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PARAMETERS OF THE OBSERVABLE UNIVERSE AND PLANCK'S CONSTANT IN ONE EQUATION: a the strange and useful unity of the constants of the microcosm and the universe.

Abstract: *Many relations of the parameters of the Universe equal to Planck's constant are revealed. The equations show that Planck's constant and the parameters of the Universe are related. The results obtained have no explanation. There is no answer why the equations, along with the parameters of the observable Universe, include the constants of the microcosm. A large number of cosmological equations have been revealed, in which constants very distant in physical meaning are combined. Despite the lack of explanation, such equations open new possibilities in cosmology. It is possible to use the high precision of Planck's constant to calculate the values of the parameters of the observable Universe with an accuracy close to that of the Newtonian constant of gravitation G. This is an important result for practice, since experimental methods for determining the parameters of the observable Universe are very complicated and do not give sufficient accuracy.*

Keywords: *large numbers, Planck constant, parameters of the observable Universe*

1. Introduction

In [1] the origin of the fundamental parameters of the Universe from the electron constants is shown. The fundamental parameters of the Universe are formed from the electron constants by their scaling transformation by means of large numbers. The scaling law of large numbers has the form (Fig. 1):

$$D_i = (D_{20})^i = (\sqrt{\alpha D_0})^i$$

$$i = 0, \pm 1, \pm 2, \pm 3, \pm 4, \pm 5, \pm 6, \pm 7, \pm 8, \pm 9$$

Fig. 1. The scaling law of large numbers.

The law of scaling gives a new method of calculating values of large numbers from dimensionless constants. The scaling law generates large numbers up to the scale 10^{180} with higher accuracy than from the relations of dimensional constants.The large numbers obtained from the scaling law are close to the accuracy of the Newtonian constant of gravitation G.

The high accuracy of the large numbers allowed us to identify previously unknown cosmological equations. Many of the new equations contain Planck's constant. This is an unexpected result, since Planck's constant is a constant of the microcosm. Its appearance in combinations of megaworld constants is the evidence of not yet revealed deep interrelation of parameters of the observable Universe and fundamental physical constants.

2. Cosmological equations that contain Planck's constant.

There are two types of equations in cosmology. The Friedman cosmological equation describes the dynamics of the expansion of the Universe [2]. This equation does not reveal the possible relationship between the parameters of the Universe and does not reveal their relationship to the fundamental physical constants.

The connection between the parameters of the Universe and fundamental physical constants is revealed by other cosmological equations. These include: the Dirac equation [3, 4], the Stewart equation [5, 6], the Eddington-Weinberg equation [7], the Teller equation [8, 9] and others.

Coincidences of large numbers on scales 10^{160} and 10^{180} allowed us to obtain new cosmological equations. On the scale 10^{160}, a new cosmological equation linking 5 fundamental parameters of the Universe was obtained [1]: $\mathbf{M_U R_U \Lambda^2 G = H^2}$.

On a scale of 10^{180}, a new cosmological equation linking the mass of the observed Universe and the cosmological constant to Planck's constant is obtained: $\mathbf{M_U \Lambda c r_e^3 = \hbar}$.

While the first equation is expected, the second equation is at least surprising. Why did the fundamental constant of the microcosm, Planck's constant, end up in the same equation as the parameters of the Universe? Further search for possible equations with Planck's constant on scales 10^{120}, 10^{140}, 10^{160} and 10^{180} revealed many equivalent equations:

$$M_U \Lambda c r_e^3 = \hbar \ (1), \qquad \frac{c^5 r_e^3}{M_U G^2} = \hbar \ (2), \qquad \frac{R_U \Lambda c^3 r_e^3}{G} = \hbar \ (3), \qquad \frac{c r_e^3 A}{G} = \hbar \ (4),$$

$$m_e c r_e^2 \sqrt{\Lambda D_0^2} = \hbar \ (5), \qquad \frac{c^5 r_e^3 \Lambda}{GA} = \hbar \ (6), \qquad \frac{c^3 t_e^3}{G R_U} = \hbar \ (7).$$

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 - cosmological acceleration (A = Hc [10 - 13]), r_e - classical electron radius; c - speed of light in vacuum; m_e - electron mass, D_0 - large number.

Thus, there are multiple coincidences of the relations of constants that lead to Planck's constant:

$$M_U \Lambda c r_e^3 = \frac{c^5 r_e^3}{M_U G^2} = \frac{R_U \Lambda c^3 r_e^3}{G} = \frac{c r_e^3 A}{G} = m_e c r_e^2 \sqrt{\Lambda D_0^2} = \frac{c^5 r_e^3 \Lambda}{GA} = \frac{c^3 t_e^3}{G R_U} = \hbar$$

The given equations (1) through (7) are equivalent. The equations are exact. This unexpected union of very precise constants of the microcosm and very imprecise parameters of the observable universe makes the equations very useful. The high accuracy of Planck's constant and the acceptable accuracy of G make it possible to calculate the values of the parameters of the Universe with an accuracy close to the accuracy of the Newtonian constant of gravitation G. This is an unprecedented accuracy for the parameters of the Universe!

3. System of cosmological equations

A system of algebraic equations (Fig. 2), where the unknown parameters are the mass M_U , the lambda Λ, and the radius R_U.

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

Fig. 2. System of cosmological equations.

The solution of the system of algebraic equations gives the parameters of the Universe with an accuracy close to the accuracy of the Newtonian constant of gravitation G. As the accuracy of the constant G increases, the system (Fig. 2) will give more accurate values of M_U, Λ, R_U.

The obtained values of the parameters of the observed Universe (mass M_U , lambda Λ, radius R_U) from the system of cosmological equations (Fig. 2) are shown in Fig. 3.

$$M_U = 1.15348\ldots \bullet 10^{53}\, kg$$
$$R_U = 0.856594\ldots \bullet 10^{26}\, m$$
$$\Lambda = 1.36285\ldots \bullet 10^{-52}\, m^{-2}$$
$$G = 6{,}6743\ldots \text{x} 10^{-11}\, kg^{-1} m^3 s^{-2}$$
$$A = 10.492\ldots \text{ x } 10^{-10}\, m/s^2$$

Fig. 3. Values of the fundamental parameters of the Universe from equations (1) through (7) and from the system of equations (Fig. 2).

4. Conclusion

We have revealed a set of cosmological equations, which together with the parameters of the observable Universe include Planck's constant. Such an unusual combination of very distant constants in one equation does not find an explanation. A large number of equivalent equations combining the constants of the microcosm and megaworld also has no explanation. At the same time, they are useful equations. They allow us to use the high precision of Planck's constant to calculate the values of the parameters of the observable Universe. This is an important result for practice, since experimental methods for determining the values of the parameters of the observable Universe are very complicated and do not give sufficient accuracy. The accuracy of the Newtonian constant of gravitation G is quite sufficient to calculate the parameters of the observable Universe with unprecedented accuracy.

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