# Systemic Theory of Ether and Particles

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**Abstract:** New method, *systemic intuition,* has enabled us to discover the following: the origin of the universe is the fundamental contradiction between *being* and *thought,* which, in physical terms, presents intself as a pair of abstract fundamental particles – virtual electron (electrino) and virtual positron (positrino), carriers of the wave-particle duality with no physical properties; their interaction gives birth to virtual positronium characterized by energy; virtual positroniums exchange photons and acquire states, called complex positroniums or composiums; there exists ether, the primary physical medium, consisting of composiums; in ether there takes place spontaneous generation of mesons and neutrons; cosmic rays and microwave background are proper radiations of ether; the origin of matter is the unification of space and time; muon is a drop of matter with no structure; π-meson has a structure determined by wave functions with a continuous spectrum of energies; K-meson has a structure determined by wave functions with a discrete spectrum of energies**;** η-meson has a structure determined by pairs of self-conjugate wave functions; neutron has a structure spatially consistent with the correlation function of ether; because of the space-time contradiction of its structure the neutron transforms into the hydrogen atom; the structure of the hydrogen atom is characterized by a vector function of time consistent with the correlation function of ether; real electron consists of a pair of self-conjugate composiums with a direct photon exchange between them; experimental data on cosmic rays enabled us to evaluate the correlation function of ether and dimensions of some particles: the mean radius of the real electron proved to be about 0.01 fm, that is over two hundred times less than the value suggested by modern theory, while the mean radius of the neutron proved to be about 0.46 fm, that is within the range of available experimental data.

**Key words:** ether, theory of space, composium, origin of matter, origin of universe, theory of particles.

## Preface

This article is a revised edition of a part of my almost 30-year independent research in theoretical physics, *"A Theory of Ether, Particles and Atoms"*. This part of the research was first published in the Indian Journal of Theoretical Physics (Calcutta, 1996-2005), but then was subjected to numerous corrections. The whole research was published privately as a book in Britain in 2007; in 2008 the book was registered at the Copyright Office of the Library of Congress; then, after some correction, it was published with an Israel publishing company, 2009, and finally, after additional corrections, it was published with an Amazon self-publishing company "CreateSpace", 2010, ISBN 9781441478418 (the book is currently available online: text:http://kvisit.com/S2uuZAQ; cover: https://kvisit.com/S2-uZAQ). In 2015, with the same company, I published another version of the book, titled *"Introduction to Theoretical Astrophysics",* designed as a textbook for universities, ISBN 9781495220877 (the book is currently available online: text: http://kvisit.com/SoPadAw; cover: http://kvisit.com/SyYWeAw ). Despite those all publishing events, the book and its parts have never been professionally discussed. So seeing no chance to break through that silence, I have decided to try and re-publish my research in one of the most authoritative peer-review journals.

## Contents

# Introduction

The crisis of modern science, caused mainly by the overestimation of the formal and experimental methods of research, manifests itself most blatantly perhaps in theoretical physics because of the fundamental character of its problems. Some of the most urgent ones seem to be the following:

- the existence and the physical nature of ether;
- the origin of matter in the universe;
- the theory of subatomic particles.

As we have ventured to start revising modern theories dealing with exactly these problems, let us consider briefly the reasons that necessitated such an enterprise.

## The problem of ether

The existence of ether[*)], a thin omnipresent substance, the physical medium supporting the propagation of light, was hypothesized as far back as by Aristotle and had been taken for granted by all physicists until the first decade of the 20th century. It is indeed difficult to imagine how it could have been otherwise, because Huygens' principles of wave construction and superposition, for example, the principles underlying the classic optics, would have made no sense without the conception of ether implied by them.

As to experimental investigations of ether, the famous experiment conducted by the American physicists Albert Michelson and Edward Morley (1887) failed to detect an ether and confirm the hypothesis. On top of that, the theory of relativity, developed 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.

As to the theory of relativity, it is usually misinterpreted now as a physical theory, but it is rather simply a method of mathematical physics designed for calculating relativistic effects. It is based on axioms that, from the philosophical point of view, are certainly not true just because they are axioms, arbitrary statements. From the physical point of view, their validity, for the subatomic world, at least, is also doubtful, because, in particular, they ignore the finite dimensions of real objects and their interaction with the frame of reference, on the one hand, and because the concept *the velocity of light* makes no sense in the subatomic world, on the other. Thus, as regards its implication to the theory of space, the theory of relativity just replaced the Newtonian abstract concepts of independent space and time by a new abstract concept *space-time*, showing no interest in its physical content.

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 as well as the birth and vanish of virtual particles in it. All that proves vacuum to be indeed a physical medium, an ether. Thus ether has clearly manifested its reality and cannot be ignored any longer by theoretical physics.

## Origin of matter

Modern cosmology is divided on this issue. The so-called super-dense *theory* asserts that the universe has evolved from one super-dense agglomeration of matter which suffered a cataclysmic explosion giving birth to all planets, stars, and galaxies. This theory is based on the assumption of the conservation of mass in the universe and, for that reason, seems untenable. Indeed, due to the possibility of mutual transformation of mass and energy, the above assumption should have been replaced by a more general one, that of the conservation of mass *and* energy. Now, as energy may be of opposite signs, as is the case, for example, with the energies of attraction and repulsion, it may be suggested that the universe has evolved from nothing. And, indeed, there are such hypotheses as well.

Another widely spread cosmological theory, the so-called *steady state theory*, postulates that the universe has always existed in a steady state, and the observable expansion of the universe is compensated by the continuous creation of matter, which is considered a property of space. Thus, whatever the origin of the universe, theoretical physics is facing now a definite challenge: to verify the hypothesis of matter being generated in space.

## Subatomic particles

The subatomic particles – the electron, the mesons, the neutron and the proton – are the main constituents of the atom and should be studied first of all, if we want to conceive its origin. These particles, along with many other much less stable ones, are usually called elementary, but that has long been called into question, and this term has become to some extent ambigious. So we shall use the term *subatomic particles*, excluding from this category the photon, because it is not an ordinary particle but rather a quantum of energy, an energy exchange agent.

At present, there is no satisfactory theory of subatomic particles. Modern theory investigates them largely from the point of view of their symmetry and, although is able to predict some experimental results and calculate some parameters, it does not present a logically consistent theory and cannot explain the nature and structure of these particles. For that reason, perhaps, there is a curious tendency now to make up the shortages of the theory by ever new experimental data and an increasingly esoteric terminology, but all that only emphasizes the necessity for the true theory.

## Method of research

The fragmentary character of modern theory of subatomic world, its increasing use of formal and experimental methods and half-empiric receipts, unable to achieve the logical integrity of the theory as a whole, show the necessity for the revision of both the basic principles of the theory and the very method of scientific cognition used by theoretical physics.

Philosophy is known to have found the true method of attaining scientific knowledge – *the dialectical logic*; it was substantiated most thoroughly in Hegel's philosophy works and was first applied in modern science by Karl Marx. According to it, the truth is neither a formula nor a statement, but *the process of self-affirmation,* and to prove the truth means *'to show how the object by itself and from itself makes itself what it is'* [2]. As regards physics, this means that a theory's evolution has to be a reflection of the research object's evolution from its simple forms to the complex ones, the reflection of its self-affirmation process.

The existing physical theories, however, are constructed, as a rule, mathematically: one formulates a set of axioms and deduces from it all the results possible. As axioms have no dialectical substantiation and are chosen according to 'common sense' - not scientifically - such an approach, although necessary at a certain stage of research, cannot provide the true solution. So we should try to revise from the dialectical point of view the main results of theoretical physics concerned with the above four problems.

The new method is called *systemic intuition.* With this method, every stage of research is a discovery rather than an intellectual work. According to Hegel's dictum, truth cannot be observed - it can only be thought; so the results of a dialectical research cannot be verified experimentally. On

the other hand, the research based on this method takes into account all achievements of modern science, digests them, supplements them with new concepts, puts all concepts in a systemic order, finds their true meaning and, in this way, solves all systemic problems that are beyond the reach of modern science.

As to the dialectical logic proper, it being now far from thoroughly comprehended and ready to use, its essence, in short, is known to be an alternation of analysis and synthesis, the aim of the analysis being the revelation of the contradictory sides of the object, while that of the synthesis being the revelation of the unity of those sides, which in turn produces a new object to be analyzed at the next stage.

In this work, as the reader will see, the mathematics is an inalienable part of this *self-developing*, as it were, logical investigation and is developing adequately, in our judgment, along with it.

## Reference

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***)** In this work, the terms *ether* and *vacuum* are used as synonyms.

# Chapter 1. A non-formal theory of vacuum

## Introduction

According to the above reasoning, the theory of subatomic world should start with the theory of vacuum, that is ether, because vacuum is supposedly the primary physical medium from which all the more complex forms of matter originate. At present, however, there is no satisfactory theory of vacuum. Modern quantum electrodynamics, based largely on Dirac's equation, cannot be considered such, because it starts with such *a priori* notions as space, time, energy, mass, momentum, charge, wave function, etc. [1,2], that themselves need substantiation and cannot be initial for the theory of vacuum. So we start with the very begnning making use of the new method, systemic intuition, mentioned above. This part was published first in [3] and is stated here with some correction.

## 1.1. Virtual positronium

**A.** We start our research with the study of the universe. It is the only possible object to begin with, because it exists for sure, because it is *something.* The universe is an integral system, it knows itself as such, it is what it knows about itself. The universe develops and has an *origin, a beginning.* The universe knows nothing about its origin, because otherwise it would have been natural to put the question about the origin of that its knowledge. So the origin of the universe is *nothing*, that is something on the one hand and nothing on the other, *something-nothing*, an abstract fundamental contradiction, *being-thought*.

Drawing on the well-known experimental results, general intuition and common sense, suggesting *the wave-corpuscular duality* to be the basic, fundamental contradiction in the physical subatomic world, we conclude that the origin of the universe is some elementary particle, a carrier of the wave-particle duality with no physical properties, *an electron.*

**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 particle, *a virtual positron.* The latter is like the electron and likewise abstract. They differ in their primary feature: the electron being primarily *a wave,* while the positron *a corpuscular*; thus the virtual electron is *a wave-particle*, while the virtual positron is a *particle-wave*.

**C.** Tthe above virtual electron and positron are the dual images of each other, can replace each other and do replace each other, producing 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, with its intrinsic intensity, the virtual positronium is characterized by *energy E* and therefore is *real.*

***Comments:***

(1) The above particles should have been given new terms, *'electrino'* and '*positrino'*, for example, because the terms 'virtual electron' and 'virtual positron' seem to be used now in a different sense; but as objection to these terms has not been expressed so far, we will use them tentatively throughout this research.

(2) It is noteworthy 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. Complex 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 *quantums* of energy, *photons.* The photon is primarily the manifestation of the virtual particles' wave properties. However, the photon inherits its ancestors' wave-corpuscular dualism and therefore has hidden corpuscular properties as well. Due to this, 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 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. The composium is characterized by its *state* and 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

$$E = E_m \pm iE_p \qquad (1.1)$$

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. Vacuum

**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, i.e. 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 $\varepsilon_o$ , 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 $\mu_o$ , the so-called *permeability of a vacuum.*

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

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

actually the *connectivity* of ether, or, in modern terms, the *velocity of light in a vacuum.*

***Comments:***

(1) It is easy to notice the above definition of vacuum to be fairly close to Dirac's concept of it as a background of negative energy electrons occupying all the states possible [1].

(2) 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 accounted for by the fact that, as shown in Sec.1.4, here $E_m<0.$ Taking (1.3) and (1.4) into account, we present (1.1) as

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

and then arrive at the formula

$$|E|^2=m^2c^4+p^2c^2 \tag{1.6}$$

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. Coherent multitude of composiums

**A.** Vacuum is a boundless and indefinite multitude of composiums. Due to the isolation and mutual repulsion of composiums, that multitude is discrete; due to the identity and attraction of composiums, that multitude is continuous. As a sequence of transitions from one state of the composium to another, this multitude is *space* measured by *distance r. A*s a sequence of the cycles of resurrection of states, which as such are identical to each other, this multitude is *time t.* However, the transition of the composium from one state to another is also the resurrection of its state, which means equivalency of time and space in vacuum and is described by the well-known identity

$$r = c\,t \tag{1.7}$$

Thus space and time in vacuum 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 coherently close to it 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 number

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

which we shall call 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 unlimited number of composiums coherently connected with the given original composium. Thus the coherent multitude combines the features of both the whole multitude, vacuum, 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,*

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

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 vacuum 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 vacuum, because in the 'clear' vacuum there are neither independent 'landmarks' for identifying direction, nor a 'clock' for gauging time. Therefore, in vacuum space is time-like, that is half-dimensional, which is expressed by (1.7).

(2) Formula (1.8) is a natural generalization of the real wave numbers used in modern physics, while function (1.9) may be considered a generalization of the expression for the wave function of a particle in free space.

## 1.5. Bounded 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* $A_\chi$.

**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, i.e. contains its boundary within itself. Therefore, the coherent multitude may be characterized by the *elasticity of the boundary,* or its *external measure* $B_\chi$.

**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*

$$C_\chi = A_\chi \pm i B_\chi \tag{1.10}$$

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

$$C_{\tilde{\chi}} = \tilde{C}_\chi \tag{1.11}$$

## 1.6. Correlation domain

**A.** The bounded multitude, with its elastic boundary, is its own boundary, its center presented by the complex measure $C_\chi$ and coherently correlated with the center of another bounded multitude, distanced from the former by a space-time interval *s*, according to the function (1.9).

**B.** The center of the bounded multitude is also its own boundary, a singularity, a unity with its own boundary, *a movement along an infinitesimal circle* in the plane of the complex parameter χ, characterized by the relation

$$\oint \frac{1}{\chi} d\chi = 2\pi i, \tag{1.12}$$

the circle differing from its center by an infinitesimal quantity $d\check{c}$ and an infinitesimal measure $dC_\chi$, the ratio of these quantities,

$$S(\chi) = \frac{dC_\chi}{d\chi} \quad , \tag{1.13}$$

determining *a complex measure density.* The function $S(\chi)$ is the *complex energy spectrum* of composiums in vacuum; it determines the relative intensity of the respective bounded multitudes, thereby setting up *a spectral correlation* between them in the half-plane $\Re\chi < 0$ bounded by the half-plane $\Re\chi \geq 0$ - *the boundary of correlation.* As follows from (1.11) and (1.13),

$$S(\tilde{\chi})=\tilde{S}(\chi) \tag{1.14}$$

**C.** The coherent correlation and the spectral correlation of bounded multitudes form by the same process of photon exchange and therefore fall into unity producing some pattern of correlation, *a correlation domain of vacuum,* characterized by the function

$$g(s)=\frac{1}{2\pi i}\int_L S(\chi)\mathrm{e}^{\chi s}d\chi;\quad \Re\chi\geq 0 \tag{1.15}$$

which, due to the relation (1.14), 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* vacuum.

In the correlation domain, the definiteness inherent in bounded multitudes and their spectral relation vanish, and vacuum arrives at a simple relation towards itself, turning into a *correlative space-time* and thereby completing its development as the 'clear' vacuum. This completeness manifests itself in the realness of the function (1.15) which is a comprehensive, essential characteristic of vacuum.

***Comments*:**

(1) When reviewing the evolution the above concept of vacuum has undergone, we see that in the beginning vacuum, 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, vacuum turns into a self-supported immediateness, becomes identical to itself. Thus vacuum has been shown here in the process of its self-affirmation, which, as mentioned in the Introduction, is a necessary attribute of any respectable theory.

(2) Vacuum per se, a clear vacuum, is an *arithmetical* space and therefore differs drastically from its so-called 'electromagnetic' models advanced by modern theory and considered four-dimensional continua.

(3) Note that the transform inverse to (1.15),

$$S(\chi)=\int_0^\infty g(s)\mathrm{e}^{-\chi s}ds\ , \tag{1.16}$$

is the Laplace transform of $g(s)$, which is known to be analytic in the half-plane $\Re\chi>0$. Therefore, the expression (1.15) makes sense only if the curve $L$ lies in the half-plane $\Re\chi\geq 0$, the motion along it being anti-clockwise. In case $\Re\chi=0$, expression (1.15) still holds turning into the Fourier integral.

(4) The existence of ether is confirmed by the so-called Cosmic Microwave Background Radiation which seems to be a natural thermal radiation of ether with its natural black body radiation spectrum.

# Conclusion

The above part of the research provides at least a qualitative solution to the problem underlying theoretical physics, that of the existence, the composition, and the properties of ether, the medium to support the propagation of electromagnetic radiation in space. As shown here, this medium does exist and proves relativistic by its very nature. Thus this research settles the controversy between the physics of the 19th century, that stated the above problem and tried to solve it, and modern physics, that has almost abandoned that problem on the ground of the formal deductions of the theory of relativity.

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# Chapter 2. Spontaneous generation of neutrons

## Introduction

In this part of the research, published first in 2004 [1], a new theory of the so-called elementary particles is stated, the one lying outside the mainstream of modern theories based, as a rule, on the properties of symmetry of those particles (see, for example, [2,3]). The results obtained here suggest a new explanation of the origin of matter in the universe. Besides they shed light on the origin and the structure of the electron and the features of the mesons. This chapter is the continuation of Chapter 1 and is based on the same method.

## 2.1. A self-consistent cloud

**A.** The correlation domain of vacuum (see Sec.1.6), is a stable, self-consistent pattern of correlation, the indication of the *self-consistency* of vacuum itself, owing to which vacuum is a steady medium identical to itself. The correlation function $g(s)$ of vacuum 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 to the same extent as the second with the first. Thus there takes place correlation of 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 above when we had to introduce 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 spatial points we shall denote $q$, meaning the totality of their 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,* and as such is *the singularity* of vacuum. 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, $\varphi_o$, 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,

$$w(q)=g^2\otimes\varphi_o=\int g^2(|q_1|)\varphi_o(q-q_1)dq_1 \tag{2.4}$$

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 logical conclusion about matter being generated by some kind of convolution of space and time was made first by Hegel who stated, *"Space and time twist themselves into matter"* [5].

## 2.2. A balanced 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 processes in the self-consistent cloud, we should determine the relation between $\psi$ 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,

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

the *tilde* sign over the character is 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

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

The scattering of photons provides *exchange interaction* of the self-consistent cloud with vacuum, 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 vacuum. That boundary is self-conjugate in a sense: not only does it scatter centrifugal photons, but, due to the exchange interaction with vacuum, 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 vacuum. In its turn, the exchange interaction with vacuum 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 vacuum 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 vacuum is brought into balance with the rate of the reflection degradation energy, which, taking into account (2.5) and (2.8), corresponds to the relation

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

## 2.3. A self-controlled 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 – *time reflection.* As it is the change of the wave function in time that is essential for the time reflection, the latter's energy, to within a constant factor, is

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

where $c$ is the velocity of light in a vacuum.

**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 – *space reflection.* As it is the change of the wave function in space 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.** The pair interaction of virtual electrons and positrons results in their spontaneous annihilation and radiation of photons, thus contributing to the exchange interaction by means of photon exchange. In its turn, the exchange interaction, due to the spontaneous generation of virtual electrons and positrons in that process, turns into the pair interaction. However, that connection is not immediate but mediated by the exchange interaction with vacuum. In that process, a change of the time reflection gives rise to the respective change of the space reflection and the penetration of that change through the boundary; but the latter *bounds* that change, that is, leads to such a change of the exchange interaction with vacuum, and that of the degradation of reflection, which seek to restore the original reflection intensity, unless its change was too large. 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

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

It is easy to show that

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

and

$$\frac{\partial}{\partial t}(\psi, \Delta\psi) = 2(\frac{\partial\psi}{\partial t}, \Delta\psi) \tag{2.13"}$$

in which case (2.13) is equivalent to the equation

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

The latter seems to be known as the equation of *the full internal reflection.*

## 2.4. A self-conjugate cloud

**A.** The effect of self-control in the self-controlled cloud gives rise to the 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,

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

$H$ is the matrix operator,

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

$I$ 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 the corresponding 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

$$\lambda^2 U - c^2 \Delta U = 0 \tag{2.20}$$

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

$$A = \int g^2\,dq \tag{2.21}$$

**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 $\varphi_o$. 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

$$\lambda U + H_o U = 0, \tag{2.22}$$

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

$$\lambda_n = \lambda_0. \tag{2.23}$$

Thus, the two different characteristics of vacuum, represented by the functions $g$ and $\varphi_o$, 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 (2.22). 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 vacuum (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

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

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

$m_k$ 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

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

## 2.5. The consistent 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 vacuum where the correlation of processes is different.

**B.** In vacuum, 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 vacuum* for the processes and their rates.

$$G=\begin{pmatrix} g \\ g \end{pmatrix} \tag{2.29}$$

**C.** Under the influence of exchange interaction with vacuum, its mode of correlation penetrates the self-conjugate cloud, impelling it to conform its totality of independent particular modes of correlation with that of vacuum. 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 [4].

Thus a spatial consistency with vacuum 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,

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

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

## 2.6. Discussion of the results

**1.** As follows from the above development, the first four creatures – the self-consistent, the balanced, the self-controlled, and the self-conjugate clouds – depend on the correlation function of

vacuum, 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*; while the above earlier creatures, not consistent with vacuum, correspond to the much less stable types of the so-called elementary 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 vacuum there takes place spontaneous generation of mesons and neutrons because this process, as shown above, is logical 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 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).

**3.** The above result confirms the well-known dialectical thesis that *"the essence must appear"* (see [6], §131). The essence of vacuum is the correlation of composiums in its correlation domain, defined by the correlation function. The birth of neutrons in vacuum is the materialization, or the '*existence* ' of that essence, because the neutron is a discrete model of the above correlation domain. Thus the aspiration for evolution and self-expression, common for the nature in general, is inherent in vacuum as well.

**4.** The conclusion about the process of spontaneous generation of mesons and neutrons in vacuum 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. Thus this result enables us to give 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 modern theory. 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 fram es 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 investigated 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.** As (2.18) suggests, the self-conjugate composium in the n-state is the basis of the *real electron* to be created after the neutron decay; the pair of momenta transforming into the *spin* of the electron; the real and imaginary parts of the factors $C_n$ and $\tilde{C}_n$ transforming into 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 is, 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 formation and transformation into the electron during the muon decay.

## Conclusion

There have been obtained new results introducing a drastic change to the existing theories concerning the nature and the adequate way of description of the so-called elementary particles, and the origin of matter in the universe.

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# Chapter 3. The neutron becoming the atom

## Introduction

In modern physics the neutron decay is considered a kind of so-called weak interaction and there is a lot of works based on such an approach, for example, [1,2]. In our view, such an approach is based on abstract assumptions and inadequate to the problem. Our above investigation of the nature and the structure of the neutron makes it possible to develop quite a different approach to, and interpretation of, the above process. This part of the research was published first in [3] and is stated here with some correction.

## 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 vacuum; it is characterized by its $4n$-component correlation function,

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

Function (3.1) 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 spacial 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 $\lambda_k$. 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 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 $\lambda_k$ 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 $H$.

## 3.2. An organized cloud

**C.** (1) As follows from the above reasoning, 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 spacial 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.

(2) Indeed, under the influence of the above contradiction, on the one hand, and the exchange interaction with vacuum, on the other hand, the structure of the consistent cloud undergoes re-structuring: there takes place the 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* (H-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.

Through the exchange interaction with vacuum, 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 the most perfect discrete model of vacuum, on the other. For that reason, the organized cloud is immune to the destructive influence of vacuum and hence absolutely stable.

With the identity of space and time in vacuum 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, means the transformation of the space consistency of the neutron into the time consistency of the H-atom.

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

$$\begin{array}{c} \delta_{11}\varphi_1+\delta_{12}\varphi_2+...+\delta_{1n}\varphi_n=0 \\ \delta_{21}\varphi_1+\delta_{22}\varphi_2+...+\delta_{2n}\varphi_n=0 \\ ----------- \\ \delta_{n1}\varphi_1+\delta_{n2}\varphi_2+...+\delta_{nn}\varphi_n=0 \end{array} \qquad (3.4)$$

where

$$\delta_{ik}=\alpha_{ik}\frac{d^2}{dt^2}+\beta_{ik}\frac{d}{dt}+\gamma_{ik}, \qquad (3.5)$$

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

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

and the n-vector function

$$\boldsymbol{\Phi}=\begin{pmatrix} \varphi_1 \\ \varphi_2 \\ ... \\ \varphi_n \end{pmatrix} \qquad (3.7)$$

we rewrite (3.4) as

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

or

$$\frac{d\boldsymbol{u}}{dt}+\hat{H}\boldsymbol{u}=0, \qquad (3.9)$$

where

$$\boldsymbol{u}=\begin{pmatrix} \frac{d\boldsymbol{\Phi}}{dt} \\ \boldsymbol{\Phi} \end{pmatrix} \qquad (3.10)$$

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

The partial solution of (3.8) is known to be

$$\boldsymbol{u}=\boldsymbol{U}\,\mathrm{e}^{\lambda t} \qquad (3.12)$$

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 $\lambda$ is determined by the characteristic equation

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

and is supposedly close to the respective frequency of the consistent cloud.

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 (3.8),

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

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 vacuum.

The vector function ***u(t)*** characterizes the structure of the organized cloud and may be called its *structural function.* Its *k*-th 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 $\lambda_k$; the vectors

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

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

## 3.3. Atomic 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 vacuum. 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 $\frac{d^2\boldsymbol{\Phi}}{dt^2}, \frac{d\boldsymbol{\Phi}}{dt}, \boldsymbol{\Phi}$ 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 $\pi$-meson, the *K*-meson, and the $\eta$-meson, two

quarks in each; these quarks being described as relative combinations of the quarks found in the nucleons (see, for example, [4,5]). 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 vacuum. 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: *А/В, А/Г, В/А, В/Г, Г/А, Г/В*. These quarks implement the simplest operations, those of the conservation of energy and exchange interaction with vacuum, and may be called, accordingly, *the quarks of conservation* and *exchange.*

## Conclusion

There have been obtained new results concerning the structure and the adequate way of description of the hydrogen atom, which introduces a useful and promising supplement to modern theories.

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# Chapter 4. Parameters and characteristics of ether

## Introduction

In this part of the research, published first in [1], we show that the above theoretical conclusions are confirmed by available experimental data on cosmic rays, making it possible to evaluate the essential parameters and characteristics of ether. In particular, there have been evaluated the normalized energy spectrum of ether and its correlation function, which enabled us to evaluate also the dimensions of subatomic particles and the electron.

## 4.1. The normalized energy spectrum of ether

### 4.1.1. Experimental data on cosmic rays

Now that the existence of ether has been confirmed and elucidated by the above theoretical analysis, it is necessary to evaluate its characteristics. To begin with, we should try and evaluate the spectrum of photons in ether, making use of the available data on cosmic rays. So let us consider the experimental data on the spectrum of cosmic rays stated in [2], and reproduced in rough in Fig.4.1.

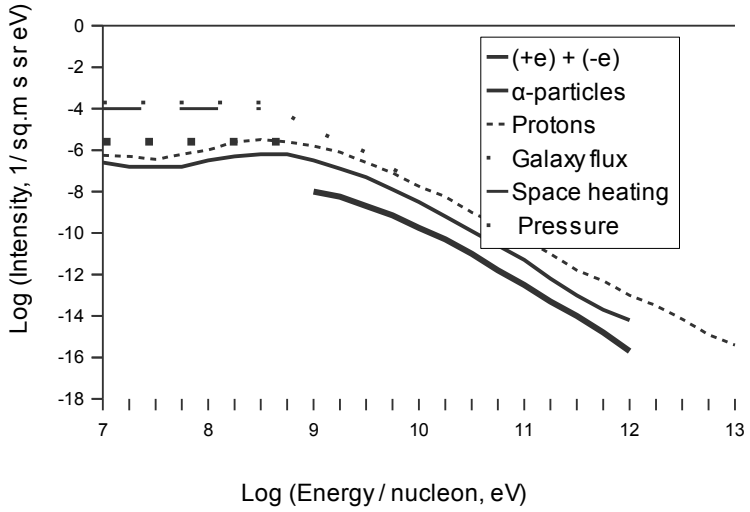


**Fig.4.1 Spectrum of cosmic rays**

Analyzing the spectra of different particles (electrons, positrons, protons and α-particles) depicted there, we notice that they have approximately the same cut-off energy (about $10^{8.5} eV$ ) and the same steepness of their slopes (about 2.7) for energies beyond the cut-off up to about $10^{12} eV$ .

This implies that the spectrum of the primary cosmic particles beyond $10^{8.5} eV$ does not depend on the nature of the particles and is determined only by the properties of ether. Therefore, the primary cosmic photons, which cannot perhaps be detected directly, but are nevertheless present in cosmic rays, should have the same spectrum, too. To evaluate the latter, let us consider the spectrum of cosmic rays electrons that should be more characteristic of the spectrum of photons.

A detailed information on the spectrum of cosmic rays electrons is stated, for example, in [4], and is reproduced in rough in Fig.4.2.

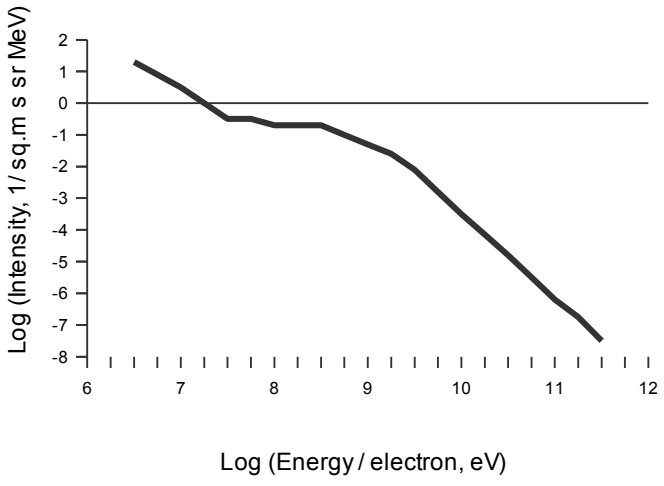


**Fig.4.2 Spectrum of cosmic rays electrons**

The spectrum depicted there consists of two parts, the main one which corresponds to energies above $10^8$eV and is ready to approximation, and the lower one which corresponds to energies below $10^8$eV and is distorted thoroughly by solar activity. The curve seems to have a plateau and is quite monotonous, as compared with the spectra of protons and α-particles (Fig.4.1), with their distinct extrema. Because of the small mass of electrons and their probable direct transformation to photons via collision with positrons, the spectrum of cosmic photons should be closer to that of electrons, rather than to those of α-particles and protons, and therefore should have the same plateau as well. Additional considerations impel us to make a much stronger assumption: the spectrum of cosmic photons is likely to have a plateau from $10^{8.5}$eV down to the zero energy.

## 4.1.2. The spectrum of cosmic rays photons

To substantiate the above assumption, let us return to Fig.4.1, to its dotted, dashed, and bold-dotted lines. As indicated in [3], the first corresponds to the estimated galactic flux, as interpreted from satellite measurements; the second is the spectrum required for interstellar cloud heating, and the third is that required for pressure support of the galactic disk. Thus different authors, from different points of view, have arrived at the same conclusion, i.e. the spectrum of the galactic flux, and therefore of cosmic photons as well, should have a plateau from about $10^{8.5}$eV down perhaps to the zero energy.

To be more confident with the above assumption, let us consider now three additional arguments of our own. The first one is that the spectrum of cosmic photons, being supposedly the Fourier transform of the correlation function, or its like, which is a positive one, should have a positive zero-energy component.

The second argument is that the electromagnetic properties of ether have been experimentally found to be constant from extremely low frequencies to, at least, X-rays.

The third argument is that in depicting the spectrum of cosmic rays we should not ignore their isotropy. Indeed, as the momentum of a cosmic rays particle is a 3-vector, the three-dimensional spectrum of momentum of cosmic rays, given their isotropy, is a function spherically symmetrical about the center of coordinates, the latter corresponding to the zero energy. In a one-dimensional representation, this spectrum is an even function, and the problem of hypothesizing the missing part of th spectrum of electrons and therefore photons is thus reduced to that of the interpolation of the even function in a close vicinity of its zero abscissa, as shown on a linear scale in Fig.4.3 for the spectrum of photons.

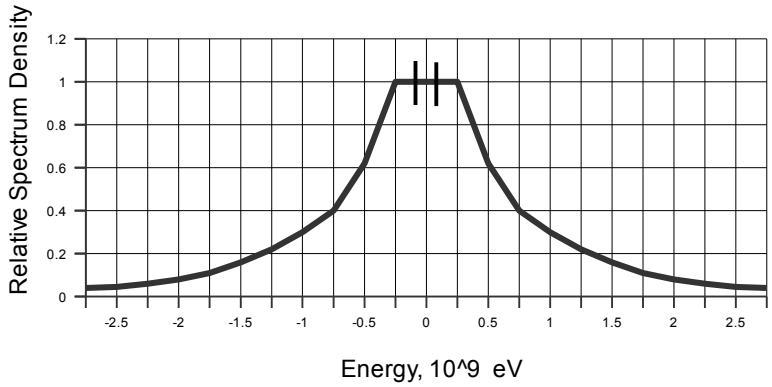


**Fig. 4.3 Spectrum of cosmic rays photons**

The most natural form of the above-mentioned interpolation is, graphically, a straight line connecting two symmetrical points at $\pm 10^8$ eV indicated in curve of Fig.4.3 by two vertical dashed lines. Consequently, applying a piecewise linear approximation to the rest of the curve, we obtain the following evaluation of the *normalized* energy spectrum (the relative intensity, P) of ether:

$$\log P(E_{eV}) = \begin{cases} 0; & 0 \le \log E \le 8.5 \\ 8.5 - \log E; & 8.5 \le \log E \le 9.0 \\ 15.7 - 1.8 \log E; & 9.0 \le \log E \le 9.5 \\ 24.06 - 2.68 \log E; & 9.5 \le \log E \end{cases} \tag{4.1}$$

## 4.2. Correlation function of ether

### 4.2.1. Formulas for computation

To evaluate the correlation function of ether (CFE), we should observe that the above evaluation of the spectrum of photons in ether (SPHE) deals with the relative probabilities of particles, which are associated with the second power of their wave functions, while the CFE, being a superposition of partial functions, is associated with the first power of wave functions. Therefore, on a linear scale, the first power of the absolute value of the SPHE is

$$SPHE(E) = 10^{0.5 \log P(E)} \tag{4.2}$$

As shown in Chapter 1, see (1.15), the CFE is determined by the formula

$$g(r) = \frac{1}{2\pi i} \int_L S(z) e^{zr} dz; \quad z = x + iy; \quad x \ge 0; \tag{4.3}$$

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

$$S(z) = F(x, y) e^{i\varphi(x,y)}, \tag{4.4}$$

where

$$F(x, y) > 0; \quad -\pi < \varphi(x, y) \le \pi; \quad \varphi(x, -y) = -\varphi(x, y); \tag{4.4'}$$

and taking natural logarithm of both sides, we get the function

$$\ln S(z) = \ln F(x, y) + i\varphi(x, y), \tag{4.5}$$

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 conditions

$$\frac{\partial f}{\partial x} = \frac{\partial \varphi}{\partial y}, \quad \frac{\partial f}{\partial y} = -\frac{\partial \varphi}{\partial x}. \tag{4.6}$$

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

$$f(x_{0,}\, y_0) = \frac{x_0}{\pi} \int_{-\infty}^{\infty} \frac{f(0,y)\,dy}{(y-y_0)^2 + x_0^2}. \tag{4.7}$$

Now, taking into account that $f(0,y) = \ln SPHE(y)$ and $SPHE(0) > 0,$ we are in a position to determine the functions *S(z)* and *g(r)* by the known function $SPHE(y).$ To that end, we should determine first the function *f(x,y)* by the formula (4.7), then, using relations (4.6), find the function *φ(x,y),* for example, by the integral

$$\varphi(x,y) = \int_{y_1=0}^{y} \frac{\partial f(x,y_1)}{\partial x}\, dy_1, \tag{4.8}$$

and, finally, find the functions *S(z)* and *g(r)* through the formulas (4.4) and (4.3), respectively.

## 4.2.2. Computation

A simplified block-program for computing the CFE according to the above algorithm is stated in Fig.4.4, 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 computation was implemented with a programmable calculator for three cases: D=0.05fm (L=100), D=0.025fm (L=200), and D=0.01fm (L=500), corresponding to three ranges of energy: $1.26\times10^{10} eV$, $2.52\times10^{10} eV$ and $6.3\times10^{10} eV$, respectively. The results of computation on a linear scale are shown in Fig.4.5 and Fig.4.6. The full program is stated in the Appendix.

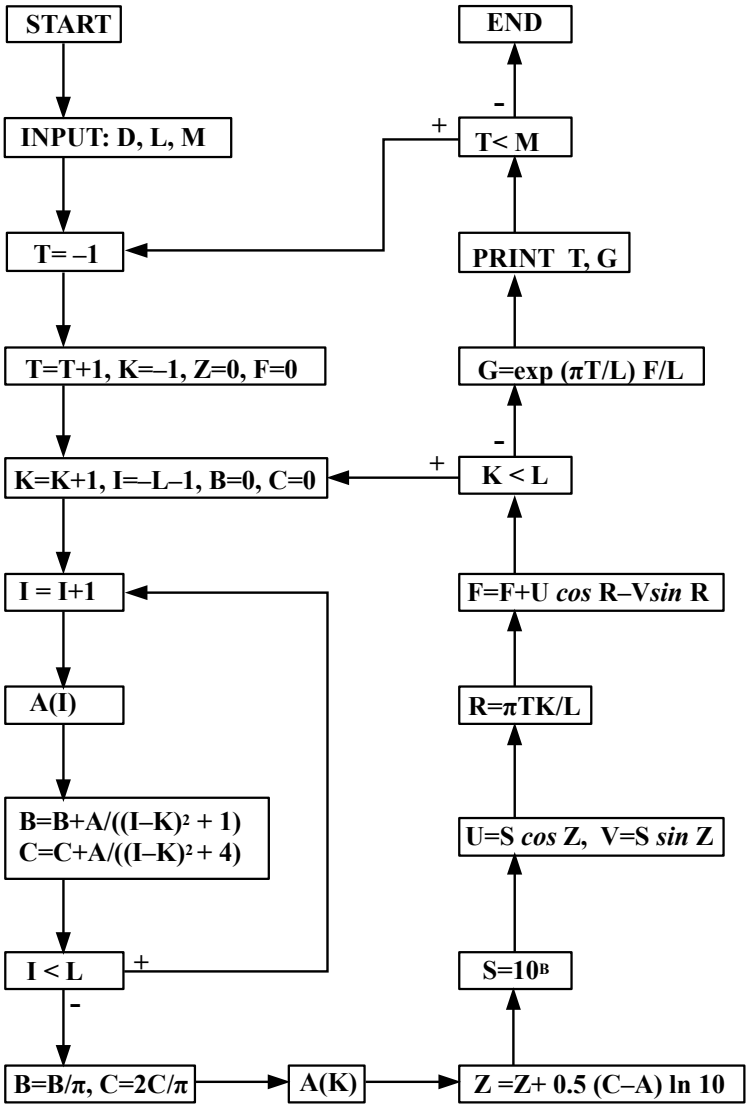


**Fig.4.4 Block-program of computation**

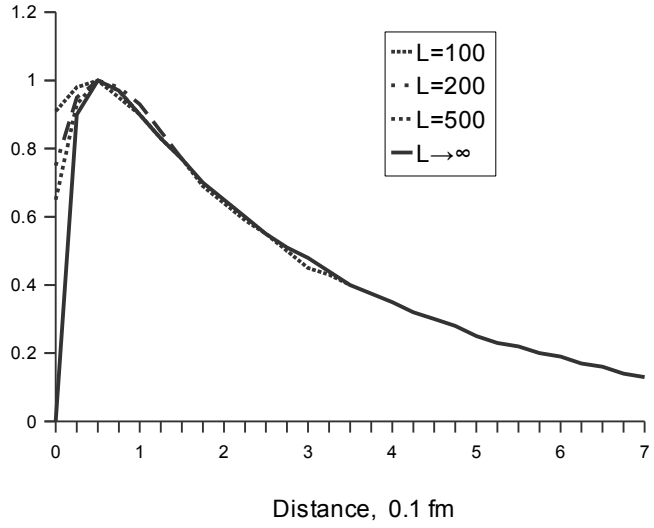


**Fig. 4.5. Correlation function of ether**

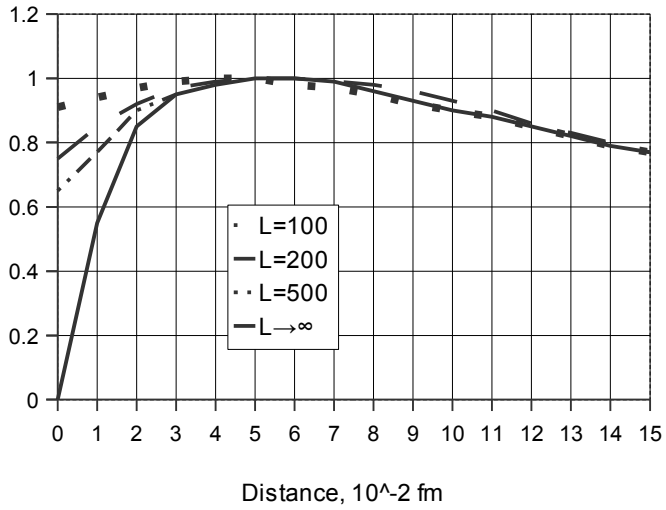


**Fig. 4.6. Correlation function of ether. Detail**

## 4.2.3. Analysis of the results

As seen in Fig.4.5, the computed curves consist of two parts, ascending and descending, meeting approximately at the distance $r_{et} \sim 0.052$ *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.

The above results seem to be quite comprehensible from the physical point of view. Indeed, the

CFE 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 of the point $r$=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 CFE at $r<r_{et}$ .

The second part of the curves ($r>r_{et}$) 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. The very fact that the above computation has exposed this intrinsic exponential character proves the above approximation of the experimental data, as well as the subsequent evaluation of the energy spectrum of ether, to be sufficiently accurate.

Taking into account both the calculation results and the above reasoning, we can describe the CFE, to a constant factor, by the expression

$$g(r) \propto \exp(-\alpha_{et} r) - \exp(-\beta_{et} r) \qquad (4.11)$$

*where* $\alpha_{et}=3.18\ fm^{-1}$; $\beta_{et}=56.81\ fm^{-1}$

The parameters $\alpha_{et}$ and $\beta_{et}$ characterize the rate of degradation with distance of the processes of photon exchange and corpuscular interaction, respectively; accordingly, these parameters may be called the *rate of exchange interaction* and *the rate of pair* (*corpuscular*) *interaction,* respectively. The function (4.11), as shown in Fig.4.5 (the solid curve), seems to provide a good approximation of the computed curves at L→ ∞.

The function $\exp(-\beta_{et} r)$ ,characterizing the zone of uncertainty, enables us to determine the singularity distribution function, SDF (see 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 $\exp(-\beta_{et} r)$ characterizes the SDF. Now, as the function g(r) has been treated above like a wave function, so should we treat its part, the function $\exp(-\beta_{et} r)$ . To convert a wave function into the density function, we should square it. After normalization, we arrive at the following form of the SDF :

$$\varphi_o(q) = \frac{2\beta_{et}^{\ 3}}{\pi^2}\exp(-2\beta_{et}|q|) \qquad (4.12)$$

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

## 4.3. 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 (4.12) may be considered the density function of the mass of the electron in the state of rest. This conclusion enables us to evaluate the the mean radius of the electron

$$\overline{R_e} = \frac{1}{2\beta_{et}} \approx 0.88 \times 10^{-2}\, fm \quad ; \tag{4.13}$$

and its mean square-root radius

$$\sqrt{\overline{R_e^2}} = \frac{1}{\sqrt{2}\,\beta_{et}} \approx 1.24 \times 10^{-2}\, fm \quad . \tag{4.14}$$

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, Its matter density function, as suggested in Chapter 2, is proportional to function (2.4). Taking into account the formula (4.11) and the inequality $\alpha_{et} \ll \beta_{et}$ we may reduce (2.4), similarly to (4.12), as

$$w(q) \propto \exp(-2\alpha_{et}|q|) \tag{4.15}$$

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 (4.15) to be the exact representation of the muon density, which gives the following estimation of the mean radius of the muon,

$$\overline{r_m} = \frac{1}{2\alpha_{et}} \approx 0.16\, fm. \tag{4.16}$$

and its mean square-root radius,

$$\sqrt{\overline{r_m^2}} = \frac{1}{\sqrt{2}\,\alpha_{et}} \approx 0.22\, fm. \tag{4.17}$$

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

$$r_n \approx r_m \times 8.89^{1/3} = 0.459\ fm \tag{4.18}$$

To compare this figure with the existing evaluations, let us consider the values given, for example, in [4]. Analyzing electric and magnetic models of nucleons, the authors arrived at the following evaluations of the mean square-root radii of the neutron: $0.86\ fm$ for the magnetic model and about $0{,}1\ fm$ for the electric model. Additional data received in electron-scattering experiments and revealing distributions of charge within individual protons and neutrons, [5, 6], suggest that the mean radius of the neutron is between 0.3 fm and 0.5 fm. All that means that our above evaluations, though obtained from quite a different approach, seem to match well with the range of existing evaluations.

# Conclusion

This part of the research confirms the theory developed in the previous chapters, concerning the

existence of ether, its composition and properties, and, complementing it with a quantitative analysis based on the well-known experimental data, seems to put an end to this most cardinal and puzzling problem of modern physics.

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## General conclusion

The research stated in this article, owing to its radically new method, has managed to solve some of the most fundamental problems of modern physics, in particular, the origin of the Universe, the existence and the composition of ether, the origin of matter, and the nature of subatomic particles.

## Acknowledgment

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