbol{f}_m(0)=0$, in accordance with the reasoning in Chapter 4. The vector

$$\boldsymbol{A_k} = \begin{pmatrix} A_{k1} \\ A_{k2} \\ ..... \\ A_{km} \end{pmatrix} \tag{5.7}$$

is a 2m-component vector characterizing the form of oscillation with the frequency λ_k .

(c) Representation of the H-atom. Comparing equation (5.2) and function (5.5) with equation (3.8) and function (3.15), respectively, the latter two characterizing the H-atom, we see their formal similarity. However, unlike the obscure set $\{\mathbf{U}_k\}$ in (3.15), characterizing the structure of the H-atom, the set $\{\mathbf{A}_k\}$ in (5.5) is thoroughly articulated and determined by the structure of the m-atom represented by its electric model . That means that, with the H-atom and the *m*-atom both seeking consistency with ether and having similar pulse responses, the *m*-atom becomes a physical, *engineering,* representation and realization of the H-atom. When m→n, $\{\mathbf{A}_k\}\rightarrow\{\mathbf{U}_k\}$ and $\{F_{mk}\}\rightarrow\{T_{k,}\}$, which takes place in the U-atom, these representation and realization are complete.

(d) The *m*-quarks. With the equations (3.8) and (5.2) having similar structures, the matrices ***L, R*** and ***D*** in (5.2) become representatives of the matrices *A, B* and *Γ* in (3.8), respectively, thus exposing the structure of the respective quarks of the H-atom. This also implies that the *m*-atom itself consists of three quarks, *m*-quarks, $\boldsymbol{L_m}$, $\boldsymbol{R_m}$, $\boldsymbol{D_m}$, which accordingly may be called *the magnetic quark, the exchange quark* and *the electric quark* of the *m*-atom, respectively. This conclusion confirms the validity of our using the terms *nuclear quarks* and *C-quark* in Sec.5.1. So the evolution of the atom may be considered the evolution of its quarks.

5.8.4 The U-atom

The nuclear structure of the atom achieves its complete and most perfect development in the U-atom, its atomic number being 92. With its most developed transparency and symmetry, it presents the most perfect possible realization of the ideal model of ether implied by the ideal of the H-atom (5.1), thus revealing the number, n=92, of its constituent pairs of conjugate composiums and, due to its perfect

symmetry, exposing the vector function (3.15) as simply a scalar function of the parameter s=r=ct,

$$g_n(s)=\sum_{k=-n}^{n} S_k \exp(\chi_k s) \tag{5.8}$$

which therefore presents the most perfect approximation of the space-time correlation function of ether (1.14).

Thus the H-atom is implicitly an ideal project of the U-atom to be realized through the building up of the nuclear structure; the ideal of the H-atom, function (5.1), is actually the correlation function of that ideal project. So the implicit structure of the H-atom is realized and turned explicit through the building up of the nuclear structure and achieves its complete development in the U-atom, the spectrum of which is supposedly the exact copy of that of ether, including its cut-off region. This is the great unification of space and time, on the one hand, and the great unification of matter and ether, on the other. The latter means matter merging with ether, *the liberation of matter,* which manifests itself by the effect of *natural radioactivity*, on the atomic level, and by the phenomenon of *supernova*, on the cosmic level. Indeed, having developed the atomic structure to the utmost and produced all sorts of atoms in the proportion and quantity necessary for its consistency with ether, the star loses its purpose of further existence and ends its life, exploding and ejecting most of its matter.

Conclusion

1. There are seven kinds of nuclear shells that are adequately represented and described by their electromagnetic models.
2. Additional neutrons perform intershell interaction binding the whole structure of the atom.
3. The electromagnetic model of the atom opens the way to the application of the methods of linear algebra to the exploration of the atom.
4. Summarizing the evolution of the nuclear structure, it is worthwhile emphasizing its eight levels corresponding, except for the first one, to the respective nuclear shells and having their specific connotations and implications as shown below:

Table 5.1 Implication of nuclear shells

N	*Shell*	*Implication*
1	D-atom (0-shell)	Basic element of nuclear structure
2	2-shell	Center; foundation; here and now
3	8-shell	Internal space
4	18-shell	Restriction of the internal space
5	36-shell	Boundary between the spaces
6	Inverse 18-shell	Openness of the external space
7	Inverse 8-shell	External space proper
8	Inverse 2-shell	Transition to ether; infinity

Questions for speculation and discussion

1. Why is there no tetrahedral shell in complex atoms?
2. What varieties of the icosahedral shell are possible?
3. What is the reason for the double-icosahedral shell?
4. What is the reason for the inverse shells?
5. How do additional neutrons perform intershell interaction?

CHAPTER 6

CALCULATIONS AND ANALYSIS

Introduction

Now that we have got acquainted with solutions to the most cardinal problems of theoretical astrophysics and acquired a new outlook of the physical world in general, it would be appropriate to support those theoretical revelations with a quantitative analysis. Fortunately, experimental data on subatomic particles make it possible to calculate the real characteristics of ether and parameter of subatomic particles. So this chapter is dedicated thoroughly to the analysis of experimental data and calculations.

6.1 Spectrum of ether

The spectrum of ether forms the spectrum of cosmic photons and therefore is adequately represented by the latter. As there is no sufficient experimental data on the spectrum of cosmic photons, we should try and infer those data from those on the spectrum of cosmic rays particles. Instead of considering all the details of the huge collection of such data, we may restrict ourselves to the following general description of them:
- the bulk of the energy of cosmic rays is contained in the low energy part of the spectrum, $\leq 10^9$ eV;
- the spectra of different particles (electrons, positrons, α-particles, protons, etc.) have a common cut-off energy, about $10^{8.5}$eV, and approximately the same steepness of the slopes beyond it.

That description implies that the spectrum of the primary cosmic particles beyond the cut-off energy does not depend on the nature of the particles and is determined only by the properties of ether. Therefore,

the primary cosmic rays photons, which cannot perhaps be detected, should have the same spectrum, too. As to the region below the cut-off energy, a theoretical analysis predicts a plateau down to the zero energy for the spectrum of photons, which is consistent with our practical knowledge about the propagation of electromagnetic waves in space. According to the above analysis, the spectrum of cosmic rays photons on a linear scale looks as presented in Fig. 6.1.

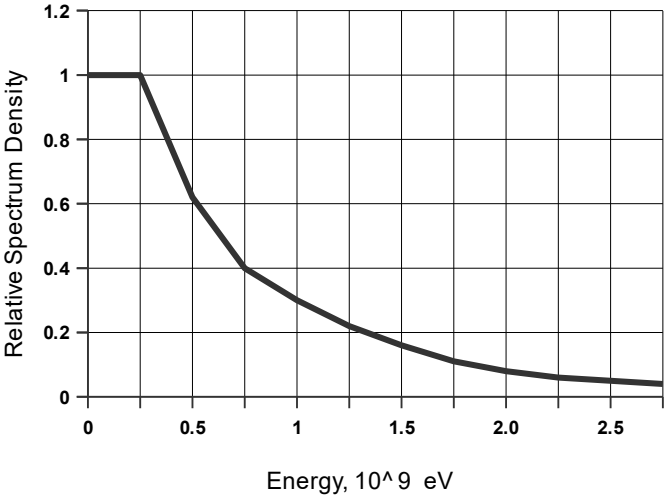

Fig. 6.1 Spectrum of cosmic rays photons

A piecewise approximation of the graph in Fig.6.1 gives the following evaluation of the *normalized* energy spectrum (the relative intensity, P) of ether:

$$\log P\left(E_{eV}\right)=\begin{cases} 0\,; & 0\le\log E\le 8.5 \\ 8.5-\log E\,; & 8.5\le\log E\le 9.0 \\ 15.7-1.8\log E\,; & 9.0\le\log E\le 9.5 \\ 24.06-2.68\log E\,; & 9.5\le\log E \end{cases} \qquad (6.1)$$

6.2 The correlation function of ether

6.2.1 Formulas for computation

The spectrum of cosmic rays photons presented by (6.1) makes it possible to evaluate the correlation function of ether g(r). To this end, we need to derive an expression for the first power of the spectrum of photons in ether on a linear scale, the function SPHE(*E*). As the evaluation (6.1) deals with the relative probability of particles, which is associated with the second power of their wave functions, with the SI units for energy, we have this expression for the SPHE(*E*):

$$g(r)=\frac{1}{2\pi i}\int_L S(z)\,\mathrm{e}^{zr}\,dz\,; \qquad z=x+iy\,; \quad x\geq 0 \tag{6.2}$$

Now let us rewrite (1.14) for convenience as follows:

$$SPHE(E)=10^{0.5\log P(E/k)}\,; \quad k=1.60210\times 10^{-19} \tag{6.3}$$

where the function *S(z),* the complex spectrum of ether, is analytic in the half-plane $\Re z>0$, an infinite curve *L* enveloping anticlockwise the half-plane $\Re z<0$. Representing *S(z)* in the polar form as

$$S(z)=F(x,y)\,\mathrm{e}^{i\varphi(x,y)} \tag{6.4}$$

where $F(x,y)>0,\ -\pi<\varphi(x,y)\leq\pi,\ \varphi(x,-y)=-\varphi(x,y),$

and taking natural logarithm of both sides in (6.4), we get the function

$$\ln S(z)=\ln F(x,y)+i\varphi(x,y) \tag{6.5}$$

which is also analytic under the above restrictions. Being conjugate parts of an analytic function, the functions $f(x,y)=\ln F(x,y)$ and $\varphi(x,y)$ satisfy the Cauchy-Riemann relations

$$\frac{\partial f}{\partial x}=\frac{\partial \varphi}{\partial y}, \qquad \frac{\partial f}{\partial y}=-\frac{\partial \varphi}{\partial x} \tag{6.6}$$

Being therefore harmonic, these functions are connected with their boundary values by Poisson's formula which, for the function *f(x,y)* in the half-plane $\Re z \geq 0$, takes the form

$$f(x_{0,}\, y_0) = \frac{x_0}{\pi} \int_{-\infty}^{\infty} \frac{f(0,y)\,dy}{(y-y_0)^2 + x_0^2} \tag{6.7}$$

Taking into account that $E = k_1 y$, $k_1 = hc/2\pi$, we have this identity:

$$f(0,y) = \ln SPHE(k_1 y), \quad SPHE(0) > 0 \tag{6.7'}$$

Now we are in a position to determine the functions *S(z)* and *g(r)* by the known function $SPHE(k_1 y)$. To that end we determine first the function *f(x,y)* by the formula (6.7); then, using relations (6.6), we find the function *φ(x,y),* for example, by the integral

$$\varphi(x,y) = \int_{y_1=0}^{y} \frac{\partial f(x,y_1)}{\partial x} dy_1 \tag{6.8}$$

and, finally, get the functions *S(z)* and *g(r)* with the formulas (6.4) and (6.3), respectively.

6.2.2 Computation

A simplified block-program of computation according to the above algorithm is stated in Fig.6.2, with D being a space step, L the number of energy steps, M the number of space steps, G the resulting space function, and A(I) the samples of the experimental data. The real program for programmable calculator is stated in the Appendix A.

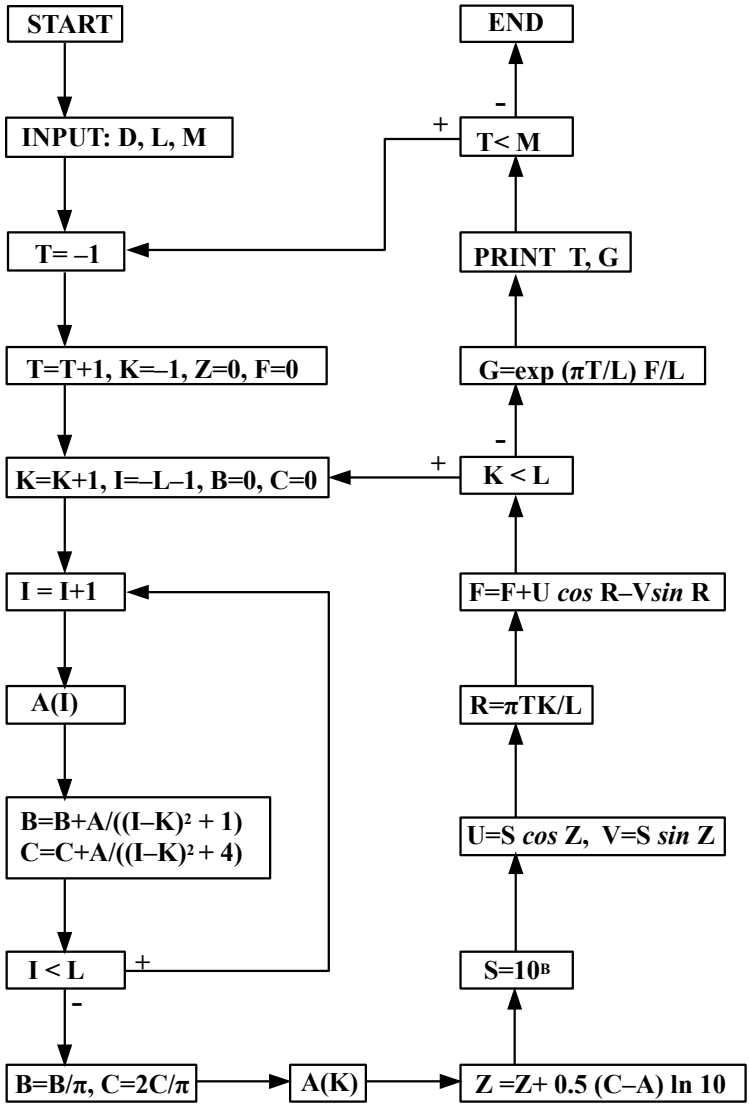

Fig.6.2 Block-program of computation

6.2.3 Results of computation and their analysis

The results of the computation of the correlation function of ether are presented in Fig.6.3 and Fig. 6.4 for three cases (L=100, 200 and 500) corresponding to three different ranges of energy: $1.26\times10^{10}eV$, $2.52\times10^{10}eV$ and $6.3\times10^{10}eV$, with accordingly more detailed space information; the solid curve (L=∞) corresponds to a hypothesized approximation.

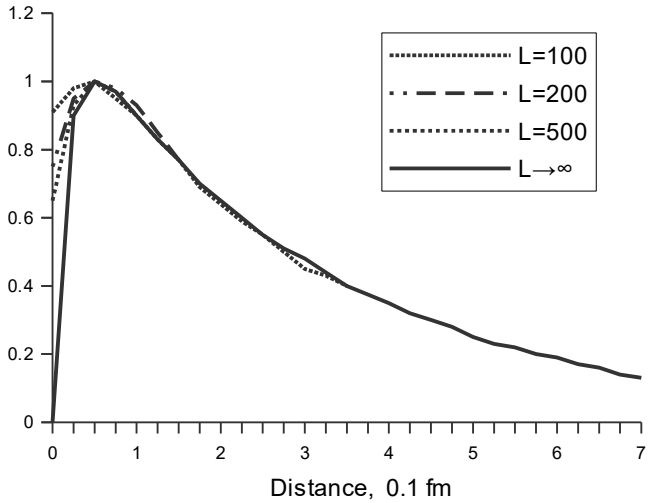

Fig. 6.3 Correlation function of ether

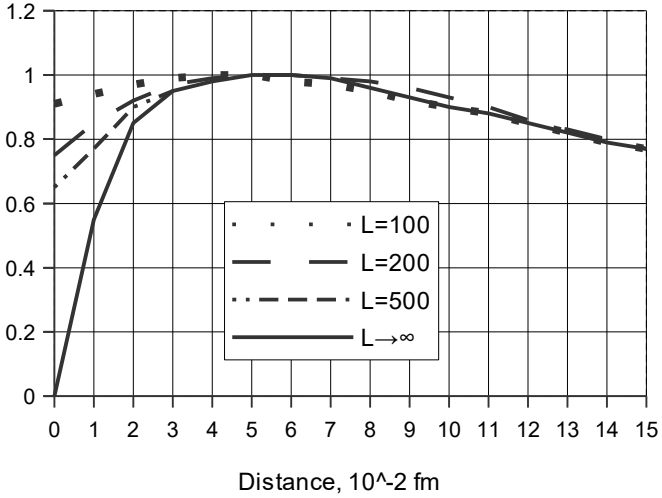

Fig. 6.4 Correlation function of ether. Detail

The correlation function of ether consists of two parts, the ascending and descending ones, meeting at $r_{et} \approx 0.052\ fm$ (*et* stands for ether). The first part depends strongly on the high energy components involved in the analysis. The second part follows almost a strict exponential law with the negative exponent

The above results seem to be quite comprehensible from the physical point of view. Indeed, the correlation function starts with an excitation at $r = 0$ which gives birth to a pair of virtual electron and positron, with their corpuscular interaction to follow. The latter cannot be concentrated in the infinitesimal region at $r = 0$ and, to develop, must spread over a finite region, about r_{et} wide. Thus the first part of the curves $r < r_{et}$ corresponds to the region of corpuscular interaction, this region being therefore the zone of uncertainty, the distance r_{et} the minimal interval discernible in ether, the *radius of uncertainty.* Within this zone, the concept of *correlation* between composiums makes no

sense, which explains the ascending character of the correlation function at $r < r_{et}$.

The second part of the curves at $r > r_{et}$ corresponds to the process of photon exchange. The intensity of this process, quite predictably, with a sufficiently wide range of energy involved in the analysis, declines exponentially with distance.

Taking into account both the calculation results and the above reasoning, we can approximate the correlation function of ether, to a constant factor, by the expression

$$g(r) \propto \exp(-\alpha_{et} r) - \exp(-\beta_{et} r) \tag{6.9}$$

where the parameters α_{et} and β_{et} characterize the rate of the processes of photon exchange and corpuscular interaction, respectively, and, accordingly, may be called *the rate of exchange interaction* and *that of pair* (*corpuscular*) *interaction,* respectively. Solving the equation

$$\frac{dg}{dr} = 0 \quad , \quad r = r_{et} \tag{6.10}$$

we find $\beta_{et} = 56.81\ fm^{-1}$.

The second term of the correlation function, $\exp(-\beta_{et} r)$, characterizes the zone of uncertainty enabling us to determine the singularity distribution function, $\varphi_o(r)$, introduced in Sec. 2.1 B. Indeed, it is the process of pair interaction that is responsible for the formation of the zone of uncertainty and is itself formed by that zone. Therefore the function $\exp(-\beta_{et} r)$ does characterize the function $\varphi_o(r)$. To convert the function $\exp(-\beta_{et} r)$ into the distribution function, we should square and normalize it; then we get the following expression for the singularity distribution function:

$$\varphi_o(r) = \frac{2\beta_{et}^{\,3}}{\pi^2} \exp(-2\beta_{et} r) \tag{6.11}$$

with the mean $\bar{r} = 0$ and the variance $\overline{r^2} = \frac{1}{2\beta_{et}^{\,2}}$.

6.3 Dimensions of particles

The above results enable us to evaluate the real dimensions of the electron and the muon. Indeed, as the results of Chapter 2 imply, in the state of rest, the real electron is a cyclic interaction of two conjugate composiums with a direct photon exchange between them, a cyclic corpuscular interaction. Therefore, in the state of rest the electron is localized within the zone of uncertainty, being actually its realization and manifestation. Thus function (6.11) is actually the distribution function of the mass of the electron in the state of rest. This conclusion enables us to evaluate the real dimensions of the electron as follows:
the mean radius of the electron

$$\overline{R_e} = \frac{1}{2\beta_{et}} \approx 0.88 \times 10^{-2}\, fm \tag{6.12}$$

the mean square-root radius of the electron

$$\sqrt{\overline{R_e^2}} = \frac{1}{\sqrt{2}\,\beta_{et}} \approx 1.24 \times 10^{-2}\, fm \tag{6.12'}$$

These values are over two hundred times less than the so-called electronic radius, $r_e \approx 2.82\, fm$, suggested by modern physics. This difference is accounted for by the unsuitability of the classical model of the electron on the basis of which the value r_e was calculated.

As to the dimensions of subatomic particles, let us consider first those of the muon, with its matter density being proportional to function (2.4). Taking into account the formula (6.9) and the inequality $\alpha_{et} \ll \beta_{et}$, we may reduce (2.4) to function

$$w(r) \propto \exp(-2\,\alpha_{et} r) \tag{6.13}$$

This function covers both the zone of correlation and that of uncertainty, that is the whole volume of the muon. Although the zone of uncertainty does not contribute to the mass of the correlated composiums, it is the birth place of the electron and therefore does contribute to the total mass of the muon. This reasoning, apart from the implications of formula (2.4), suggests expression (6.13) to be a fair representation of the mass

distribution of the muon, which gives the following estimation of its mean radius,

$$\overline{r_m} = \frac{1}{2\alpha_{et}} \approx 0.16\ fm \tag{6.14}$$

and its mean square-root radius,

$$\sqrt{\overline{r_m^2}} = \frac{1}{\sqrt{2}\,\alpha_{et}} \approx 0.22\ fm \tag{6.14'}$$

To evaluate the dimensions of the neutron, let us take into account that the relation of the masses of neutron and muon is about 8.89. Assuming the same matter density in both particles, we arrive at the following estimation of the mean square-root radius of the neutron

$$r_n \approx r_m \times 8.89^{1/3} = 0.459\ fm \tag{6.15}$$

This figure seems to match well with the range of experimental evaluations suggesting the mean radius of the neutron to be 0.3-0.5 *fm*.

6.4 Evaluation of the electric parameters

Let us now evaluate the parameters of the electric models of the atom introduced in Chapter 4. First of all, taking into account the wave nature of the D-atom interaction with ether and the common origin of its parameters generated and maintained in the process of that interaction, we should confirm the above-assumed relation (4.22), which is characteristic in general of such electromagnetic devices as antennas, waveguides, electromagnetic lines, etc. Now, taking into account the intrinsic consistency of the D-atom with ether, we should assume also the equality

$$R_o^2 = \frac{\mu_o}{\varepsilon_o} \tag{6.16}$$

because the value $\sqrt{\mu_o / \varepsilon_o} \approx 120\pi$ is known to be exactly the wave impedance of space. Thus we conclude:

$$R_o \approx 120\,\pi = 376.7\Omega. \tag{6.17}$$

Now let us evaluate the fundamental frequency f_o of the D-atom. To this end, taking into account the identity of the expressions (4.12) and (6.9) for the correlation functions of the H-atom and ether, respectively, on the one hand, and the experimental fact about the H-atoms being dominant in ether and therefore its spectrum being close to that of ether, on the other hand, we conclude for (4.12):

$$p_1=-\alpha_{et}c\,,\quad p_2=-\beta_{et}c \tag{6.18}$$

which gives the following formulas:

$$\begin{aligned} C_o&=\frac{|\alpha_{et}+\beta_{et}|}{cR_o\alpha_{et}\beta_{et}},\quad L_o=C_oR_o^2,\\ L_1&=\frac{R_o}{c|\alpha_{et}+\beta_{et}|},\quad C_1=\frac{L_1}{R_o^2} \end{aligned} \tag{6.19}$$

Calculating, we obtain the following evaluation for the electric parameters:

$$\begin{aligned} L_o&=4.17\times10^{-22}H\,,\quad C_o=2.94\times10^{-27}F\,,\\ L_1&=2.09\times10^{-23}H\,,\quad C_1=1.48\times10^{-28}F. \end{aligned} \tag{6.20}$$

Accordingly, the evaluation of the fundamental frequency of the D-atom

$$f_o=\frac{1}{2\pi\sqrt{L_oC_o}}=1.44\times10^{23}Hz \tag{6.21}$$

which corresponds to quantum energy

$$E=hf_o\approx9.54\times10^{-11}J\approx5.95\times10^{8}eV. \tag{6.22}$$

6.5 Spectral characteristics of ether and atoms

To complete the quantitative analysis of the theory, it important to compare the spectral characteristics of the light atoms with that of ether. Such a comparison is presented graphically in Fig.6.5.

As mentioned above, the spectrum of radiation of the H-atom (the small-dashed curve) is close to that of ether beyond the energy corresponding to frequency f_o. The spectrum of radiation of the D-atom (the dash-pointed curve) has its extrema at f_o, about twice as much as the cut-off frequency of the ether spectrum (the thick solid curve), while the spectrum of the He-atom (the thin solid curve), that has a low-pass form similar and roughly close to that of ether, makes a good approximation of the cut-off region. That comparison suggests the abundance of the He-atom to be responsible, to a significant extent, for the formation of the cut-off region of the ether spectrum. All that warrants our preliminary treatment of the He-atom, with its partial transparency, as a rough physical model of ether accounting for its high stability and its role as the foundation of all the more complex atoms.

Conclusion

1. The spectrum of ether has a plateau from the zero energy to the cut-off energy $10^{8.5}$eV.
2. The correlation function of ether consists of two parts: ascending and descending ones, corresponding clearly to the processes of the pair and exchange interactions respectively.
3. The real mean radius of the electron is about $10^{-2}\,fm$, that is over two hundred times less than was suggested by its former model.
4. The minimal distance discernible in ether is about $5\times10^{-3}\,fm$.
5. The spectrum of radiation of the H-atom beyond 10^{9}eV is close to the spectrum of ether.
6. The abundance of He-atoms and the more complex atoms in space is responsible for the formation of the cut-off region of its spectrum.

Questions for discussion and speculation

1. Why does the correlation function of ether have an ascending part?
2. How is it possible to explain the *knee* of the spectrum of cosmic rays particles at 10^{15}eV observed in experiments?

CHAPTER 7

REVIEW OF THE THEORY

Introduction

This short review of the theory stated in the preceding chapters is very important because of its synergy effect and therefore deserves a separate chapter. The whole research deals actually with three major topics: the theory of ether, the theory of subatomic particles and the nuclear structure of the atom. These topics are reviewed below.

7.1 Theory of ether

The structure of the first part of the theory stated in Chapter 1, *Theory of Ether,* is represented in Table 1. The first three columns, *Thesis, Antithesis* and *Synthesis,* contain concepts, their interpretation and symbolism. The last column, *Formula*, contains mathematical symbols and expressions characterizing the concepts of the third column. Research in this part starts with a speculation about the physical world suggesting the virtual electron to be its origin, the first concept of the theory, its fundamental contradiction. Then a new paragraph of speculation about the virtual electron reveals its dual counterpart, the virtual positron, after which there follows a speculation suggesting their synthesis, the virtual positronium, a real entity. The latter proves to have a new quality, energy, registered in the last column, which ends the first concept row of the table. The next row start with a speculation about the last synthesized entity of the preceding row and develops in a similar way. Then there follow the next four rows of concepts revealing the existence of ether, its composition and its essence, *the correlation domain of ether*, the last concept of the table. The logic used in this part is called *'transition to the opposite',* because the concepts of the first

two columns do look like opposites to each other.

Table 1. Ether

Thesis	Antithesis	Synthesis	Formula
Virtual electron Wave-particle duality	Virtual positron Particle-wave duality	Virtual positronium Interaction. Energy	E
Corpuscular interaction Energy E_m	Exchange interaction Energy E_p	Complex positronium (composium). State Complex energy E	$E=E_m \pm i\,E_p$
Repulsion of composiums. Constant ε_o	Attraction of composiums. Constant μ_o	Primary physical medium, ether. Constant c	$c=\frac{1}{\sqrt{\varepsilon_o \mu_o}}$
Multitude of composiums. Continuity Space-time equivalency $s=r=ct$	One composium Discreteness $\chi=\frac{2\pi E}{hc}$	Coherent multitude of composiums. Function of coherency $\varphi_\chi(s)$	$\varphi_\chi(s)=\mathrm{e}^{\chi s}$
Coherent multitude proper. Internal measure Massiveness A_χ	Boundary of multitude External measure Elasticity B_χ	Bounded multitude Complex measure C_χ	$C_\chi=A_\chi \pm i\,B_\chi$
Center of multitude Complex spectrum of ether $S(\chi)=\frac{dC_\chi}{d\chi}$	Correlation of centers Unlimited motion of center in half-plane $\Re\,\chi<0$	Unlimited motion along boundary of half-plane $\Re\,\chi<0$ Correlation domain Function $g(s)$	$g(s)=\frac{1}{2\pi i}\int_L S(\chi)\mathrm{e}^{\chi s}\,d\chi$

7.2 Subatomic particles

The structure of the second part of the theory stated in Chapters 2 and 3 is dedicated to the origin, properties and characteristics of the subatomic particles; it is represented in Table 2 similar to Table 1 but with a different logic called '*reflection'*. The research in this part starts with a speculation about the last synthesized concept of Table 1 and proceeds in a similar way until its last concept, *the H-atom,* which is of special importance for the whole theory; this concept may be called *the Project*, because the structure of the H-atom, unclear at this stage, serves as *a scheme* for the realization of the correlation domain of ether.

Table 2. Subatomic particles

Thesis	Antithesis	Synthesis	Formula
Self-consistency of ether. Density of correlation $g^2(r)$	Singularity of ether Density of singularity $\varphi_o(r)$	Self-consistent cloud Material particle (muon) Matter density $w(r)$	$w = g^2 \otimes \varphi_o$
Reflection Wave function ψ Energy of reflection E_{ref} and its operator $\hat{E}_{ref}$ $E_{ref} = (\psi, \hat{E}_{ref}\psi)$	Exchange interaction with ether. Its power $P = (\frac{\partial \psi}{\partial t}, \frac{W}{c}\frac{\partial \psi}{\partial t})$ $W = w_{max} - w(q)$	Balance of reflection and interaction. Balanced cloud (π-meson) $P = -\frac{\partial E_{ref}}{\partial t}$	$\frac{\partial(\psi, \hat{E}_{ref}\psi)}{\partial t} = -(\frac{\partial \psi}{\partial t}, \frac{W}{c}\frac{\partial \psi}{\partial t})$
Time reflection characterized by energy $E_t = \frac{1}{2c^2}(\frac{\partial \psi}{\partial t}, \frac{\partial \psi}{\partial t})$	Space reflection characterized by energy $E_s = -\frac{1}{2}(\psi, \Delta\psi)$	Effect of self-control Self-controlled cloud (K-meson) $E_{ref} = E_t + E_s$	$\frac{1}{c^2}\frac{\partial^2 \psi}{\partial t^2} - \Delta\psi + \frac{W}{c}\frac{\partial \psi}{\partial t} = 0$
Multitude of discrete bound states. Equation $\lambda U + H U = 0$ $U = U(q)$; H operator	Free self-conjugate state State of rest. Equation $\lambda U + H_o U = 0$ $H \to H_o$, $w \to \varphi_o$	Multitude of free self-conjugate bound states Set of functions $\{u_k\}$ Self-conjugate cloud (η-meson)	$u_k = U_k e^{\lambda_k t} + \tilde{U}_k e^{\tilde{\lambda}_k t}$ $u_k = \begin{pmatrix} \frac{\partial \psi_k}{\partial t} \\ \psi_k \end{pmatrix}$
Internal particular correlation. Two-component functions $\{U_k(q)\}$	Two-component correlation function of ether $G(q) = \begin{pmatrix} g \\ g \end{pmatrix}$	Consistent correlation Consistent cloud (neutron). Its correlation function $f(q,t)$	$f(q,t) = \sum_{k=-n}^{n} C_k U_k e^{\lambda_k t}$ $C_k = \frac{(V_k, G)}{(V_k, U_k)}$
Linear system with continuously distributed parameters. Standing waves $\{U_k(q)\}$	Lumped oscillators Modes of oscillaion $\{e^{\lambda_k t}\}$	Linear system with lumped parameters Organized cloud (H-atom). Its structural function $\boldsymbol{u}(t)$	$\boldsymbol{u}(t) = \sum_{k=-n}^{n} T_k \boldsymbol{U}_k e^{\lambda_k t}$ $\{\boldsymbol{U}_k\} \sim vectors$

7.3 Evolution of the nuclear structure

The structure of the third part of the theory stated in Chapters 4 and 5 and shown in Table 3 is different. It is dedicated to the evolution of the nuclear structure, its logic called '*evolution'*. The first column, *Atom,* shows the atoms whose nuclear structures are most representative of the evolution. Columns 2-8 show the hierarchy of nuclear shells and the number of their D-atoms in representative atoms. The last two columns

contain the total number of D-atoms in each representative atom and the latter's function concerning the structure of the atom and its relation with ether.

Table 3. Evolution of the nuclear structure

Atom	2-shell	8-shell	18-shell	36-shell	18-shell	8-shell	2-shell	D-atoms	Function
He	2							2	Center
Ne	2	8						10	Internal space
Ar	2	8	8					18	Restriction
Kr	2	8	18	8				36	Boundary
Xe	2	8	18	18	8			54	Openness
Rn	2	8	18	32	18	8		86	External space
U	2	8	18	36	18	8	2	92	Model of ether

Research in this part starts with a speculation about the two last concepts of row 5 and 6 of Table 2, *neutron* and *H-atom*, suggesting their synthesis, *D-atom*. The latter proves to be the main component of nuclear structure in all the more complex atoms. Further speculation shows inconsistency of the D-atoms with ether, which prompts them to unite in pairs into He-atoms, the He-atom being the center of the structure of all the more complex atoms. Further speculation reveals some inconsistency of the He-atom and its need of a new shell. Further speculations show necessity for additional shells and so forth until the U-atom with its thoroughly complete and perfect nuclear structure, *the realization* of the Project.

7.4 Implication of the theory

The fact that the above theory has a structure represented by its above three tables of concepts is an important sign suggesting the self-consistency of the whole theory, its internal logical organization and therefore its credibility. Indeed, the first two parts of the theory are actually a physical interpretation of the respective parts of Hegel's *The Science of Logic* (*Being* and *Essence)* because of the similarity in their logic and

structure. As to the third part, its truthfulness is confirmed by its consistency with the whole theory and, indirectly, by the experimental data provided by modern physics. All that suggests the above theory to be actually *The Systems Theory* stated in the language of physics and, therefore, of general scientific significance, which is elaborated in the next chapter.

Conclusion

The above theory is the systems theory stated in the language of physics, which adds to its credibility and implies its general scientific significance.

Questions for speculation and discussion

1. What does the above structure of the whole theory imply?
2. What are the main features of the new method of research?
3. What are the four basic concepts of the theory?
4. What is the difference between the logic of its different parts?
5. Can the logic of speculation be formalized (computerized)?
6. Can this new physics have an axiomatic foundation?
7. How do the definite formulas in Table 1 and Table 2 emerge?
8. What is the relation of the above theory to quantum mechanics?
9. What is the relation of the above theory to the theory of relativity?
10. Evolution of which components of the atom does Table 3 reflect?

CHAPTER 8

SYSTEMS THEORY

Introduction

The term *systems theory* has already been used in science and technology for several decades meaning the interdisciplinary study of the abstract organization of phenomena, independent of their substance, type, or spatial or temporal scale of existence. It investigates both the principles common to all complex entities, and the (usually mathematical) models which can be used to describe them.

As a branch of modern science, systems theory was introduced in the 1940's by the biologist Ludwig von Bertalanffy (*General Systems Theory*, 1968). He emphasized that real systems are open to, and interact with, their environments, and that they can acquire qualitatively new properties through emergence, resulting in continual evolution.

Rather than reducing an entity (e.g. the human body) to the properties of its parts or elements, systems theory focuses on the arrangement of and relations between the parts which connect them into a whole. The same concepts and principles of organization underlie the different disciplines (physics, biology, technology, sociology, etc.), providing a basis for their unification.

However, it is only the proper interpretation of Hegel's *Science of Logic* that revealed the true essence and structure of system theory and opened the way to the reviewing of modern science in general, reorganizing its branches in the true systematic order.

As follows from the preceding chapter, the systems theory is actually *the philosophy of science* stated in a language of a particular science; it is *a logical framework* that can be used for a consistent and systematic reorganization of any body of knowledge with a potential systemic structure. If applied to the theory of thinking, it would produce an analog of Hegel's dialectical logic, the philosophy proper. If applied to

economics, it would produce an analog of Marx's research in that field, or a part of it at least. In physics, as shown above, it has reorganized the whole former knowledge about space, time, matter, particles and atoms, dismissing redundant concepts, correcting false ones, introducing new concepts and formulas, advancing new methods of research and general outlooks, solving all cardinal problems in that field and, thus, initiating a radical reform of modern physics. So the systems theory is the proper means of reforming modern science into a new, perfectly organized science – *the reform science.* This reform and the new science deserve special attention provided below.

8.1 Reform science and its method

The method of reform science, called *'the method of systematic intuition',* is based on the dialectical logic modified in accordance with achievements of modern science. Although this true scientific method can, in principle, solve any correctly stated problem, it is not a clear-cut one easy to use in all cases; it cannot be formalized and should be applied with the highest extent of creativity after a comprehensive analysis of the problem in question. The method can be applied only to the sciences that have potentially a systemic structure.

According to this method, every stage of research consists of two phases: a paragraph of *speculation* and *a statement of concept*, the former suggesting the latter by necessity. The whole research is a series of such stages, where any new statement is analyzed by a further speculation suggesting a new statement and so forth until the end. The first concept is the beginning of the reform science reflecting *the origin* of the research object itself; that concept is *a fundamental contradiction* revealed by a comprehensive speculation about the research object. So the development of the reform science follows the development of the research object. Therefore, unlike modern science where the terms 'science' and 'research' have generally different meaning, in reform science they mean the same. Thus, the reform science is actually its unique research, its *source*.

The reform science is a thoroughly *theoretical* science, which corresponds to Hegel's dictum that '*truth cannot be observed, it can only be thought'*. Thus the reform science cannot be developed or verified experimentally; on the other hand, it takes into consideration all achievements and the whole experimental base of modern science and can provide a

valid explanation to every experimental fact; the reform science realizes the goals beyond the reach of experimental and formal methods.

Unlike modern science that is actually a collection of research works and theories in a particular field, the reform science keeps only the research works recognized as its sources and, in addition, the records of *the state* of the reform science in every particular field.

8.2 Structure of the reform science

The reform science consists of three parts called *Medium*, *Population* and *Associations,* each with a different logic, that of *transition, reflection* and *evolution,* respectively. In contrast to modern science, the reform science has *a structure* common for all branches of science, which allows to introduce *a classification of concepts*, thus purifying, perfecting and organizing the whole science. That emphasizes the truly systematic nature of reform science, a logically consistent system of concepts. Owing to its structure, the reform science is able to sort out the existing concepts, right and generalize them and find the proper meaning to them, and, when necessary, introduce new concepts.

Table 1. Transitions

A Thesis	B Antithesis	C Synthesis	Q Quality
SC-1A1 (Origin)	SC-1B1	SC-1C1	SC-1Q1
SC-1A2	SC-1B2	SC-1C2	SC-1Q2
SC-1A3	SC-1B3	SC-1C3	SC-1Q3
SC-1A4	SC-1B4	SC-1C4	SC-1Q4
SC-1A5	SC-1B5	SC-1C5	SC-1Q5
SC-1A6	SC-1B6	SC-1C6	SC-1Q6 (Essence)

The structure of Part 1 (Medium) with its classification of concepts is presented by Table 1 below. In this table, columns A, B, C (Thesis,

Antithesis, Synthesis) are intended for the concepts, their symbolism and their brief description, while the column Q is for the qualitative characteristics of the corresponding *entities* of column C. Every concept of Table 1 is classified as SC-1ik, where SC is for SCIENCE, the common two-letter abbreviation of the name of a particular science (PH for physics, BI for biology, etc.), i – the column letter (A, B, C), k – the row number (1-6).

The structure of Part 2 (Population) is similar in many respects to that of Part 1 and is presented by Table 2 similar to Table 1; its concepts are classified similarly as SC-2ik. Instead of transition to the opposite, from thesis to antithesis, there takes place here their mutual *reflection* leading to their synthesis, the birth of a new *creature* which settles *the conflict* between its two constituent entities and is characterized by its specific quality. The synthesized creatures and their qualities are registered in columns C and Q, respectively.

Table 2. Reflections

A Thesis	B Antithesis	C Synthesis	Q Quality
SC-2A1	SC-2B1	SC-2C1	SC-2Q1
SC-2A2	SC-2B2	SC-2C2	SC-2Q2
SC-2A3	SC-2B3	SC-2C3	SC-2Q3
SC-2A4	SC-2B4	SC-2C4	SC-2Q4
SC-2A5	SC-2B5	SC-2C5	SC-2Q5
SC-2A6	SC-2B6	SC-2C6	SC-2Q6 (Project)

The classification of concepts in Part 3 is presented by Table 3 which illustrates the evolution of the *species* from the simplest one to the most complex. The classification of the species is given in the first column as SC-3-i, where i=0, 1, 2, ...7 is the number of the row. Columns A-G are intended for the description of *substructures,* which are classified as SC-3ik, similar to the classification in the preceding tables.

Table3. Evolution

Substructures Species ↓	A	B	C	D	E	F	G	Q Quality
SC-3-1	SC-3A1							SC-3Q1
SC-3-2	SC-3A2	SC-3B2						SC-3Q2
SC-3-3	SC-3A3	SC-3B3	SC-3C3					SC-3Q3
SC-3-4	SC-3A4	SC-3B4	SC-3C4	SC-3D4				SC-3Q4
SC-3-5	SC-3A5	SC-3B5	SC-3C5	SC-3D5	SC-3E5			SC-3Q5
SC-3-6	SC-3A6	SC-3B6	SC-3C6	SC-3D6	SC-3E6	SC-3F6		SC-3Q6
SC-3-7	SC-3A7	SC-3B7	SC-3C7	SC-3D7	SC-3E7	SC-3F7	SC-3G7	SC-3Q7 Realization

8.3 The research

As suggested above, the researcher in Part 1 must fill in all the cells of Table 1 with the proper concepts and qualitative characteristics. The research starts with a paragraph of speculation to suggest an entity introduced by the statement of its concept SC-1A1. This step may prove the most difficult, because this concept has no predecessor and, as is mentioned above, should be determined by a speculation about the research object itself.

Then the research proceeds with a speculation about the entity SC-1A1 to suggest its *transition* to its *dual* entity marked by concept SC-1B1. After that the research proceeds with a speculation about the two preceding entities, *the thesis* and *the antithesis*, to suggest their *synthesis*, a new entity marked by concept SC-1C1. The latter has its specific *quality* to be registered in cell SC-1Q1. The speculation about entity SC-1C1 generates entity SC-1A2 to be transited by a new paragraph of speculation to entity SC-1B2, and so forth until determining entity SC-1C6 and its quality SC-1Q6. Entity SC-1C6 is *the essence* of the science, its concept being central for the whole theory. Every step is *a discovery* revealed by *intuition* rather than found by a formal work of intellect.

The research in Part 2 starts with a paragraph of speculation about

concept SC-1C6 and ends with concept SC-2C6 which, as suggested earlier, is called *the Project.* Every statement must again be preceded and necessitated by the proper speculation about the statement of the preceding step. As a result, this stage of research generates a series of six creatures, SC-2C1 to SC-2C6, of increasingly higher order and quality populating the Medium.

The research in Part 3 starts with a paragraph of speculation about the creatures SC-2C5 and SC-2C6 to suggest their *merger* into the species SC-3-0, *the fundamental component of substructures.* A speculation about the latter should suggest the species SC-3-1 consisting of the substructure SC-3A1. Further speculation should expose the internal contradiction of SC-3-1 necessitating its development, *evolution,* by generating a new substructure, SC-3B2, which adds to SC-3B1 to make the species SC-3-2. The research proceeds further until generating the substructure SC-3G7 which adds to the preceding six substructures, SC-3A7, SC-3B7, SC-3C7, SC-3D7, SC-3E7, SC-3F7, to make the most perfect species SC-3-7, *the Realization.* To complete in rough the research, it is necessary to show the concept SC-3-7 to be indeed the realization of the concept SC-2C6.

Thus the whole research of reform science, in its every branch, is a great endeavor concerned with finding the Origin of the branch, revealing its Essence, working out its Project and fulfilling its Realization.

8.4 Publishing reform science

As mentioned above, the reform science publishes both the state of science and the sources, the research works themselves. To this end, there should be two kinds of media: *The Bulletin of Reform Science,* publishing the state of different branches of reform science in the form of above three tables of concepts with references to the sources, and *The Journal of Reform Science,* publishing the research works recognized as sources of reform science to be kept in a specialized library, *The Reform Science Archive.*

Conclusion

1. There have been revealed the structure, the method, the logic and the essence of the systems theory.

2. The systems theory consists of three parts, that may be called *Medium, Population* and *Associations*, each with a different logic, *transition, reflection* and *evolution*, respectively.
3. The method of the systems theory, called systematic intuition, is alternation of speculation and formal statement, the latter suggested by the former as an imperative.
4. The systems theory is able to reorganize any potentially systemic body of knowledge, including potentially systemic branches of modern science, into the true, perfectly organized science.
5. The systems theory admits the classification of concepts.
6. The plan of the systems theory in reorganizing any body of knowledge is to find its origin, work out its essence, develop its project and implement its realization.
7. The systems theory is able to realize the goals beyond the reach of modern science.

Questions for speculation and discussion

1. Can the systems theory be applied to research in mathematics?
2. Can the systems theory be applied to research in humanities?
3. Can the systems theory be applied to research in technology?
4. What is the difference between modern science and reform science in doing research?
5. What is the difference between modern science and reform science in publishing research works?

Further Reading

1. G. Hegel. *Encyclopedia of the Philosophical Sciences*: vol.1 - *The Science of Logic*; vol.2 - *The Philosophy of Nature*; vol.3 - *The Philosophy of Spirit*. Online: http://www.marxist.org/reference/archive/hegel/works/ol/encycind.htm.

2. G. Hegel. *Phenomenology of Spirit.* Online: see the line above.

3. Igor S. Makarov. *A Theory of Ether, Particles and Atoms. Second Edition.* Open University Press, 2010. ISBN-13: 9 781441 478412 (www.amazon.com).

4. Igor S. Makarov. *Reform of Modern Science. Politics. Economics.* Reform Science Center, 2012. ISBN-13: 9781469985770 (www.amazon.com).

APPENDIX

PROGRAM OF COMPUTATION

```
START
Print "Step D, fm"
Input D
Print D
Input L
Print L
Wait
Print "Wave-number step, fm^-1"
H = π/(DL)
Print H
Wait
Print "Log-energy step (eV)"
P = 8.296 + log H
T = –1
Label TIME
T = T + 1
K = –1
Z = 0, F = 0
Label FREQ
K = K + 1
Print K
I = –L –1
B = 0, C = 0
Label SHIFT
I = I + 1
X = 0
IF I = 0 GOTO TRICK
X = P + log ABS I
Label TRICK
A = 0
```

```
*)IF X < 8.5 GOTO SPEC
A = 8.5 – X
IF X < 9 GOTO SPEC
A = 15.7 – 1.8X
IF X < 9.5 GOTO SPEC
A =24.06 – 2.68X
Label SPEC
A = 0.5A
B = B + A/((I –K)^2 + 1)
C = C + A/((I –K)^2 + 4)
IF I < L GOTO SHIFT
B = B/π
C = 2C/π
X = 0
IF K = 0 GOTO JUMP
X = P + log K
Label JUMP
A = 0
**)
IF X < 8.5 GOTO SPC
A = 8.5 – X
IF X < 9 GOTO SPC
A = 15.7 – 1.8X
IF X < 9.5 GOTO SPC
A =24.06 – 2.68X
Label SPC
A = 0.5A
O = 1.1513 (C – A)
Z = Z + O
S = 10^B
IF K > 0 GOTO PHASE
E = Z/2
Label PHASE
U = S cos (Z – E – O/2)
V = S sin (Z – E – O/2)R = πTK/L
IF K > 0 GOTO FUNC
W = U/2
Label FUNC
F = F + U cos R – V sin R
```

```
IF K < L GOTO FREQ
G = (F – W)  exp (πT/L)/L
IF T > 0 GOTO FINAL
Q = G
Label FINAL
G = G/Q
Print T
Print G
Wait
GOTO TIME
FINISH
```

The auxiliary program

```
Input M      *)
IF M = 1 GOTO AI
IF I = 0 GOTO SPEC
Y = 10^(X – 8.8)
A = –log (1 + Y^2)
GOTO SPEC
Label AI

IF M = 1 GOTO AK       **)
IF K= 0 GOTO SPC
Y = 10^(X – 8.8)
A = –log (1 + Y^2)
GOTO SPC
Label AK
```

The auxiliary program assumes an exponential form of the correlation function and, when inserted into the places marked *) and **), can be used to test the main program.

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