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Quantum of action of the Universe

Abstract: *In this short communication a new formula is given which shows that the Universe has its own* Quantum of action *as an analog of Planck's constant. The value of the* Quantum of action of the Universe *is obtained with an accuracy close to that of the Newtonian constant of gravitation G. The* Quantum of action of the Universe *is derived from new cosmological equations obtained from the coincidence of large numbers on the previously unknown scales 10^{140}, 10^{160} and 10^{180}.*

Keywords: *large numbers, cosmological parameters, Planck's constant, parameters of the observable Universe.*

1. Introduction

The problem of coincidence of large numbers is the main unsolved problem of modern physics. This problem inhibits the solution of many other problems of physics and cosmology. The law of scaling of large numbers [1] leads to new cosmological equations that demonstrate the mutual coupling and mutual dependence of the parameters of the observable Universe. In addition to the connection of cosmological parameters among themselves, their direct connection with fundamental physical constants is revealed. This opens new possibilities in cosmology.

2. The Quantum of action of the Universe as an analog of Planck's constant.

The coincidence of large numbers on scales 10^{140} 10^{160} and 10^{180} [1] leads to a formula that unifies the three fundamental parameters of the observable Universe (Fig. 1):

$$\hbar_U = \frac{M_U H}{\Lambda} \quad (1)$$

Fig. 1. Quantum of action of the Universe.

where : $\hbar_U$ is the Quantum of action of the Universe, M_U is the mass of the observable Universe, H is the Hubble parameter, Λ is the cosmological constant.

Formula (1) is an analog of Planck's Quantum of action. It is the Quantum of action of the Universe. The Quantum of action of the Universe is a scaled Planck constant. The scaling factor is the large number $D_{120} = 28.088... \times 10^{120}$.

$$\mathbf{\hbar_U = \hbar D_{120} = 29.621...x\ 10^{86}\ JHz^{-1}} \quad (2)$$

where : $\hbar_U$ is the Quantum of action of the Universe, $\hbar$ is Planck's constant, D_{120} is a large number on a scale of 10^{120} ($D_{120} = 28.088... \times 10^{120}$).

3. Value of the Quantum of action of the Universe

The value of the Quantum of action of the Universe is obtained with an accuracy close to the accuracy of the Newtonian constant of gravitation G.

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

where : $\hbar_U$ is the Quantum of action of the Universe, $\hbar$ is Planck's constant, α is the fine structure constant, D_0 is the large Weyl number ($D_0 = 4.16561...x\ 10^{42}$).

For the energy of the universe, Planck's formula is satisfied:

$$E_U = \hbar_U H = M_U c^2 \quad (4)$$

where : $\hbar_U$ is the Quantum of action of the Universe, E_U is the energy of the Universe, M_U is the mass of the observable Universe, H is the Hubble parameter, c is the speed of light in vacuum.

4. Equivalent formulas of the Quantum of action of the Universe

The Quantum of action of the Universe $\boldsymbol{\hbar_U}$ can be represented by equivalent formulas. As an example, 10 equivalent formulas are given (Fig. 2):

$$\boldsymbol{\hbar_U} = \left\{ \begin{array}{lll} \frac{M_U H}{\Lambda}, & \hbar\alpha^3 D_0^3, & \frac{c^3}{G\Lambda}, \\ \frac{M_U A_0}{\Lambda c}, & \frac{R_U^5 H^3}{G}, & \frac{R_U^5 \Lambda H c^2}{G}, \\ \frac{M_U c^2}{H}, & M_U R_U^2 H, & \frac{R_U H c^2}{G\Lambda}. \end{array} \right. \frac{M_U R_U^2}{T_U}, \Bigg\} = \mathbf{29.621...\ x\ 10^{86}\ JHz^{-1}}$$

Fig. 2. Equivalent formulas for calculating the Quantum of action of the Universe.

All formulas give the same value of the Quantum of action of the Universe:

$$\boldsymbol{\hbar_U} = \hbar\alpha^3 D_0^3 = \frac{M_U H}{\Lambda} = \frac{M_U R_U^2}{T_U} = M_U R_U^2 H = \frac{M_U A_0}{\Lambda c} = \frac{R_U^5 H^3}{G} = \frac{R_U^5 \Lambda H c^2}{G} = \frac{R_U H c^2}{G\Lambda} =$$

$$= \frac{M_U c^2}{H} = \frac{c^3}{G\Lambda} = \mathbf{29.621...\ x\ 10^{86}\ JHz^{-1}} \quad (5)$$

where : $\hbar$ - 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 - cosmological acceleration, T_U - time of Universe, H - Hubble constant, c - speed of light in vacuum, D_0 - large Weyl number.

5. Conclusion

From the coincidence of large numbers the analog of Planck's constant with respect to the Universe is derived. The equivalent formulas for the new constant of the Universe give its value with accuracy close to the accuracy of the Newtonian constant of gravitation G. The Quantum of action of the Universe and Planck's constant are related by a large number of scale 10^{120}.

References

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