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A THEORY APPROACH FOR CREATION OF THE MATTER OF UNIVERSE

Duong Van Phi

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Duong Anh Duc

INTERNATIONAL ATOMIC ENERGY AGENCY

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A THEORY APPROACH FOR CREATION OF THE MATTER OF UNIVERSE

Duong Van Phi [1]
International Centre for Theoretical Physics, Trieste, Italy

and

Duong Anh Duc
Department of Computer Science, Hochiminh City University,
227 Nguyen Van Cu, Distr.5, Hochiminh City, Vietnam.

ABSTRACT

We shall represent an approach for the creation of the matter of Universe in the framework of a Quantum Theory, established in an 8-dimensional space. The primitive matter was being created from the Primary Vacuum and it consisted of the deuterons atoms, neutrinos and photons. From these neutral elements the attractive centres were formed and in the final stage an extremely high mass density Universe was built, and successively, the Big-Bang occurred. The problems of particle dominance, of excess of the deuterons and of magnitude of the numbers of neutrinos, etc. are discussed.

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[1] On leave of absence from: Hochiminh City University, P.O. Box 657, Central Post Office, Hochiminh City, Vietnam.

I INTRODUCTION

The hypothesis of a Big-Bang is gradually having the confident evidences [1], [3], [4]. And, for it there are the Theory Models [1], [2], in which the explanations of its evolution are considered. However, up to the present time some fundamental problems, as the problems of the creation of the matter, of the particle dominance, of the magnitude of the number of deuterons, etc..., are really unclosed.

In this paper we shall present an approach of a theory model for the creation of the matter, for the Big-Bang and for its related problems. The representation is based on a Quantum Theory, established in an 8-dimensional space [6], [15]. We shall suppose that the matter of Universe is created from a Primary Vacuum, where are located the fundamental absolutely neutral sets of the Prefermions and Prebosons. The terminology *"absolutely neutral"* means that, the particles in these sets are massless and the particle set has zero energy, zero electric charge and zero Fermionic Number. Preparticles are the ones having the characteristic numbers identical to the characteristic numbers of the corresponding particles, but can have any mass. In the fermion set are enclosed the massless preparticles of the p, e, ν, n and of the $\underline{p}$, $\underline{e}$, $\underline{\nu}$,$\underline{n}$, where the first group particles are of positive energy and the second group particles are of negative energy. For the particles of the first group, the fermionic number F = 1 and for the particles of second group, F=-1.

In the boson set, the massless preparticles of $\gamma, \pi^+, \pi^-, \pi^0$, are enclosed. They can turn only into the particles of positive energies. The sense of *"fundamental set"* relates to the fact that, the particles in this set belong to the dynamical equations, established in accordance with the fundamental group representations. The fermion set belongs to the spinor equation and the boson set belongs to the vector equation, in the above mentioned 8-dimensional Space. The first equation is ivariant on the first rank spinor group representation and the second equation is invariant on the vector group representation.

The notion *"Primary Vacuum"* is issued from the fact that we consider the problems in the Quantum Mechanism category and with the Uncertainty Principle. The last permits the fluctuations to occur in the Primary Vacuum and since occur the appearance of the positive energy particles and the negative energy particles. In this appearance the eletromagnetic field, the field of photon, was created around the charged particles; the strong interaction field, the field of pions, was created around the nucleons; and the weak interaction field, the field of the vector bosons W^+, W^- and Z^0, was created around the neutrinos and others particles. The vector bosons are supposed to be the composites of the photons and pions.

Thus, the positive energy particles were created in the interactions between the preparticles from Primary Vacuum and in the primitive matter there were the deuteron atoms, the neutrinos and the photons.

We shall prove that the negative energy particles should be unobservable, and that in the past,before the Big-Bang, and in the present time, the positive energy particles were and are dominant.

The lowest energy states of the massless preparticles of positive energy are in the Secondary Vacuum. This is the Vacuum of the Quantum Field Theory. And by closure of theory,in this Vacuum must be also the massless preantiparticles, which could become the antiparticles obtaining the positive energies from the primitive matter.

The primitive positive energy matter, as was proved, consisted of the neutral particle systems. And gradually from these systems the attractive centres must be formed. The concentration of these centres involved the formation of the great mass density Universe and the Big-Bang.

In next section we shall present the fundamental postulates for an 8-dimentional Unified Space and the Spinor and the Vector Field Equations, established in this space. We shall define the Primary Vacuum and consider the problem of creation of the particles from this.

In section III, we shall consider the theory of Secondary Quantization. In section IV we shall consider the problem of the matter concentration and the Big-Bang. Finally, in section V we shall make some discussions about the results of this considered theory approach and compare these results those of other theories and with the actual facts in Astromical observations.

II CREATION OF THE MATTER OF UNIVERSE

The 8-dimensional space takes a particular place among n-dimensional spaces. It relates to the algebra of the Octonions as the the Minkowskian Space relates to the algebra of the Quaternions. And as is well known, the successive algebras are the algebra of the complex numbers, the algebra of the Quaternions, the algebra of the Octonions, Thealgebra of the Octonions is maximal normalisable and so we suppose that for the Symmetry and Dynamics of Physics, on the side of dimensions, the 8-dimensional space is maximal [5], [6].

II.1 Fundamental postulates

For the problems of Elementary Particles, we shall start from the following Postulates:

a.The maximal Symmetry for the Elementary Particles is one of the coordinate transformations in an 8-dimensional space, determined by the relation

$$d\xi^2 = dx^2 - dX^2 = 0 \qquad (2.1)$$

where x is the coordinate 8-vector, x = (t,**x**), X = X(T,**X**); **x** and **X** are the usual and internal 3-vectors; t and T are the usual and [Binternal times. The space satisfying (2.1) is called Unified Space [7].

b. In the case of free motion of the particles the Unified Space is divided into two invariant subspaces, Usual and Internal. Then the Usual Space is the Minkowskian Space and the Internal Space is the Euclidean 4-dimensional Space. The spatial relations should be:

$$dx^2 = ds^2 = dX^2 \qquad (2.2)$$

Note that the motion in Internal Space is imaginary and so it should be unobservable [15].

II.2 The Spinor Equation in the Unified Space

The Spinor Equation in the Unified Space takes the form [5]

$$i\Gamma^\mu \partial_\mu \Psi(\xi) = 0 \qquad (2.3)$$

where $\Gamma^\mu, \mu = 1, 2, ...7, 8$, are the 16×16-matrices:

$$\Gamma^k = \begin{pmatrix} \gamma^k & 0 & 0 & 0 \\ 0 & \gamma^k & 0 & 0 \\ 0 & 0 & \gamma^k & 0 \\ 0 & 0 & 0 & \gamma^k \end{pmatrix} B \quad \Gamma^5 = \begin{pmatrix} 0 & 0 & 0 & \gamma^5 \\ 0 & 0 & \gamma^5 & 0 \\ 0 & \gamma^5 & 0 & 0 \\ \gamma^5 & 0 & 0 & 0 \end{pmatrix} \quad \Gamma^6 = \begin{pmatrix} 0 & 0 & 0 & -i\gamma^5 \\ 0 & 0 & +i\gamma^5 & 0 \\ 0 & -i\gamma^5 & 0 & 0 \\ +i\gamma^5 & 0 & 0 & 0 \end{pmatrix}$$

$$\Gamma^7 = \begin{pmatrix} 0 & 0 & \gamma^5 & 0 \\ 0 & 0 & 0 & -\gamma^5 \\ \gamma^5 & 0 & 0 & 0 \\ 0 & -\gamma^5 & 0 & 0 \end{pmatrix} \qquad \Gamma^8 = \begin{pmatrix} 0 & 0 & -i\gamma^5 & 0 \\ 0 & 0 & 0 & -i\gamma^5 \\ i\gamma^5 & 0 & 0 & 0 \\ 0 & i\gamma^5 & 0 & 0 \end{pmatrix}$$

where γ^k, k=1, 2, 3, 4 and γ^5 are the Dirac matrices

Equation (2.3) has 16 independent solutions. Eight solutions for the positive energy particles and eight solutions for the negative energy particles. We shall denote by A, B, C ...the particles having positive energies and by $\underline{A}$, $\underline{B}$, $\underline{C}$, ... the corresponding particles having negative energies.

II.3 The Nother Theorem in the Unified Space

For determination of the conserved quantities in the Field Theory in the Unified Space let us consider now the Nother Theorem.

We shall denote by $L(\xi)$ the Lagrangian in Unified Space:

$$L(\xi) = L(u_1(\xi), u_2(\xi), ...u_{1;k}(\xi), u_{2;k}(\xi), ...) \qquad (2.4)$$

where $u_i(\xi)$ are the components of the field functions and $u_{i;k}(\xi)$ are their derivations on ξ_k. And we have $\mathcal{A}$ as the Action:

$$\mathcal{A} \ = \ \int L(\xi) d\xi$$

The Extremum Principle $\delta\mathcal{A} = 0$ gives us the relation

$$\int d\xi^{\theta}_{(l),k}(\xi)\delta\omega^{(l)} \ = \ 0 \qquad (2.5)$$

in which

$$\theta^k_{(l)}(\xi) = \frac{\partial L(\xi)}{\partial u_{j,m}}(u_{j,k}(\xi)\chi^k_m - \lambda_{i(l)}) - L(\xi)\chi^k_{(l)} \tag{2.6}$$

The quantities χ^k_m are determined by transformations:

$$\xi \rightarrow \xi' + \chi^k_{(l)}\delta\omega^{(l)}$$

and $\lambda_{i(l)}$ are determined by

$$u_i(\xi) \rightarrow u'_i(\xi') + \lambda_{i(m)}\delta\omega^{(m)}$$

The conserved quantities then should be in the form

$$C^{(l)}_{(l)} = \int d\mathbf{x} dX \theta^4_{(l)}(\xi) \tag{2.7}$$

II.4 Characteristic numbers

Using (2.7) we shall have two following unique conserved internal characteristic numbers: third component of the Isospin I and third component of the so called D-Spin [7]. The Isospin is obtained by rotations in the plans (6,7), (7,5), (5,6) and the D-Spin is obtained by rotations in the plans (8,5), (8,6), (8,7). The Isospin, as well as the D-Spin, take value $\frac{1}{2}$: I = $\frac{1}{2}$, $D = \frac{1}{2}$

The rotations in the plans (2,3), (3,1), (1,2), as usually, give the Spin J = $\frac{1}{2}$.

Thus, the equation (2.3) describes a set of the fermions of J = $\frac{1}{2}$, I = $\frac{1}{2}$ and D = $\frac{1}{2}$. And, accounting the Gell-Mann-Nishijima Relation Q = $I_3 + D_3$ [7] and the above mentioned conserved numbers we shall have the following clssification (table 1)

State	I_3	D_3	Q	Preparticle
1	$\frac{1}{2}$	$\frac{1}{2}$	1	p^+
2	$\frac{1}{2}$	$\frac{1}{2}$	1	$\underline{p}^+$
3	$-\frac{1}{2}$	$-\frac{1}{2}$	-1	e^-
4	$-\frac{1}{2}$	$-\frac{1}{2}$	-1	$\underline{e}^-$
5	$\frac{1}{2}$	$-\frac{1}{2}$	0	ν_e
6	$\frac{1}{2}$	$-\frac{1}{2}$	0	$\underline{\nu}_e$
7	$-\frac{1}{2}$	$\frac{1}{2}$	0	n
8	$-\frac{1}{2}$	$\frac{1}{2}$	0	$\underline{\mathrm{n}}$

Table 1

In the table 1, in the last column we have written the names of the preparticles of the set of fermions belonging to (2.3).

The preparticle is the one having the characteristic numbers identical to the characteristic numbers of corresponding particle, but it can have any mass. The notion of preparticles issued from the Spectral Expansion [8] of the wave functions and about it we shall discuss below.

II.5 Fermion number

We have eight fermions of the equation (2.3). Four of these have positive energies and the four remaining particles have negative energies. Now, let us introduce a global gauge transformation: $e^{i\hat{F}\alpha}$, where α is a scalar infinitesimal quantity and $\hat{F}$ takes the form:

$$\hat{F} = \begin{pmatrix} f & 0 & 0 & 0 \\ 0 & f & 0 & 0 \\ 0 & 0 & f & 0 \\ 0 & 0 & 0 & f \end{pmatrix} \quad in\ which\ f = \begin{pmatrix} 0 & \sigma_3 \\ \sigma_3 & 0 \end{pmatrix}\ and\ \sigma_3 = \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix} \tag{2.8}$$

Then, related to (2.7), the conserved numbers will be

$$\mathrm{F} = \int \overline{\Psi}(\xi)\hat{F}\Psi(\xi)d\xi$$

And it is easy to prove that, corresponding to the states 1,3,5 and 7, F takes the value 1 and coresponding to the states 2,4,6 and 8 the F takes the value -1. So, we obtain that the particles of positive energies have F = 1 and the particles of negative energies have F = -1. The quantity F is a characteristic number for different fermions belonging to (2.3) and so we shall call it the fermion number.

II.6 Spectral Expansion

The equation (2.3) could be transformed into the Dirac equation by using the following unitary operator:

$$U = 2^{-\frac{1}{2}}\left[1 + (P^2)^{-\frac{1}{2}}\Gamma^\alpha P^\alpha\right],\ \alpha = 5,6,7,8$$

Acting this operatorto the equation (2.3), in the momentum representation, we have

$$\left(\Gamma^k p_k + \sqrt{P^2}\right)\psi(p,P) \;=\; \left(\Gamma^k p_k + \sqrt{G^\alpha P^\alpha G^\beta P^\beta}\right)\psi(p,P) \;=\; 0 \tag{2.9}$$

in which p and P are the usual and internal momenta, ψ(p,P) is the Fourier image of Ψ(x,X), obtained from $\Psi(\xi)$ after the about mentioned transformation. The G are the 16x16-matrices satisfying the relations

$$G^\alpha G^\beta + G^\beta G^\alpha \;=\; 2\delta^{\alpha\beta} \tag{2.10}$$

In (2.9) the radical operation should be performed after the derivation action.

Because the Γ^k (k = 1, 2, 3, 4) are diagonal, the equation (2.9) just takes the form of the one of the Dirac equation.

The function $\psi(x, X)$ then could be represented as

$$\psi(x,X) \;=\; \textstyle\sum_{j_1}\sum_{j_2}\int_{-\infty}^{+\infty} dm\ h(j_1,j_2;m)\psi(x,j_1,m)\chi(X,j_2,m) \tag{2.11}$$

where $\psi(x, j_1, m)$ is the usual spinor wave function with the mass m and the set of the characteristic numbers j_1; $\chi(X, j_2, m)$ is the internal spinor wave function with the mass m and the set of the internal characteristic numbers J_2; $h(J_1, J_2; m)$ is the expansion coefficient. The internal spinor wave function satisfies the equation [9].

$$\left(iG^{\alpha}\frac{\partial}{\partial X_{\alpha}} - m\right)\chi(X, J_2, m) = 0 \qquad (2.12)$$

Thus,the function (2.11) is the superposition of the products of the usual and internal spinor wave functions with the determined masses and determined sets of usual and internal characteristic numbers. Each term in (3.1) is invariant on L*O(4) group. The form (2.11) is called the Spectral Expansion of the function $\psi(x, X)$ [8].

II.7 The Vector Equation in the Unified Space

The equation (2.3) is of the most fundamental group representation in the Unified Space, of the spinor representation of the first rank. For the tensor representations it is reasonable to consider the equation of vector representation as the nontrivial fundamental. It takes the form [7]

$$\partial^2 V_{\mu}(\xi) = 0 \quad (\mu = 1, 2, ..., 7, 8) \qquad (2.13)$$

The vector function satisfies the generalized Lorentz condition

$$\partial^{\mu} V_{\mu}(\xi) = 0 \qquad (2.14)$$

In the case of variable separation we shall have two equation pairs of x and of X:

$$(\partial^2 + m^2) A_k(x) = 0 \quad (k = 1, 2, 3, 4) \qquad (2.15)$$

$$(\partial^2 + m^2)\phi(X) = 0 \quad 0 \leq m^2 \leq \infty \qquad (2.15')$$

with the Lorentz condition

$$\partial^k A_k(x) = 0 \qquad (2.16)$$

and

$$(\partial^2 + m^2)\Pi_{\beta}(X) = 0 (\beta = 5, 6, 7, 8) \qquad (2.17)$$

$$(\partial^2 + m^2)\varphi(x) = 0 \quad 0 \leq m^2 \leq \infty \qquad (2.17')$$

with the internal Lorentz condition

$$\partial^{\beta}\Pi_{\beta}(X) = 0 \qquad (2.18)$$

In the relations (2.15)-(2.18) the $A_k(x)$ and $\Pi_{\beta}(X)$ are the usual and internal vector functions; the ϕ(X) and φ(x) are the internal and usual scalar functions.

The Spectral Expansion for the first case is

$$A_k(x, X) = \sum_{J_1}\sum_{j_2}\int_0^{+\infty} dm^2 g(j_1, j_2; m^2) A_k(x, J_1; m^2)\phi(X, J_2; m^2) \qquad (2.19)$$

and for the second case is

$$\Pi_{\beta}(x, X) = \sum_{J_1}\sum_{J_2}\int_0^{+\infty} dm^2 G(J_1, J_2; m^2)\phi(x, J_1; m^2)\Pi_{\beta}(X, J_2; m^2) \qquad (2.20)$$

Using the Nother Theorem for the present case we shall have the result shown in table 2

State	I_3	D_3	Q	Preparticle $E > 0$
$\frac{A_1 + A_2}{\sqrt{2}}$	0	0	0	γ
$\frac{A_1 - A_2}{\sqrt{2}}$	0	0	0	γ
A_3	0	0	0	γ
$\frac{\Pi_5 + i\Pi_6}{\sqrt{2}}$	1	0	1	π^+
$\frac{\Pi_5 - i\Pi_6}{\sqrt{2}}$	-1	0	-1	π^-
Π_3	0	0	0	π^0

Table 2

Thus the equation (2.14) describes the particle set, in which the the prephotons of the particle group I(J)=0(1) and the prepions of the particle group I(J)=1(0) are enclosed.

II.8 Primary Vacuum

From (2.11), (2.19) and (2.20) we can see that there are the states of zero mass and since exsist the states of zero energy. Now let us consider the set of the prefermions. In these states this set is absolutely neutral: zero energy, zero electric charge and zero fermion number. By the local Lagrangian (2.4) we have that the pr[Befermions are located in the point ξ in the Unified Space and the set of these presented as a Bose-Einstein Statistics particle. And we shall call the corresponding point in the momentum space a point of the Primary Vacuum.

Related to the equation (2.13), we have a vacuum point of the neutral set of the prephotons and prepions, where each of these has the zero energy.

Thus, we can define the Primary Vacuum as the Hilbert Subspace, composed by the points, where are located the absolute neutral sets of the zer^ energy (zero mass) prefermions, belonging to the Fundamental Spinor Equation (2.1) and by the points, where are located the neutral sets of the zero energy photons and zero energy prepions, belonging to the Fundamental Vector Equation (2.13).

The Primary Vacuum is stable, perpetual and unobservable.

II.9 Creation of the matter

a. Mass Spectrum

The wave function (2.11) is superposition of the total wave functions with the masses, taking the values from minus infinity to plus infinity. Each term in this is a wave function of a preparticle of a given mass.

The wave functions (2.19) and (2.20) are the superpositions of the total wave functions of the prephotons and prepions, with the masses, taking the values between zero and infinity.

The masses in the Spectral Expansion forms are continual and some of these are coincident to the masses in the Mass Spectrum. In these cases the preparticles become the particles.

We shall suppose that the nature of the Mass Spectrum is similar to the nature of the Energy Spectrum. For an example, let us consider the case of the energy of an electron in an atom. It is that, the electron must be in a determined energy level in the Energy Spectrum of this atom. And, when an electron comes into the interaction domain of the nucleus, if it has an energy different from all energy levels of the atom, it should emit or absorb a part of the energy in order to have an energy just equal to one of the energy spectrum. A preparticle has the same situation. It should transfer a part of its mass (energy) to other bodies, by the decay, or should obtain the energy from other bodies, by the collision, and turn into a corresponding particle.

The similarity between Mass Spectrum and Energy Spectrun could be seen in their structures. Really, in the energy Spectrum there is a fundamental energy level, in which the energy takes the lowest value and the mean life of the electron where takes the highest value. The energy levels increase with the increasing of excitation of the states. Among the excited levels there are usually the metastable levels.

The wave function (2.11) describes the particle and preparticles of spin $J = \frac{1}{2}$ and Isospin $I = \frac{1}{2}$. They are of the particle group $I(J) = \frac{1}{2}(\frac{1}{2})$ [13]. And from the experimental data [12] we can see that among the particles of a given particle group always exists a particle of *"fundamental mass level"*. It is the particle having the lightest mass and longest mean life. The other particles could be considered as the particles of the *"excited mass levels"*

The same situation holds for the case of the particle group $I(J) = 0(1)$ and $I(J) = 1(0)$, which were considered above [12]. Futhermore, among the particles of the *"excited mass levels"* usually exist the particles being in the *"metastable mass levels"*, the levels in which the particles have the mean lives, relatively longer than the ones of the particles in the neighbouring mass levels [12], [13].

We can assume here the view-point that the Mass Spectrum, as well as the Energy Spectrum are the forms of the Rational Structures of the Nature. The affirmation of this could hold accounting the rational conditions posed for the wave functions in solving of the problems of energy spectrum.

We shall use this view-point in the next discussions of creation of the matter. It is that, in the creation, from the Primary Vacuum, generally we have the preparticles and these must be transformed into the corresponding particles with the determined masses. The transformations happen by the way of the decays and of the collisions. The processes, then, should occur with transfering and obtaining the 8-dimensional momenta to and from other bodies. The following processes are the rotations of the 8-dimensional momenta of the preparticles into the ones of the corresponding particles. The last momenta should have the internal 4-momenta, and the lenghts of these must be equal to the masses of corresponding particles [14].

b. Fluctuation in Primary Vacuum

We are considering the problems in the Quantum Mechanism category Theory. The specific property of this is the presence of the Uncertainty Principle for the coordinates and momenta. And, therefore the exact location of a particle in a point of the space and in a point of the Primary Vacuum is undetermined. Since, the coordinate fluctuations and the momentum fluctuations could occur and then the preparticles could be created.

Let us consider now a set of the fundamental fermions in the Primary Vacuum. They are the p and $\underline{p}$ of positive charge; the e and $\underline{e}$ of negative charge; the neutral ν and $\underline{\nu}$ and the neutral n and $\underline{n}$.

By the momentum fluctuations, in the above mentioned pairs, the first preparticles should have positive energies and the second preparticles should have negative energies. The processes should occur in the conservation of energies and momenta.

For the preparticles in a Boson set in the Primary Vacuum, by the fact that these particles could have only positive energies, the momentum fluctuations could happen with the neglected probabilities.

On the other side, the coordinate fluctuations could happen simultaneously with the momentum fluctuations, particularly for the fermion set. Then, the Interaction Field around the prefermions are created.

Let us consider the prefermions of positive energies. These fermions, then, can tranfer some energies to the particles of the Boson set and they should be able to participate in the interactions between the fermions: the pions in the Strong Interaction between the proton and the neutron, the photon in the Electromagnetic Interaction between the electron and the proton.

As is well known, besides the Strong and Electromagnetic Interactions there is another type of interaction, the Weak Interaction, which is effectuated by exchange of the Vector Bosons W^+, W^- and Z^0 [10], [11]. These are very unstable particles: the full width of W^+ and W^- is 2.12 ± 0.11 GeV and of Z^0 is 2.487 ± 0.010 GeV. The masses of the charged Bosons are 80.22 ± 0.26 GeV and of neutral Boson is 91.173 ± 0.26 GeV. The Vector Bosons have the spin $J = 1$ [12].

A note is that the difference of the masses of charged Boson and neutral Boson is very large: $m_Z - m_W = 10.96 \pm 0.26$ GeV. And so it is impossible to assume that the W^+, W^- and Z^0 are the components of an isotriplet.

Taking into account for these facts, it is rational to suppose that the W^+, W^- and Z^0 are the resonance composites of two particles, of a prephoton and a prepion. The W^+ is composed from a prephoton and a positive charge prepion, the W^- is composed from a prephoton and a negative charge prepion and the Z^0 is composed from a prephoton and a neutral prepion. These preparticles were considered above and they can have very large masses.

Before considering the mechanism of the creation of the matter, we would like to remark that, in framework of the interaction approach in the Unified Space, by Spectral Expansion, the exchange factors are not the virtual particles, but they are the virtual preparticles, i.e. they can have any possible masses, related to the internal momemtum conservation [15].

Another remark is that, the natures of the interactions for the particles and for the preparticles are the same [15].

Thus, by momentum and coordinate fluctuations, between the prefermions in the fermion set appear the interactions: strong interaction with exchange of the virtual prepions, electromagnetic interaction with exchange of the virtual prephotons and weak interaction with exchange of the virtual vector prebosons.

The essential stage is transforming the preparticles from the Primary Vacuum to the corresponding particles in the fundamental mass levels. Due to similarity of the Mass Spectrum and Energy Spectrum, these transformations should be performed, if the preparticles can obtain the energies larger than their masses in the mass levels.

In the Primary Vacuum are located also the negative energy prefermions $\underline{p}$, $\underline{n}$, $\underline{e}$ and $\underline{\nu}$. They can give the positive energies to the positive energy preparticles and turn into the particles of negative energies.

Now let us consider the created particles . The nucleons, p and n, then, should be in strong interaction , with exchange of the pion. and the Deuteron Nucleus are formed. The electron, with exchange of the photon, should be attrated by the proton of this nucleus, and so, the Deuteron atom is formed.

The neutrinos in the Primary Vacuum, in this evolution should obtain some energies, by interaction with the electron and nucleons, through the Vector Bosons, and should become free neutrinos.

Thus, in the Universe, in the first period of the matter creation, there were the Deuteron atoms, the photons and the neutrinos.

c. Forbidden transformation from positive energy states to negative energy states

Really, the Fermion Numbers are determined by the matrix (2.8) and it is *"diagonal"* for the particle states and so after division of the particles in the fermion set, the values of the Fermion Numbers remain unchanged. Since, by conservation of the last characteristic numbers, the transformation of the fermions of positive energies into the fermions of negative energies is forbidden.

For the bosons, the photons, pions and vector bosons, the transformation from positive energy state to negative energy state is also forbidden, since they are the particles of positive energies.

d. Noninteraction between the world of negative energies and the world of positive energies

When a particle leaves the Primary Vacuum, to it the invariance is not on the O(7,1) group, but on the L*O(4) group [19], [13]. And in the Usual Space the particles move in accordance with the Relativistic Theory. Then, the particle of positive energies should be in the Future Branch of the Hyperbola and the particle of negative energies should be in the Past Branch of the Hyperbola. And, as is well known, two events could be related only if they are in a branch of the Hyperbola, either in the future branch or in the past branch.

Therefore, between the particles of positive energies and the particles of negative energies the interaction could not be realized.

The observation is realized by interaction of the equipment and the considered body. And, therfore, the bodies of negative energies cannot be observed by our equipments, which are of positive energies. The world of negative energies is really unobservable.

Finally, briefly we would like to discuss about the world of negative energies. Where, as was proved, the interaction exchange factors do not exsist, and so the particles are in the free states. They succesively drift to the infinite past.

III THEORY OF SECONDARY QUANTIZATION

III.1 Quantization of the fields

The Secondary Quantization Theory, the Quantum Field Theory, is formulated on the requirement that the particles must have the positive energies [16]. This is the essential difference between this theory and the above considered one, being in framework of the Quantum Mechanism category.

In the Quantum Field Theory. For the Bosons the Field Operators respect the algebra of commutators and for the Fermions the Field Operators respect the agebra of anticommutators.

We start to consider the problems from the field equations in (2.3) and (2.13). The Statistics for the particles belonging to these equations are the same as in the case of the theory established in Minkowskian Space, that the particles of (2.3) obey the Fermi-Dirac Statistics and the particles of (2.13) obey the Bose-Einstein Statistics [15].

Let us consider the energy, related to (2.3). Before quantization, for the energy we have the expression

$$E \propto \int d\lambda \lambda^0 \left[\overset{*}{a}{}^{+}_{\nu} (\vec{\lambda}) a^{-}_{\nu}(\vec{\lambda}) - \overset{*}{a}{}^{-}_{\nu} (\vec{\lambda}) a^{+}_{\nu}(\vec{\lambda}) \right] \tag{3.1}$$

in which, because of the non-operator nature, there is no difference between $\overset{*}{a}{}^{-}_{\nu}(\vec{\lambda})a^{+}_{\nu}(\vec{\lambda})$ and $\overset{*}{a}{}^{+}_{\nu}(\vec{\lambda})a^{-}_{\nu}(\vec{\lambda})$, which could be explained as the probability density of the negative energy particles.

After quantization the second term in (3.1) obtains a minus sign and therefore, (3.1) turns into the positive energy expression for two sorts of particles: particles and antiparticles. The first terms in (3.1) are of the fermions and the second term are of the antifermions.

At the same time, after quantization, the I_3 and D_3 of the antifermions should take the opposite values [15]. And in the result we have that, the I_3 and D_3 and so the charge Q of the fermions are not changed but for the antiparticles ē, p̄, $^{-}\nu$ and n̄, these characteristic numbers take the opposite values: for ē, $I_3 = \frac{1}{2}$, $D_3 = \frac{1}{2}$ and Q = 1; for p̄, $I_3 = -\frac{1}{2}$, $D_3 = -\frac{1}{2}$ and Q = -1; for $\bar{\nu}$, $I_3 = -\frac{1}{2}$, $D_3 = \frac{1}{2}$ and Q = 0 and for n̄, $I_3 = \frac{1}{2}$, $D_3 = -\frac{1}{2}$ and Q = 0.

For the vector field of the equation (2.13), the quantization is made in accordance to the Bose-Einstein Statistics and so the expressions for the energies, as well as for the characteristic numbers are not changed.

III.2 Separation of the leptons and nucleons from the fermion multiplet

Let us consider now the Spectral Expansion for the fermions. It is easy to see that in Secondary Quantization, the total field operators of the fermions should take the same form as in (2.11), however with a change that the integrals must be taken over the mass values from zero to infinity.

In these expansions there are the products of the usual spinor field operators and internal spinor fiels operators. And here we would like to make a note about their quantizations. Of course, for the usual field operators the quantization should be in accordance with the Fermi-Dirac Statistics. However, as is proved in [17], by Euclidean property of Internal Space, the internal spinor field operators must be quantized in accordance to the Bose-Einstein Statistics.

Another problem which we must consider here is the appearance of the Baryonic number and the Leptonic number in separation of the particles from the fermion set. In table 1 we see that, in the case of positive energies, the third and fifth states are of the leptons and the first and seventh states are of the nucleons; in the case of negative energies, the fourth and the sixth states are of the leptons and the second and eighth states are of the nucleons. And it is clear that after Secondary Quantization, in the places of the last, will be the antiparticles, with the opposit values of the D^3 and I^3

The Spectral Expansions are of the pairs of leptons and antileptons and the pairs of nucleons and antinucleons. The terms in these expansions are invariant on the L∗O(4) group , where L is the Lorentz group and O(4) is the internal group. In this invariance, the internal symmetry can give only the conserved I_3. The D_3 are absent [15]. Then, to

accomplish the Gell-Mann-Nishijima Relation, it is necessary to introduce the baryonic and leptonic numbers [13]:

$$Q = I_3 + \frac{B-L_i}{2} \tag{3.2}$$

where B is the baryonic numbers and L_i are the leptonic numbers of the lepton i (i = e, μ, τ).

To obtain these characteristic numbers we can introduce a global gauge transformation. The argument for this is that the difference between nucleons and leptons is determined by the D_3 : for nucleons $D_3 = \frac{1}{2}$, for leptons $D_3 = -\frac{1}{2}$. And, because the Spectral Expansions do not contain the D_3, they must be presented in some transformation operator for the determination of the kinds of the particles , particularly in deduction of the baryonic numbers and leptonic numbers.

Let us consider a transformation

$$\psi(x)\chi(X) \rightarrow e^{i a_f^{(\frac{1}{2}-D_3)} B \alpha}\psi(x)\chi(X) \tag{3.3}$$

where α is a positive infinitesimal quantity.

Then, for nucleons we have the B, which could be indentified with the baryonic number and for the leptons we have the $a_f B$, which could be identified with the leptonic number $-L_f$ of the leptons f. For the fundamental leptons f = e. For the other *"generations"*, f = μ, f = τ. However, for nucleons, the baryonic numbers are the same as for all other nucleon *"generations"*: N(1440), N(1535), ... [13].

It is easy to see that the baryonic numbers and leptonic numbers of the particles and of the antiparticles are opposit

III.3 Secondary Vacuum

In separation of the particles, the equation (2.3) is divided into four Dirac equations with the masses m = $(P^2)^{1/2}$, and $0 \leq m \leq \infty$. Each of these describes a pair of the prefermions and preantifermions. Then, in the Spectral Expansion of the field operators of these particle pairs, should exsist the states of zero energy (zero mass). The massless preparticle pairs in these states are absolutely neutral and they are formed as a particle system obeying the Bose-Einstein Statistics.

For the vector field of the equation (2.13) we have the same situation. There are the photons and massless neutral prepion sets in the lowest energy states.

We shall define the Secondary Vacuum as a subspace, formed by the above mentioned neutral sets (and the other sets, which will be considered below).

Thus, the Secondary Vacuum is neutral and massless. It should be unobservable.

III.4 Particle creation from Secondary Vacuum

A pairs of particle and its antiparticle can leave the Secondary Vacuum only if it obtain an energies from the other body (bodies). This energy must be twice more than the mass of the corresponding particles. The source of these energies is from the primitive matter. The such creation of the particles and antiparticles is the production of *"laboratory"* actions.

III.5 Other particles and antiparticles

From laboratories and Cosmology investigations, beside of the above mentioned particles, there are the other particles and antiparticles. They are the nonstrange bosons, the strange and charmed bosons, the strange and charmed baryons, etc... and their antiparticles. Here we do not intend to consider all these. But, we shall represent some results, deduced from our theory approach [9], [10]. According to the last theory there are two sorts of particles. The first is called particles of first kind. They are the particles which must have the spins and the isospins simultaneously either integral or half-integral. The second are the particles which could have the arbitrary spins and isospins.

The particles of the first kind are called the normal particles, the ones of $S_t = 0$.

The second kind particles are called the anomalous particles. They have S_t different from zero.

The particles of the first kind belong to the field equations, invariant on O(7,1) group and the particles of the second kind belong to the field equations, invariant on the L*O(4) group.

The above considered particles of the fermion set and boson set are of the first particle kind. Other particles belonging to the last are the mesons η, ω, ϕ, J/Ψ, ρ, ... and the baryons N, Δ, ... [12], [13].

The particles of the second kind are the mesons K, D, D_s, η_c, B, ..., S_1, S_2 and the baryons Λ, Σ, Ξ, Λ_c, Σ_c, Ξ_c ... The S_1, S_2 are called the Spurions. They were supposed in the Heisenberg Unified Field Theory. They have zero-mass, spin J = 0. The S_1 has $I_3 = \frac{1}{2}$ and S_t = -1, the S_2 has $I_3 = -\frac{1}{2}$ and S_t =1. In the free state the Spurions are unobservable [18], [19].

The S_t are introduced into the Generalized Gell-Mann-Nishijima Relation as

$$Q = I_3 + \frac{B - L_i + S_t}{2} \tag{3.4}$$

which is applicable for all particle, hadrons, gauge particles, leptons and Spurions [19]. The S_t could be represented as the summation of the strangeness, charmed number, ... in the Quark Model Theory .

All field operators of the particles of the first kind, as well as of the second kind are able to be represented in the Spectral Expansion [8], and so the corresponding particles should have the lowest energy states, in the Secondary Vacuum. In these states they are massless and composed in form of neutral preparticle sets. The preparticles of these sets

could be turned into the particles by the way of *"laboratory"* actions, as was mentioned above.

IV MATTER CONCENTRATION AND BIG-BANG

In section II we have proved that the primitive matter exsisted in the forms of Deuteron atoms, of photons and neutrinos. The Deuteron atom was a neutral particle system and so it could become an attractive centre. On the other hand, the matter creation happens in accidental situation and so the distributions of the particle systems were inhomogenous. And therefore, the concentration of the matter centres in the Universe was performed successively. Furthermore, these centres had different mass magnitudes and they were distributed inhomogenously, so the bigger attractive centres were formed. The evolutions were continued and finally, a great centre of great mass density was been builded. And, by self attraction of this centre, the mass density contunially was being increased up to a moment, after this, the Big-Bang had occurred.

In this evolution most of the smaller matter centres was concentrated. Most of the photons and the neutinos, were also obsorbed by this grandios centre.

In the concentration processes the 8-dimensional λ, $\lambda = \lambda(p, P)$, of each of the e, p and n, was turned in order to transform the kinetic energy into the mass : $p = p(p^0, \vec{p}) \rightarrow p'(p'^0, \vec{p'})$ and $P \rightarrow P'$, where $|\vec{p}| > |\vec{p'}|$ and $|\vec{P}| < |\vec{P'}|$. Particularly, when $\vec{p'} = 0$ the mass takes maximal value. The rotation of the 8-momentum is a mechanism of the change of the mass in this considered theory [15]. This must hold for experiments, because, for example, in the creation and annihilations of a particle-antiparticle pairs, the mass change is a reality.

The burst of a very high mass density centre could be understood as a result of a horrible protest of the matter components, which were under suppression of actractive forces. The tendency is to return to the normal states, in which each particle is in its fundamental mass level.

The picture after the Big-Bang was one of extremely high temperature, and then the interactions between the particles (preparticles) were neglected. The atoms and nuclei were destructed and the preparticles existed in the individual states.

Next processes were the thermal radiations in thermodynamic equilibrium and the expansion of the Universe. In these radiations great numbers of the thermal photons were emitted.

V DISCUSSIONS AND CONCLUSION

The components of the primitive Universe were the electrons, the protons, neutrons, pions, neutrinos and photons. After, by collisions of these particles of very large energies, the pairs of particles and antiparticles were created. Particle-antiparticle creation is realized in connection with the Secondary Vacuum and so the created pairs could be of the first particle kind, as well as could be of the second particle kind.

We must remark that at any moment of the evolution, the Universe was Neutral, the Barionic Numbers were equal to the Leptonic Numbers and furthermore, these numbers always remained unchanged.

We shall make some discussions about the results of above considered theory approach, compare these with the observed facts and the results of other theories.

Let us consider now the problem of the magnitude of the numbers of neutrinos and antineutrinos.

As it has been, before the Big-Bang the number of neutrinos was in the order of the ones of electrons and nucleons. After the Big-Bang, the neutrinos and the antineutrinos were created from the decays of the neutrons, of the preneutrons and of the preprotons. The decays of the neutrons and the preneutrons give the protons, the electrons and the antineutrinos. Here we would like underline a fact that the preprotons, in principle, could have the masses bigger than the mass of the neutron and so they can be disintegrated into the neutrons, the positrons and the neutrinos. Besides the above mentioned creation of the neutinos and antineutrinos,however, the creation of neutrinos and antineutrinos occured essentially in the stage of thermodynamic equilibrium. In this state, the collisions of the photons could create the neutrino-antineutrino pairs and the numbers of the last, rationally, could reach the number of photons.

In the expansion of the Universe and with the decrease of temperature, some parts of the neutrinos and antineutrinos were annihilated. However, by weak interaction, most of the neutrinos and antineutrinos remained in free states. And, it is reasonable to assume that the numbers of the neutrinos and antineutrinos are comparable with the numbers of the thermal radiation photons.

This conclusion is in agreement with the view-point of some other Cosmology Big-Bang Models [1]. However, for it the observations and verification are very difficult.

The second problem, which could be the most important, is the particle dominance, that the bodies (from atoms) of Universe consist only of the particles.

As it was been , the matter of positive energy, created from the Primary Vacuum, consisted of the particles. In primitive stage of the Universe the matter consisted mainly of the deuteron atoms, photons and neutinos. In the concentration centres the heavy atoms were also formed. And, certainly, besides these, in the attractive centres were the other particles and antiparticles, created from the Secondary Vacuum. They are created obtaining the energy of the primitive matter.

After Big-Bang, in the stage when the temperature was higher than the threshold temperature of the nucleons, the nucleon-antinucleon pairs, the lepton-antilepton pairs and other particle-antiparticle pairs were created. However, by the mass-energy equivalence and the energy conservation, the numbers of these particle pairs were not very great, in comparison with the numbers of the photons, which were emitted in the thermodynamic equilibrium

However, in the process of the decrease of the temperature, the particle-antiparticle annihilations successively were performed, and starting from the temperature lower than the threshold temperature of the electron, in the Universe the particles were dominant.

For explanation of particle dominance in the Universe, in the Cosmology Theory Models there are different hypotheses. Here we will remember some of these. Accounting the fact of particle-antiparticle symmetry in the Field Theories one takes a view-point that the dominance of the particles in our Universe corresponds to the dominance of the antiparticles in other Universe. However, the information from *"Anti-Universe"*, at least up to now, is not obtained. And on the other side, there is also the problem that if there were at some time in the past two these Universes were been the neighbouring ones, by interactions they could be not separated.

Another assumption is that, in the thermodynamic equilibrium there was an excess of particles with the number of magnitude of 10^{-9} of the number of particle-antiparticle pairs. Such excess number, theoretically, could be neglected. However, if it is so, by the mass-energy equivalence, after annihilation of all these pairs, in the Universe should be a great radiation energy. But, as is well known, the last is very small in comparison with the energy of the matter particles

Here we would also discuss the problem of the nucleons. Accoring to present general assumption, the hadrons are composed from the quarks. Nucleons are the composites of 3 quarks, pions are the composites of a quark and an antiquark. And in some Theory Models was supposed that, in the first time after Big-Bang, in very high temperature, the quarks were been in free states. Thus, it can be seen that the problem of excess of the number of the quarks, in comparing with the number of quark-antiquark pairs should appear as above. Furthermore, here we have also another problem, the problem of unification of the quarks into the nucleons.

The unification of 3 bodies in a domain of dimension less than 10^{-13}cm and with the determined components, uud for proton and ddu for neutron, in principle, must be difficult. Moreover, the condition for unification should be more difficult, because all free quarks should be unified in an extremely short stage, about 10^{-6}s. Related to the last situation, we will discuss another problem on the side of theory. As is well known, suggestion of the hypothesis of asymptotic freedom and confinement of the quarks in the hadrons was issued from a result of the effective charge $G(\overset{*}{m})$ of quark interaction. It becomes zero when the distance of two quarks equal to zero and becomes infinity at the critical distance, corresponding to the critical effective mass $\overset{*}{m}$, which is in accordance to the relation:

$$G(\overset{*}{m}) = \frac{g_\lambda^2}{[1 + (\frac{25}{6\pi})(\frac{g_\lambda^2}{\hbar c})\ln\frac{\overset{*}{m}}{\lambda}]}$$

where λ and g_λ are the constants. The critical effective mass then is $\overset{*}{m}_c = \lambda e^{\frac{-6\pi\hbar c}{25 g_\lambda^2}}$. Therefore, when $\overset{*}{m}$ takes value $\overset{*}{m}_c - \epsilon$, where ϵ is a positive infinitesimal quantity, the effective charge $G(\overset{*}{m})$ becomes a negative great charge and then the interaction force between two quark becomes an extremely strong repulsive force. Therefore, after the first moment of the Big-Bang there was not any opportunity for unification of the free quarks into the hadrons.

Was an estimation for the present number of the free quarks that the magnitude of this number is about the one of the gold atoms [1].

Now let us consider the problem of magnitude of the number of deuterons. It is that, after Big-Bang, in very high energies, the deuteron atoms, as well as the deuteron nuclei were destructed. In the lower temperatures the hydrogen atoms, the heli atoms and other heavier atoms successively were formed. But, the deuterons, by their relative unstability, actually, in principle, must be remained with very small quantity. However, from Astronomical observations, a general assumption for the magnitude of the number of deuterons is about 10^{-8} of the number of matter particles [1].

Here we can have another discussion about the magnitude of the number of the ! -drogen atoms. Actually, Astronomic Observations show that it takes a value of 25% of the heli atoms and such value really is very large, if the hydrogen atoms were formed only from the result of the Big-Bang [1].

In this theory approach, as has been, the birth of the Universe was not at the time of occurring of the Big-Bang. The matter creation was and is occuring successively. The deuteron atoms the neutrinos and the photons were and are the primitive forms of the created matter. And, thus, the excess of the deuterons could be explained as the one, which was being created after Big-Bang. In the formation of the attractive centres the deuteron atoms could be destructed and the hydrogen atoms could be formed.

Finally, we would like to note that, at the time of occurring of the Big-Bang, all matter centres could not be concentrated. Some of these, which were very far from the burst centre could be on the way to come to there, and so they could not participate in this burst. After this, in expansion of Universe and formation of the Galaxies, some remained matter centres were being absorbed by the last and some other centres were being continued to come to the place, where was been the old burst centre.

Accounting the discussions above we would suppose that the new celestial matter centres, the new stars, etc..., composed from primitive matter, were and are being in the continual processes of formation.

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