Determining Dark Energy and Dark Matter from the values of Redshift for the present time, Planck and Trans-Planck epochs of the Big-Bang model

Abstract As an alternative to the Standard \( \Lambda \)CDM cosmology model in which the cosmological redshift quantified by relation \( f(z) \sim (1 + z) \), and presented the Universe Dark Energy \( \Omega_{DE} \) as an Einstein’s Cosmological Constant \( \Lambda \), we have developed a new modified Freundlich’s (quantum relativity) redshift (MFRS) mechanisms, which provide a precise solutions of the Dark Energy and Dark Matter problems. We apply the joint solution of three MFRS equations for concordances quantize bounce Planck hierarchy steps. Simultaneous scaling solutions of MFRS equations in logarithmic scale appropriate to three cosmological epoch’s, yields a currently testable predictions regarding the Dark Matter \( \Omega_{DM} = 0.25 \), and Dark Energy \( \Omega_{DE} = 0.75 \). These predictions coincides with the recent observational data from WMAP and other key supernovae SNe Ia findings. Thus, the presence of Dark Matter and Dark Energy had already been not only detected observationally, but also confirmed theoretically with the very compelling accuracy. From the WMAP7 and our predicted ages we find a value of the Hubble constant \( H_0 = (65.6 \pm 0.6) \text{km} \cdot \text{s}^{-1} \text{Mpc}^{-1} \) which is excellent agreement with the Planck 2013 results XVI. Compared with the “holographic scenario” results, we find an important coincidence between our new and “holographic” parameters. We discuss the connection hierarchy between the multiverse masses and examine the status of the cosmic acceleration. The product of the age of the Universe into the cosmic acceleration in each cosmological epochs –including present day are constant and precisely corresponds to an possible observable-geophysical parameter \( g_U = \frac{9.50005264}{265} \text{m/s}^2 \). For the derived by WMAP7 age of the Universe \( t_{W7} = 13.75(13) \times 10^9 \text{yr} \), we find the relevant acceleration \( a_{W7} = 6.91(65) \times 10^{-11} \text{m/s}^2 \). The predicted value of \( t_0 = 9.0265(51) \times 10^9 \text{Gyr} \) is consistent with the background acceleration. \( a_0 = 1.052464(61) \times 10^{-11} \text{m/s}^2 \).

Keywords Quantum Big Bang Cosmology · Planck and Trans-Planck redshifts · Dark Energy and Matter · Holographic parameters · Cosmic Acceleration · Multiverse

1 Introduction

The mysterious nature of Dark Energy (DE) is clearly on of the outstanding puzzles of the present quantum gravity and particle physics united in the quantum cosmology. In “Report of the Dark Energy

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The First of DETF recommendation states: “We strongly recommend that there be an aggressive program to explore dark energy as fully as possible, since it challenges our understanding of fundamental physical laws and the nature of the cosmos” [3].

The corresponding astrophysics measurements show that Universe is spatially flat, contains about (73–75)% of the DE (or the near equivalent Einstein’s cosmological constant $\Lambda$, see, i.e. [104]) and about (23–30)% in the form Dark Matter (DM) (see e.g. [11, 61, 122], and references therein). These data are compatible with the recent Wilkinson Microwave Anisotropy Probe (WMAP) observations (see e.g. [64, 68, 69, 80], and references therein). There many several cosmological efforts were made to understanding the origin of DE and DM (for review, e.g. [35, 85, 86, 101, 117, 128], and references therein).

In the preceding paper [53] we make a first attempt at such a study, by compiling quantum cosmological parameters taken for Today, Planck and Trans-Planck epochs of the Universe. In the present paper we anew give a comprehensive analysis for the exact solution of these challenges. We discuss their observational and experimental viewpoints, believe that exact explanations of the DM and DE problem lie outside of Standard model (SM) [52], since the present-day failures of the “standard model of cosmology require a new” [74] reality. Thus, this paper is partially similar to the one of an Dark Matter and Dark Energy scenario, which we have considered previously [53], with the only difference that here the problem discussed in more detail by the adding the new knowledge and references. In the end of work [52] (see, also, [53]) it is mentioned that conception Synthesis of the Big Bang model with the modified Freundlich’s redshift (MFRS) at Trans-Planck and the Planck scales provide a powerful tool to probe this problem. Further, based on combining shape constraints on simultaneous scaling solution of MFRS equations in logarithmic scale, a sequence of present day, Planck and Trans-Planck epochs cosmological parameters gives these “puzzling parameters,” rigorously defined as $\Omega_{DE} = 0.75$ and $\Omega_{DM} = 0.25$. These predicted values of the Dark Energy and Dark Matter parameters are coincides with the predictions of the “Millennium-I and II Simulations” [18, 82] cosmological scenarios, and are compatible with the recent WMAP observational [64, 68, 69, 80] data. The supernova SNe Ia high redshift data (see e.g. [66, 69, 118]) was an ideal object for the application of this model. The calculation showed that results of validity of accelerated expansion of the Universe based on the scenario of flat Friedman-Robertson-Walker (FRW) model are highly esoteric. The model that opened the way for a simple interpretations of the SNe Ia high redshift data (see e.g. [4, 83, 84]) perhaps is the $\Lambda$-Cold-Dark-Matter ($\Lambda$CDM) model with the some “hot” complementary.

This paper is organized as follows: In Sec. 2 we summarize the necessary information about the discrete MFRS formalism under discussion. Here and what follows the subscripts “Pl” and “TPl” denotes values of Planck’s and Trans-Planck’s epoch parameters of MFRS equations, respectively. In Sec. 3 we choose a family of MFRS equations for the three steps discrete $10^{52}$ folding phase transition from the current epoch down to Trans-Planck’s regime. Here along with the well-known Planck’s parameters $m_{Pl}, T_{Pl}, l_{Pl}$ and $t_{Pl}$ [41, 110], it is given also some new quantum cosmological parameters. In Sec. 4 the detailed analysis of quantum cosmological parameters in the latest post Planck’s epochs is given. Here we apply the logarithmic method to joint solution of these three cosmological redshift equations. Thereby, we firstly derive the corresponding predicted key parameters of $\Omega_{DM}$ and $\Omega_{DE}$ from the full combinations of above MFRS equations. In Sec. 5 we give refined version of state parameter of the Dark Energy $w$. In the next 6 Sec. we compare predicted values $\Omega_{DM}$ and $\Omega_{DE}$ with the observational data. The Sec. 7 is devoted to the age of Universe. The nature of Multiverse is discussed in Sec. 8. In Sec. 9 we briefly describe the latest Planck’s epochs. In Sec. 10 the problem of accelerated expansion has been analyzed. In Sec. 11 the recommended values of Dark Energy and Dark Matter in physical units are presented. Finally, in the last Sec. 12 we draw our concluding remarks.

2 Discrete Redshift Formalism and its Quantum Cosmological Parameters

Traditionally, it is proposed that the Universe originated at $t \rightarrow 0$ by an event called the “Big Bang” from a single point called a singularity [72]. As has already been noted, we firstly applied a new
quantum cosmological representation for the creation of the Universe after the Big Bang, based on the MFRS in some fixed steps of cosmological epochs [52, 53]. The basic idea in the beginning of this creation history of the Universe is that the time evolution between the birth and death for our permanently stepped expanding Universe divided into five distinct Planck epochs separated by steps \( n = 2, 1, 0, -1, -2 \) at \( z_{Pl} \). In this quantum cosmological scenario Dark Energy and Dark Matter can be predicted by simultaneous solutions of the first three Planck epochs of MFRS equations, which are relevant to the current observable Universe \((z_{Pl}^0 = z_0)\), Planck epoch \((z_{Pl})\), and Trans-Planck epochs \((z_{Pl}^2 = 2z_{Pl})\). (Moreover, by the Planck MFRS hierarchy presentation are reasons to assume that there available a further steps with the \( n = 3, 4, \cdots, 8 \) (These steps of MFRS are considered in Sec.3).

While “the observable Universe exhibits several time asymmetries called of arrow of time”, in logarithmic scale these results does not asymmetry “distinctions between past, present, and future” [53]. Then, for all history of our observable Universe with the “characteristic mass \( M_U \)” [52, 53, 150] after of Big Bang up to a Big Rip (the end of our Universe), for expanding Universe we assume five discrete steps (eras) of fundamental MFRS equations with \( z^n \). Eventually, the beginning and break down of our Universe may then have been at some MFRS between \( z_{Pl}^2 \sim 10^{122} \) and \( z_{Pl}^2 \sim 10^{-120} \). As a result, for the present-day observable Universe we have a first cosmological MFRS by \( z_{Pl}^0 = z_0 = 1 \) at the age of \( t_0 \sim 10^{13} \text{s} \) (the expanding time from the Big Bang to \( z_0 = 1 \)) and predicted constant cosmic background radiation (CBR) temperature \( T_0(CBR) \sim 2.7662 K \), (like to the cosmic microwave background (CMB) temperature \( T_0(CMB) = 2.7252 K \) measured COBE in 1992). (Here and in the following, the subscript “0” denotes the present epoch values). In second, we assumed that the Planck epoch MFRS (Planck redshift) by \( z_{Pl} \sim 10^{62} \) at the Planck time of \( T_{Pl} \sim 5 \times 10^{-47} \text{s} \) with temperature of \( T_{Pl} \sim 10^{12} \text{K} \) is landmark, in accord with Planck’s concept [110]. The creation of a homogenous Universe in the Trans-Planck “epoch” can be described by a Trans-Planck MFRS (Trans-Planck redshift) equation by \( z_{Pl} \sim 10^{45} \), at time of \( T_{Pl} \sim 10^{-108} \text{s} \), and constrained with temperature as \( T_{Pl} \sim 10^{106} \text{K} \). This step proposed that the present-day Universe begin from a non-zero radius \( r_{Pl} \sim 10^{-38} \text{m} \), with a total energy of \( M_U \cdot c^2 \sim 10^{38} \text{GeV} \). So, these quantum gravity parameters correspond to the creation of our observable Universe from the Big Bang, which are derived without violate the Heisenberg’s uncertainty principle [52]. However, here we convinced that the generalized uncertainty principle is not generally valid at time \( t \sim 10^{-169} \text{s} \). In addition, the moment \( T_{Pl} \) is along way from initial zero singularity when in the Friedman universe \( t \to 0 \), and the energy density was infinity, i.e. \( u_e(t) \to \infty \). Thus, this ultimate historical difficulty of singularity in Friedman cosmology model is eliminated.

Notice also that in the pre-current evolutions of the Universe the MFRS is \( z > 1 \), and in post-current this is \( z < 1 \), respectively. The value \( z \equiv 0 \equiv 1 \) corresponds to the current Universe.

### 3 The MFRS Equations for Three Discrete Steps of Planck’s Epochs

When MFRS model was proposed in 2006 [51] it contained three types of MFRS equations, covering the present, electromagnetic and Planck’s epochs, with utilizing \( z = z_0 = 1 \), \( z = z_e \approx 2 \times 10^{40} \), and \( z = z_{Pl} \approx 5 \times 10^{62} \), respectively. In subsequently, in detailed description of a MFRS models [52,53] it has been argued that the current values of \( \Omega_{DE} \) and \( \Omega_{DM} \) can be determined from combinations of the several bounce steps of Planck’s MFRS equations. In this sense, below we anew use three complex set of discrete steps \( z^n \) Planck’s MFRS equations from \( z \equiv z^0_{Pl} \equiv z_0 \) at \( n \equiv 0 \) (Today), to \( z^n_{Pl} \equiv z_{Pl} \) at \( n \equiv 1 \) (Planck) and \( z^n_{Pl} \equiv z_{Pl} \) at \( n = 2 \) (Trans-Planck). As illustrated in Section 4 the most plausible estimation of the Dark Matter (making of 0.25 parts) and the Dark Energy (making of 0.75 parts) of

1. This value correspond to predicted temperature \( T_0(CBR) \) is calculated completely on the basis of fundamental physical constants of \( c, h, k, G \) and Freundlich-Melvin constants \( A_S \). Clearly, parameter \( T_0(CBR) \) can expect as a quantum temperature of the novel quantum cosmology.

2. In this work it has been mistakenly argued that the creation moment of the Universe (the Big Bang) begin at the \( t_{OTPl} \sim 10^{-169} \text{s} \) (take Over Trans-Planck energy scales). Presented in subsection 5.3.4 equations are valid in the first order approximations by relation of \( z = t_{OTPl} \cdot T_0^{OTPl} \), where \( T_0^{OTPl} \sim 10^{94} \text{K} \). Initially this is true. However, when time became \( t = t_{OTPl} \) the quantum relativistic approximation \( (M_U \cdot c^2) \cdot t_{OTPl} = h \) will do not and numerical simulations by the Eqs. (5.20a)–(5.21a) may be exists before creation of the today Universe. But that was before basic MFRS \( z_{Pl}^0 \) was established: here exists of the quantum relation \( (M_{PMV} \cdot c^2) \cdot t_{OTPl} = h \) evolving for the Planck Multiverse \( M_{PMV} \) was yet to come (see Subsection 3.4).
The relation between the present observable Universe energy, come from combining solutions of these three scaling steps of discrete Planck’s MFRS equations.

3.1 The Present-day Universe MFRS equation

According to a quantum relativity approaches [51-53] the first bounce steps of MFRS for the our observable Universe may be “scaling scenario” (for review, see [28], and references therein), for \( n = 0 \) characterized by the ratios

\[
z_0 \equiv \left( \frac{T}{T_0} \right)^2 = \frac{t_0}{t} = \frac{a}{a_0} = \cdots = \frac{m}{m_0} = \cdots = \frac{a_0}{a} = \cdots \equiv (c \cdot a \cdot A_S) \cdot T_0^2 = 1, \tag{1}
\]

where the \( T_0, t_0, A_0, M_U \) and \( a_0 \) are the predicted key quantum relativity cosmological parameters for the cosmic background radiation (CBR) temperature, age of the Universe, horizon size comparable to the radius of curvature, the total mass and the background acceleration at the present Universe, since the Big Bang. Basically, these key constant scaling parameters for describing our observable Universe are expressed in terms of the speed of light in vacuum \( c \), the new quantum gravity-cosmological constant \( \sigma \) parameterized as \( T_0^2 \cdot t \) [52, 53], the Newton’s gravitational constant \( G \), and the Freundlich-Melvin constant \( A_S \approx 2 \times 10^{-36}m^{-1}K^{-4} \) [46, 93]. In fact, one of the basic result follows from relation (1) is identity combinations today horizon \( l_0 \) and age of the Universe \( t_0 \) with the CBR temperature \( T_0 \). The relation between \( T_0 \) and \( A_S \) is inextricable coupled to the relation between \( T \), \( t \), and constant \( \sigma \), presenting in the general case, an intractable problem. This can, however, be solved in closed form under the following [21] assumption \( A_S \cdot T_0^4 = 1/R_U \), where \( R_U \) is the radius universe. To determine the present “relic temperature” \( T_0 \) we set \( R_U = l_0 \) in the above equation, finding

\[
(l_0 \cdot T_0^4)^{-1} = A_S, \text{ and } t_0 \cdot T_0^2 = \sigma. \tag{2}
\]

In this way [at MFRS of \( z_0 = 1 \) based on (1)], we can predict the following present-epoch values\(^3\) of the some today quantum-cosmological parameters as

\[
T_0 = \pm (c \sigma A_S)^{-1/2}, \quad t_0 = c \sigma^2 A_S, \quad l_0 = (c \sigma)^2 A_S \quad \text{and} \quad a_0 = (c \sigma A_S)^{-1}, \tag{3}
\]

where the constant \( \sigma \) is measured in \( s \cdot K^2 \) units. The constant \( \sigma \) was the firstly proposed in 2004 [50]. Actually, for all cosmological epochs constant \( \sigma \) can be written as [51-53]

\[
\sigma \equiv \cdots \equiv t_0 \cdot T_0^2 \equiv \cdots \equiv t_{P1} \cdot T_{P1}^2 \equiv \cdots \equiv b(c_2/c_1)E_{P1}, \tag{4}
\]

where \( b \) is Wien’s displacement law constant, \( c_1 \) and \( c_2 \) are the first and second radiation constants, respectively and \( E_{P1} \) is the Planck energy. We already discussed the importance universality of quantum cosmological constant \( \sigma \) in an above our works. Thus, proposed relationship by (4) does not vary in various epochs of the Universe. Then in either case, the set \( (T_0, t_0), (T_{P1}, t_{P1}) \) and \( (T_{T_{P1}}, t_{T_{P1}}) \) pairs are enough to assure the robustness determine, which remains constant in time intervals \( 10^{-106}s \leq t \leq 10^{32}s \) since the Big Bang. Because \( \sigma \) is the universal quantum gravity-cosmological constant, it may be of interest to include the quantized state \( n = -1, -2 \) into the computation, to obtain a realistic estimation in the final fate of the Universe history. In the latest post-current epochs [142] the constant \( \sigma \) appear also at \( z_{P1}^{-1} \) and \( z_{P2}^{-2} \) RMFS equations ranging up to Big Rip. This problem is considered in Sec. 4 as \( \sigma = T_0^2 \cdot t_0 \cong 2.18 \times 10^{20}K^{-2}s \).

\(^3\) The classical description \( a_0 \) is the Newtonian gravitational acceleration.

\(^4\) It is evident from Eq. (3), that the Universe may be accepted the negative temperature, which comes from the fact that the CBR temperature \( T_0 \) follows from \( T_0^2 = (c \cdot a \cdot A_S)^{-1} \)
3.1.1 The Value \( \vartheta \) on the basis of Fundamental Physical Constants

The value of the quantum-cosmological constant \( \vartheta \) cannot be calculated directly since the \( T_0(CBR) \) temperature, and present age of the observable Universe \( t_0 \), or the Planck's temperature \( T_{Pl} \) and Planck's time \( t_{Pl} \) has not been determined. Here the basic idea, consistent with the MFRS is that, this new constant has the fundamental importance for application in all epochs of the expansion history of the Universe, i.e. it does not depend on age of the Universe. With these assumptions there may be exception for an independent direct determination of constant \( \vartheta \) on the basis of current Fundamental Physical Constants (FPC). Therefore, we hopes that this constant in the near time would be included to CODATA list as one new quantum gravity- cosmological constant.

Using the FPC of \( b, c_1, c_2 \) and \( E_{Pl} \), from CODATA-2006 [95] early we obtain (see paper [52])

\[
\vartheta = 2.179555_{13} \times 10^{20} K^2 s. \tag{5}
\]

In this paper, we improve the numerical value of \( \vartheta \) by using recent CODATA-2010 data sets for the FPC [96]. In that case, the universal constant \( \vartheta \) could be defined as

\[
\vartheta = b(c_2/c_1) \cdot E_{Pl} = \frac{(h/k^2) \cdot E_{Pl}}{4.965114231} = 2.179627_{6}(130) \times 10^{20} K^2 s, \tag{6}
\]

where \( h = 6.58211928(15) \times 10^{-16} eV \cdot s \) is Planck's constant, \( k = 8.61733247(8) \times 10^{-5} eV \cdot K^{-1} \) is Boltzmann's constant, and \( E_{Pl} = m_{Pl} \cdot c^2 = 1.220932(73) \times 10^{19} GeV \) is the Planck energy.

However, in that background, fine adjustment of the constant \( \vartheta \) and other constants are limited by the accuracy of Newtonian constant of gravitation \( G \), and the Stefan-Boltzmann constant \( \sigma \). A useful picture for improve our calculations of the \( \vartheta \) is based on absolutely precision of the product of the \( G \sigma^2 \) and \( \sigma \) given by

\[
(G \sigma^2) \cdot \sigma = (4.965114231)^{-2} (\pi^2/60) \cdot c^3 = 1.797844453_{2} \times 10^{23}(m/s)^3\text{(exact)}. \tag{7}
\]

The importance of this equation comes from the fact that the speed of light in vacuum \( c \) in right side is an “exact” and independent of any quantum-electromagnetic parameters. So if we adopt CODATA-2010 [96] values of \( G = 6.67384(80) \times 10^{-11} m^3 kg^{-1} s^{-2} \) and \( \sigma = (\pi^2/60)k^4/h^3c^2 = 5.670373(21) \times 10^{-8} W \cdot m^{-2} K^{-4} \), then the constant \( \vartheta \) from the Eq. (6) can be anew directly calculated within the accuracy of 0.00006, and equal

\[
\vartheta = 2.179627_{6}(130) \times 10^{20} K^2 s. \tag{8}
\]

Then, according to the estimates of Eqs. (6) and (8) today final revised result for the quantum gravity- cosmological constant \( \vartheta \) is given by

\[
\vartheta = 2.179627_{6}(130) \times 10^{20} K^2 s. \tag{9}
\]

In principle, by using the revised Eq. (7), the Newton’s gravitational constant \( G \) becomes calculable in terms of FPC \( c, h, k, \sigma \) and new quantum gravity-cosmological constant \( \vartheta \).

On the other hand it is evident that, “the expanding universe is an excellent laboratory to study the effect of scale change on physical laws and physical constants” [97]. After all, the derived new constant \( \vartheta \) offers way for MFRS equations in at all epochs of expanding Universe. These epochs corresponded to a quantized interval of \( z^2_{Pl} - z^2_{Pl} \), from the pre-Big Bang to the “Big Rip” [23]. Consequently, the constant \( \vartheta \) attained the status of fundamental quantum gravity- cosmological constant for all cosmological epochs.

The application of the new constant is very similar to the application of the Boltzmann constant \( k \), which can be used especially at some new correct quantum-cosmological computations.

3.1.2 The Mass of the Our Observable Universe

Throughout this paper we introduce the total rest mass of the observable Universe \( M_{U} \), accepted in Einstein theory as a “characteristic mass scale” [150]. In addition, the quantum cosmological quantity this mass \( M_{U} \) is defined as (See, also [52, 53])

\[
M_{U} \equiv \frac{c^2}{G} l_0 \equiv \frac{ac^3}{GT^2_0} \equiv \frac{(ac^2)^2}{G} A_S \equiv \frac{T_{Pl}}{T_0} m_{Pl} \equiv \cdots
= 1.15000_{0}(76) \times 10^{56} kg = 6.4510_{6}(21) \times 10^{81} GeV/c^2. \tag{10}
\]
From Table 1 and Eq. (1) it is immediate that $T_0(CBR)$ shown in Table 1 as a function of $c$ be estimated many times better than a few percents \[52, 53, 60\]. The numerical examples for the some radiation temperature given by $A$ the 2010 data \[96\]. However, it is worth noting that there difficult to asses the error in value of constant $A$ the Absolute Radiometer for Cosmology, Astrophysics andDiffuse Emission (\textit{ARCADE}) 2 team measurements \[121\] (though this may be interpreted as another radiation not associated with CMB temperature). Nonetheless, from comparison results of these temperatures, at once we estimate the CMB radiation temperature at redshift $z = 0$ and coincides with the $T_0(CMB) = (2.766 \pm 0.160)K$ derived at an 8.3GH frequency by the Planck mission (Planck team science) \[44\].

The present-day age of the Universe $t_0 = T_U / T_0$ gets a worse when we come to the early Universe with the Planck time scale $t_{pl}$ or temperatures well beyond the Planck temperature $T_{ppl}$ in Big Bang scenario \[52\], though this claim is questionable \[143\]. As is repeatedly mentioned, there is no underlying fundamental physical theory for the Trans-Planck regime \[19, 28, 67, 94\]. Since the constant $\vartheta$ depends exclusively on the condition of cosmological parameters, at constant value of velocity of light in vacuum $c$ (here and further), are shown in Table 1 as a function of $T_0(CBR)$.

### Table 1 The present-day quantum gravity cosmological parameter sets of the Universe.

| Parameters                          | Symbol | Definition | Value                  |
|-------------------------------------|--------|-----------|------------------------|
| Background temperature              | $T_0(CBR)$ | $(\vartheta \cdot c \cdot A_S)^{-1/2}$ | 2.7662_{05}(160)K |
| Modified Freundlich's Red Shift     | $z_0$  | $(\vartheta \cdot c \cdot A_S) \cdot T_0^2$ | 1 |
| Present-day age of the Universe     | $t_0 = T_U$ | $\vartheta / T_0^2$ | 2.8484_{81}(16) $\times 10^{19}$ s |
| Horizon size                        | $l_0 = c t_0$ | $\vartheta \cdot c / T_0^2$ | 8.5395_{32}(49) $\times 10^{27}$ m |
| Background acceleration             | $a_0$  | $(c / \vartheta) \cdot T_0^2$ | 1.6524_{62}(61) $\times 10^{-11}$ m/s$^2$ |
| $G$\times Mass of the Universe      | $GM_U$ | $(\vartheta \cdot c^3 / T_0^2)$ | 7.674_{94}(33) $\times 10^{44}$ m$^3$/s$^2$ |
| Present Cosmological constant       | $A_0 = l_0^{-2}$ | $(T_0^2 / \vartheta \cdot c)^2$ | 1.371_{30}(16) $\times 10^{-56}$ m$^{-2}$ |
| Mass of the Graviton                | $m_{G,r}$ | $(h / \vartheta \cdot c^2) T_0^2$ | 4.119_{20}(10) $\times 10^{-71}$ kg |
| Present matter density              | $\rho_\Lambda(t_0)$ | $(T_0^3 / \vartheta^2) / 8\pi G$ | 7.347_{80}(43) $\times 10^{-31}$ kg/m$^3$ |
| Present energy density              | $u_\nu(t_0)$ | $\rho_\nu(t_0) \cdot c^2$ | 6.603_{87}(40) $\times 10^{-14}$ J/m$^3$ |
| Expanding velocity of the Universe  | $l_0 / t_0 \equiv a_0 \cdot t_0$ | $c$ | 299792458_{2}(exact) m/s |
| Cosmological acceleration           | $c / 1$yr | $g_U$ | 9.5000526_{265}(exact) m/s$^2$ |

(Throughout this paper the figures in parentheses after the values give the one-standard-deviation uncertainties in the last significant digits.)

It turns out that the mass $M_U$ is about $\sim 10^{25}$ times the mass $M_S$ of the Sun, that is, $M_S = 1.988435(27) \times 10^{30}$ kg \[57\]. Here and in what follows, numerical values of all physical constants and new cosmological parameters with the exception of constant $A_S$, are determined according to CODATA-2010 data \[96\]. However, it is worth noting that there difficult to assess the error in value of constant $A_S$. The accuracy $A_S$ was determined as follows: Our predicted cosmic (frequency independent) background radiation temperature given by $T_0(CBR) = (c \vartheta A_S)^{-1/2} = 2.7662_{1}K$ \[52\], comparable with the Cosmic Microwave Background (CMB) black-body temperature $T_0(CMB) = 2.725(1)K$ \[44\] (measured locally at redshift $z = 0$) and coincides with the $T_0(CMB) = (2.766 \pm 0.160)K$ derived at an 8.3GH frequency by the Absolute Radiometer for Cosmology, Astrophysics andDiffuse Emission (ARCADE) 2 team measurements \[121\] (though this may be interpreted as another radiation not associated with CMB temperature). However, the problem theoretical explanation for the actual interpretation of CMB gets a worse when we come to the early Universe with the Planck time scale $t_{pl}$, or temperatures well beyond the Planck temperature $T_{ppl}$ in Big Bang scenario \[52\], though this claim is questionable \[143\]. As is repeatedly mentioned, there is no underlying fundamental physical theory for the Trans-Planck regime \[19, 28, 67, 94\]. Since the constant $\vartheta$ depends exclusively on the condition of cosmological parameters, at constant value of velocity of light in vacuum $c$ (here and further), are shown in Table 1 as a function of $T_0(CBR)$.

### 3.1.1 Equality between density and pressure

From Table 1 and Eq. (1) it is immediate that

$$u_\nu(t_0) = \rho_\nu(t_0) \cdot c^2 = 6.603_{87}(40) \times 10^{-14} J/m^3$$

Recall, derived in SI units $J/m^3$ is named Pascal (Pa) and use for pressure measurements.
An alternative view of this result is the identification of positive sign of the energy density $w_\nu(t_0)$ with a negative pressure parameter $P_\nu(t_0)$ taking into account that (see e.g. [109]) $w_\nu(t_0) = -P_\nu(t_0)$.

In this case, considering that $1\text{Pa} \approx 10^{-5}\text{atm}$, the above negative pressure may be written also as

$$P_\nu(t_0) = 6.60385(40) \times 10^{-14}\text{Pa} \approx 6.60385(40) \times 10^{-21}\text{atm},$$

(13)

which confirmed the equation of state of the dark energy $w_\nu(t)$ for a flat Universe, and should be negative. In such (vacuum dominated) flat Universe case for the present-day value of the $w_\nu(t_0)$ correspond to

$$w_\nu(t_0) = -P_\nu(t_0)/\rho_\nu(t_0) = -[a_0^2/8\pi G]/\rho_\nu(t_0) = -1.00.$$

(14)

3.2 The Planck’s epoch MFRS equation

In the most cosmological models the Planck parameters $m_{Pl}$, $t_{Pl}$, $l_{Pl}$ and $T_{Pl}$ are accepted as a rigorously derived fundamental quantum gravity constants of the cosmology (see e.g. [75]). Except the Planck’s temperature $T_{Pl}$, these parameters somewhat already known (e.g. [41, 52, 53, 134]). By regarding Eq. (4) we first notice the fact that there is no agreement between $T_{Pl}$ and other Planck units [52] by the “scaling scenario”.

As was determined in our previous works [52, 53] the MFRS for the Planck epoch step can be expressed by a scaling relation between Planck’s parameters and the predicted present quantum relativity parameters at $n = 1$, leading to

$$z_{Pl} \equiv \frac{T_{Pl}}{t_{Pl}} = \frac{t_0}{l_{Pl}} = \frac{a_{Pl}}{a_0} = \ldots = \frac{w_\nu(t_{Pl})}{w_\nu(t_0)} = \frac{\rho_\nu(t_{Pl})}{\rho_\nu(t_0)} = \ldots$$

$$\equiv \frac{M_{PMV}}{M_U} \equiv \frac{M_U}{m_{Pl}} \equiv \frac{m_{Pl}}{m_G} \equiv \ldots = 5.28371(31) \times 10^{62},$$

(15)

where statistical dual $N_{Pl}$ coincides with redshift $z_{Pl}$ and equal to a number of Planck’s particles at moment $t_{Pl}$. Here $t_{Pl} = (\hbar G/\epsilon^2)^{1/2} = 5.39106(32) \times 10^{-44}\text{s}$, $l_{Pl} = (\hbar G/c^3)^{1/2} = 1.616199(97) \times 10^{-35}\text{m}$ and $m_{Pl} = (\hbar c/G)^{1/2} = 2.17651(13) \times 10^{-8}\text{kg}$ [96] are the Planck’s time, length and mass, respectively.

In particular, according to the scaling scenario of Eq. (15) the reduced Planck’s temperature $T_{Pl}'$ previously determined in (see, [52]) here corrected, namely,

$$T_{Pl}' = (\sigma/t_{Pl})^{1/2} = T_{Pl}/(4.965114231)^{1/2} = 6.358490(23) \times 10^{31}\text{K},$$

(16)

where $T_{Pl}$ is Planck’s temperature [95, 96] defining as

$$T_{Pl} = (\hbar c^3/Gk)^{1/2} = 1.416833(85) \times 10^{32}\text{K}.$$  

(17)

In this case $T_{Pl}'$ is a fixed scaling approach determination of Planck’s temperature.

The Planck matter density within the time $t_{Pl}$ is given by

$$\rho_\nu(t_{Pl}) = 3.8823\times(23) \times 10^{32}\text{kg/m}^3,$$

(18)

and the Planck energy density will be

$$u_\nu(t_{Pl}) = \rho_\nu(t_{Pl})c^2 = 3.4893\times(20) \times 10^{49}\text{J/m}^3.$$  

(19)

Then, Planck’s redshift is the quantum cosmological scaling ratio of present day parameters $[T_0^{-2}, t_0, l_0, M_U, a_0, \rho_\nu(t_0), w_\nu(t_0), \ldots]$ of the our observable Universe to the Planck’s parameters $[T_{Pl}^{-2}, t_{Pl}, l_{Pl}, m_{Pl}, a_{Pl}, \rho_\nu(t_{Pl}), w_\nu(t_{Pl}), \ldots]$, and equal to $z_{Pl} \equiv N_{Pl}$.

It should noted that, the above coincident resembles ratio equality between present-day values of the radius, age and mass of the observable Universe and Planck parameters for length, time and mass in other form is roughly ($\approx 10^{61}$) proposed also by J. Casado. [27]
3.3 The Trans-Planck’s epoch MFRS equation

Extensions of the MFRS model below to time interval with \( t << t_{Pl} \), similar to above Planck’s equation, allowed the Trans-Planck’s epoch (TPE) following the Big Bang [Because we don’t have reliable theory of Quantum gravity for earlier \( t_{Pl} \) time (see, i.e. [34, 63, 119]), we are now able to probe the Trans-Planck’s time as \( t_{TPE} \equiv t_{Pl} \)]. The application of the MFRS to the Trans-Planck “epoch” is very similar to the application this in the Planck’s epoch of the observable Universe. We show that inserting \( n = 2 \) in place \( n = 0 \) into (1) the Trans-Planck’s MFRS is given by [52,53],

\[
z_{TPE} \equiv z_{Pl}^2 \equiv N_{TPE} \equiv \left( \frac{t_{TPE}}{t_0} \right)^2 \equiv \frac{t_0}{t_{Pl}} \equiv \frac{a_{TPE}}{a_0} \equiv \frac{u_{TPE}}{u_0(t_0)} \equiv \frac{\rho_{TPE}}{\rho_0(t_0)} \equiv \cdots \equiv \frac{M_U}{m_{Gr}} \equiv \left( \frac{M_U}{m_{Pl}^2} \right)^2 \equiv \frac{M_{OTMV}}{M_U} \equiv \frac{m_{Pl}^2}{m_{Str}} \equiv \cdots \equiv 2.79176(30) \times 10^{125}, \tag{20}
\]

where dual with the \( z_{TPE} \equiv z_{Pl}^2 \) parameter \( N_{TPE} \) is the number of created (graviton) particles in Trans-Planck epoch, and time \( t_{TPE} \) is moment of the Big Bang. Then, the other parameters with the “TPE” in the very early universe are still too limited to indicate the properties of the Big Bang. The analysis Eq. (20) shows us that the cosmological parameters of the Trans-Planck’s MFRS are determined from the combinations of the present day and Planck’s epochs MFRS parameters by the following relations

\[
z_{TPE} \equiv z_{Pl}^2/z_0 \equiv (M_U/m_{Pl})^2 \equiv z_{Pl}^2 = 2.79176 \times 10^{125}, \tag{21}
\]

\[
T_{TPE} \equiv (t_{Pl}^2)/T_0 = 1.46155(8) \times 10^{63} K, \tag{22}
\]

\[
t_{TPE} \equiv t_{Pl}/t_0 \equiv h/M_U c^2 = 1.0506(6) \times 10^{-106} s, \tag{23}
\]

\[
l_{TPE} \equiv l_{Pl}/l_0 \equiv h/M_U c = 3.0588(18) \times 10^{-98} m, \tag{24}
\]

\[
m_{Gr} \equiv m_{Pl}^2/M_U = 4.11928(10) \times 10^{-71} kg = 2.31075(13) \times 10^{-35} eV/c^2 \tag{25}
\]

\[
m_{Str} \equiv m_{Gr}^2/m_{Pl} = 7.7961(45) \times 10^{-134} kg = 4.3733(25) \times 10^{-98} eV/c^2. \tag{26}
\]

\[
\rho_{TPE} \equiv \rho_0(t_{Pl})/\rho_0(t_0) = 2.0513(41) \times 10^{96} kg/m^3, \tag{27}
\]

\[
u_0(t_{Pl}) = \frac{u_0^2(t_{Pl})}{u_0(t_0)} = 1.96254(19) \times 10^{112} J/m^3, \tag{28}
\]

\[
\alpha_0 \equiv a_{Pl}/a_0 = 2.93823(17) \times 10^{114} m/s^2. \tag{29}
\]

The one crucial point of these developments is that the today Quantum cosmological constant \( \Lambda_0 \) is linked with the Planck and Trans-Planck’s redshifts (for a more confirmative view, see also [52], Sect. 4) by relations

\[
(A_0 \cdot l_{Pl}^2)^{-1} \equiv (l_0/l_{Pl})^2 \equiv \cdots \equiv z_{Pl}^2 \equiv z_{TPE} \equiv N_{TPE}^2 \equiv N_{TPE}. \tag{30}
\]

Then, above sets of predicted parameters can be considered as one of most remarkable successes of \textit{new modified quantum gravity cosmology}, that led to the direct predictions birth parameters of the Universe, corresponding to a extremely tiny Trans-Planck time \( t_{TPE} \) and short Trans-Planck length \( l_{TPE} \) [52]. It is conceived also that this scale may be used for refinement a basic guideline in many quantum gravity theories [5, 19, 28, 67, 94, 114].

However, there is a point which has been often emphasis that lower limit of space-time parameters cannot be performed with precision higher than the Planck scales (see e.g. [63]; and references therein) and believed that “the Planck scales are limits” [13]. Nevertheless, it is truly that we are not nearly “\textit{know any basic principle which characterizes the concurrence of General Relativity and Quantum Mechanics}, in a similar way as the locality principle does for Special Relativity and Quantum Mechanics” [34].

To make above our point precise, note that Quantum Cosmology character of time and length parameters of \( t_{TPE} \) and \( l_{TPE} \) by the Heisenberg uncertainty principle, losing their applicability only at Universe mass \( M_U \gg 10^{53} kg \), \( t_{TPE} \ll 10^{-106} s \) and \( l_{TPE} < 10^{-96} m \), respectively ([52], Sec. 5).

As a result, at the TPE take place the \textit{modified quantum cosmological} processes at which the Universe filled with the \( \sim 3 \times 10^{125} \) gravitons. Moreover, by a TPE scenario in the early Universe creation of any one particle with masses exceed \( m_{Gr} \) cannot be arises. Furthermore, prior to the “\textit{formation of Planck particles}” in the Universe, matter must have existed in the form of string and graviton particles. The fact that, obtained under the assumption (26) creation of string particles appear just at after of \( t \sim 2 \times 10^{-109} s \), which take place beyond the Trans-Planck epoch, which we named as Over
Trans-Planck epoch (OTPE) [52]. Yoneya [151] argued that the generalized uncertainty principle in String theory is not generally valid. In the cited above our work (Sec. 5.4), we also note that “in the string case, the quantizing gravity by the concepts of the Heisenberg’s uncertainty principle losing their applicability”. However, the string parameters are closely connected to each other Trans-Planck and Planck parameters in a variety of ways, depending on the direct manner in which we compare them. Then, using the relation (26) for the OTPE redshift it is argued that

\[ M_U/m_{Str} \equiv \lambda_{Str}/\nu_{TPi} \equiv \cdots \equiv \lambda_{OTPl} \equiv N_{Str} \equiv \nu_{TPi}^3 \equiv \nu_{Pl}^3 = 1.47489(26) \times 10^{108}, \]  

where \( N_{Str} \) is the number of String particles generated in the OTPE of Universe.

In conclusion this paragraf note that the Standard model does not explained neither the mass, nor other parameters of the physical particles [59, 71].

4 Direct Prediction of the Quantized Dark Energy and Dark Matter

4.1 The history of problem

As discussed in the extensive studies (see e. g. [28, 35, 47, 76, 99, 100, 105, 111, 112, 128]) a large number of different theoretical models exist for Dark Energy and Dark Matter. But up to the present, an entirely convincing theoretical breakthrough has not yet been achieved. In addition, Paul Steinhardt and Neil Turok [125] wrote in 2004: “Dark energy has shattered that dream. Dark energy was not anticipated and plays no significant role in the theory”.

Observations have forced us to add dark energy “ad hoc” [123, 124, 140]. In fact, these first treatments of course are not accurate. More recently (a ten years later), Turner in discussing this problem point out that ([78]; see also, [138]) “Dark Energy may be the most profound problem in all of science today”. Li Miao et al., also at the extreme final point of paper [86] are writing: “It is without any doubt that the processes of detecting the nature of dark energy and understanding its origin will prove to be one of the most exciting stories in modern science”, and so on. These historical sayings may be continued. For a recent outlook see also [53].

4.2 Joint solution of MFRS equations for the three epochs

Thus, these results show that there are bound to be a radical change in the correct construction of this problem. Nevertheless, in preceding paper [53] as well in a this work we shows that, in an alternative to the Inflationary cosmological model [58, 87, 88] and Standard model of Big bang (see e. g. [15, 47, 91, 105]), problem of origin, nature and quantities DM and DE can be very precisely resolved. With the data from the cited paper we see that, for a more quantitative calculation of the energy distribution in the Universe subparts, it is necessary simultaneous solutions of three above discrete-scaling system of MFRS equations for the present, the Planck’s and the Trans-Planck’s bounce epochs.

Nowadays, in spite of the abrupt jumps by going from a Trans-Planck’s MFRS \( z_{TPi} = \nu_{Pl}^2 \) to a present structure with \( z_0 = 1 \), these equations are linked with the other cosmological parameters via the constant \( A_0 \) by

\[ \frac{u_\nu(t_{TPi})}{\nu_{TPi}(t_{TPi})} \equiv \frac{u_\nu(t_{Pl})}{\nu_{Pl}(t_{Pl})} \equiv \cdots \equiv \frac{u_\nu(t_0)}{\nu_{Pl}(t_0)} \equiv \rho_\nu(t_0) \cdot c^2 \equiv \frac{c^4 A_0}{8\pi G} = 6.6038 \times 10^{-14} J/m^3, \]  

where \( \nu_{Pl}(t_0) \) is defined as \( \nu_{Pl}(t_0) = 1 \) for the present observable Universe, and \( A_0 \) is an Present quantum cosmological constant (See also, Table 1).

In addition to Eq (32), the complete state of the homogeneous Universe for various times \( t_i \), similar to the current value of the energy density parameter \( u_\nu(t_0) \), can be described also as

\[ u_\nu(t_i) = \rho_\nu(t_i) \cdot c^2 = (T_i^4/8\pi)e^2/Gc^2. \]  

Numerical evolutions of three epochs MFRS equations by formulas (1), (15) and (20) as a function of cosmic time \( t \), started out from \( t_{TPi} \sim 10^{-108}s \) to today \( t_0 \sim 10^{19}s \), and temperature started out from \( T_{TPi} \sim 10^{64}K \), lead to \( T_0 \) after the Big Bang, in logarithmic scale are plots in Fig.1. (In such
Fig. 1 The phase diagram include the $\log_{10}T(K) - \log_{10}t(s)$ dependence of the Planck’s MFRS parameters for the steps $n = 2, 1, 0$ and under the assumption that the current Universe is very close to a spatially flat with $\Omega_{DM} + \Omega_{DE} \approx \Omega_{\text{total}} \approx 1$.

In these cases, one expected that the basic structure of our observable Universe in cosmological expansion, is characterized by the three discrete expanding quantized time steps of $\Delta t \sim 10^{-62}s$, each which characterized by an increase in the Planck redshift scale, with a factor of about $\sim 10^{62}$. However, the characteristic manifolds of a system are invariant under the transformations of temperature and time, i.e., products of the square of temperature on time defined by Eqs. (4) are remains constant for any one discrete expanding space-time epoch and phase of the Universe.

4.3 Identification and calculations of Dark Matter and Dark Energy

In Figure 1 we show the two quantity illustrated combinations of the “cosmic energy triangle” in the $\log_{10}T - \log_{10}t$ plane. The little triangle, for the Planck epoch of space-time, is constructed on the basis of Planck redshift relation (15). Also, a large logarithmic triangle including the very early epoch of space-time is build on the basis of Trans-Planck redshift relation (20). The area of greater logarithmic triangle corresponds to the total energy of the Universe $-M_U \cdot c^2$.

From these “cosmic energy triangles” we can construct some large dimensionless logarithmic ratios. Let us consider the area of little triangle. According to constructing an area of right –angled triangle, the logarithm of the area of little triangle is given by

$$\log_{10}S(z_{Pl}) \equiv \log_{10}\frac{t_0}{t_{Pl}} \cdot \log_{10}\frac{T_{Pl}'}{T_0} \equiv \log_{10}z_{Pl} \cdot \log_{10}z_{Pl}^{1/2} = 1967.0811,$$

where $S(z_{Pl})$ is the component of cosmic energy of the expanding Universe “enclosed” in little triangle and corresponding to the Planck and present epochs position.
The same estimation leads to the logarithm of the full cosmic energy of the Universe predicted in a given cosmological model, corresponding to a maximal area of a large triangle by \( S(z_{\text{Pl}}) \), and determining as

\[
\log_{10} S(z_{\text{Pl}}) \equiv \log_{10} \frac{t_0}{t_{\text{Pl}}} \cdot \log_{10} \frac{T_{\text{Pl}}}{T_0} \equiv \log_{10} z_{\text{Pl}}^2 \cdot \log_{10} z_{\text{Pl}} = 7868.3244. \tag{35}
\]

The resolutions of Eqs.\((34)\)-(\(35\)) and that follows is discussed in detail in [53]. We present here the crucial feature.

Dividing a logarithm of the area of little cosmic triangle \((34)\) to a logarithm of the area of a large cosmic triangle \((35)\), the present dark matter energy (DM) density \( \Omega_{DM} \) can be defined by

\[
\Omega_{DM} \equiv \frac{\log_{10} S(z_{Pl})}{\log_{10} S(z_{TPl})} \equiv \frac{\log_{10} \frac{t_0}{t_{Pl}} \cdot \log_{10} \frac{T_{Pl}}{T_0}}{\log_{10} \frac{t_0}{t_{TPl}} \cdot \log_{10} \frac{T_{TPl}}{T_0}} \equiv \frac{\log_{10} z_{Pl}^2}{\log_{10} z_{TPl}^2} \equiv \frac{\log_{10} z_{Pl}^{1/2}}{\log_{10} z_{TPl}^{1/2}} = \cdots = \frac{1967.0811}{7868.3244} = \frac{1}{4} = 0.25. \tag{36}
\]

The logarithm of cosmic energy “enclosed” in the trapezium corresponding to the Trans-Planck and the Planck epochs position of the early Universe, appearing in Fig.1, is given by

\[
\log_{10}(S_{\text{Trapez}}) \equiv \log_{10} S(z_{TPl}) - \log_{10} S(z_{Pl}) \equiv \log_{10} z_{Pl}^2 (\log_{10} z_{Pl}^{1/2} - \log_{10} z_{TPl}^{1/2}) = 5901.2433. \tag{37}
\]

From the ratio of the latter to the \((35)\) may eventually inferred a second key – physical understanding of Dark Energy (DE) density \( \Omega_{DE} \) defined in the form

\[
\Omega_{DE} \equiv \frac{\log_{10} S(\text{Trapez})}{\log_{10} S(z_{TPl})} \equiv \frac{\log_{10} z_{Pl} (\log_{10} z_{Pl}^2 - \log_{10} z_{TPl}^{1/2})}{\log_{10} z_{TPl}^2 \cdot \log_{10} z_{Pl}} \equiv 1 - \frac{\log_{10} z_{Pl}^{1/2}}{\log_{10} z_{TPl}^{1/2}} = \cdots = \frac{5901.2433}{7868.3244} = \frac{3}{4} = 0.75. \tag{38}
\]

It’s worth noticing that the relations in \((37)\) and \((38)\) may also be replaced by the ratios of the time and temperature defined in \((34)\) and \((35)\). Then, we precise estimate an analytic expressions \( \Omega_{DM} \) and \( \Omega_{DE} \) densities via the scaling solution parameters of the three Planck MFRS for the “quantized” cosmological epochs. Fig.1 and Eq. \((38)\) shows that, \( \Omega_{DE} \) is available in the early Universe at times interval \( t_{Pl} \leq \Delta t_{DE} \ll t_{Pl} \) and length scales \( l_{Pl} \leq \Delta l_{DE} \ll l_{Pl} \). Then, Dark Energy is some initial sort of invisible energy pervading which corresponding prior to Planck epoch of the Universe at time interval \( \Delta t_{DE} \) and this “is bad for Astronomy” [149]. For the \( \Omega_{DM} \) case, we have time interval \( t_{Pl} < \Delta t_{DM} \leq t_0 \) and lengths scales \( l_{Pl} \leq \Delta l_{DE} < l_{Pl} \). These limits corresponds to the MFRS scales \( z_{Pl} \leq z < z_{Pl} \) and \( z_{Pl} < z \leq z_0 \), respectively. This mechanism is contrary to ideas “in which the Electro-Weak (EW) scale is the large scale, and dark energy scale is the low energy scale” [73].

Our results means that Dark energy density \( (\Omega_{DE}) \) is appropriate to the invisible early phase of the expanding Universe, including the energy up to the Planck time \( t_{Pl} \), after the Big Bang. And, correspondingly, Dark Matter density \( (\Omega_{DM}) \) is appropriate to the other parts of the Universe energy following a Planck’s time \( t_{Pl} \), up to the present phase of cosmic expansion.

Thus, in the model, where researches “adopt the point of view that the Planck scales are limits: nothing can go below Planck time and Planck length, and no single particle can go beyond Planck energy” [13] the search of Dark Energy is unthinkable!

In particular, derived above shape of \( S(z_{Pl}) \) and \( S(z_{Pl}) \) implies that the quantum relativity cosmological parameters \( t_{Pl}, \cdots, t_0 \) and \( T_{Pl}, \cdots, T_0(CBR) \), corresponding to the testable by observation predictions Dark Matter density \( \Omega_{DM} \) and Dark Energy density \( \Omega_{DE} \) of the Universe, also are known quite accuracy. This also “suggests that Dark Energy may somehow reflect the unification of gravity with the other fundamental forces, and hence, paradoxically, physics at energies far above those that can be probed directly with accelerators” [14, 52, 149].
It is worth noting that the Current Standard ΛCDM Cosmological model of the Universe mistakenly presented Dark Energy density \( \Omega_{DE} \) as an Einstein’s Cosmological constant \( \Lambda \) ([1, 16, 25, 28, 31, 48, 85, 99, 104, 105, 152] and others), and the Dark Matter density \( \Omega_{DM} \) as a \( \Omega_{DM} = \Omega_{CDM} + \Omega_B \) (CDM = Cold dark matter), with an approximate values of \( \Lambda \approx 0.74 \), \( \Omega_{CDM} \approx 0.21 \), and \( \Omega_B \approx 0.04 \) ([25, 77], and references therein). The curvature of a flat Universe for today is given by \( \Omega_k = 1 - \Omega_{DM} - \Omega_{DE} = 0 \).

Above “identity” raises a very deep physical and cosmological problem (see, i.e. [138]). In particular, it requires that the value of Dark Energy density expressed by 0.75 [53], hereafter denoted by \( \Omega_{DE} \), and do not \( \Lambda \), or \( \Omega_A \).

When the best-fit predicted results (36) and (38) are combined they provide that there is the assumption of a flat Universe and that for the present time total mass-energy budget we have a constant value

\[
\Omega_{DM} + \Omega_{DE} \equiv \Omega_{tot} \equiv 1, \quad (39)
\]

Thereby, we hope that the precise calculation, which corresponds to endowing the Dark Energy and the Dark Matter densities given above, which corresponds to endowing the Dark Energy and Dark Matter densities will provide a basis for the concrete formulation on possible construction of our observable Universe in the time interval between \( t_{TPl} \) and \( t_0 \). These results are remarkable for many reasons, including its unique fine current observational proof similar to the famous Pythagorean Theorem, although this theorem is strictly realize only for the extremely small fields [81, 148].

5 To Understand the Parameter \( w \)

Considering \( P = p_v(t) \) as a pressure parameter we must have [109]

\[
u_v(t) = -p_v(t) = c^4A/8\pi G. \quad (40)\]

Then as a more exotic alternative for the equation of state parameter is [15, 25, 47, 66, 117, 139]

\[w(t) \equiv -p_v(t)/\nu_v(t) \equiv -p_v(t)/\rho_A(t) \cdot c^2. \quad (41)\]

If accept at face values \( \rho_A(t_0) \) and \( \nu_v(t_0) \) from Table 1, using Eq. (40) for today-vacuum dominated case, we infer from Eqs. (10) and (41) that the Dark energy equation of state parameter has a constant value \( w(t_0) = -1 \). The independent analyze of a flat Universe confirms that equation of state parameter of the dark energy \( w(t_i) \) for a flat cosmology can be (e. g. [23, 131] and references therein) assumed to be constant in time.

For example, applying the relation (41) to the Trans-Planck epoch we derived

\[w(t_{TPl}) \equiv -p_v(t_{TPl})/\nu_v(t_{TPl}) \equiv \cdots \equiv -c^4A_{TPl}/8\pi G \cdot a_{TPl}^2/8\pi G \equiv -(c/t_{TPl})^2 \equiv -1.00 \pm 0.02. \quad (42)\]

For other cosmological models of dark energy, \( w(t) \) can differ from \(-1\) and vary in time. Then, by \( \rho_A(t) \) and \( \nu_v(t) \) parameters from Sec.3, we postulate that parameter \( w = -1 \) is invariant under the Planck epoch.

6 Comparison with the Observations

Using data from the [66], we have identified values of our two theoretical components \( \Omega_{DM} = 0.25 \) and \( \Omega_{DE} = 0.75 \) from Eqs. (36) and (38) with the fundamental sets of eleven high-red shifted Supernovae SNe Ia observed with the Hubble Space Telescope (HST), which yield \( \Omega_{DM} = 0.25^{+0.15}_{-0.11} \), and \( \Omega_A = 0.75^{0.12}_{-0.11} \), under the assumptions of a flat universe and that a constant value \( w = -1 \). This nicely illustrates that the initial The Supernova Cosmological Project observational data [66] are fully coincides with predictions of theoretical model, given Eqs. (36) and (38), if cosmological constant expected like a Dark Energy. However, in the question that these data “confirms previous supernova evidence for an accelerating Universe”, there is a significant disparity on the basis of our MFRS results (see, Sec. 10).

The WMAP3 measurements of the CMB together with the Sloan Digital Sky Survey (SDSS) provides [134], at \( H_0(km/s/Mpc) = 72(3) \) and age of the Universe \( t_0 = 13.8(2) Gyr \) the following accurate
values $\Omega = 0.757(20)$, $\Omega_{DM} = 0.243(20)$ and $\Omega_0 = 1.003(10)$. Our results show good agreement also with the results of [122], which from the combinations of WMAP, SDSS, 2dFGRS, and SNe Ia data finds $w = -1.08(12)$. These data do imply that, there is evidence that in the Trans-Planck and Planck epochs of the very early Universe space-time is characterized as the Euclidean (flat) space, coming predominately from the first studies of the CMB measurements (e.g. [11, 122]).

According to the recent combined analysis of the WMAP 5-yr results [61, 68] the current Universe is consistent with being flat at the 1 % level, i.e., $\Omega_{tot} \equiv \Omega_{DM} + \Omega_{DE} = 1$, practically coincides also with a measured value $\Omega_{tot} = 0.996_{-0.015}^{+0.015}$ of the critical flatness density recently derived in the WMAP 7-year data for the total density of normal matter DM, and DE [64, 69, 80].

Observationally, the precision measurements of $\Omega_{DM}$ and $\Omega_{DE}$ are reduced to determine the Hubble constant $H_0$ with high accuracy [118]. Different methods of determinations and results of measurements these parameters summarized in [3]. The mean value of Dark Matter and Dark Energy measurements by the WMAP7 Collaborations [69] is

$$\Omega_{DM} = 0.27, \text{ and } \Omega_{DE} = 0.71.$$ (43)

The latter values for the Dark Matter and Dark Energy density based on a new “the Millenium-II Simulations” recommended values [18] are

$$\Omega_{DM} = 0.25, \text{ and } \Omega_{DE} = 0.75.$$ (44)

Thus, it follows that, above theoretical predictions by Eqs. (36) and (38) are in complete agreement with recent results of considerable statistical data.

### 7 Age of the Universe

Substituting for $t_0$ value given by Table 1 and from value $1yr = 3.15569259747 \cdot 10^7 s$, for the total age of the present Universe we have

$$t_0 = a/T_r^2 = 2.8484_{-41}^{+16} \times 10^{19} s = 9.0264_{-9}^{+51} \times 10^2 \text{Gyrs}. \quad (45)$$

This value is about of 63.6 times of magnitude older than “the dynamical age” $14.2^{+1.0}_{-0.8} \text{Gyr}$ discovered by Riess et al. [115] and 60.6 times of magnitude greater than age $14.9^{+1.4}_{-1.4} \text{Gyr}$ derived by Perlmutter et al. [108] for a flat space-time. The best fit values, the SCP group suggests

$$0.8\Omega_M - 0.6\Omega_A \equiv -0.2 \pm 0.1,$$ (46)

which for a flat model gives

$$\Omega_M \equiv 0.28 \text{ and } \Omega_A \equiv 0.72.$$ (47)

The best-fit value the HZT for the flat case also is $\Omega_M \equiv 0.28$ and density parameter $\Omega_A \equiv 0.7$.

The Eq. (46) do not change if only our theoretically derived $\Omega_{DM}$ and $\Omega_{DE}$ results are used. Since our prediction from Sect.4, within the observational errors coincides with the Eq. (46) results

$$0.8\Omega_{DM} - 0.6\Omega_{DE} \equiv -0.25.$$ (48)

The result derived from the WMAP1 observations under the flat space-time assumptions defined an age of the Universe as $t_0 = 13.7(2) \text{Gyr}$ [11]. The best present (dynamical) age for the Universe by WMAP7 is [69]

$$t_{W7} = (13.75 \pm 0.13) \text{Gyrs}. \quad (49)$$

With the above value of $1yr$ we get

$$t_{W7} = 13.75(13) \times 10^9 yr = 4.34(41) \times 10^{17} s, \quad (50)$$

from which one can see for the $t_0/t_{W7}$ ratio

$$t_0/t_{W7} \equiv z_{W7} \equiv \cdots = 65.6333(6). \quad (51)$$
Table 2 The Hubble constant according to different authors.

| $h$  | Author                                |
|------|---------------------------------------|
| 0.72 ± 0.08 | Freedman et al. (2001) [15]          |
| 0.68 ± 0.07 | Gott et al. (2001) [56]               |
| 0.623 ± 0.063 | Sandage et al. (2006) [118]          |
| $0.704^{+0.013}_{-0.014}$ | Komatsu, Smith et al. (2011) [69]   |
| 0.673±0.012 | Ade et al. (2013) [1]                 |
| 0.656 ± 0.033 | In this work                         |

This means that the age of the Universe by the WMAP observations for SNe Ia objects is evenly small than in the case of the total age of the today Universe $t_0$. Or, the today Universe $t_0$ based on the relation (45) is a factor 65.633 larger than adopted dynamical age of the Universe $t_{W7}$ from the (49) and (50). It can be inferred that this predict difference is connected with the Hubble constant problem [15, 56, 69, 118]. In addition, the parameter $t_0/t_{W7}$ from the ratio (51) within the errors of determination of $t_0$ coincides with the adopting value of $100h$, commonly employed in the Hubble constant expression of $H_0 = 100h \cdot km \cdot s^{-1} Mpc^{-1}$. With above age value of $t_0$ from Eq. (45) and $100h = t_0/t_{W7} = 65.63(6)$ we determine $h = 0.6563(6)$ and $H_0 = 6563(6) \cdot km \cdot s^{-1} \cdot Mpc^{-1}$. Then, it turned out that the parameter $t_0/t_{W7}$ bounded with MFRS $z_{W7}$ as given in Eq. (51) can be written as

$$t_0/t_{W7} \equiv z_{W7} \equiv \cdots \equiv 65.6333 \equiv 100h. \quad (52)$$

In Table 2, we compare our estimate with the results of $h$ some authors. As is seen, the errors bars in the key experiment [1] are very small. This mean that our predict result $h = 0.6563 \pm 0.033$ similar to PLANCK results.

For the latest case the product of $H_0 \cdot t_0$ can be evaluated as

$$H_0 t_0 \approx 1, \quad (53)$$

i. e., the inverse of the Hubble constant is the total age of the present Universe $t_0$.

This equality is consistent with an illustration also in Fig.3 [28] at a flat Universe model with of value $\Omega_{DM} \equiv \Omega_m^{(0)} = 0.25$.

8 Multiverses Mass and the Number of Different Universes

From the previously cosmology literature [32, 89], we little know on exist and nature Multiverse. Current best understanding what constitutes the evidence for Multiverse was developed in during the ensuing years [6, 24, 30, 37, 38, 113, 126, 133, 147]. In particular, Ellis [39] noted that “the multiverse idea is not probable either by observation, or as an implication of well established physics. It may be true but cannot be shown to be true by observation or experiment. Continuation beyond horizon is fine-but just the same old universe! (of horizon on earth). However it does have great explanatory power: it does provide an empirically based rationalization for fine tuning, developing from known physical principles.”

In Sec.2 we revealed that hypothetical Multiverse masses can be regarded a consequences of predictions of the universal Planck MFRS wrinkles at $n = 2(z_{Pl}^2)$ as $M_U$, at $n = 3(z_{Pl}^2)$ as $M_{PMV}$, and at $n = 4(z_{Pl}^2)$ as $M_{BMV}$, respectively. Actually, by the our model the mass of observable Universe originated at following quantum cosmological temperature and time

$$M_U \equiv (h/c^2) T_{Pl}^2 \equiv (h/c^2) \cdot T_{Pl}^{-1}, \quad (54)$$

or as an energy based on the Einstein presentation in the form (see, also [33])

$$M_U \cdot c^2 \equiv \pm (h/c) \cdot T_{Pl}^2 \equiv \pm h/T_{Pl}. \quad (55)$$
consistent from the existences of “Mini Multiverse” (ensemble of universes) with the mass \( M_{PMV} \), and MFRS’s the \( z_{Pl}^4 \equiv z_{OTP} \equiv N_{Pl}^3 \), “Big Multiverse” with the mass \( M_{BMV} \), and with MFRS \( z_{Pl}^4 \equiv z_{Pl}^4 \equiv N_{Pl}^4 \sim 10^{250} \).

How large is \( z \equiv N \) likely to be? Linde and Vanchurin [90] summarized number \( \sim 10^{500} \) as the “popular estimate of the total number of different universes.” Using Eq. (19) the derived \( z_{Pl}^4 \) we can be generated to Planck numbers of “some \( 10^{500} \) possible vacua of an underlying superstring theory” [79, 130] by a relation

\[
z_{Pl}^4 \equiv N_{Pl}^4 \equiv N_{Pl}^8 \approx 10^{501}.
\]

Then, quoted above hypothetical masses of the Mini Multiverse \( M_{PMV} \) equals to

\[
M_{PMV} \equiv z_{Pl} \cdot M_U \equiv N_{Pl}^4 \cdot M_U \equiv 10^{63} M_U,
\]

Thus for \( M_{BMV} \) related to the Trans-Planck’s MFRS by Eq. (19), we have at once

\[
M_{BMV} \equiv z_{Pl}^2 \cdot M_U \equiv N_{Pl}^4 \cdot M_U \sim 10^{250} \cdot M_U.
\]

We can now determine directly “Mega Multiverse” with the mass \( M_{MMV} \) and with Planck’s MFRS equation \( z_{Pl}^4 \equiv z_{Pl}^8 \equiv N_{Pl} \equiv 6.1 \times 10^{501} \), giving

\[
M_{MMV} \equiv z_{Pl}^4 \cdot M_U \equiv z_{Pl}^8 \cdot M_U \equiv N_{Pl}^8 \cdot M_U \sim 10^{502} M_U.
\]

(As is seen, the mass of \( M_{MMV} \) may be predicted also by a “seesaw mechanisms” [54]).

8.1 Wrinkles Planck’s MFRS equations and physical meaning of the big number

The formation of our Universe may originate from discrete Planck’s MFRS by the follows schematic sketch

\[
\cdots (z_{Pl}^4 \sim 10^{500}) \rightarrow (z_{Pl}^2 \sim 10^{250}) \rightarrow z_{Pl}^2 \rightarrow \cdots \rightarrow M_{UV} \rightarrow \cdots \rightarrow z_{Pl}^2 \sim 10^{250} \cdots .
\]

We next consider one scenario on the larger number, which have been discussed by Herman Nicolay [98] in the following way: “To conclude let me restate my main worry. In one form or another, the existing approaches to quantum gravity suffer from a very larger number of ambiguities so far preventing any kind of prediction with which the theory well stand or fall. Even at the risk of sounding polemical, I would put this ambiguity at 10^{500} (or even more) – in any case a number too large to cut down” then, it should be noted that a crucial quantity for phenomenology of larger and infinitely smaller numbers of cut down, possible are bound by the Planck MFRS’s \( z_{Pl}^4 \equiv N_{Pl}^4 \sim 10^{501} \) and \( z_{Pl}^4 \equiv N_{Pl}^4 \sim 10^{250} \) from Equation (15) which are defined as a relevant combinations of \( T_{Pl}, t_{Pl} \) and the quantum cosmological constant \( \lambda \) by relations (4).

8.2 Conversion of Planck mass in the different epochs

The conversion of “cosmological particles” in these epoch transfers can be treated as a four “quantized cosmological multiple mass” transitions from one to the other in follows the order

\[
N_{Pl}^2 \cdot \mathcal{M}_{St} \rightarrow N_{Pl} \cdot m_{GR} \rightarrow M_U / N_{Pl} \rightarrow (M_U \cdot m_{GR})^{1/2} \rightarrow (hc/G)^{1/2} \equiv m_{Pl}.
\]

Hence, each of these discrete multiple mass of (61) is identical to the classical “Planck mass” of \( m_{Pl} \), which remains constant in all times [41, 110] of the Universe evolution after the Big Bang. The total numbers of Planck mass (setting\( N_{Pl} \equiv z_{Pl} \)) in the Universe after \( t = t_{Pl} \) gets a number somewhere around of\( N_{Pl} \sim 5 \times 10^{62} \). In this case, the Planck redshifts \( z_{Pl}^4, z_{Pl}^8, \ldots \) corresponding to the bounce steps of \( 10^{62} \) e-folds time intervals between \( t \sim 10^{-160} \) s and \( t \sim 10^{-480} \) s, sandwiched between Big Bang and of \( t = 0 \) Friedmann model of universe.
8.3 Constancy of the total mass (energy) of the Universe in the different epochs

To summarize, we consider the mass of the Universe in various shape.

1. Assuming that Trans-Planck epoch responsible for the dark energy, the Universe mass from Eq. (20) can be estimates as a vacuum energy

\[ M_U \cdot c^2 \equiv \pm (h/\sigma) T_0^2 \cdot N_{TP1} \equiv \pm (T_{TP1}/T_0) \cdot E_{Pl} \equiv \pm (m_{Gr} \cdot c^2) \cdot N_{TP1} \equiv \cdots. \] (62)

So that in the Trans-Planck epoch of Universe model is scaled to represent the maximal temperature and here is not necessary for determination length scale [34, 63].

2. In the next Planck epoch step, we introduce Planck’s parameters to the Universe energy as

\[ M_U \cdot c^2 \equiv \pm (h/\sigma)(T_{Pl})^2 \cdot N_{Pl}. \] (63)

3. Of course, the corresponding quantum cosmological constant mass of the currently observable Universe\( M_U \), may be presented also as this is given in Eq. (10).

Here, we initially define a more motivated model for the six cosmological “particles” as

\[ M_{PMV} \cdot t_{OTP1} \equiv M_U \cdot t_{TP1} \equiv m_{Pl} \cdot t_{Pl} \equiv \cdots \equiv m_{Gr} \cdot t_0 \equiv m_{Str} \cdot t_{Str} \equiv m_{Last} \cdot t_{Last} \equiv h/c^2 \] (64)

that can be considered as a modified quantum cosmological mass-time relation, which is compatible with the Heisenberg’s uncertainty principle.

As is noted in ([52], Sec.5) “macroscopic and microscopic” [114] cosmological particles \( M_U, m_{Pl}, m_{Gr}, m_{Str}, \cdots \) may be evolved according to relation

\[ M_U : m_{Pl} : m_{Gr} : m_{Str} : m_{Last} \equiv z_{Pl} \equiv N_{Pl}. \] (65)

These masses for the each substance \( m_i \) are bounded with the corresponding value of origin temperature \( T_i \) by the precise relations

\[ m_i c^2 \equiv \pm (h/\sigma) \cdot T_i^2 \equiv \pm (h/\sigma) \cdot z_i \cdot T_0^2 \equiv \pm (h/\sigma) \cdot N_i \cdot T_0^2. \] (66)

These new relations between mass (energy) and the temperature, differ essentially from the classical expression of the particle energy

\[ m_i c^2 = k \cdot T_i(thr), \] (67)

presented in up-to-date textbook. Here \( T_i(thr) \) is the threshold temperature [52, 145].

8.4 On some important coincidence with the holographic parameters

“Assuming that the holographic principle holds” [62, 144], we compared some our cosmological parameters derived from the works [52, 53] with the results of Verlinde. These comparisons lead us to following interrelated identity

\[ aV/2\pi = a_0 = (\sigma^2 \cdot A_S)^{-1}, \] (68)

\[ A_V/4\pi = l_0^2 = [(\sigma \cdot c)A_S]^2 = (\sigma \cdot c/T_0^2)^2 = A_0^{-1}, \] (69)

\[ N_V/4\pi = z_{TP1} = z_{Pl} = N_{TP1} = N_{Pl}^2, \] (70)

\[ E_V/2\pi \approx M_U \cdot c^2, \] (71)

where represented in the left hand side parameters are from the Verlinde [144]. Thus, there are two generic features between the holographic scenario and Planck’s hierarchy of MFRS, which could be a powerful tool for development in the future of a “new physics” theory! In particular, Verlinde [144], named \( N_{TP1} = N_{Pl}^2 \) as an “number of bit”.

As is seen from Eq. (69) value \( A_V/4\pi \) is the inverse cosmological constant introduced by Einstein [52]. Then, Einstein greater blunder “constant” holds in the “new physical” theory! Henceforth, if we adopted \( A_V = 4\pi(N_0)^{-1} \equiv 4\pi(l_0)^2 = 9.162(11) \times 10^{96}m^2 \), then it is straightforward area of the spheres of today Universe’s surface!
9 MFRS in the latest Planck’s epochs corresponding to the low-temperature phase

In conclusion of Section 3, we shall reiterate the point of clarity on understanding of the classical small value $A \cdot (G/\hbar^2) \sim 10^{-123}$ (see, i.e., [99]). In this light, the last equation of subsection 3.3 established the fundamental cosmological meaning of this famous relation as an inverse Trans-Planck epochs $z_{\Lambda T,Pl} \equiv z_{\Lambda T,Pl}^2$ predicted from basic MFRS model by Eq. (20).

Over many years, there was no clear theoretical picture of what to expect. In 1992 at this George Darwin Lecture J. Barrow stated that “It is worth remarking that in the 1930s the largeness of reciprocal of equation $A \cdot t_{\Lambda Pl}^2 \leq 10^{-121}$ was regarded as a major mystery” and “problem by Eddington and Dirac” [7-9]. So, in accordance with our previous estimates [52], the proposed Planck hierarchy of MFRS model can resolve this very olden and profound cosmological problem.

Thus, it turned out that the problem which at once directly thinks of Eddington and Dirac at cyclic Universe scenario may be based on $(z_{\Lambda T,Pl}^2)^{-1} \rightarrow z_{\Lambda T,Pl}^2$ in “classical” form $(A_0 \cdot t_{\Lambda Pl}^2)^{-1} \rightarrow (A_0 \cdot t_{\Lambda Pl}^2)$.

On the other hand, the analysis of Eq. (30) immediately shows us that the above smaller values can be related to the post-Big-Bang steps of MFRS equations in the following correct way

$$z_{\Lambda T,Pl}^{-1} \equiv z_{\Lambda T,Pl}^{-2} \equiv N_{\Lambda T,Pl}^{-1} \equiv N_{\Lambda T,Pl}^{-2} \equiv (G/\hbar^2 \cdot A_0 \cdot t_{\Lambda Pl}^2 \equiv (m_{Gr}/m_{Pl})^2 \equiv \cdots \equiv (m_{Gr}/m_{Pl})^2 \equiv \cdots \equiv (t_{Pl}/t_0)^2 \equiv \cdots \equiv 3.58113(40) \times 10^{-126}.$$ (72)

Note also, that this representation allows us to write some string parameters in terms of purely Planck parameters as

$$z_{Pl}^{-2} \equiv \left(\frac{T_{Str}}{T_{Pl}}\right)^2 \equiv \left(\frac{l_{Pl}}{l_{Str}}\right)^2 \equiv \left(\frac{m_{Str}}{m_{Pl}}\right)^2 \equiv \left(\frac{m_{Gr}}{m_{Pl}}\right)^2 \equiv \left(\frac{m_{Last}}{m_{Gr}}\right)^2 \equiv \cdots \equiv \left(\frac{a_{Str}}{a_{Pl}}\right)^2 \equiv \cdots \equiv 3.58113(40) \times 10^{-126}.$$ (73)

Here

$$T_{Str} = \pm (T_{0}^2/T_{Pl}) = \pm (z_{Pl}^{-1} \cdot t_{Pl}^\prime) = \cdots \pm 1.20327(13) \times 10^{-31} K,$$ (74)

$$l_{Str} = l_{0}^2/l_{Pl} = 1.50506(16) \times 10^{82} s,$$ (75)

$$l_{Str}^2 = l_{0}^2/l_{Pl} = 4.51204(48) \times 10^{90} m,$$ (76)

$$m_{Str} = m_{Gr}/m_{Pl} = 7.79436(83) \times 10^{-134} kg = 4.374(47) \times 10^{-96} eV/c^2,$$ (77)

$$a_{Str} = a_{0}^2/a_{Pl} = 1.99167(21) \times 10^{-74} m/s^2,$$ (78)

$$m_{Last} \equiv z_{Pl}^{-2} \cdot m_{Gr} = 1.47411 \times 10^{-156} kg = 8.274 \times 10^{-151} eV/c^2.$$ (79)

Here $T_{Str}$ corresponds to an age of Universe since the Big Bang comprising “Inverse Trans-Planck Rip” $t_{Str} = 4.8 \times 10^{30} Gyr$. So, this is compelling moment in “the destiny of the Universe” [139], and is the oldest age limit of our Universe!

Pre-existing step in this direction by on MFRS model is $z_{Pl}^{-1}$, achieved ranging a temperature $\sim 6.4 \times 10^{-13} K$ and time $\sim 2 \times 10^{38} Gyr$. This result obtained based on MFRS model, is $\sim 10^{27}$ large than “limit on the minimum time to a (speculative) Big Rip” $\sim 30 Gyr$, derived by Riess et al. [116]. In addition, one of the first estimates of minimal remaining time to the Big Rip, found in [23] is $22 Gyr$.

Noting that above results, from MFRS with $z_{Pl}^{-1}$ is also $\sim 4 \times 10^{11}$ times large than predicted for the Big Rip moment $\sim 10^{60} Gyr$, taken from WMAP7 data [49].

In this limiting case, after a break down of all structures and particles [99], in accordance with the “quantum gravitational uncertainty principle” [102] the Universe is filled only string particles with the masses $m_{Str} \sim 7.8 \times 10^{-134} kg$ and numbers of

$$N_{Str} \equiv N_{Pl}^3 \equiv z_{Pl}^3 \equiv M_U/m_{Str} \sim 7 \times 10^{189}.\quad (80)$$

In work [17], with a few exceptions, for an “absolute minimal mass” adopted $M_{min} \approx 1.4 \times 10^{-124} kg$.

Then, it would be possible that in an instant at an expansion of the Universe, the quantum-cosmological fluctuations of the vacuum [70, 136] would reverse the *arrow of time* [106] and the huge Universe can suffer of quantum bounce with the $(z_{Pl}) \rightarrow z_{Pl}^{n \rightarrow 0}$. This shape is meant that the going from $z_{Pl}^2$ to a $z_{Pl}^n$ at $n \geq 0$ may be compared with the application of Weyl scenarios $WEYL = 0$ and $WEYL \rightarrow \infty$ for quantum fluctuations [107].
On the other hands, there is evidence that particle with the minimal energy $E_{\text{Min}}$ for both MFRS events are, $m_{\text{Last}} \cdot c^2 \equiv (m_{GR} \cdot c^2)z_{Pl}^{-1}$ and the strings with the masses $m_{\text{STR}} \gg m_{\text{Last}}$. Eventually, following the breakdown and the beginning of the Universe may retain of $N_{\text{Str}} \sim 7 \cdot 10^{48}$ number of string numbers. Nevertheless, the temperatures $T_{\text{STR}}$ and $T_{\text{Last}}$ can be changed from a positive to a negative absolute temperature by the above commutation relation (56) in the forms

$$T_{\text{STR}} = \pm z_{Pl}^{-1/2} [(m_{GR} \cdot c^2)(\alpha / \hbar)]^{1/2} = \pm [(m_{\text{STR}} \cdot c^2)(\alpha / \hbar)]^{1/2} = \pm 1.20(13) \times 10^{-31} \text{K}. \quad (81)$$

and

$$T_{\text{Last}} = \pm [(m_{\text{Last}} \cdot c^2)(\alpha / \hbar)] = \pm z_{Pl}^{-1} [(m_{GR} \cdot c^2)(\alpha / \hbar)]^{1/2} = \pm 1.45 \times 10^{-62} \text{K}. \quad (82)$$

The idea for the rest energy of String particles $\pm m_{\text{Str}} \cdot c^2 \sim 4 \times 10^{-98} \text{eV}$ supported also by an explanation of the Einstein formula of $E = \pm m \cdot c^2$, which was discussed by Dirac in 1975 \[78\].

As a result, the fundamental third law of thermodynamics (Nernst’s Law) is satisfied and ruled out of singularity of Friedmann model (see, Eq.(3) and schematically of Fig.2).

Later the universe much like to an our observable Universe is beginning of new cycle expansion in a set of the big Planck Multiverse with the very massive “particle” $\sim 10^{62} \text{M}_U$, in form of one collapsing with positive and possible symmetric negative energy

$$M_U \cdot c^2 \equiv \pm (c^4 / G)_{\text{Str}} \cdot z_{Pl}^{-1} \equiv \pm (\hbar / \alpha) \cdot N_{\text{Str}} \cdot T_{\text{Pl}}^2 \equiv \cdots \equiv \pm (\hbar / \alpha) \cdot N_{\text{GR}} \cdot T_0^2 \equiv \cdots \equiv \pm (\hbar / \alpha) T_{\text{Pl}}^2. \quad (83)$$

On the other hand, this assumption “leads us directly to the idea that..., the overall time scale leads us to the conclusion that the universe is cyclic” [22, 125, 140] and “in this oscillatory, our universe will be destroyed and the be rebuilt again and again” [148]. In the popular form similar process well described by Joseph Silk in the classical book of “The Big Bang” ([120]; see, also [29, 146]).

Thus, consistent with the three important equations (1), (15) and (20) durations, during the transformation MFRS between $z_{Pl}^2$ and $z_{Pl}^2$ makes possible, rewrite equation (4) for the constant of $\alpha$ as

$$\alpha \equiv T_{Pl}^2 \cdot t_{\text{Pl}} \equiv (T_{Pl}^2)^2 \cdot t_{\text{Pl}} \equiv \cdots \equiv T_{0}^2 \cdot t_0 \equiv \cdots \equiv T_{BR}^2 \cdot t_{BR} \equiv \cdots \equiv b^2 / c^2 \cdot E_{Pl}. \quad (84)$$

This equation explicitly shows that for all feasible cosmological epochs a set of discrete points Planck’s MFRS should have five quantum steps of description by an expansion factor of approximately $5 \times 10^{62}$, permissible for our Universe by the Heisenberg’s uncertainty principle, represented by

$$Z_{\text{MFRS}} \rightarrow z_{\text{Pl}} \equiv z_{Pl}^2 \cdot z_{Pl} \equiv z_{Pl} \equiv \pm (\hbar / \alpha) \cdot T_{Pl}^2 \equiv \pm (\hbar / \alpha) \cdot T_{Pl}^2. \quad (85)$$

As is shown above the first three bound of Planck MFRS with $n = 2, 1$ and 0 from Eq. (85) are suitable for Eq. (83). But in which the product $T_{BR}^2 \cdot t_{BR}$ should be replaced by a term $T_{\text{Str}}^2 \cdot t_{\text{Str}}$, or in this case $z_{BR} = z_{Pl}^2 \equiv z_{Pl}^2$ has no evidence.

The results of this part of our analysis shows that the decomposing of the predicting Universe comes to $z_{Pl}^2 \sim 10^{-126}$ and age of $10^{65} \text{Gyr}$ provided that, $T_{\text{Str}} = \pm (\alpha / T_{\text{Str}})^{1/2}$ is to be near absolute zero temperature, and also by Eqs. (75) and (81), equal to $\pm 1.2 \times 10^{-31} \text{K}$. In addition, it is clear from Eq. (82) that temperature $T_{\text{Last}} \sim 10^{-62} \text{K}$ by the Eq. (84) will approximately corresponds to fantastically finite time of our Universe of $t_{\text{Last}} \sim 10^{128} \text{Gyr}$.

Eventually, main argument supporting above calculations is the assumption of the Big Bang the evidence of creation $+ M_U \cdot c^2 / - M_U \cdot c^2$ from the Multiverse annihilation back into new Universe.

10 On accelerated expansion problem

As is noted above in recent years, once a cosmic acceleration is essentially has been established in observations by two above quoted group’s data on SNe Ia [108, 115]. At different time the visible Universe is defined as an accelerated by many researchers [4, 42, 43, 83, 84, 116]. In a similar manner, referring back to SNe Ia data, even if “the first supernovae results did not yet show acceleration” [137].

Yet, our understanding is that this phenomenon may be physically related directly to speed of light in vacuum $c = 299792458 \text{m/s}$ [95]. Recall also that the Universe acceleration is the time-dependent
value [52]. Then this is phenomena which should be also subject to the physical deciphering. Here we explore whether this exceptional condition can assist in providing an accelerating model.

Below we shall use the directly measured in [116] and by Seven-Year WMAP (WMAP7) [69] observational data and borrow their results. (Here for the brevity WMAP7 we replaced by “W7”). However, existence of acceleration must be taken as probable, but not conclusively proved. In the light of the new methods [52] this phenomenon may no longer be valid.

It is well known that none of the WMAP and SNe Ia measurements in the expansion history of the Universe for the $t \leq t_0$ does not give a correct value of $a(t)$ in physical contents (i. e., in $m/s^2$ units). Therefore, the total set of physical parameters our consistent system not represents $a_W$.

Nevertheless, it is conceived that the comoving acceleration $a_W$ and dynamical time $t_W$ in the observations of SNe Ia are related to the identical predicted background acceleration $a_0$ and total age of the present Universe $t_0$ by the general definition – with the new law of cosmological expansion, derived earlier ([52], Eq. (5.3))

\[
a_{TP} \cdot t_{TP} \equiv a_{P1} \cdot t_{P1} \equiv \cdots \equiv a_c \cdot t_c \equiv \cdots \equiv g_U \cdot t_U \equiv \cdots \equiv a_{W7} \cdot t_{W7} \equiv \cdots \equiv a_0 \cdot t_0 \equiv \cdots \equiv c. \quad (86)
\]

These equalities suggest that the velocity of expansion of the Universe represented as $a_i \cdot t_i$ does not vary with the cosmological time, and is equal to speed of light in vacuum $c$. (Here all times and accelerations are reckoned from Big Bang).

More specific case, for the other presentation of the early Universe, Eq. (86) can be expected as

\[
\cdots \equiv a_{P1} \cdot \left( \frac{t_{P1}}{1yr} \right) \equiv \cdots \equiv a_{W7} \cdot \left( \frac{t_{W7}}{1yr} \right) \equiv a_0 \cdot \left( \frac{t_0}{1yr} \right) \equiv \cdots \equiv \frac{c}{1yr} \equiv g_U \equiv 9.50005264265(m/s^2). \quad (87)
\]
On the other hand, utilizing these equations we deduced that in all expansion epochs of the Universe the product of cosmological acceleration on this age in this moment, remains constant and is equal\footnote{It is impessive that the value of $g_U$ from Eqs. (87)-(88) coincides with acceleration of gravity at the Earth’s surface in altitude 9286 m, equivalent to a top of Mount Everest (8850 m), plus 436 m from sea level, which makes the $g_U$ testable. The detailed analysis of a given “geophysical constant” for the acceleration of the Earth’s surface realm could allow us to establish prediction observation for the all times of evolution of the Universe. Then, apart from the constant $c$ the cosmology should be allowed no less a key observable cosmological-geophysical constant $g_U$. It seems plausible that existing of $g_U$ can be tested with the high-precision accelerometers in terrestrial experiments.} to
\begin{equation}
g_U \equiv a_i(t_i) \cdot \left( t_i / \text{yr} \right) \equiv \frac{c}{1 \text{yr}} \equiv 9.50005264_{2005} \text{(exact)}(m/s^2). \tag{88}
\end{equation}

Utilizing above equations for the $U = 1 \text{yr}$, we can determine other parameters of MFRS, giving
\begin{align}
z_U &= 9.02_{(50)} \times 10^{11}, \tag{89} \\
T_U &= 2.63_{(15)} \times 10^6 K, \tag{90} \\
l_U &= 9.46_{(52)} \times 10^{15} m. \tag{91}
\end{align}

According to Eq. (86) ratio of accelerations two moments of the Universe is equal to ratio their instant times. Then we have
\begin{equation}
a_{W7} / a_0 \equiv t_{W7} / t_0 \equiv \cdots. \tag{92}
\end{equation}

With the new laws of expansion we must revise our estimate of the acceleration by using the WMAP7 result from (86) combined with SNe Ia data (see, e. g. [4]). With the value $t_{W7}$ from Eq. (92) we get
\begin{equation}
a_{W7} = \frac{a_0 \cdot t_0}{t_{W7}} = \frac{c}{t_{W7}} = 6.91_{(65)} \times 10^{-10} m/s^2. \tag{93}
\end{equation}

The existence of such equations between cosmological accelerations and the “dynamical ages” would place a fundamental role in quantum cosmology.

In particular, the values of Planck’s epoch parameters are the simplest route to probing the acceleration history. In the Planck epoch, $t_{Pl} = (hG/c^5)^{1/2}$ is “the Planck age” of the Universe. The value $a_{Pl} = c^2/(hG)^{1/2}$ [52] is the Planck’s acceleration for this epoch. Then, for the corresponding Planck epoch by (87) we have
\begin{equation}
a_{Pl} \cdot t_{Pl} \equiv c. \tag{94}
\end{equation}

In turn, at $t_c = 1.2880886570(18) \times 10^{-21} s$ [95, 96] and $a_c = 2.32742099(3) \times 10^{29} m/s^2$ [52], for the electromagnetic time phase, we anew have
\begin{equation}
a_c \cdot t_c = 299792457.73 m/s = c! \tag{95}
\end{equation}

Thus, it is fortunate that the product of the time to acceleration by the identity relations (72) is applicable for the all epochs of the Universe history [52] and is unshakable law. In this way, there are firm physical grounds for assuming that
\begin{equation}
at_{Pl}(t_{Pl}) \gg a_{Pl}(t_{Pl}) \gg \cdots >> g_U(t_U) \gg a_{W7}(t_{W7}) \gg \cdots > a_0(t_0). \tag{96}
\end{equation}

This means that the cosmological acceleration in each later epoch of evolution of our Universe is less than in proceeding then the much. The fundamental reasons for the origin of “acceleration” are assumptions on higher values for Hubble constant and younger age of the Universe defined from the product $H_0 t_0$.

Final result of HST collaboration, ranging over 15 yr based on 62 SN Ia with $3000 km/s < zc = v_{CMB} < 20000 km/s$ and on 10 luminosity-calibrated SN Ia is [118] $H_0(cosmic) = 62.3 \pm 1.3(random) \pm 5.0(systematic)$. Nowadays, however, there are strong opinions that this value can be overestimated [132]. Therefore one can conclude that observational data required “reliable astrophysical estimates off$H_0$” [15]. For example, at value for Hubble constant $H_i = 37.4 km s^{-1} Mpc^{-1}$ and age of the Universe $t_i = 17.4 G y = 5.49 \times 10^{18} s$, the “acceleration” of the Universe disappears [97].

The relations (86), and (95) are fundamental for the reconciliation of the parameters $t_i$ and the $a_i$. Therefore, the causes of the acceleration of the Universe at the epoch $t_{W7} < t_i$ would a large $a_{W7} > a_0$. Thus a cosmic acceleration $a_{W7}$, established in early observations [108, 115] and calculated
here in Eq.(94), really appertain to the Universe instant time of \( t_W \), and not a present epoch time (age) \( t_0 \), at which the present day acceleration \( a_0 \) (see Tabl.1) is equal to

\[
a_0 = c/t_0 = \frac{c}{t_0^2} \approx 1.05246_{42}(61) \times 10^{-11} \text{m/s}^2. \quad (97)
\]

Finally, we may argue that in the history of the expanding Universe based on Eqs. (86)-(97), throughout its all epochs, acceleration as a function of time decreased with increasing of time.

11 Recommended values of the Dark Energy and Dark Matter in physical units

For most cases of interest involving the exact quantities of the dimensionless parameters \( \Omega_{DE} \) and \( \Omega_{DM} \). Then, derived parameters along with the constant \( x \) from Eqs.(3), (4) and (32) to the list of FPC can be considered as the “Recommended values of the Fundamental Constants for Cosmology and Astrophysics” (RFCfCA), which are nonetheless important in the immediate cosmological analysis and applied physics [134, 141]. In this case, these parameters of new cosmological physics can be expressed in SI system or atomic energy units.

Then, our one of other new physical findings it would also seem that the dominant component of the Universe – the \( \Omega_{DE} \) (in the physical units \( M_{DE} \)) is defined to

\[
M_{DE} = \Omega_{DE} \times M_U = 8.6250_{4}(52) \times 10^{54} \text{kg} = 4.8383_{0}(28) \times 10^{81} \text{GeV}/c^2,
\]

where \( M_U \) is the total mass of the observable Universe given by Eq. (10). The same value for DM is

\[
M_{DM} = \Omega_{DM} \times M_U = 2.8750_{1}(18) \times 10^{54} \text{kg} = 1.6127_{7}(9) \times 10^{84} \text{GeV}/c^2.
\]

Eventually \( M_{DE} \cdot c^2 \) and \( M_{DM} \cdot c^2 \) are the Trans-Planck and the Post-Planck epochs energy of our current Universe, respectively. It is evident that

\[
M_{DE} \cdot c^2 = 3M_{DM} \cdot c^2 = 0.75(h/e) \cdot T_{Pl}^2, \quad (100)
\]

Thereby, \( M_{DE} \) is impressive cosmological parameter, content of the explosive temperature with dimensions of energy.

In conclusion, above equations contain a four good determined quantum – “cosmological particles” mass – the \( m_{Str} \), \( m_{Gr} \), \( m_{Pl} \) and \( M_U \), which at all time related to each other by relation

\[
m_{Str} = m_{Pl} \cdot \frac{m_{Gr}}{M_U} \equiv m_{Gr} \cdot \frac{m_{Pl}}{M_U} \equiv \frac{m_{Gr}}{z_{Pl}} \equiv \frac{m_{Pl}}{z_{Gr}} \equiv \ldots. \quad (101)
\]

Note that expression (101) via graviton mass \( m_{Gr} \) is meaningful for some physical particles. Employing the definition (G2010)

\[
m_{Gr} = m_e/z_e \equiv m_{Z^0}/z^0, \quad (102)
\]

where \( m_e \), \( m_{Z^0} \) are the electron and \( Z^0 \) boson rest masses, and \( z_e \) and \( z_{z} \) are MFRS for the electron and \( Z^0 \) bosons “epochs”, respectively. For the sake of simplicity, in the case electron, from the combination of (101) and (102) the \( m_{Str} \) can be determined as

\[
m_{Str} = m_{Pl} \cdot \frac{m_e}{z_e} \equiv m_{Gr} \cdot \frac{m_e}{z_{Pl}} \equiv \ldots \approx 7.8 \times 10^{-134} \text{kg}. \quad (103)
\]

These results can play an important role in understanding the future development of the fundamental quantum theory of testable Universe (see, e.g. [60, 114]). (Here will not be considered other relation with the \( m_{last} \), which is determined in (61). On the other hand, it is argued that, particle with the \( m_{last} \) can be regarded as the first cosmological mass in a creation of matter from the radiation before the Over-Trans-Planck (OTP) epoch).
12 Concluding remarks

Finally, as noted in the preceding works [50-53], we with assiduity determined our quantum cosmological parameters better than with ±10% precisions. This type of determinations for the physical measurements, point out William Thompson early as 1900 ([55], see also, [60]).

What our predicted results, in agreement with WMAP observations [11, 61, 68, 69, 80, 84, 122] suggest that, in general our predictions on the total mass-energy of the Universe no significant distinguished from the standard $\Lambda$CDM flat model, with $0.99 < \Omega_{\text{tot}} < 1.01$ (95% CL). Then, it appears that via scaling parameters of the three discrete cosmological epochs MFRS, we firstly obtain (see, also [53]) more precise and consistent expressions for the alternative DM and DE densities of the Universe, which one gets to $\Omega_{\Lambda M} = 0.25$, and $\Omega_{\Lambda E} = 0.75$. Then, the greatest mystery nature of the dark matter, dark energy and the cosmic acceleration (see, e.g. [12, 26, 138]) here is answered.

Thus, we have compelling theoretical evidence for explanations nature the Dark Energy and Dark Matter content of the observable Universe. At the same time, our scenario fit presented in Sect.7 do not indicate any motivation for cosmic acceleration in the Universe history of the expansion [53]. This is a tight connection between quantum cosmology conception and simultaneous scaling solutions of MFRS equations and we have concentrated our efforts on this direction.

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