

SYSTEM OF COSMOLOGICAL EQUATIONS FOR THE MATHEMATICAL DERIVATION OF THE PARAMETERS OF THE OBSERVABLE UNIVERSE.

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Abstract. *A system of cosmological equations has been obtained that allows one to mathematically derive the values of the parameters of the observable Universe with unprecedented accuracy. The system of equations was formed by combining separate cosmological equations derived at different times by renowned scientists. The parameters of the observable Universe are the roots of the system of algebraic equations, which eliminates the ambiguity of their values. The solution to the inverse problem gives the entire package of parameters of the observable Universe with an accuracy close to the accuracy of the gravitational constant G . Mass of the observable Universe: $M_U = 1.15348 \cdot 10^{53} \text{ kg}$; radius: $R_U = 0.856594 \cdot 10^{26} \text{ m}$; time: $T_U = 2.85729 \cdot 10^{17} \text{ s}$; cosmological constant: $\Lambda = 1.36285 \cdot 10^{-52} \text{ m}^{-2}$; acceleration constant (new parameter of the Universe): $A_0 = 10.4922 \cdot 10^{-10} \text{ m/s}^2$. All values of the derived parameters of the Universe are verified with high accuracy using fundamental constants well known in physics.*

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1. Introduction

At various times, prominent scientists (Schrödinger, Bleksley, Milne, Dirac, Teller, Rice) discovered equations linking the parameters of the observable Universe with fundamental physical constants [1-4]. Erwin Schrödinger attempted to formulate Mach's principle mathematically and, as early as 1925, proposed the equation $GM_U = c^2 R_U$ [1]. A similar equation, $M_U G = c^2 R_U$, was derived by Bleksley [2]. Milne in 1936 proposed the equation $GM_U = c^3 T_U$ [3]. The Tully–Fisher relation, well known for galaxies, also holds for the Universe: $GM_U A_0 = c^4$

Using the known equations individually leads to inconsistent values of the Universe's parameters. Known equations containing three or more parameters of the Universe do not provide an unambiguous solution. For example, the Schrödinger equation ($GM_U = c^2 R_U$) yields an infinite number of pairs $M_U -- R_U$ that satisfy the equation. Substituting highly imprecise experimental values into an equation containing highly precise constants of the microworld negates the very idea of mathematically calculating the parameters of the universe. As a result, the purpose of combining highly precise constants of the microworld and low-precision constants of the macroworld in a single equation is lost.

2. Solving the inverse problem to deduce the values of the parameters of the observable Universe.

Experimental values of the parameters of the Universe are known with very low accuracy. When experimental methods fail, a solution must be sought mathematically. The differential equations known in physics and cosmology do not allow us to directly obtain the parameters of the Universe.

We have found a solution to this problem. To do this, we solve the inverse problem: using known cosmological equations, we determine the values of the parameters of the Universe that satisfy a group of disparate equations. The known cosmological equations [1 - 4] are consequences from which the characteristics of a physical object (the Universe) can be reconstructed. Since all the equations presented relate to a single physical object—the Universe—we have grouped and combined the equations into a system of algebraic equations. The transition from disparate cosmological equations to a SYSTEM OF COSMOLOGICAL EQUATIONS is a key step in solving the inverse problem. We do not use experimental values of the parameters of the Universe due to their extremely low accuracy. This isn't about searching for random numerical coincidences, but rather a rigorous, deterministic system of algebraic equations of the observable Universe, where all parameters are calculated analytically.

Since the equations include fundamental physical constants, the system of equations yields precise values of the Universe's parameters without introducing any adjustable coefficients. Solving the system of equations yields the entire package of Universe parameters. The parameters of the observable Universe are the roots of the system of algebraic equations. The system of cosmological equations includes "a priori" parameters represented by the gravitational constant G and the fundamental physical constants. This leads to an unambiguous result for the entire package of Universe parameters.

3. The System of Algebraic Equations of the Universe.

To calculate the parameters of the Universe, we combined the disparate cosmological equations of Schrödinger, Bleksley (1), Milne (2), and Tully-Fisher (3) into a single system of cosmological equations. To these equations, we added two equations (4) and (5) that we had previously obtained. The result is a system of five algebraic equations containing all the necessary parameters of the Universe.

$$GM_U = c^2 R_U \quad (1)$$

$$GM_U = c^3 T_U \quad (2)$$

$$GM_U A_0 = c^4 \quad (3)$$

$$M_U \Lambda c r_e^3 = \hbar \quad (4)$$

$$GM_U \Lambda = A_0 \quad (5).$$

Where: M_U is the mass of the Universe, G is the gravitational constant, c is the speed of light, R_U is the radius of the Universe, r_e is the electron radius, $\hbar$ is Planck's constant, A_0 is the constant of the Universe's acceleration, T_U is the time of the Universe, and Λ is the cosmological constant.

The system of algebraic equations of the Universe is shown in Figure 1.

$$\left\{ \begin{array}{l} \mathbf{GM_U = c^2 R_U} \\ \mathbf{GM_U = c^3 T_U} \\ \mathbf{GM_U A_0 = c^4} \\ \mathbf{M_U \Lambda c r_e^3 = \hbar} \\ \mathbf{GM_U \Lambda = A_0} \end{array} \right.$$

Figure 1. System of algebraic equations of the Universe.

4. The parameters of the observable Universe are the roots of a system of algebraic equations.

The parameters of the Universe are the mathematical roots of a system of algebraic equations. All calculated values of the parameters of the Universe have an accuracy close to that of the gravitational constant. This is an unprecedented level of accuracy for the parameters of the observable Universe. Previously, the values of these parameters were known only approximately in cosmology and astrophysics. For example, instead of an approximate value for the mass of the observable Universe ($M_U \approx 1.45 \cdot 10^{53} \text{ kg}$), we obtained its exact value ($M_U = 1.15348 \cdot 10^{53} \text{ kg}$). The values of the parameters of the observed Universe ($M_U = 1.15348 \cdot 10^{53} \text{ kg}$, $R_U = 0.856594 \cdot 10^{26} \text{ m}$, $T_U = 2.85729 \cdot 10^{17} \text{ s}$, $\Lambda = 1.36285 \cdot 10^{-52} \text{ m}^{-2}$, $A_0 = 10.4922 \cdot 10^{-10} \text{ m/s}^2$) are derived with an accuracy of 5 - 6 digits. Figure 2 shows a group of parameters of the Universe, which are obtained as the roots of the system (Fig. 1) of algebraic equations.

$$\begin{array}{l} M_U = 1.15348 \dots \cdot 10^{53} \text{ kg} \\ R_U = 0.856594 \dots \cdot 10^{26} \text{ m} \\ T_U = 2.85729 \dots \cdot 10^{17} \text{ s} \\ \Lambda = 1.36285 \dots \cdot 10^{-52} \text{ m}^{-2} \\ G = 6.67430 \dots \cdot 10^{-11} \text{ kg}^{-1} \text{ m}^3 \text{ s}^{-2} \\ A_0 = 10.4922 \dots \cdot 10^{-10} \text{ m} / \text{s} \end{array}$$

Fig. 2. Values of the parameters of the Universe derived from the system of cosmological equations.

The system of algebraic equations of the Universe has made it possible to completely eliminate the use of inaccurate experimental values of the Universe's parameters, eliminate the need to adjust the parameters of the Universe to measured values, and eliminate numerical fitting. As a result, the roots of the system of algebraic equations turn out to be fundamental mathematical constants and codes of the Universe, rather than random physical quantities.

5. The acceleration constant $A_0 = 10.4922 \cdot 10^{-10} \text{ m/s}^2$ is a new parameter of the observable Universe.

One of the roots of the system of algebraic equations of the Universe is a new parameter of the Universe: the cosmological acceleration $A_0 = 10.4922 \cdot 10^{-10} \text{ m/s}^2$. This acceleration constant is the basis for the new law of gravity: $F_{\text{Cos}} = mA_0 = mc^2/\Lambda$. The constant $A_0 = 10.4922 \cdot 10^{-10} \text{ m/s}^2$ complements the family of acceleration constants known in physics:

- Planck acceleration $a_P = 5.56073 \times 10^{51} \text{ m/s}^2$.
- classical limiting acceleration $a_{\text{max}} = 3.1894046 \times 10^{31} \text{ m/s}^2$.
- critical Schwinger acceleration $a_s = 2.3274210 \times 10^{29} \text{ m/s}^2$.
- gravitational acceleration created by the mass of an electron at a distance of its classical radius $a_g = 7.65651 \times 10^{-12} \text{ m/s}^2$.
- MOND critical acceleration: $a_0 \approx 1.2 \times 10^{-10} \text{ m/s}^2$.

6. Verification of the Derived Parameters of the Observable Universe

We will verify the derived parameters of the observable Universe by calculating them using well-known constants in physics:

1. The following five combinations of universe parameters (GM_U^2/R_U^2 , $M_U A_0$, $M_U R_U/T_U^2$, $M_U c^2/\Lambda$, $GM_U^2 \Lambda$) yield the Planck force with high accuracy. $F_P = 1.21027 \times 10^{44} \text{ N}$:

$$F_P = GM_U^2/R_U^2 = M_U A_0 = M_U R_U/T_U^2 = M_U c^2/\Lambda = GM_U^2 \Lambda = 1.21027 \times 10^{44} \text{ N} \quad (6)$$

Physics used only one formula (c^4/G) for calculating the Planck force without using Planck units. We presented five more formulas based on the derived parameters of the universe.

2. The combination of the parameters of the universe $M_U R_U^2 \Lambda^2 T_U$ yields a value of $4.49174 \cdot 10^{18} \text{ kg s m}^{-2}$. This is a known constant in physics: the linear gravitational momentum of the vacuum/

3. The combination of the parameters of the universe $M_U R_U A_0/T_U$ yields a value of $3.62825 \cdot 10^{52} \text{ W}$. This is a known constant in physics: the Planck power.

4. The combination of the parameters of the universe $M_U R_U \Lambda A_0 T_U$ yields a value of $4.03681 \cdot 10^{35} \text{ kg/s}$. This is a known constant in physics: the characteristic gravitational impedance of the vacuum.

5. The combination of the parameters of the universe M_U/R_U yields a value of $1.34659 \cdot 10^{27} \text{ kg/m}$. This is a known constant in physics: the Planck linear density.

6. The combination of the universe's parameters $M_U \cdot R_U A_0^2$ yields a value of $1.08774 \cdot 10^{61} \text{ W} \cdot \text{m/s}$. This is a well-known constant in physics: the gravitational power flux. It sets the absolute upper limit on the rate of change of energy per unit length in the Universe.

7. Dimensionless combinations of the parameters of the universe ($M_{\text{re}}/m_e R_U$ and $M_U R_U \Lambda r_e/m_e$) give the famous large Weyl number: $D_0 = 4.1656 \cdot 10^{42}$

$$M_U r_e/m_e R_U = M_U R_U \Lambda r_e/m_e = D_0 = 4.1656 \cdot 10^{42} \quad (7)$$

8. The combination of the parameters of the universe R_U , T_U , G , M_U gives the cosmological analogue of Kepler's Third Law: $R_U^3/T_U^2 = GM_U$

9. The combination of the parameters of the universe R_U , T_U , M_U , $\hbar$ gives the cosmological analogue of the quantum of action (the quantum of action of the universe) $M_U \cdot R_U^2/T_U = \hbar \alpha D_0^3$. The quantum of action of the universe is a scale-transformed Planck constant.

10. The product $A_0 \alpha^2 D_0$ yields the value: $2.3274210 \times 10^{29} \text{ m/s}^2$. This is the Schwinger acceleration constant, known in physics.

11. The product $A_0 \alpha D_0$ yields the value: $3.1894046 \times 10^{31} \text{ m/s}^2$. This is a well-known acceleration constant in physics: classical limiting acceleration $a_{\text{max}} = 3.1894046 \times 10^{31} \text{ m/s}^2$.

12. The product $A_0 \alpha D_0 \sqrt{(\alpha D_0)}$ gives the value: $5.56073 \times 10^{51} \text{ m/s}^2$. This is the Planck acceleration: Planck acceleration $a_P = 5.56073 \times 10^{51} \text{ m/s}^2$.

13. The product $A_0 \cdot \alpha$ yields the value: $7.65651 \times 10^{-12} \text{ m/s}^2$. This is well-known in physics gravitational acceleration created by the mass of an electron at a distance of its classical radius $a_g = 7.65651 \times 10^{-12} \text{ m/s}^2$.

Mathematical verification shows that the derived parameters of the universe ($M_U = 1.15348 \cdot 10^{53} \text{ kg}$, $R_U = 0.856594 \cdot 10^{26} \text{ m}$, $T_U = 2.85729 \cdot 10^{17} \text{ s}$, $\Lambda = 1.36285 \cdot 10^{-52} \text{ m}^{-2}$, $A_0 = 10.4922 \cdot 10^{-10} \text{ m/s}^2$) are flawless. They have no internal contradictions and are completely consistent with fundamental physics.

7. Conclusion.

1. A system of algebraic equations for the Universe has been proposed that allows us to derive the parameters of the observable Universe with unprecedented accuracy, close to the accuracy of the gravitational constant.

2. An inverse problem has been solved: instead of substituting approximate experimental values of the Universe's parameters into the equations, the parameters are mathematically derived as the roots of a system of algebraic equations.

3. The following high-precision values for the parameters of the observable Universe have been derived for the first time:

Mass $M_U = 1.15348 \cdot 10^{53} \text{ kg}$,
radius $R_U = 0.856594 \cdot 10^{26} \text{ m}$,
time $T_U = 2.85729 \cdot 10^{17} \text{ s}$,
lambda $\Lambda = 1.36285 \cdot 10^{-52} \text{ m}^{-2}$,
acceleration $A_0 = 10.4922 \cdot 10^{-10} \text{ m/s}^2$.

4. Verification of the derived parameters of the observable Universe, conducted by comparing the calculated values with known constants in physics, demonstrated their impeccability.

5. The Universe is an absolutely deterministic, rigidly connected, and mathematically tuned structure. The parameters of the Universe are not arbitrarily selected values from an infinite number of possibilities or adjusted to match measured values, but the only possible roots of a system of algebraic equations.

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