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THE ELECTRON AND THE UNIVERSE: HOW ARE THEIR PARAMETERS RELATED?

Abstract: *The connection between the parameters of the Universe and fundamental physical constants is disclosed. It is shown that three constants G, c, Λ are sufficient to obtain all the parameters of the Universe. The parameters of the Universe and the parameters of the electron are mathematically precisely related to each other by scale transformations. The scaling factors are formed by the large Weyl number and the fine structure constant "alpha". The scaling factors are derived from the law of scaling of large numbers. The appearance of the fine structure constant "alpha" and electron constants in the cosmological equations is evidence of the fundamental connection between microphysics and cosmology. The disclosure of the origin of the parameters of the Universe from the fundamental physical constants of the electron provides new possibilities. By studying the electron, one can unravel the mysteries of the Universe.*

Keywords*: electron, Universe, large numbers, cosmological equations, fine structure constant "alpha", parameters of the observable Universe, fine-tuning of the Universe.*

1. Introduction

H.Weyl was the first to draw attention to the ratio of the radius of the Universe to the radius of the electron (**$R_U/r_e \approx 10^{40}$**), leading to a large number of the order of 10^{40} [1]. Other ratios of the Universe parameters to fundamental physical constants also led to large numbers of order 10^{40}, 10^{60}, 10^{80}. H. Weyl considered the empirical fact of the coincidence of large numbers as a connection between cosmology and microphysics [2].

Following H. Weyl, James Rice, Stewart J. O., A. S. Eddington, P. A. M. Dirac, E. Teller, and S. Weinberg attempted to find a connection between cosmological parameters and the constants of microphysics.

In 1925 James Rice [3] attempted to relate the constant alpha to the radius of the Universe. He proposed an approximate formula:

$$\frac{4\pi}{\alpha} \approx \frac{r_e^2 c^2}{6 R_U G m_e} \qquad (1)$$

In 1931 Stewart J. O. in 1931 [4, 5] proposed a cosmological equation that relates the constant alpha to the Newtonian constant of gravitation G and to the Hubble constant:

$$\frac{G m_e^2}{\hbar H r_e} = \alpha^2 \qquad (2)$$

In 1931 Eddington [6, 7, 8] tried to find a connection between the cosmological constant **Λ** and fundamental physical constants. He proposed an approximate equation of the form:

$$\mathbf{\Lambda \approx (m_e/\alpha\hbar)^4 (2Gm_p/\pi)^2} \qquad (3)$$

Later attempts were made to find a relationship between the Hubble parameter and the fundamental physical constants. The corresponding approximate equations were proposed by Dirac, Weinberg, and Teller. In 1937 Dirac proposed the following **GH -equation**[9, 10]:

$$\mathbf{m_e c^3/(He^2) \approx e^2/(Gm_e^2)} \quad (4)$$

The **GH-equation** of Eddington-Weinberg [11] has the form:

$$\hbar^2 H \approx Gcm_p^3 \qquad (5)$$

The **GH-equation** of Teller [12, 13] has the form:

$$2\frac{G\hbar H}{c^4 l_{Pl}} = 2t_{Pl}H = 2\frac{Gm_{Pl}H}{c^3} \cong \exp(-1/\alpha) \quad (6)$$

Approximate equations and unknown exact values of large numbers did not give an opportunity to turn the empirical fact of coincidence of large numbers into a scientific theory. The law of scaling of large numbers allows to solve this problem. The law of scaling of large numbers made it possible to refine the approximate equations of James Rice, A. S. Eddington, P. A. M. Dirac, E. Teller, S. Weinberg and bring them to exact equations. New cosmological equations were obtained [14], from which systems of algebraic equations of the Universe are composed. This allows us to obtain the parameters of the Universe mathematically as a solution of the system of algebraic equations of the Universe. In this case, the accuracy of the values of the parameters of the Universe is close to the accuracy of the Newtonian constant of gravitation G. Such accuracy is quite sufficient for the parameters of the Universe.

2. The law of scaling of large numbers.

The law of scaling of large numbers includes two dimensionless constants: fine structure constant "alpha" and Weyl number.

The law of scaling of large numbers has the form (Fig. 1):

$$D_i = (\sqrt{\alpha D_0})^i$$

$i = 0, \pm1, \pm2, \pm3, \pm4, \pm5, \pm6, \pm7, \pm8, \pm9.$

Fig. 1. The scaling law of large numbers. D_0 is a large Weyl number (D_0 = 4.16561...x 10^{42}), α - fine structure constant.

The scaling law gives a new method for calculating the values of large numbers from dimensionless constants. The large numbers obtained from the scaling law are close to the accuracy of the Newtonian constant of gravitation G. The values of the large numbers and the formulas for their calculation are given in Fig. 2.

3. The large Weyl number and the fine structure constant "alpha" in the scaling law of large numbers.

All large numbers contain the large Weyl number and the fine structure constant "alpha" (Fig. 2).

$$(\sqrt{\alpha D_0})^0 = 1$$

$$D_{20} = (\sqrt{\alpha D_0})^1 = 1.74349... \bullet 10^{20}$$

$$D_{40} = (\sqrt{\alpha D_0})^2 = 3.03979... \bullet 10^{40}$$

$$D_{60} = (\sqrt{\alpha D_0})^3 = 5.29987... \bullet 10^{60}$$

$$D_{80} = (\sqrt{\alpha D_0})^4 = 9.24033... \bullet 10^{80}$$

$$D_{100} = (\sqrt{\alpha D_0})^5 = 16.1105... \bullet 10^{100}$$

$$D_{120} = (\sqrt{\alpha D_0})^6 = 28.088... \bullet 10^{120}$$

$$D_{140} = (\sqrt{\alpha D_0})^7 = 48.972... \bullet 10^{140}$$

$$D_{160} = (\sqrt{\alpha D_0})^8 = 85.383... \bullet 10^{160}$$

$$D_{180} = (\sqrt{\alpha D_0})^9 = 148.86... \bullet 10^{180}$$

Fig. 2. Large numbers and formulas for their calculation.

The law of scaling gives new large numbers on scales 10^{140}, 10^{160} and 10^{180}. The law of scaling of large numbers opens the way to obtain the parameters of the Universe by mathematical calculation.

4. The set of coincidences of large numbers.

The table in Fig. 3 shows the relations of dimensional quantities equal to large numbers. The set of relations of dimensional quantities and the set of coincidences of large numbers make it possible to derive cosmological equations for various combinations of cosmological parameters.

Ratios of dimensional constants	Scale
$\frac{Gm_e^2}{r_e\alpha^2\hbar\sqrt{\Lambda}c} = \frac{G\hbar}{r_e^3\sqrt{\Lambda}c^3} = \frac{Gm_e}{r_e^2\alpha\sqrt{\Lambda}c^2} = \frac{Gm_e^3}{\alpha^3\hbar^2\sqrt{\Lambda}} = \frac{c^2}{M_U R_U G\Lambda} = \frac{c^2}{M_U G\sqrt{\Lambda}} = \frac{c^2 R_U}{M_U G} = \frac{l_{Pl}^4}{\Lambda r_e^6} = \frac{R_U}{M_U G T_U^2\Lambda} = \frac{c^3 T_U^3\Lambda}{R_U} = . \frac{c r_e^3 A_0}{G\hbar} = \frac{c^2}{M_U R_U \Lambda G} = \frac{M_U R_U\sqrt{\Lambda}A_0 G}{c^4} = 1$	10^0
$D_{20} = \frac{r_e}{l_{Pl}} = \frac{t_0}{t_{Pl}} = \frac{\alpha\ m_{Pl}}{m_e} = \frac{l_{Pl}}{r_e^2\sqrt{\Lambda}} = \frac{l_{Pl}R_U}{r_e^2} = \frac{c^2 l_{Pl}}{r_e^2 A_0} = \sqrt{\alpha D_0}$	10^{20}
$D_{40} = \frac{T_U}{t_0} = \frac{R_U}{r_e} = \frac{m_e c}{\alpha\hbar\sqrt{\Lambda}} = \frac{r_e\alpha c^2}{Gm_e} = \frac{1}{t_0 c\sqrt{\Lambda}} = \frac{r_e^2}{l_{Pl}^2} = \frac{t_0^2}{t_{Pl}^2} = \frac{\alpha^2 m_{Pl}^2}{m_e^2} = \frac{l_{Pl}^2}{r_e^4\Lambda} = \frac{c^2}{r_e A_0} = \frac{1}{r_e\sqrt{\Lambda}} = (\sqrt{\alpha D_0})^2$	10^{40}
$D_{60} = \frac{T_U}{t_{Pl}} = \frac{R_U}{l_{Pl}} = \frac{M_U}{m_{Pl}} = \frac{1}{l_{Pl}\sqrt{\Lambda}} = \frac{r_e^3}{l_{Pl}^3} = \frac{t_0^3}{t_{Pl}^3} = \frac{c^2}{Gm_{Pl}\sqrt{\Lambda}} = \frac{c^2}{l_{Pl}A_0} = (\sqrt{\alpha D_0})^3$	10^{60}
$D_{80} = \frac{R_U^2}{r_e^2} = \frac{\sqrt{\Lambda}M_U^2\alpha G}{c^2 m_e} = \frac{cT_U}{r_e^2\sqrt{\Lambda}} = \frac{r_e}{\sqrt{\Lambda}l_{Pl}^2} = \frac{1}{r_e^2\Lambda} = (\sqrt{\alpha D_0})^4$	10^{80}
$D_{100} = \frac{m_e c}{l_{Pl}\alpha\hbar\Lambda} = \frac{r_e\alpha M_U}{l_{Pl}m_e} = \frac{\sqrt{\Lambda}M_U^2\alpha G r_e}{c^2 m_e l_{Pl}} = \frac{R_U^2}{r_e l_{Pl}} = \frac{1}{r_e l_{Pl}\Lambda} = (\sqrt{\alpha D_0})^5$	10^{100}
$D_{120} = \frac{T_U^2}{t_{Pl}^2} = \frac{R_U^2}{l_{Pl}^2} = \frac{M_U^2}{m_{Pl}^2} = \frac{R_U}{r_e^3\Lambda} = \frac{M_U c}{\hbar\sqrt{\Lambda}} = \frac{GM_U^2}{\hbar c} = \frac{c^3}{G\hbar\Lambda} = \frac{1}{l_{Pl}^2\Lambda} = (\sqrt{\alpha D_0})^6$	10^{120}
$D_{140} = \frac{r_e^2 m_e c}{l_{Pl}^3\alpha\hbar\Lambda} = \frac{r_e^3\alpha M_U}{l_{Pl}^3 m_e} = \frac{R_U^3}{l_{Pl}r_e^2} = \frac{1}{c^3 t_{Pl}t_0^2\sqrt{\Lambda}\Lambda} = \frac{1}{l_{Pl}r_e^2\Lambda\sqrt{\Lambda}} = \frac{c^2}{l_{Pl}r_e^2 A_0\Lambda} = (\sqrt{\alpha D_0})^7$	10^{140}
$D_{160} = \frac{M_U c^2\alpha^2}{Gm_e^2\sqrt{\Lambda}} = \frac{M_U^2 G\alpha}{c^2 r_e^2 m_e\sqrt{\Lambda}} = \frac{1}{r_e^4\Lambda^2} = \frac{r_e^2}{l_{Pl}^4\Lambda} = (\sqrt{\alpha D_0})^8$	10^{160}
$D_{180} = \frac{r_e^4 m_e c}{l_{Pl}^5\alpha\hbar\Lambda} = \frac{r_e^5\alpha M_U}{l_{Pl}^5 m_e} = \frac{R_U}{l_{Pl}^3\Lambda} = \frac{1}{l_{Pl}^3\Lambda\sqrt{\Lambda}} = \frac{c^2}{l_{Pl}^3 A_0\Lambda} = \frac{GM_U T_U^2 l_{Pl}}{\Lambda r_e^6} = \frac{1}{r_e^3\Lambda^2 l_{Pl}} = (\sqrt{\alpha D_0})^9$	10^{180}

Fig. 3. Coincidences of relations of dimensional quantities with large numbers. M_U is the mass of the observable Universe, α is the fine structure constant, ħ is Planck's constant, G is the Newtonian gravitational constant, Λ is the cosmological constant, R_U is the radius of the observable Universe, T_U is the time of the Universe, A_0 is the cosmological acceleration, r_e is the classical radius of the electron; c - speed of light in vacuum; $t_0 = r_e/c$, m_e - electron mass, D_0 - large Weyl number, t_{pl} - Planck time, l_{pl} - Planck length, m_{pl} - Planck mass.

5. Cosmological equations that contain the parameters of the Universe and fundamental physical constants.

Cosmological equations that contain the constant speed of light are shown in Fig. 4.

$$
\begin{aligned}
&G\hbar/r_e^3A_0 = c^1 && M_UR_UA_0^2G = c^6 \\
&1/T_U^2\Lambda = c^2 && M_UR_UA_0G/\Lambda T_U^3 = c^7 \\
&M_UR_U\Lambda GA_0T_U = c^3 && M_U^2R_UA_0^2G^2\sqrt{\Lambda} = c^8 \\
&M_UA_0G = c^4 && M_UA_0^2G/\Lambda^2T_U^3 = c^9 \\
&A_0/\Lambda^2T_U^3 = c^5 && M_U^2R_UA_0^2G^2/T_U^2\sqrt{\Lambda} = c^{10}
\end{aligned}
$$

Fig. 4. Speed of light in cosmological equations. Where : ħ - Planck constant, c - speed of light in vacuum; r_e - classical electron radius; M_U - mass of the observable Universe, G - Newtonian constant of gravitation, Λ - cosmological constant, R_U - radius of the observable Universe, A_0 - cosmological acceleration.

The cosmological equations that include Planck's constant are given in Fig. 5.

$$
M_U\Lambda c r_e^3 = \hbar\,, \quad \frac{c^5r_e^3}{M_UG^2} = \hbar\,, \quad \frac{R_U\Lambda c^3r_e^3}{G} = \hbar\,, \quad \frac{cr_e^3A_0}{G} = \hbar, \quad \frac{m_ec}{l_{Pl}\alpha\Lambda(\sqrt{\alpha D_0})^5} = \hbar,
$$

$$
m_ecr_e^2\sqrt{\Lambda D_0^2} = \hbar, \quad \frac{c^5r_e^3\Lambda}{GA_0} = \hbar\,, \quad \frac{c^3r_e^3}{GR_U} = \hbar, \quad \frac{M_Ur_e^3}{R_UT_U} = \hbar\,, \quad \frac{M_Uc}{\sqrt{\Lambda}\;\alpha^3D_0^3} = \hbar\,.
$$

Fig. 5. Planck constant in cosmological equations. Where : ħ - Planck constant, M_U - mass of the observable Universe, G - Newtonian constant of gravitation, Λ - cosmological constant, R_U - radius of the observable Universe, A_0 - cosmological acceleration, r_e - classical electron radius; c - speed of light in vacuum; m_e - electron mass, Do - large number.

The cosmological equations, which consist directly of the parameters of the Universe, are given in Fig. 6.

$$
\begin{aligned}
&M_U\Lambda G = A_0 \\
&M_UR_U\Lambda^2GT_U^2 = 1 \\
&M_UR_U^3\Lambda^2G = A_0^2T_u^2 \\
&M_UGT_u^2 = R_u^3 \\
&R_u^3\Lambda = A_0T_u^2 \\
&M_UG\Lambda A_0T_U^4\sqrt{\Lambda} = R_U \\
&M_U\Lambda GT_u^2 = R_U
\end{aligned}
$$

Fig. 6. Cosmological equations consisting directly of the parameters of the universe.

6. Systems of algebraic equations of the Universe

A system of algebraic equations composed of five cosmological equations containing the speed of light yields all the parameters of the observable universe.

$$\begin{cases} G\hbar/r_e^3 A_0 = c^1 \\ 1/T_U^2\Lambda = c^2 \\ M_U A_0 G = c^4 \\ M_U R_U A_0 G/T_U = c^5 \\ M_U R_U A_0^2 G = c^6 \end{cases}$$

Fig. 7. System of cosmological equations for calculating the parameters of the observed Universe.

In this system of cosmological equations, only the fundamental physical constants **ħ, r_e, G, c** are known quantities. The unknown cosmological parameters **M_U, R_U, Λ, A_0, T_U** are easily obtained by solving the system of algebraic equations.

A system of five cosmological equations containing Planck's constant also yields all the parameters of the observable universe.

$$\begin{cases} \dfrac{c^5 r_e^3}{M_U G^2} = \hbar \\ M_U \Lambda c r_e^3 = \hbar \\ \dfrac{R_U \Lambda c^3 r_e^3}{G} = \hbar \\ \dfrac{c r_e^3 A_0}{G} = \hbar \\ \dfrac{M_U r_e^3}{R_U T_U} = \hbar \end{cases}$$

Fig. 8. System of cosmological equations containing Planck's constant.

In this system of cosmological equations only the fundamental physical constants **ħ, r_e, G, c** are known quantities. The unknown cosmological parameters **M_U, R_U, Λ, A_0, T^U** are easily obtained by solving the system of equations.

From the new cosmological equations, other systems of algebraic equations can be composed (Fig. 9):

$$
\begin{cases}
M_U \Lambda G = A_0 \\
c^5 r_e^3 / M_U G^2 = \hbar \\
M_U G T_u^2 = R_u^3 \\
G M_U = c^2 R_U \\
M_U \Lambda G T_u^2 = R_U
\end{cases}
$$

Fig. 9. System of algebraic equations of the Universe.

In this system of cosmological equations, only the fundamental physical constants $\mathbf{r_e}$**, G, c** are known quantities. The unknown cosmological parameters $\mathbf{M_U}$**,** $\mathbf{R_U}$**,** $\mathbf{\Lambda}$**,** $\mathbf{A_0}$**,** $\mathbf{T_U}$ are easily obtained by solving the system of equations.

All given systems of cosmological equations give the same values of the parameters of the Universe (Fig. 10).

$$
\begin{aligned}
M_U &= 1.15348... \bullet 10^{53}\, kg \\
R_U &= 0.856594... \bullet 10^{26}\, m \\
T_U &= 2.85729\, ... \bullet 10^{17}\, s \\
\Lambda &= 1.36285\ \ ... \bullet 10^{-52}\, m^{-2} \\
A_0 &= 10.4922\, ... \bullet 10^{-10}\, m / s^2
\end{aligned}
$$

Fig. 10. Identical values of the Universe parameters obtained from different systems of algebraic equations of the Universe.

7. Cosmological equations of the Universe from coincidences of large numbers.

The parameters of the universe can be obtained mathematically from the coincidence of large numbers.

$$M_U = m_{Pl}(\sqrt{\alpha D_0})^3 \qquad (7)$$

$$R_U = l_{Pl}(\sqrt{\alpha D_0})^3 \qquad (8)$$

$$T_U = t_{Pl}(\sqrt{\alpha D_0})^3 \qquad (9)$$

$$\Lambda = \frac{l_{Pl}^4}{r_e^6} \qquad (10)$$

$$A_0 = \frac{c^2}{l_{Pl}(\sqrt{\alpha D_0})^3} \qquad (11)$$

Formulas (7) - (11) give the same values of the Universe parameters as the systems of cosmological equations (Fig.11).

$$M_U = 1.15348... \bullet 10^{53}\, kg$$
$$R_U = 0.856594... \bullet 10^{26}\, m$$
$$T_U = 2.85729... \bullet 10^{17}\, s$$
$$\Lambda = 1.36285... \bullet 10^{-52}\, m^{-2}$$
$$A_0 = 10.4922... \bullet 10^{-10}\, m/s^2$$

Fig. 11. Values of the Universe parameters obtained from coincidences of large numbers.

8. Fine structure constant "alpha" in the cosmological equations.

The cosmological equations that contain the fine structure constant are given in Fig. 12.

$$\frac{M_U G^2 m_e}{c^4 r_e^2} = \alpha, \quad \frac{m_e}{M_U \Lambda r_e^2} = \alpha, \quad \frac{G m_e}{R_U \Lambda c^2 r_e^2} = \alpha, \quad \frac{G m_e}{r_e^2 A_0} = \alpha,$$

$$\sqrt{\frac{1}{r_e^2 \Lambda D_0^2}} = \alpha, \quad \sqrt[3]{\frac{c^3}{G\hbar\Lambda D_0^3}} = \alpha, \quad \frac{G m_e A_0}{\Lambda c^4 r_e^2} = \alpha, \quad \frac{R_U G m_e}{r_e^2 c^2} = \alpha,$$

$$\frac{G m_e}{r_e^2 c^2 \sqrt{\Lambda}} = \alpha, \quad \frac{m_e c^4}{M_U A_0^2 r_e^2} = \alpha. \quad \frac{T_U G m_e}{r_e^2 c} = \alpha \quad \frac{m_e c^2 T_U^2}{M_U r_e^2} = \alpha$$

Fig. 12. The fine structure constant alpha in the cosmological equations.

where : α - fine-structure constant, ħ - Planck constant, M_U - mass of the observable Universe, G - Newtonian constant of gravitation, Λ - cosmological constant, R_U - radius of the observable Universe, A_0 - cosmological acceleration, r_e - classical electron radius; c - speed of light in vacuum; m_e - electron mass, D_0 - large number, r_e - classical electron radius; c - speed of light in vacuum; m_e - electron mass.

A system of five cosmological equations containing the fine structure constant alpha gives all the parameters of the observable Universe.

$$
\begin{cases}
\dfrac{M_U G^2 m_e}{c^4 r_e^2} = \alpha, \\[2ex]
\dfrac{m_e}{M_U \Lambda r_e^2} = \alpha, \\[2ex]
\dfrac{G m_e}{R_U \Lambda c^2 r_e^2} = \alpha, \\[2ex]
\dfrac{G m_e}{r_e^2 A_0} = \alpha, \\[2ex]
\dfrac{m_e c^2 T_U^2}{M_U r_e^2} = \alpha.
\end{cases}
$$

Fig. 13. The system of algebraic equations of the Universe containing the fine structure constant alpha.

In this system of cosmological equations, only the fundamental physical constants $\mathbf{r_e}$, **G**, **c**, $\boldsymbol{\alpha}$, $\mathbf{m_e}$ are known quantities. The unknown cosmological parameters $\mathbf{M_U}$, $\mathbf{R_U}$, $\boldsymbol{\Lambda}$, $\mathbf{A_0}$, $\mathbf{T_U}$ are easily obtained by solving the system of algebraic equations.

The values of the Universe parameters and formulas for their calculation are given in Fig. 14.

$$
\begin{aligned}
M_U &= m_e \alpha D_0^2 = 1.15348... \bullet 10^{53}\, kg \\
R_U &= r_e \alpha D_0 = 0.856594... \bullet 10^{26}\, m \\
T_U &= \frac{r_e \alpha D_0}{c} = 2.85729\,... \bullet 10^{17}\, s \\
\Lambda &= \frac{1}{r_e^2 \alpha^2 D_0^2} = 1.36285... \bullet 10^{-52}\, m^{-2} \\
G &= \frac{r_e^3}{t_0^2 m_e D_0} = 6.67430\,... \bullet 10^{-11}\, kg^{-1} m^3 s^{-2} \\
A_0 &= \frac{c^2}{r_e \alpha D_0} = 10.4922\,... \bullet 10^{-10}\, m/s^2
\end{aligned}
$$

Fig. 14. Values of the Universe parameters obtained from the system of algebraic equations of the Universe containing the fine structure constant "alpha".

All parameters of the Universe turned out to be scale-transformed parameters of the electron. The scaling factors for the parameters of the universe are large numbers. The study of the electron can provide important insights into the universe [15].

The results show how mathematically fine-tuned the universe is. Together with the proofs of the constancy of the constant G in time [16, 17], the revision of the status of the parameters of the Universe and the transformation of some parameters into fundamental constants of the Universe deserve special attention.

9. Other parameters of the Universe.

Below it will be shown that not only the parameters $\mathbf{M_u}$, $\mathbf{\Lambda}$, $\mathbf{R_u}$, $\mathbf{T_U}$, $\mathbf{A_0}$, but also other parameters of the Universe are not independent. They too derive from the fundamental physical constants of the electron.

9.1. The mass density of the Universe

Let us determine the mass density of the Universe from Kepler's law for the Universe:

$$\mathbf{M_u G = Ru^3/T_U^2} \qquad (12)$$

From formula (12) the value of the mass density of the Universe follows:

$$\mathbf{\rho_u = M_u/Ru^3 = 1/T_U^2 G = 1{,}83520\ldots \times 10^{-25}}\ \text{кг/м}^3 \quad \mathbf{m_e/r_e^3(\alpha^2 D_0)} \qquad (13)$$

It follows from formula (13) that the mass density of the Universe is directly "encoded" in the Newtonian constant of gravitation G as an inverse value with dimensionality m^3/kg

The value of the mass density (9) corresponds to the value of the cosmological constant Λ:

$$\mathbf{\Lambda = R_u/M_u T_U^2 G =} 1.36285\ldots \text{x } 10^{-52} m^{-2} \mathbf{= 1/r_e^2 \alpha^2 D_0^2} \qquad (14)$$

Mass density for an electron:

$$\mathbf{\rho_e = m_e/r_e^3} \qquad (15)$$

The value of the mass density of the electron corresponds to the value of the cosmological constant Λ_e:

$$\mathbf{\Lambda_e = 1/r_e^2 = 0.12593209\ldots \times 10^{30}}\ m^{-2} \qquad (16)$$

Planckian mass density:

$$\mathbf{\rho_{Pl} = m_{Pl}/l_{Pl}^3} \qquad (17)$$

The value of the Planck mass density corresponds to the value of the cosmological constant Λ_{Pl}:

$$\Lambda_{Pl} = 1/l_{Pl}^{\,2} = \alpha D_0/r_e^{\,2} = 0.382807... \text{ x } 10^{70}\ m^{-2} \qquad (18)$$

The ratio of values Λ , Λ_e, Λ_{Pl} is as follows:

$$\Lambda_{Pl} / \Lambda_e = (\sqrt{\alpha D_0})^2 = 3.03979 ... \bullet 10^{40} = D_{40} \qquad (19)$$

$$\Lambda_e / \Lambda = (\sqrt{\alpha D_0})^4 = 9.24033 ... \bullet 10^{80} = D_{80} \qquad (20)$$

$$\Lambda_{Pl} / \Lambda = (\sqrt{\alpha D_0})^6 = 28.088 ... \bullet 10^{120} = D_{120} \qquad (21)$$

In quantum field theory as the cosmological constant **Λ** the value corresponding to the Planck energy density is erroneously accepted. This value exceeds the real value of Λ for the gravitational field by 10^{120} **.** Regarding this value it was said: "it must just qualify as the *worst prediction* ever made by a scientific theory" [18].

The mass density of the universe is related to the mass density of the electron by a scaling transformation:

$$\rho_e/\rho_u = \alpha^2 D_0 \qquad (22)$$

9.2. Cosmological momentum

Cosmological momentum:

$$P_U = M_U R_U/T_U \qquad (23)$$

Electron momentum:

$$P_e = m_e c \qquad (24)$$

The cosmological momentum is related to the electron momentum through the large number αD_0^2.

$$P_U/P_e = \alpha D_0^2 \qquad (25)$$

9.3. The Quantum of Action of the Universe

The quantum of the action of the Universe:

$$\hbar_U = \frac{M_U c}{\sqrt{\Lambda}} = 29.621... \text{x } 10^{86}\ JHz^{-1} \qquad (26)$$

where : $\hbar_U$ - quantum of action of the Universe, M_U - mass of the observable Universe, Λ - cosmological constant.

Formula (26) is an analog of Planck's action quantum with respect to the Universe. The action quantum of the Universe is a scaled Planck constant. The scaling factor is the large number D_{120} = 28.088... x10^{120}.

$$\hbar_U = \hbar D_{120} = 29.621... \text{x } 10^{86}\ JHz^{-1} \qquad (27)$$

$$\hbar_U = \hbar \alpha^3 D_0^3 = 29.621... \bullet 10^{86}\ JHz^{-1} \qquad (28)$$

where : $ħ_U$ is the action quantum of the Universe, ħ is Planck's constant, D_{120} is the large number of mass 10^{120} ($D_{120} = 28.088...x10^{120}$), α is the fine structure constant, D_0 is the large Weyl number ($D_0 = 4.16561...x\ 10^{42}$).

Planck's formula is satisfied for the energy of the universe:

$$E_U = \hbar_U c\sqrt{\Lambda} = M_U c^2 \quad (29)$$

where : $ħ_U$ - quantum of the Universe action, E_U - energy of the Universe, M_U - mass of the observable Universe, Λ - cosmological constant, c - speed of light in vacuum.

The quantum of action of the Universe is represented by equivalent formulas.

$$\mathbf{ħ_U} = \hbar\alpha^3 D_0^3 = \frac{M_U c}{\sqrt{\Lambda}} = \frac{M_U R_U^2}{T_U} = \frac{M_U A_0}{\Lambda c} = \frac{c^3}{G\Lambda} = \mathbf{29.621...\ x\ 10^{86}\ JHz^{-1}} \quad (30)$$

where : ħ - Planck constant, α - fine-structure constant, M_U - mass of the observable Universe, G - Newtonian constant of gravitation, Λ - cosmological constant, R_U - radius of the observable Universe, A_0 - cosmological acceleration, T_U - time of Universe, c - speed of light in vacuum; D_0 - large Weyl number.

9.4. Standard gravitational parameter of the Universe

Standard gravitational parameter of the Universe:

$$\boldsymbol{\mu}_\mathbf{U} = GM_U \quad (31)$$

The standard gravitational parameter of the Universe is represented by the equivalent formulas.

$$\boldsymbol{\mu}_\mathbf{U} = GM_U = \frac{R_U^3}{T_U^2} = \frac{A_0}{\Lambda} = \frac{R_U^3 A_0^2}{c^2} = c^2 R_U^3 \Lambda = c^2 R_U = \frac{r_e^3 \alpha D_0}{t_0^2} =$$

$$= \frac{c^2}{\sqrt{\Lambda}} = 7{,}69868...x\ 10^{42}\ m^3 s^{-2} \quad (32)$$

The product Gm_e is called the Standard gravitational parameter of the electron.

$$\mu_e = Gm_e = \frac{r_e^3}{t_0^2 D_0} = 0.607987... \bullet 10^{-40} m^3 s^{-2} \quad (33)$$

The standard gravitational parameter of the universe is related to the gravitational parameter of the electron by means of a large number αD_0^2.

10. Three constants G, c and Λ set all parameters of the Universe.

The revealed mutual relation between the parameters of the Universe and the known experimental values of the fundamental constants G and c make it possible to obtain all the parameters of the Universe from the three constants.Let us show it on the example of the cosmological constant

Λ.The step-by-step algorithm for calculating the parameters of the Universe using the three constants G, c, Λ is as follows:

1. From Kepler's law formula for the universe $\mathbf{M_uG = Ru^3/T_U^2 = c^2/\sqrt{\Lambda}}$, the mass of the universe is calculated:

$$\mathbf{M_u = c^2/G\sqrt{\Lambda}} \qquad (34)$$

2. From the formula of A.E.H. Bleksley [19] $\mathbf{M_u = c^2Ru/G}$ the radius of the Universe is calculated:

$$\mathbf{Ru = M_uG/c^2} \qquad (35)$$

3. From Kepler's law for the Universe $\mathbf{M_uG = Ru^3/T_U^2}$ the time of the Universe is calculated:

$$\mathbf{T_U = \sqrt{(Ru^3/M_uG)}} \qquad (36)$$

4. From the equivalent formula of Kepler's law for the Universe $\mathbf{M_uG = A_0/\Lambda}$ the cosmological acceleration is calculated:

$$\mathbf{A_0 = M_uG\Lambda} \qquad (37)$$

Other derived parameters of the Universe can be easily calculated using the parameters **Mu, Ru, T_U, G, Λ, A_0**.

11. Conclusion

The theory based on the law of scaling of large numbers predicts the values of all parameters of the Universe. The parameters of the Universe are obtained independently from the systems of algebraic equations of the Universe and from the coincidence of large numbers. The accuracy of the obtained values of the parameters of the Universe is close to the accuracy of the Newtonian constant of gravitation G. The parameters of the Universe are not primary and independent. Their origin from the fine structure constant "alpha" and electron constants is revealed.

The discovery of the dependent, secondary status of the parameters of the Universe and the discovery of their origin from the fundamental physical constants of the electron give new possibilities in cosmology. The Universe is a very inconvenient object for measurements and laboratory studies. At the same time, the electron is a very convenient physical object for laboratory studies.Its parameters are known with high precision. The electron helps to unravel the mysteries of the Universe.

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