PHYSICAL COSMOLOGY IN RELATIVE UNITS

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The latest astrophysical data on the Supernova luminosity-distance—redshift relations, primordial nucleosynthesis, value of Cosmic Microwave Background-temperature, and baryon asymmetry are considered as evidence for a relative measurement standard, field nature of time, and conformal symmetry of the physical world. We show how these principles of description of the universe help modern quantum field theory to explain the creation of the universe, time, and matter in the way compatible with the Biblical Scenario.

1. Introduction

Physics is the science that concerns the measurable part of our world. Physical cosmology is the science that concerns observations and measurements of the physical parameters of cosmic objects. The results of these measurements, accumulated since ancient times, and their theoretical interpretation within the framework of modern physical theories of space, time, and matter enable one to describe the history of cosmic evolution of the universe in the whole.[1]

In particular, observational data on the dependence of the redshifts z of spectral lines of atoms of cosmic objects on their distance to the Earth,[2] and the new data[3] for large values of redshifts z~1, z=1,7 testify that our universe is mainly filled not with a massive "dust" of far and, therefore, invisible Galaxies, but with mysterious substance of a much different nature, with a different equation of state called Quintessence.[4] The data, including primordial nucleosynthesis and the chemical evolution of the matter in the universe (described in the nice book by Weinberg[5]), point to a definite equation of state of the matter in the universe. This equation helps us to determine a kind of matter taking part in the cosmic evolution of the redshift. The data on the visible number of particles (baryons, photons, neutrinos, etc.) testify that the visible baryon matter gives only 0.03 part of the critical density of the observational cosmic evolution.[6] The data on the Cosmic Microwave Background radiation with the temperature 2.7K and its fluctuations give information about the evolution of the early universe.[7]

Beginning with the pioneer papers by Friedmann[8] and ending with the last papers on inflationary model of the Hot Universe Scenario,[9] all observational data are interpreted in theoretical cosmology as some evidence of the expanding universe. Here, it is necessary to clearly distinguish the expansion of theoretical intervals from the expansion of "measurable intervals" obtained by matching with a particular measurement standard.

Not all clearly understand that this treatment of the Friedmann interval as a measurable one is true, if there are "absolute" units that do not expand together with the cosmic scale factor $a(t)$ in the universe, because an observer can measure only a ratio of physical quantities and the units.

As soon as the cosmic photon has been carved out from an atom, there are two distance scales: the wavelength of a photon and the size of an atom that is determined by its mass.[10] The observer can measure only the evolution of a dimensionless ratio of the size of the atom, emitting a photon on a far cosmic object, to the wavelength of this photon. These measurements irrefutably testify only to a permanent magnification of this dimensionless ratio. However, these measurements cannot tell us which value is affected: the wavelength of the photon, or the mass of the atom emitting the photon? In the first case, a cosmic photon becomes red during transit; in the second case, the photon is emitted red since it is emitted by an atom with smaller mass.

To answer this question, it is necessary to select the unit of measure. Thus, the observer who selected the absolute measurement standard of length (that does not expand together with the universe) concludes that the wavelength is augmented while the one who selected the relative measure, concludes that the mass is augmented.

The real situation is even more complicated. Not all clearly realize that modern cosmology in fact employs a dual standard in describing the phenomenon of the cosmic evolution of photons emitted by a distant cosmic object.

The relative units (expanding together with the universe) are used in observational cosmology to determine initial data for cosmic photons traveling toward an observer,[11] whereas the absolute units are utilized for interpretation of observational data in theoretical cosmology.

Usage of the dual standard in the cosmology means that there are two mathematically equivalent versions of the theoretical description of cosmological data in the form of two mathematically equivalent versions of general relativity and Standard Model of elementary particles.

By virtue of this equivalence the usage of the dual standard in cosmology does not lead to conflicts and enables one to reformulate the theory by treating the relative quantities as measurable ones, and the absolute ones as a mathematical tool for solving problems. As a result we can recalculate all astrophysical data in the relative units, including the conformal time, coordinate distance, and constant temperature, so that the z-history of temperature becomes the z-history of masses.

The attempt at this recalculation has shown[12] that the symmetry of equations of motion of the theory in the relative units increases, and number of phenomenological parameters decreases. This choice of the relative units results in a number of coincidences of parameters of cosmic evolution and elementary particle physics that could be considered as random ones if such coincidences were not so large.

The purpose of the present paper is the description of the results and consequences of the relative measurement standards that expand together with the universe.

2. *Astrophysical data in the relative units*

Modern field theories have their origin in the Faraday-Maxwell electrodynamics. Theoretical cosmology is based on general relativity and the Standard Model of elementary particles constructed in a manner similar to the Faraday-Maxwell electrodynamics, in accord with the predictions of Faraday about a field nature of matter and unity of all forces of nature.

Maxwell revealed that the description of results of experimental measurement of electromagnetic phenomena by the field theory equations depends on the definition of measurable quantities in the theory and the choice of their measurement standard. In the introduction to his "A Treatise on Electricity and Magnetism" Maxwell wrote: "The most important aspect of any phenomenon from mathematical point of view is that of a measurable quantity. I shall therefore consider electrical phenomena chiefly with a view to their measurement, describing the methods of measurement, and defining the standards on which they depend."[13]

Defining a measurable interval of the length as the ratio of a measurable interval to the standard one requires pointing out the measurement standard. In modern physics such a measurement standard of length is the Parisian meter equal to a particular number of lengths of a light wave of a concrete spectral line of the krypton isotope - 86.[14]

Physical cosmology is based on the interval[15]

$$ds^2_{\text{THEORY}}=(dt)^2-a^2(t)\,[(dx^1)^2+(dx^2)^2+(dx^3)^2], \quad (1)$$

expanding with the scale factor $a(t)$. In physical cosmology one uses two standards: the relative and absolute. Observational conformal cosmology (CC) uses the relative Parisian meter

$$\textit{Relative Parisian Meter}=1m\bullet a(t) \quad (2)$$

for measurements of all lengths with the corresponding conformal interval of the space-time

$$ds^2/a^2(t)=(d\eta)^2-(dx^i)^2 \quad (3)$$

of the cosmic photons traveling on the light cone to an observer. This interval is given in terms of the conformal time $d\eta=dt/a(t)$ and coordinate distance.

Theoretical standard cosmology (SC) proposes that all lengths in the universe are measured with respect to the absolute Parisian meter

$$\text{Absolute Parisian Meter}=1\text{m} \quad (4)$$

which is not expanding together with the universe. The measurable quantity of an observational cosmology — redshift of spectral lines — depends on values of *c*onformal time at the moment of emission of photons by the atoms of a cosmic object at the coordinate distance $r=\sqrt{(x^1)^2+(x^2)^2+(x^3)^2}$ from the Earth, where these photons are absorbed by a photoplate of the spectator at the moment η_0.[16]

In terms of the relative units (2) and the conformal interval (3) we find that the measurable spatial volume of the universe is a constant $V_{(r)}$, while all masses including the Planck mass are scaled by the cosmic scale factor,

$$m(r)(\eta)=m_0a(t). \quad (5)$$

It was shown that the relative units give a completely different physical picture of the evolution of the universe than the absolute units of the standard cosmology.[17] The spectrum of photons emitted by atoms from distant stars billions of years ago remains unchanged during the propagation and is determined by the mass of the constituents at the moment of emission. When this spectrum is compared with the spectrum of similar atoms on the Earth that, at the present time, have larger masses, then a redshift is obtained. The temperature history of the expanding universe copied in relative units looks like the history of evolution of masses of elementary particles in the cold universe with a constant temperature of the cosmic microwave background.

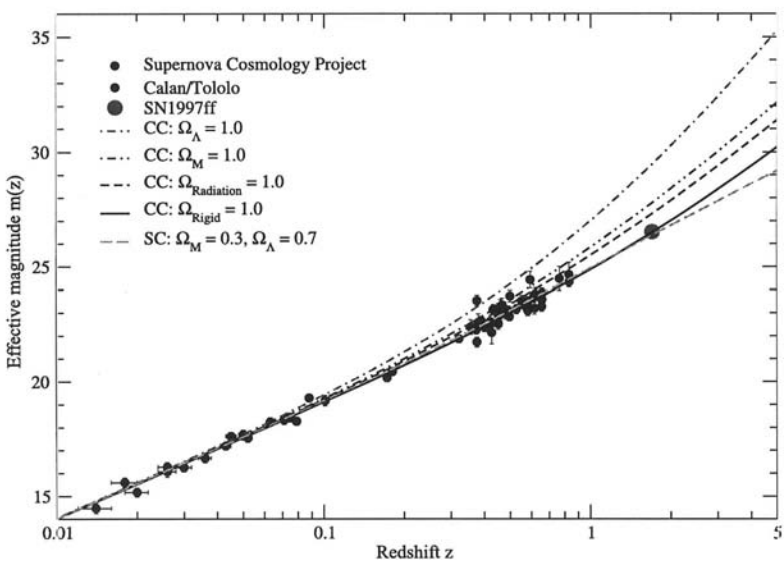


Figure 1: The Hubble diagram in cases of the absolute units of standard cosmology (SC) (4) and the relative ones of conformal cosmology (CC) (2).[18] The points include 42 high-redshift Type Ia supernovae and the reported farthest supernova SN1997ff.[19] The best fit to these data requires a cosmological constant $\Omega_\Lambda=0.7\Omega_{ColdDarkMatter}=0.3$ in the case of SC, whereas in CC these data are consistent with the dominance of the rigid state (6).

In the standard cosmology, an absolute measured distance is defined as the product of the scale factor and the coordinate distance $x^i = a(t)x^i$. This product can be treated as a conformal transformation of the relative variables that leads to the theory with the absolute variables and constant mass. This theory is mathematically equivalent to the theory with a relative interval and variable mass as all solutions of the second theory can be received from those of the first theory by the conformal transformations. However, the mathematical equivalence does not mean physical equivalence of the absolute and relative units. When we assert that the cosmic factor was equal to the square root of "time" in the epoch of the primordial nucleosynthesis, the question appears: what time does an observer measure by his watch, and what time is identified with the time of chemical evolution?

If this time is absolute, the square root of "time" means that the universe in the epoch of chemical evolution was completed by radiation.

If this time is conformal, the square root of "conformal time"

$$a(t)=\tilde{a}(\eta)=\sqrt{1+2H_0(\eta-\eta_0)}=1-rH_0+O(r^2), \quad (6)$$

means that the homogeneous free scalar field called "Quintessence" completed the universe in the epoch of chemical evolution.[20] Such evolution (6) corresponds to the rigid equation of state, when pressure coincides with energy.

If we identify the time of the evolution with conformal time and substitute the law of nucleosynthesis (6) into the Hubble diagram which concerns the dependence of redshift on distances to Supernovae, we can reveal that this law corresponds to the black line in a Fig. 1 that is in agreement with all data on the Supernova luminosity-distance — redshift relation.

As it was shown in the case of the relative Parisian meter (2), both the epoch of chemical evolution and the recent experimental data for distant supernovae are described by the square root dependence of the cosmic factor on "time."[21]

Another consequence of the relative standard of measurement is the redshift independence of the cosmic microwave background temperature.[22] This is at first glance in striking contradiction with the observation[23] of $6.0K<T_{\text{CMBR}}(z=23371)<14\ K$. However, the relative population of different energy levels E_i from which the temperature has been inferred in this experiment follows basically the Boltzmann statistics with the same z-dependence of the Boltzmann factors for both the absolute standards and relative one.[24] Therefore, the experimental finding can equally well be interpreted as a measurement of the z-dependence of energy levels (masses) at constant temperature. The abundance of nuclear species is also mainly governed by the Boltzmann factors with the z-dependence that is invariant with respect to the theoretical interpretation.

Thus, one more argument in favor of the relative units is the sharp simplification of the scenario of the evolution of the universe. Astrophysical data in relative units can be described by a single epoch with the dominance of the Scalar Quintessence, while the same data in the absolute units require the scenario with three different epochs (inflation, radiation, and inflation with the dark matter).

All these arguments give a reason for the recalculation of all astrophysical data in terms of the relative measurement standard (conformal time, conformal density, constant temperature, running mass and others). This recalculation was performed.[25]

One of the major arguments in favor of the relative measurement standards is the symmetry of the theory. The astrophysical data in the relative units testify to the hidden conformal symmetry of the Einstein general relativity and Standard Model.[26]

3. *Conformal symmetry of the world*

Any physical theory, beginning with Newtonian mechanics, consists of two parts: I) the differential equations of motion and II) the initial data (of the sort which Laplace required for unambiguous solutions of the Newton equations and which are measured by a set of physical instruments identified with a frame of reference).

The equations of motion are considered as a kingdom of laws of nature, and the initial data, as a kingdom of freedom. The parameters of the equations are treated as fundamental constants and initial data, as random numbers. In accelerator high-energy physics the experimenters set the geometry of instruments and initial states of an investigated physical object. The initial data of the universe are probably set by Lord-God, but the essence of theoretical statement of the task remains the same, and practically does not differ from the school task (7) about a train moving in the one-dimensional space with the coordinate $X(\eta)=a^2(\eta)$ with constant speed $V_1=H_0$ from St. Petersburg $X(0)=X_I=a_I^2$ to Moscow $X(\eta_0)=X_0=1$.

To find the time dependence of the coordinate of the train

$$X(\eta)=X_I+V_I\eta, \quad (7)$$

it is necessary to solve the Newton equation. This equation does not depend on the initial data (i.e., on the kingdom of freedom of passengers of this train who chose St. Petersburg and the speed of the train V_I), but the final result of the solution of this task — Moscow — is a consequence of both the kingdoms: the will of the passengers and the laws of Nature. It is important that the Newton equations do not depend on the initial data of the variable X.

Independence of the laws of nature on the initial data is called the symmetry of the theory with respect to transformations changing the frame of reference, i.e., rearranging the initial position and speed.

Historically, frame symmetries appeared as the Galilean group of transformations rearranging positions and velocities of the initial data of particles in the Newton mechanics. The frame symmetry of the modern unified theory is the Poincare group of transformations rearranging the initial data of relativistic fields. Lorentz and Poincare recovered the Poincare group from the Maxwell equations. All field theories of the 20th century were constructed by analogy with the Maxwell electrodynamics.[27] In particular, the field nature of light in electrodynamics and its relativistic symmetry were an example for Einstein to formulate his gravitation theory.

However, an analogy with the Maxwell electrodynamics was incomplete. The collection of Faraday's experimental results in the form of Maxwell's equations testifies to the fact that these equations are invariant with respect to conformal transformations.[28]

The relative measurement standard means transferring from the Einstein general relativity to the mathematically equivalent theory of scalar field called dilaton, the symmetry of which coincides with the conformal symmetry of the Maxwell equations.

This conformal-invariant theory of the scalar field, mathematically equivalent to general relativity, was revealed by Penrose, Chernikov, and Tagirov (PCT).[29] In such a theory the symmetry of the universe coincides with the symmetry of light.

Equations of motion of Einstein's theory contain a fundamental constant — the Planck mass

$$M_{\text{Planck}}=\sqrt{\text{hc}/G}=2.177\text{x}10^{-8}\text{kg}, \quad (8)$$

where Newton's constant G determines the strength of the force between two massive objects, the velocity of light c is a maximum velocity, and Planck's constant h is a minimum quantum of action.

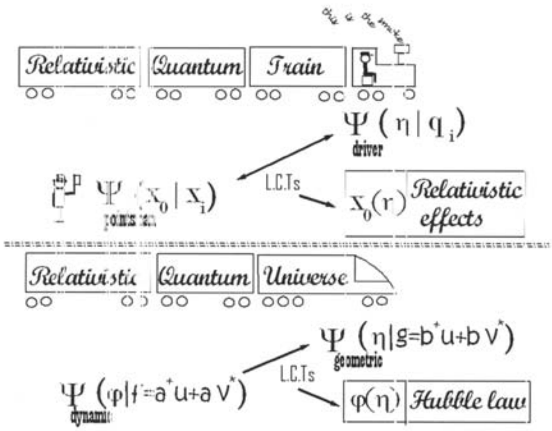
In the conformal theory the Planck mass

$$M_{\text{Planck}}=\varphi_0\sqrt{8\pi hc/3} \quad (9)$$

changes its status. The relative units transfer the Planck mass from the kingdom of laws of the Einstein theory to the kingdom of freedom of the conformal theory. The Planck mass φ_0 becomes one of present-day values of the dynamic variable $\varphi(\eta)=\varphi_0 a(\eta)$, just as the Ptolemaic absolute position of the Earth becomes one of present-day values of the dynamic coordinate in Newton's theory.

Just as Newton's theory is not compatible with the Ptolemaic absolutization of the initial data, the conformal theory is not compatible with the absolutization of the Planck mass and the hypothesis of existence of the Planck epoch. Therefore, the task of the inflationary model[30] — to describe the expansion of the universe from the Planck epoch to radiation, the dominant epoch — loses physical meaning in the conformal theory.

Within the framework of the relative measurement standard there is a need to investigate the quantum creation of the universe and matter from the physical vacuum in the limit of small masses $\varphi(\eta)\rightarrow 0$ and large values of the Hubble parameter $H(\eta)\rightarrow\infty$ for which the product of square of mass and the Hubble parameter does not depend on time: $\varphi^2(\eta)\text{H}(\eta)=constant$. Remember that the Hubble parameter gives a speed of variation of these masses that in this limit can become comparable with masses. To understand a problem of cosmic initial data in the relativistic quantum universe, we consider a well-known and conventional solution to this problem for a relativistic quantum particle.



4. The relativistic quantum world

Figure 2: At the top of figure, a relativistic train is depicted with an unstable particle. The lifetime of this particle is measured by two Einstein observers, by a pointsman and a driver, who communicate to each other their measurement outcomes on the phone. Each of the observers has his world space of events, his time (pointsman - variable X^0, and driver - geometrical interval *t*) and his notebook, as a wave function of a particle in terms of amplitudes of probability to find a particle at an arbitrary point of the world space, if at the initial moment its initial data are given. At the bottom of the figure there is an image of the universe where each observer has two sets of measurable quantities corresponding to two observers of the particle. To the pointsman there corresponds a field set of measurable quantities (mass j and density of a number of particles $n=a_q^+a_q$with a set of quantum numbers q), and to the driver, the geometrical set of measurable quantities (time interval h and initial data of the density of the Bogoliubov b_q,b_q^+ quasiparticles).[31]

Let's remember that in Newtonian mechanics, the concept of the spatial coordinates of a particle X_i,i=1,2,3, as dynamic variables, is clearly distinct from a Newtonian time *t*, as the evolution parameter of these variables. Relativistic symmetry of the Maxwell electrodynamics, as it has revealed by Minkowski, means the equal rights of time $t=X_0$ and spatial coordinates of a relativistic particle X_i. Such equal rights means that the time $t=X_0$ becomes a dynamic variable with initial data X_{I0},$v_i=P_i/P_0$. A particle goes into the Minkowskian space - time X_0,X_i, called the space of events, where a role of the evolution parameter is played by a geometric interval η on a world line of a particle in the space of events.

In relativistic mechanics, in contrast to classical mechanics, a complete description of a relativistic particle one needs two observers. In Fig. 2 they are depicted in the role of a pointsman and a driver. A pointsman measures the time by his watch as a variable X_0 in the world of Minkowskian space X_0,X_i of all events, and a driver measures by his watch the time as a geometrical interval h on a world line of events. Only both sets of measurements restore a pathway of a particle in the world space X_0, X_i

$$X_0(\eta)=X_I^0+\frac{P_0}{m}\eta, \quad X_i(\eta)=X_I^i+\frac{P_i}{m}\eta,$$

where the momenta of a particle P_0, P_i are linked by the mass-shell equation

$$(P_0)^2-(P_i)^2=m^2, \quad (10)$$

where P_0 is treated as an energy of a particle. Its initial coordinate X_I^0 is treated as the point of its creation or annihilation in the wave function of a particle

$$f(X_0,X_i)= \sum_q [a_q^+ \Psi(X_0 \geq X_I^0 \mid X_i)+a_q\Psi(X_0 \leq X_I^0 \mid X_i], \ (11)$$

where the coefficients are treated as operators of creation, if a particle goes forward, and of annihilation, if a particle goes backward. This causal quantization excludes the negative value of the energy $P_0=-E$ to make stable a quantum state of a particle.[32]

The set of measurable quantities and the wave function of a relativistic particle for a driver can be obtained by a transformation $(X_0 \mid X_i) \rightarrow (\eta \mid \xi_i)$ that converts the time as the variable into the time as the geometrical interval η;[33] and coordinates X_i, into the initial data ξ_i on the world line. Such transformation was first proposed in the theory of differential equations by Levi-Civita as far back as 1906. [34]

From the point of view of Newtonian physics, the complete description of any relativistic object is possible by two realizations of this object. For a particle, one such realization is Minkowskian space, where the evolution parameter is treated as the dynamic variable X_0, and the second is the geometrical realization where the evolution parameter is treated as the time interval η. The relationship between these realizations $X_0(\eta)$ is treated as the pure relativistic effect.

In a relativistic mechanics the main problem was to understand how time became a variable, while in a field theory the main problem is to understand how one of the field variables becomes time. In the modern field theory of space, time, and matter all dynamic variables are fields that form the field space of events $[\varphi \mid F=f,Q]$ including the dilaton φ, set of fields of Standard Model f, and scalar field Q.

The universe as a relativistic object can also be completely described by two realizations: field and geometric. Each of them has its world space of variables (field φ, $F=(e,f,Q)$, or geometric η,G), its evolution parameter (the cosmic scale factor φ or geometric time η), its initial data, and its wave function (the field $\Psi_F[\varphi \geq \varphi_I \mid F,F_I]$, or geometric $\Psi_G[time_c=\eta \geq o \mid G,G_0]$).

Both these realizations are connected by the Levi-Civita transformations that convert the field space with the field evolution parameter φ into the geometric world space with the time evolution parameter. The geometrization as a rigorous mathematical construction of the geometric time η

includes the transformations of the initial fields $F=\Sigma_q (a_q^+\psi_q+a_q \psi_q^*)$ with a set of quantum numbers q into the geometric fields $G=\Sigma_q(b_q^+\underline{\psi}_q+b_q\underline{\psi}_q^*)$ known as the Bogoliubov transformations.[35]

The vacuum initial data $\varphi_I, Q_I=0$ including a number of particles $n_I=\sum_q\langle 0 \mid a_q^+a_q \mid 0\rangle=0$ can be treated as field coordinates of the creation of the universe in its field realization. Such a creation takes place out of time η that belongs to another realization of the universe in the geometric space (η, G).

The evolution of the cosmic scale factor with respect to time $\varphi(\eta)$ is considered as a pure relativistic effect that is beyond the scope of the Newton-like mechanics.

5. *"Creation" of the universe and time*

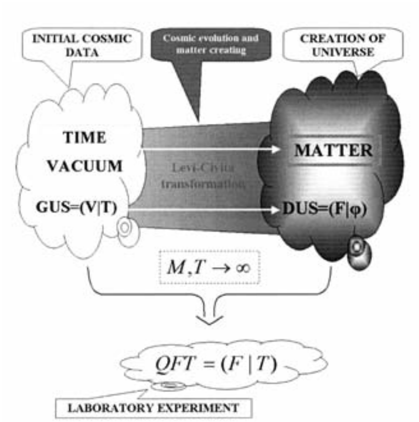


Figure 3: This figure, taken from,[36] shows the quantum creation of the universe in the field reality out of the time $\eta=T$ (right) and in the geometric reality without matter (left). The Hubble law $\varphi(\eta)$, and creation of matter from vacuum with particle density $n(\eta)$ ($n(0)=0$) are described as pure relativistic effects by the geometrization of the energy constraint. Only in the limit of tremendous energy of the Quintessence there does appear a possibility of describing the universe as the Newton-like system $F(\eta)$.

The mathematical structure of general relativity and the Standard Model in the relative units (with the evolution parameter φ and an energy of the universe defined as a value of the canonical momentum $P\varphi$ of this evolution parameter) allow us to use the analogy with the relativistic particle (11) to construct a wave function of the relativistic universe in the world field space for positive and negative energy with the initial data $\varphi=\varphi_I$.

This wave function of the universe

$$\Psi_{field}[\varphi,\varphi_I \mid F,F_I]=A^+_E\Psi_{universe}[\varphi \geq \varphi_I \mid F,F_I]+A^-_E\Psi_{anti\text{-}universe}[\varphi \leq \varphi_I \mid F,F_I] \quad (12)$$

describes the greatest events – the creation of the universe with positive energy traveling forward $\varphi \geq \varphi_I$ in the field space: the cosmic singularity is in wave function of the universe with negative energy traveling backward $\varphi \leq \varphi_I$ to the point of the singularity.

To make His creation (i.e., our universe) stable and good, God as a Real Master constructs the wave function of the quantum universe in the field realization excluding the negative value of the energy $P_\varphi=-E$ from the wave function. To do so, He needed to treat the creation of the universe with negative energy as annihilation of the anti-universe with positive energy. This construction is known in quantum field theory as causal quantization with the operators of creation A^+ and annihilation A^- of the universe.[37] Consequences of the causal quantization (12) are the positive arrow of the geometric time and its beginning $\eta \geq 0$.[38]

The wave function of the universe in the geometric realization

$$\Psi_{geometric}[\eta \geq 0 \mid G] \quad (13)$$

describes the quantum evolution of the universe in the geometric world space $[\eta \mid G]$ with the zero initial data for matter fields, as in the beginning there was "nothing." For modern scientists "nothing" is the vacuum as a stable state with the lowest energy, when numbers of all particles as local excitations of quantized fields G are equal to zero $\eta_G=0$.

At the beginning of universe there were only two global excitations in the form of "superfluid motions" (according to the terminology by and Bogoluibov[39]): the running Planck mass $\varphi(\eta)$ and Quintessence. The momenta of these motions are linked as the momenta of a relativistic particle (10). All further evolution of the running Planck mass j(h) and measurable number of particles $n_F(\eta)=0$ in the field space $[\varphi \mid F]$ is treated as the Levi-Civita geometrization of fields in the unified theory $F=F(\eta,G)$.[40] These transformations for local particles coincide with the Bogoliubov transformations in his microscopic theory of superfluid helium: $a_q=c_q(\eta)b_q+s_q(\eta)b_q^+$.[41] In our theory these transformations describe cosmological creation of a matter from vacuum in the early universe. The number of created particles is defined as the sum of quadrates of the Bogoliubov coefficients $s_q(\eta)$: $n_F(\eta)=\sum_q \mid s_q(\eta) \mid^2$ where the magnitude $\mid s_q(\eta) \mid^2=N(q,\eta)$ is called the distribution function of the numbers of particles.

Thus, the absolute-free conformal unified theory, in the concrete frame of reference and geometrization of fields introducing cosmic initial data, forms a conceptual basis of the theory for explanation of physical facts including physical cosmology. At least, this explanation should be considered on equal footing with the old scheme conserving Newtonian absolutes such as the absolute Parisian meter, or the absolute Planck mass.

6. *Creation of matter*

Can modern physical theory explain the genesis of all observed matter in the Universe literally under the Biblical Scenario as its creation from "nothing," which is a physical vacuum as state with lowest energy?

The answer to this problem of the genesis of matter is discussed in current papers.[42] Some scenarios of the inflationary model have utilized the cosmological particle-antiparticle creation from a vacuum for an origin of matter. However, one obviously considered that such cosmological creation from a vacuum is not enough for a genesis of all observed matter.[43]

Here we list arguments in favor of the claim that the cosmological particle creation from a vacuum[44] in the conformal-invariant unified theory can explain the genesis of all observed matter in the Universe and describe the cosmic energy density budget of observational cosmology.

At the first moment $\eta_I=1/2H_I$ of the lifetime of the universe, the frame-fixing quantization[45] of W-, Z- vector bosons in the Standard Model shows us an effect of their intensive cosmological creation[46] from the geometric Bogoliubov vacuum.[47,48] The distribution functions of the longitudinal $N^{||}$and transverse $N^{\perp}$ vector bosons calculated for the initial data $H_I=M_I$ are introduced in Fig. 4.[49]

We can speak about the cosmological creation of a pair of massive particles in the universe, when the particle mass $M_v(\eta=0)=M_I$ is larger than the initial Hubble parameter $M_I \geq H_I$.

The distribution functions of the longitudinal $N^{||}(x,\tau)$ vector bosons introduced in Fig. 2 show the large contribution of relativistic momenta. This means the relativistic dependence of the particle density on the temperature in the form $n(T)\sim T^3$. These distribution functions show also that the time of establishment of the density and temperature is the order of the inverse primordial Hubble parameter. In this case, one can estimate the temperature T from the equation in the kinetic theory[50] for the time of establishment of the temperature

$$\eta^{-1}_{relaxation}\sim n(T) x \sigma \sim H,$$

where $\sigma\sim 1/M^2$ is the cross-section.

This kinetic equation and values of the initial data $M_I=H_I$ give the temperature of relativistic bosons

$$T\sim(M_I^2 H_I)^{1/3}=(M_0^2 H_0)^{1/3}\sim 2.7K$$

as a conserved number of cosmic evolution compatible with the Supernova data and the primordial chemical evolution. We can see that this calculation gives the value surprisingly close to the observed temperature of the CMB radiation[51] $T=T_{CMB}=2.73\ K$

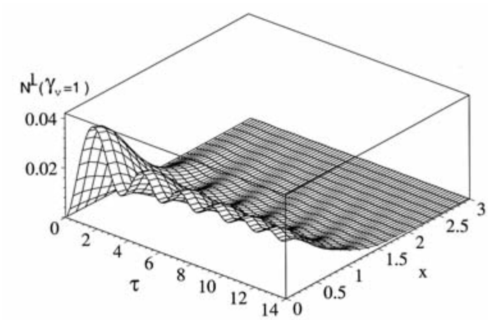


Figure 4: The figure taken from Blaschke *et al.*[52] shows the dependence of longitudinal $N\|$ and transverse $N^{\perp}$ components of the distribution function of vector bosons describing their very fast creation in units of the primordial lifetime of the universe $\tau=2H_I\eta$.[53] Their momentum distributions in units of the primordial mass $x=q\,|\,M_I$ show the large contribution of longitudinal bosons and their relativistic nature.

A ratio of the density of the created matter $\rho_v(\eta_I)\sim T^4$ to the density of the primordial cosmological motion of the universe $\rho_{cr.}(\eta)=H_I^2\varphi^2_I$ has an extremely small number

$$\frac{\rho_v(\eta_I)}{\rho_Q(\eta_I)} \sim \frac{M_I^2}{\varphi_I^2} = \frac{M_W^2}{\varphi_0^2} \sim 10^{-34}. \quad (14)$$

On the other hand, it is possible to estimate the lifetime of the created bosons in the early universe in dimensionless units $\tau_L=\eta_L\,|\,\eta_I$, where $\eta_I=(2H_I)^{-1}$, by utilizing the equation of state $\varphi^2(\eta_L)=\varphi_I^2(1+\tau_L)$ and define the lifetime of *W*-bosons in the Standard Model

$$1+\tau_L=\frac{2H_I\sin^2\theta_W}{\alpha_{QED}M_W(\eta_L)}=\frac{2\sin^2\theta_W}{\alpha_{QED}\sqrt{1+\tau_L}}, \quad (15)$$

where is the Weinberg angle, $\alpha_{QED}=1/137$. The solution of equation (16) gives the value for $M_{vI}H_I$

$$\tau_L+1=\left[\frac{2\sin^2\theta_W}{\alpha_{QED}}\right]^{2/3}\simeq 16. \quad (16)$$

The transverse bosons during their lifetime form the baryon asymmetry of the universe as a consequence of the "polarization" of the Dirac sea vacuum of fermions left by these bosons, according to the selection rules of the Standard Model[54] with left current interaction. This interaction freezes the violation of the baryon number,

$$\Delta B=0.4_{CP}n_\gamma\,,$$

where X_{CP} is a factor determined by a superweak interaction of *d* and *s*-quarks ($d+s \to s+d$) with the CP-violation experimentally observed in decays of *K* mesons with a constant of a weak coupling $X_{CP}\sim 10^{-9}$.[55]

After the decay of bosons, their temperature is inherited by the Cosmic Microwave Background radiation. All the subsequent evolution of matter with varying masses in the constant universe replicates the well-known scenario of the hot universe, as this evolution is determined by the conformal-invariant ratios of masses and temperature m/T.

Since the baryon density increases as mass and the Quintessence density decreases by the inverse square of mass, the present-day value of the baryon density can be estimated by the relation,

$$\Omega_b(\eta 0) = \left[\frac{\varphi_0}{\varphi_L}\right]^3 \frac{\rho_b(\eta_L)}{\rho_Q(\eta_L)} = \left[\frac{\eta_I}{\eta_L}\right]^{3/2} \sim \left[\frac{\alpha_{QED}}{\sin^2\theta_W}\right] \sim 0.03, \qquad (17)$$

if the baryon asymmetry with the density,

$$\rho b(\eta{=}\eta_L) \simeq 10^{-9} 10^{-34} \rho_Q(\eta{=}\eta_L) \qquad (18)$$

is frozen by the superweak interaction. This estimation gives the value surprisingly close to the observational density in agreement with the observational data.

Thus, we have shown that the conformal-invariant version of general relativity and Standard Model with geometrization of constraint and frame-fixing with the primordial initial data , $\varphi_I=10^4 GeV, H_I=2.7\ K=10^{29}H_0$ (determined by a free homogeneous motion of the Scalar Quintessence, i.e., its electric tension) can describe the following events:

	$\eta = 0$	*creation of the* "empty" universe from "nothing"
[1.5mm]	$\eta \sim 10^{-12}$s	creation of vector bosons from "nothing"
[1.5mm] 10^{-12}s <	$\eta < 10^{-11} \div 10^{-10}$s	formation of baryon asymmetry
[1.5mm]	$\eta \sim 10^{-10}$s	decays of vector bosons
[1.5mm] 10^{-10}s <	$\eta < 10^{11}$s	primordial chemical evolution of matter
[1.5mm]	$\eta \sim 10^{11}$s	recombination, or separation of CMB
[1.5mm]	$\eta \sim 10^{15}$s	formation of galaxies
[1.5mm] 10^{17}s <	η	hep experiments and Supernova evolution.

The key difference of such a description from the inflationary model[56] is the vacuum initial data as a stable state with lowest energy, instead of a mysterious "fireball."

7. *Paths of modern physics*

The relative measurement standard shows the well-known truth that the universe is an ordinary physical object with a finite volume and finite lifetime.

Results of the theoretical description of the finite universe depend on the choice of a frame of reference and initial data, as the results of the solution of the Newton equations, depend on initial positions and initial velocities of a particle. The creation of the universe has taken place in a particular frame of reference that was remembered by the cosmic microwave radiation. We recall that the "frame of reference" is identified with a set of the physical instruments for measuring the initial data needed for unambiguous solutions for the differential equations of theoretical physics. These differential equations are invariant structural relations of the whole manifold of all measurable quantities with respect to their transformations. The determination of a group of these transformations is the most important problem of modern theoretical physics.

There are two types of the transformation groups of differential equations in the gauge theory: frame-transformations that change initial data, i.e., the frame of reference; and gauge-transformations that do not change initial data and are associated with the calibration of physical instruments.

Gauge symmetries and constraints between the initial data are fundamentally new in comparison with classical physics. To emphasize this fact, Julian Schwinger wrote: "It has been the historical role of gauge-variant systems to pose the greatest challenge to relativistic quantum-field theory."[57] But the question arises: How do we describe dynamics of variables and its initial data in gauge relativistic theories?

Derivation of frame-covariant and gauge-invariant solutions of differential equations as well as the construction of frame-covariant and gauge-invariant quantization of gauge fields were considered in the mainstream of development of theoretical physics beginning with the work by Dirac[58] and ending with the work by Schwinger in the sixties who called this quantization fundamental.[59] The strategy of this fundamental quantization was to construct gauge-invariant variables in a definite frame of reference and to prove the relativistic invariance of a complete set of results. The dependence of gauge-invariant observables on the parameters of the frame of reference, on the time axis in particular, is called the implicit relativistic invariance.[60]

The basic method of quantization in gauge field theories, however, became the other heuristic quantization, proposed by Feynmann.[61] Feynmann noticed that the scattering amplitudes of the elementary particles in perturbation theory do not depend on the frame of reference and the gauge choice. The independence of the frame of reference was called simply the relativistic invariance, and the gauge choice became the formal procedure of choosing the gauge non-invariant field variables. It may seem that this slight substitution of the meaning of the concepts in the method of heuristic quantization completely depreciates the goals and tasks of the fundamental quantization. Why should we prove the "relativistic invariance" of a complete set of results at the level of the algebra of the Poincare group generators for gauge-invariant observables, if the result of calculating of each scattering amplitude is relativistic invariant, i.e. does not depend on a frame of reference?[62] What do we need gauge-invariant observables for, if one can use any variables also for solving the problems of construction of the unitary perturbation theory and proving the renormalizability of the Standard Model?[63] The statement and solution of these important problems carried out within the limits of heuristic quantization resulted when the latter became the one and only method of solving all the problems of the modern field theory. The highest achievements of the abstract formulation are the frame-free quantization of string theories and M-theory as a candidate for the role of a future consistent theory of all interactions with the Planck absolute mass.[64]

At the end of the past century, a dramatic situation arose in physics, when a historical path of physics — the path frame of references, seemed to be absolutely interrupted. There remained only the "kingdom of laws" burdened with absolutes independence from a frame of reference. The "kingdom of freedom" of initial data turned out to be enclosed by heuristic quantizing and its claims for a successful solution of all problems. There was a new terminology with the distorted definition of relativistic invariance, suitable only for the description of the tasks of scattering and discrediting fundamental quantizing where concrete results depend on parameters of a frame of reference.

However, physicists have forgotten that the simplified heuristic quantizing is proven only for amplitudes of scattering of elementary particles, and its applicability is restricted to only scattering problems — the domain where it first appeared.[65] The fundamental quantization is more suitable for describing the physics of bound states, hadronization and confinement, relativistic strings,[66] and the quantum universe.[67] Yet in 1962, Schwinger[68] pointed out that the frame-free formulations can distort the initial gauge theory and lead to a wrong spectrum of nonlocal collective excitations.[69] Schwinger rejected all frame-free formulations of relativistic theories "as unsuited to the role of providing the fundamental operator quantization."[70]

The relative measurement standard reverts us on a historical path of the development of physics, the path of frame of references. This path began with relativity by Copernicus, Galilei, and Newton, and it was prolonged by Einstein's relativity theories and papers by Dirac, Heisenberg, Pauli, Fermi and Schwinger on gauge-invariant fundamental quantizing. It is the path of definition of a transformation group of all measurable physical quantities, which leaves invariant their structural relations called the differential equations. It is the path opened by Copernicus where all absolutes of theories become, eventually, ordinary initial data.

The relative units reveal that a symmetry group of the whole manifold of measurable physical quantities demand that the field nature of matter should also be supplemented by the field nature of space and time.

The relative units lead us to the "kingdom of freedom" of initial data including also the final dimensional absolute of modern quantum field theory and those initial data of creation of the universe, for which an observer does not carry any responsibility, as he at this moment existed only as an intention. Who has carried out this experiment of creation of the universe? Who has determined the initial data of this creation? Whose notebook contains the wave function of the universe?

8. Conclusion

S. Weinberg finished his book by the words "The effort to understand the universe is one of the very few things that lifts human life a little above the level of farce, and gives it some of the grace of tragedies."[71]

One can try to understand the meaning of this tragedy considering the history of physics. A symbol of the classical physics is a small boy playing stones on the coast of a huge ocean of mysteries of nature. Trying to penetrate into the mysteries of the universe, an observer is convinced by its real existence in "absolute space and time," i.e., with its complete independence of his "games" with measurements and observations. In the requirement of Laplace of initial data in order to explain the world, there is an implicit assertion that these initial data exist irrespective of an observer as mathematical truth, and he, simultaneously, is surprised that they are not known yet. An observer discovers consolation in the very study, when he creates instruments allowing him to open up a mystery of nature through its laws and to utilize these laws not only for advancing his instruments, but also his life. Utilizing these laws, an observer creates huge mechanical devices helping him to master and to subordinate the whole world to the kingdom of freedom of his will.

He sees, as the world varies due to his desires and whims, how results of his measurements depend on the means of his observations and measurements in creation of which he has put in his own reason, and he comes to comprehension of the reasonable nature of a reality.

The reasonable nature of a reality are principles of the special and general relativity theories that included Einstein's observers in description of nature, the wave function as a notebook of an observer in quantum mechanics and quantum field theory, Dirac's gauge-invariant observables, and the relative units. Albert Einstein "could not find the best expression, beyond the religious conviction of the reasonable nature of reality and its comprehensability by human reason. There, where this comprehension is missing, science turns into soulless empiricism," as he wrote in the letter to Moris Solovin of January 1, 1951.[72]

And now, our observer is forced to transfer his reasonable games to the beginning of the universe, when there were no reasonable observers. He convinces himself surprisingly that the huge energetics of the macrocosmos is successfully described in the same way as the energetics of relativistic quantum microcosmos (probabilistic laws which he explained by the impossibility of their complete separation from an experimental device). The point here is that the universe plays successfully the role of microcosmos without any "Macrodevice" and its Unknown Owner.

The problem is that our observer, having mastered the huge energies of macrocosmos, will eventually force it to work for himself, and will give the universe up to the will of his desires and whims. The problem is that due to his desires and whims the universe will have the sad destiny of Schrödinger's cat together with all its observers. Facing an ecological catastrophe of the whole universe, our observer, at last, realizes the unity of all human culture: sciences, philosophy and religion. He, at last, will see, that philosophy and religion attach deep meaning to his "games" on the coast "of a huge ocean of mysteries of nature," alongside with which there exists no less a "great and immeasurable ocean of mysteries of an observer."[73] He will see that a path of knowledge of the measurable world retraces a path of knowledge of the spiritual world,[74] according to which "… the creative activity of understanding intellect [and] the activity of mind determine objects in their correlations and constructing new notions" (Basil the

Great)[75] and "things can be cognized in their relations, actions, and interactions" (Gregory of Nyssa).[76]

And then our observer of the universe will not discover the best expression, other than the "religious" expression of a conviction in a spiritual nature, of a reasonable reality and its comprehensibility by human reason. There, where this conviction is missing, science may turn into the tragedy of eternal death.[77]

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NOTES

1. A.A. Friedmann, *Z. für Phys*, 10, 377 (1922); *Ibid*, 21, 306 (1924); H.P. Robertson, *Rev. Mod. Phys*, 5, 62 (1933); A.G. Walker, *Monthly Notice of Royal Soc*, 94, No.2, 154 (1933); 95, No.3, 263 (1935); G. Lemaitre, G. *Ann. de la Soc. Scien. de Bruxelles*, A 47, 49 (1927); A. Einstein and W. de-Sitter, *Proc. of Nat. Acad. of Scien*., 18, No.3, 213 (1932). S.W. Hawking, and G.F.R. Ellis, *The large scale structure of space-time*, Cambridge: Cambridge University Press, 1973. V.L. Ginsburg, *Kak ustroena Vselennaya i kak ona razvivaetsia po vremeni*, M, Znanie, 1968 (in Russian). T. Regge, *An elementary Course on General Relativity*, Series Acad. Training, Lectures, CERN-83-09, (1983). S. Weinberg, *Gravitation and Cosmology: Principles and Applications of the General Theory of Relativity*, New York: Basic Books, Inc.,Publishers, 1971. F.Hoyle, J.V. Narlikar, *Proc.Roy Soc* Teoria Polya, M, Nauka, (1967) in Russian. S. Weinberg, *First Three Minutes: A modern View of the Origin of the universe*, New York: Basic Books, Inc, 1977. A.F. Zakharov, "Microlens could bring Dark Matter into focus." *Physics Newsletter*, 3, 1 (2000). D. Chernin, *Uspekhi Fiz*. Nauk 171, 11 (2001). G. Gamow, *Phys. Rev*., 70, 572 (1946); *ibid*, 74, 505 (1948). A.D. Linde, *Elementary Particle Physics and Inflation Cosmology*, Nauka: Moscow, 1990. A.G. Gut, P.J. Steinhardt, *Scientific American*, 250, 90 (1984).
2. T. Regge, *An elementary Course on General Relativity*, Series Acad. Training, Lectures, CERN-83-09, (1983).
3. S. Weinberg, *Gravitation and Cosmology: Principles and Applications of the General Theory of Relativity*, Basic Books, Inc.: New-York, 1971. F.Hoyle, J.V. Narlikar, *Proc.Roy Soc*. A277, A282, (1964).
4. L.D. Landau, E.M. Lifshits, *Teoria Polya*, Nauka, (1967) in Russian.
5. S. Weinberg, *First Three Minutes: A modern View of the Origin of the universe*, Basic Books, Inc., Publishers, New-York, 1977.
6. M. Fukugita, C.J. Hogan, and P.J.E. Peebles, *ApJ*, 503, 518 (1998).
7. J. R. Bond et al. (MaxiBoom collaboration), "CMB Analysis of Boomerang & Maxima & the Cosmic Parameters ," in: *Proc. IAU Symposium 201 (PASP)*, CITA-2000-65 (2000). [astro-ph/0011378].
8. A.A. Friedmann, *Z. für Phys*, 10, 377 (1922); *Ibid*, 21, 306 (1924); H.P. Robertson, *Rev. Mod. Phys*, 5, 62 (1933); A.G. Walker, *Monthly Notice of Royal Soc*, 94, No.2, 154 (1933); 95, No.3, 263 (1935); G. Lemaitre, G. Ann. *de la Soc. Scien*. de Bruxelles, A 47, 49 (1927); A. Einstein and W. de-Sitter, *Proc. of Nat*. Acad. of Scien., 18, N3, 213 (1932).
9. S.W. Hawking, and G.F.R. Ellis, *The large scale structure of space-time*, Cambridge: Cambridge University Press, 1973. G. Gamow, *Phys. Rev*., 70, 572 (1946); *ibid*, 74, 505 (1948).

10. The less the mass of particles, the greater the size of atoms formed by these particles.

11. D. Behnke, D.B. Blaschke, V.N. Pervushin, and D.V. Proskurin, *Phys. Lett*. B 530, 20 (2002); [gr-qc/0102039].

12. M. Pawlowski, V. V. Papoyan, V. N. Pervushin, and V. I. Smirichinski, *Phys. Lett*. B 444, 293 (1998). D. Behnke, D.B. Blaschke, V.N. Pervushin, and D.V. Proskurin, *Phys. Lett*. B 530, 20 (2002); [gr-qc/0102039]. D. Blaschke, D. Behnke, V. Pervushin, and D. Proskurin, *Proceeding of the XVIIIth IAP Colloquium "On the Nature of Dark Energy"*, Paris, July 1-5, 2002; Report-no: MPG-VT-UR 240/03; [astro-ph/0302001]. V.N. Pervushin, D.V. Proskurin, and A. A. Gusev, *Grav.& Cosmology*, 8, 181 (2002). D. Blaschke et al., *Cosmological creation of vector bosons and CMB*, [gr-qc/0103114]; [hep-th/0206246]. V.N. Pervushin and D.V. Proskurin, *Proceeding of the V International Conference on Cosmoparticle Physics (Cosmion-2001) dedicated to 80-th Anniversary of Andrei D. Sakharov* (21-30 May 2001, Moscow-St.Peterburg, Russia); [gr-qc/0106006]. V.N. Pervushin, *"Astrophysical Data and Conformal Unified Theory"*, [hep-ph/0211002]. B.M. Barbashov, A.G. Zorin, V.N. Pervushin, P. Flin, *Astrophysics in relative units as Conformal Unified Theory without Planck Absolutes*, Preprint *JINR* P2-2002-295, submitted to *Theor. Math. Phys*.

13. J.C. Maxwell, *A Treatise on Electricity and Magnetism*, Clarendon Press, Oxford, 1873.

14. Jay Orear, *Physics*, Cornell University, New York: Macmillan Publishers,1979.

15. A.A. Friedmann, *Z. für Phys*, 10, 377 (1922); *Ibid*, 21, 306 (1924); H.P. Robertson, *Rev. Mod. Phys*, 5, 62 (1933); A.G. Walker, *Monthly Notice of Royal Soc*, 94, No.2, 154 (1933); 95, No.3, 263 (1935); G. Lemaitre, G. Ann. *de la Soc. Scien*. de Bruxelles, A 47, 49 (1927); A. Einstein and W. de-Sitter, *Proc. of Nat. Acad. of Scien*., 18, No.3, 213 (1932).

16. A second is defined as an interval of conformal time h, on which one can stack 9.19263117x10^9 oscillations of radiation emitted by an atom of cesium 133. Jay Orear, *Physics*, New York, Macmillan Publishers, 1979.

17. M. Pawlowski, V. V. Papoyan, V. N. Pervushin, and V. I. Smirichinski, *Phys. Lett*. B 444, 293 (1998). D. Behnke, D.B. Blaschke, V.N. Pervushin, and D.V. Proskurin, *Phys. Lett*. B 530, 20 (2002); [gr-qc/0102039]. V.N. Pervushin, D.V. Proskurin, and A. A. Gusev, *Grav. & Cosmology*, 8, 181 (2002).

18. D. Behnke, D.B. Blaschke, V.N. Pervushin, and D.V. Proskurin, *Phys. Lett*. B 530, 20 (2002); [gr-qc/0102039].

19. A.G. Riess *e*t al., *Astron*. J. 116, 1009 (1998); S. Perlmutter *e*t al., *Astrophys. J*. 517, 565 (1999). A.G. Riess *e*t al., *Astrophys*. J. 560, 49 (2001); [astro-ph/0104455].

20. V.N. Pervushin, D.V. Proskurin, and A. A. Gusev, *Grav. & Cosmology*, **8**, 181 (2002).

21. A.G. Riess *e*t al., *Astron*. J. 116, 1009 (1998); S. Perlmutter *e*t al., *Astrophys. J*. 517, 565 (1999). A.G. Riess *e*t al., *Astrophys. J*. 560, 49 (2001); [astro-ph/0104455]. D. Behnke, D.B. Blaschke, V.N. Pervushin, and D.V. Proskurin, *Phys. Lett*. B 530, 20 (2002); [gr-qc/0102039].

22. V.N. Pervushin, D.V. Proskurin, and A. A. Gusev, *Grav. & Cosmology*, 8, 181 (2002). D. Blaschke *e*t al., *Cosmological creation of vector bosons and CMB*, [gr-qc/0103114]; hep-th/0206246. V.N. Pervushin and D.V. Proskurin, *Proceeding of the V International Conference on Cosmoparticle Physics (Cosmion-2001) dedicated to 80-th Anniversary of Andrei D. Sakharov* (21-30 May 2001, Moscow-St.Peterburg, Russia); [gr-qc/0106006].

23. R. Srianand, P. Petitjean, and C. Ledoux, *Nature*, 408, 931 (2000).

24. D. Behnke, D.B. Blaschke, V.N. Pervushin, and D.V. Proskurin, *Phys.*

Lett. B 530, 20 (2002); [gr-qc/0102039].

25. D. Behnke, D.B. Blaschke, V.N. Pervushin, and D.V. Proskurin, *Phys. Lett.* B 530, 20 (2002); [gr-qc/0102039]. D. Blaschke, D. Behnke, V. Pervushin, and D. Proskurin, *Proceeding of the XVIIIth IAP Colloquium "On the Nature of Dark Energy"*, Paris, July 1-5, 2002; Report-no: MPG-VT-UR 240/03; [astro-ph/0302001]. V.N. Pervushin, D.V. Proskurin, and A. A. Gusev, *Grav.& Cosmology*, 8, 181 (2002). D. Blaschke et al., *Cosmological creation of vector bosons and CMB*, gr-qc/0103114; hep-th/0206246. V.N. Pervushin and D.V. Proskurin, *Proceeding of the V International Conference on Cosmoparticle Physics (Cosmion-2001) dedicated to 80-th Anniversary of Andrei D. Sakharov* (21-30 May 2001, Moscow-St.Peterburg, Russia); gr-qc/0106006. V.N. Pervushin, *"Astrophysical Data and Conformal Unified Theory"*, hep-ph/0211002. B.M. Barbashov, A.G. Zorin, V.N. Pervushin, P. Flin, *Astrophysics in relative units as Conformal Unified Theory without Planck Absolutes*, Preprint *JINR* P2-2002-295, submitted in *Theor. Math. Phys.*

26. V.N. Pervushin, D.V. Proskurin, and A. A. Gusev, *Grav.& Cosmology*, **8**, 181 (2002). V.N. Pervushin, *"Astrophysical Data and Conformal Unified Theory"*, [hep-ph/0211002]. B.M. Barbashov, A.G. Zorin, V.N. Pervushin, P. Flin, *Astrophysics in relative units as Conformal Unified Theory without Planck Absolutes*, Preprint *JINR* P2-2002-295, submitted to *Theor. Math. Phys.*

27. V.N. Pervushin, *Riv. Nuovo Cim.* 8, N 10, 1 (1985).

28. The conformal group was discovered by Möbius in the 19th century. H. Weyl, *Proc.American Philosophical Society*, **93**, 535-541 (1949), It was extracted from electrodynamics by Bateman and Cuningham in 1909. H. Bateman, *Proc. London Math.* Soc. **7**, 70-92 (1909); E. Cuningham, *Proc. London Math.* Soc. 8, 77-98 (1909). The conformal transformations keep invariant the angle between two vectors in space-time and include the scale transformations.

29. R. Penrose, *Relativity, Groups and Topology*, Gordon and Breach, London, 1964; N. Chernikov and E. Tagirov, *Ann. Inst.* Henri Poincarè 9, 109 (1968).

30. A.D. Linde, *Elementary Particle Physics and Inflation Cosmology*, Nauka: Moscow, 1990.

31. V.N. Pervushin, D.V. Proskurin, and A. A. Gusev, *Grav.& Cosmology*, **8**, 181 (2002).

32. S. Schweber, *An Introduction to Relativistic Quantum Field Theory*, Row, Peterson and Co.: Evanston, Ill., Elmsford, N.Y, 1961. N. N. Bogoliubov, A. A. Logunov, A. I. Oksak, I. T. Todorov, *Obshie Prinzipi Kvantovoj Teorii Polja*, 1st edn., Nauka, Moscow, 1987.

33. M. Pawlowski, V. N. Pervushin, *Int. J. Mod. Phys.* 16, 1715 (2001), [hep-th/0006116]; V. N. Pervushin and D. V. Proskurin, *Gravitation and Cosmology*, 7, 89 (2001).

34. T. Levi-Civita, *Prace Mat.-Fiz.* 17, 1 (1906); S. Shanmugadhasan, *J. Math. Phys* 14, 677 (1973); S.A. Gogilidze, A.M. Khvedelidze, and V.N. Pervushin, *J. Math. Phys.* 37, 1760 (1996); *Phys. Rev.* D 53, 2160 (1996); *Phys. Particles and Nuclei* 30, 66 (1999).

35. N.N. Bogoliubov, *J. Phys.* USSR 2, 23 (1947). V. N. Pervushin and V. I. Smirichinski, *J. Phys. A: Math. Gen.* 32 (1999) 6191.

36. M. Pawlowski, V. N. Pervushin, *Int. J. Mod. Phys.* **16**, 1715 (2001), [hep-th/0006116]; V. N. Pervushin and D.V. Proskurin, *Gravitation and Cosmology*, **7**, 89 (2001).

37. S. Schweber, *An Introduction to Relativistic Quantum Field Theory*, Row, Peterson and Co: Evanston, Ill., Elmsford, N.Y, 1961. N. N. Bogoliubov, A. A. Logunov, A. I. Oksak, I. T. Todorov, *Obshie Prinzipi Kvantovoj Teorii Polja*, 1st edn., Nauka: Moscow, 1987.

38. M. Pawlowski, V. N. Pervushin, *Int. J. Mod. Phys.* 16, 1715 (2001), [hep-

th/0006116]; V. N. Pervushin and D. V. Proskurin, *Gravitation and Cosmology*, 7, 89 (2001). B.M. Barbashov, V.N. Pervushin, and D.V. Proskurin, *Theoretical and Mathematical Physics* 132, 1045 (2002) (Translated from Teoreticheskaya Matematicheskaya Fizika, Vol.132, No.2, pp.181 -197, August, 2002).

39. N.N. Bogoliubov, *J. Phys.* USSR 2, 23 (1947).

40. M. Pawlowski, V. N. Pervushin, *Int. J. Mod. Phys.* 16, 1715 (2001), [hep-th/0006116]; V. N. Pervushin and D. V. Proskurin, *Gravitation and Cosmology*, 7, 89 (2001). B.M. Barbashov, V.N. Pervushin, and D.V. Proskurin, *Theoretical and Mathematical Physics* 132, 1045 (2002) (Translated from Teoreticheskaya Matematicheskaya Fizika, Vol.132, No.2, pp.181 -197, August, 2002).

41. N.N. Bogoliubov, *J. Phys.* USSR 2, 23 (1947).

42. E. A. Tagirov, N. A. Chernikov, Preprint JINR P2-3777, *Dubna*, 1968; G. L. Parker, *Phys. Rev. Lett.* 21, 562 (1968); *Phys. Rev.* 183, 1057 (1969); *Phys. Rev.* D 3, 346 (1971). A.A. Grib, S.G. Mamaev, V. M. Mostepanenko, *Quantum effects in intensive external fields*, Energoatomizdat, Moscow, 1988. A.A. Starobinsky, *Phys. Lett.* B, 91, 99 (1980). L.A. Kofman, A.D. Linde, A.A. Starobinsky, *Phys. Rev. Lett.*, 73, 3195 (1994); *Phys. Rev.* D 56, 3258 (1997).

43. A.A. Grib, S.G. Mamaev, V. M. Mostepanenko, *Quantum effects in intensive external fields*, Energoatomizdat, Moscow, 1988.

44. E. A. Tagirov, N. A. Chernikov, Preprint JINR P2-3777, *Dubna*, 1968; G. L. Parker, *Phys. Rev. Lett.* 21, 562 (1968); *Phys. Rev.* 183, 1057 (1969); *Phys. Rev.* D 3, 346 (1971).

45. H.-P. Pavel and V.N. Pervushin, *Int. J. Mod. Phys.* A 14, 2285 (1999).

46. E. A. Tagirov, N. A. Chernikov, Preprint JINR P2-3777, *Dubna*, 1968; G. L. Parker, *Phys. Rev. Lett.* 21, 562 (1968); *Phys. Rev.* 183, 1057 (1969); *Phys. Rev.* D 3, 346 (1971).

47. For massive particles the cosmological singularity, i.e., disappearance of the spatial scale, means disappearance of masses. The massive vector bosons are unique particles of SM which have a mass singularity H.-P. Pavel and V.N. Pervushin, *Int. J. Mod. Phys.* A 14, 2285 (1999).

48. D. Behnke, D.B. Blaschke, V.N. Pervushin, and D.V. Proskurin, *Phys. Lett.* B 530, 20 (2002); [gr-qc/0102039]. V.N. Pervushin, D.V. Proskurin, and A. A. Gusev, *Grav.& Cosmology*, 8, 181 (2002). D. Blaschke et al., *Cosmological creation of vector bosons and CMB*, gr-qc/0103114; hep-th/0206246. V.N. Pervushin and D.V. Proskurin, *Proceeding of the V International Conference on Cosmoparticle Physics (Cosmion-2001) dedicated to 80-th Anniversary of Andrei D. Sakharov* (21-30 May 2001, Moscow-St.Peterburg, Russia); [gr-qc/0106006].

49. D. Behnke, D.B. Blaschke, V.N. Pervushin, and D.V. Proskurin, *Phys. Lett.* B 530, 20 (2002); [gr-qc/0102039]. V.N. Pervushin, D.V. Proskurin, and A. A. Gusev, *Grav.& Cosmology*, 8, 181 (2002). D. Blaschke et al., *Cosmological creation of vector bosons and CMB*, gr-qc/0103114; hep-th/0206246. V.N. Pervushin and D.V. Proskurin, *Proceeding of the V International Conference on Cosmoparticle Physics (Cosmion-2001) dedicated to 80-th Anniversary of Andrei D. Sakharov* (21-30 May 2001, Moscow-St.Peterburg, Russia); [gr-qc/0106006].

50. J. Bernstein, *Kinetic theory in the expanding universe*, Cambridge: Cambridge University Press, 1985.

51. Note that the cosmological creation of particles (J. Martin and R.J. Brandenberger, [hep-th/0005209]; R.J. Brandenberger and J. Martin, [astro-ph/0005432]; J.C. Niemeyer, *Phys. Rev.* D 63, 12352 (2001).) of the type of shown in Fig. 3. is already connected with the primordial fluctuations of temperature of CMB J. R. Bond et al. (MaxiBoom collaboration), *CMB Analysis of Boomerang & Maxima & the Cosmic Parameters* , in: *Proc. IAU Symposium* 201 (PASP), CITA-2000-65 (2000). [astro-ph/0011378].

52. D. Blaschke et al., "Cosmological creation of vector bosons and CMB,"

[gr-qc/0103114; hep-th/0206246].
53. See also V.N. Pervushin, D.V. Proskurin, and A. A. Gusev, *Grav.& Cosmology*, 8, 181 (2002)
54. A. D. Sakharov, *Pis'ma v ZHETF*, **5**, 24 (1967); V. A. Rubakov and M. Shaposhnikov, *Uspekhi Fiz*. Nauk, 166, 493 (1996).
55. L. B. Okun, *Leptons and Quarks*, Moscow: Nauka, 1981
56. A.D. Linde, *Elementary Particle Physics and Inflation Cosmology*, Moscow: Nauka, 1990.
57. J. Schwinger, *Phys. Rev.* 127, 324 (1962).
58. P.A.M. Dirac, *Proc. Roy. Soc.*, A114, 243 (1927).
59. J. Schwinger, *Phys. Rev.* 127, 324 (1962).
60. *Ibid.*,I.V. Polubarinov, *Phys. Particles and Nuclei*, 34, 377 (2003). Nguyen Suan Han and V.N. Pervushin, *Mod. Phys. Lett*. A2 367 (1987); V.N. Pervushin, *Phys. Particles and Nuclei*, 34, 348 (2003); [hep- th/0109218]; L.D. Lantsman, V.N. Pervushin, *Physics of Atomic Nuclei*, 66, No.7 (2003); [hep- th/0205252].
61. R. Feynman, *Phys. Rev.* 76, 769 (1949). R. Feynman, *Acta Physica Polonica* 24, 697 (1963).
62. L. Faddeev, V. Popov, *Phys. Lett*. B 25, 29 (1967).
63. G. 't Hooft and M. Weltman, *Nucl. Phys*. B 44, 189 (1972); *Ibid*. 50, 318 (1972).
64. M.J. Duff, *The world in eleven dimensions: supergravity, supermembranes and M-theory*, I.O.P. Publishing 1999, http://bookmark.iop.org/bookpge.htm/book?5.
65. R. Feynman, *Phys. Rev.* 76, 769 (1949). L.D. Faddeev, *Teor. Mat. Fiz*. 1, 3 (1969), in Russian.
66. In 1974, Barbashov and Chernikov (B.M. Barbashov and N.A. Chernikov, *Classical dynamics of relativistic string* [in Russian], Preprint *JINR* P2-7852, *Dubna*, 1974.) applied the frame-fixing formulation to the relativistic string theory and proved that this theory coincided with the Born-Infeld theory that strongly differs from the abstract frame-free formulation of a string with the so-called Virasoro algebra (B.M. Barbashov and V.V. Nesterenko, *Introduction to Relativistic String Theory, World Scientific*, Singapore, 1990). Reiman and Faddeev reproduced and generalized this result in 1975 (for details see B.M. Barbashov, V.N. Pervushin, and D.V. Proskurin, *Theoretical and Mathematical Physics* 132, 1045 (2002) (Translated from *Teoreticheskaya Matematicheskaya Fizika*, Vol.132, No.2, pp.181 -197, August, 2002)).
67. M. Pawlowski, V. N. Pervushin, *Int. J. Mod. Phys*. 16, 1715 (2001), [hep-th/0006116]; V. N. Pervushin and D. V. Proskurin, *Gravitation and Cosmology*, 7, 89 (2001). Nguyen Suan Han and V.N. Pervushin, *Mod. Phys. Lett*. A2 367 (1987); V.N. Pervushin, *Phys. Particles and Nuclei*, 34, 348 (2003); [hep-th/0109218]; L.D. Lantsman, V.N. Pervushin, *Physics of Atomic Nuclei*, 66, N 7 (2003); [hep- th/0205252].
68. J. Schwinger, *Phys. Rev.* 127, 324 (1962).
69. As was shown in (Nguyen Suan Han and V.N. Pervushin, *Mod. Phys. Lett*. A2 367 (1987); V.N. Pervushin, *Phys. Particles and Nuclei*, 34, 348 (2003); [hep- th/0109218]; L.D. Lantsman, V.N. Pervushin, *Physics of Atomic Nuclei*, 66, N 7 (2003); [hep- th/0205252].) the frame-free formulations lose instantaneous atoms and hadrons in gauge theories of electromagnetic and strong interactions.
70. J. Schwinger, *Phys. Rev.* 127, 324 (1962).
71. S. Weinberg, *First Three Minutes: A modern View of the Origin of the universe.* New York: Basic Books, Inc., 1977. p155.
72. A. Einstein, *The Einstein collected articles*, Moscow: Nauka, 1967, p. 23.
73. A.C. Crombie, *Robert Grosseteste and the Origin of Experimental Science*, Oxford: Clarendon Press, 1953.

74. G.V. Florovsky, *Eastern Fathers of the IVth century*, Intern. Publishers Limited, 1972. L. B. Okun, *L*eptons and Quarks, Nauka, Moscow, 1981.

75. G.V. Florovsky, *Eastern Fathers of the IVth century*, p.70.

76. G.V. Florovsky, *Eastern Fathers of the IVth century*, p.141.

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