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Research paper

Equivalences of Physical Quantities and Constants

Vladimir Nikolayevich Sukhanov [1, 2] *

[1] *ORCID: https://orcid.org/0000-0003-1387-4017*
[2] *c/o 366 Westgate Road, Newcastle upon Tyne, NE4 6NX, United Kingdom*
**Corresponding author E-mail: svn@physics.org*

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Abstract

The principle of equivalence of physical quantities was demonstrated on the equivalences of the basic physical quantities: energy, space, time, electric charge, magnetic flux, and mass, as well as electrical ones: capacitance and inductance. A series of physical quantities and equivalences of each of these quantities, as well as the coefficients of these equivalences, are presented.
Sequences of equivalences of physical quantities will expand our understanding of the physics of nature. Equivalences of energy, mass, space, and other physical quantities indicate equivalences of physical constants.
Equivalences of physical constants allow one constant to be calculated through another, while it is possible to increase the accuracy of some constants at the expense of others, more accurate ones.
This article pertains to theoretical physics.

Keywords: *Equivalence; Physical Quantity; Energy; Mass; Space; Time; Electric Charge; Magnetic Flux; Physical Constant.*

1. Introduction

The article presents 72 equivalences of physical quantities (PhQs). Five of these equivalences are already known. [1, formula (123)]
Based on the deduction of a deductive construction based on the axiomatic method [2] and the known five equivalences of PhQs, a conclusion was made about the equivalence of all PhQs. [1]
A picture of the equivalences of PhQs is presented in the form of formulas-sequences of these equivalences, and a sequence of coefficients of these equivalences, which, in turn, made it possible to describe the equivalences of physical constants (PhCs) with the expression of some constants through others in the form of sequences of formulas.

1.1. History

1905. Albert Einstein first presented the equivalence of mass and energy. [2]
1921. Wolfgang Pauli presented an extension of Einstein's equivalence (and vice versa) in the form of the equivalence of energy and mass. [3]
These were the first successful steps towards formulating the equivalence of PhQs.
In 1984, the geometric system of units was introduced. This system of units is based on the equivalence of PhQs. [4]
2003. The nature of PhQs [5] is based on the equivalence of PhQs.
In 2020 was the first example of formulating the equivalence of PhQs was seen. [6]
In 2024, the equivalences of space, time, electric charge, magnetic flux, and energy were formulated. [1] [7] [8]
In the same 2024, the equivalences of all PhQs were preliminarily formulated. [1]
In 2024, the equivalence of PhCs was also established, with the possibility of expressing some constants through others. [7]

2. Methods

Based on the equivalence of all PhQs [1, Equation (123)], here provide a list of these equivalences: Φ is magnetic flux, E is energy, T is time, L is space, m is mass, Q is an electric charge, $\sqrt{\boldsymbol{m}}$ is the square root of the magnetic moment, C is electrical capacity, $\boldsymbol{L}$ is electrical inductance:

$$\Phi - E - T - L - m - Q - \sqrt{\boldsymbol{m}} - C - \boldsymbol{L} \text{ — Equivalence} \quad (1)$$

The equivalence of each pair of PhQs has an equivalence coefficient. The series of equivalences of PhQs are presented taking into account each PhQ given here.

3. Equivalences of PhQs

Here are the formulas for the equivalences of PhQs (1) taking into account the coefficients of these equivalences.
Equivalence of PhQs (1) and energy E , [1, Eqs. (65), (68), (69), (109), (114), (117), (118)], [2], [7, Equation (54)], [8, Eqs. (22), (53)]. PhQs: G is gravitational constant, c is speed of light in vacuum, k_e is Coulomb constant, k_Φ is magnetic interaction constant [1, Equation (24.2)], and F_p is Planck force [9]:

$$E = \Phi c^2\sqrt{\frac{k_\Phi}{G}} = \frac{Tc^5}{G} = \frac{Lc^4}{G} = mc^2 = Qc^2\sqrt{\frac{k_e}{G}} = \sqrt{\boldsymbol{m}}\sqrt[4]{\frac{c^{10}\,k_e}{G^3}} = C\,\frac{k_e\,c^4}{G} = \boldsymbol{L}\,\frac{c^6}{Gk_e} \tag{2}$$

Or

$$E = \Phi I_o = TcF_p = LF_p = mc^2 = QU_o = \sqrt{\boldsymbol{m}}\sqrt[4]{\frac{F_p^3 R_o}{c}} = CU_o^2 = \boldsymbol{L}I_o^2 \tag{2.1}$$

Natural unit of physical quantities are also used here I_o , U_o and R_o as PhCs: I_o is electric current, both Planck and Stone (natural unit of electric current) [1, Eqs (15) and (74)], U_o is a natural unit of electrical voltage [1, Equation (80)], R_o is a natural unit of electrical resistance [1, Equation (82)].
And vice versa, from formula (2), for all physical quantities presented here (1):

1) Equivalence of PhQs (1) and magnetic flux Φ , [1, Eqs. (24), (24.1), (51), (52.1), (66), (67), (68)], (2):

$$\Phi = E\sqrt{\frac{Gk_e}{c^6}} = T\sqrt{F_p\,k_e} = L\sqrt{\frac{c^2\,k_e}{G}} = m\sqrt{\frac{Gk_e}{c^2}} = Q\,\frac{k_e}{c} = \sqrt{\boldsymbol{m}}\sqrt[4]{\frac{k_e^3}{c^2\,G}} = C\sqrt{\frac{k_e^3\,c^2}{G}} = \boldsymbol{L}\sqrt{\frac{c^6}{Gk_e}} \tag{3}$$

Or

$$\Phi = E\sqrt{\frac{1}{k_\Phi\,F_p}} = T\sqrt{\frac{c^6}{k_\Phi\,G}} = L\sqrt{\frac{F_p}{k_\Phi}} = m\sqrt{\frac{G}{k_\Phi}} = Q\,\frac{c}{k_\Phi} = \sqrt{\boldsymbol{m}}\sqrt[4]{\frac{c^4}{G\,k_\Phi^3}} = C\sqrt{\frac{c^8}{k_\Phi^3 G}} = \boldsymbol{L}\sqrt{\frac{k_\Phi\,c^4}{G}} \tag{3.1}$$

Or

$$\Phi = E\,\frac{1}{I_o} = TU_o = L\,\frac{U_o}{c} = m\,\frac{c^2}{I_o} = QR_o = \sqrt{\boldsymbol{m}}\sqrt{\frac{R_o\,U_o}{c^2}} = CU_oR_o = \boldsymbol{L}I_o \tag{3.2}$$

2) Equivalence of PhQs (1) and time T , [1, Equation (72)], [7, Equation (32.2)], (2), (3):

$$T = E\,\frac{G}{c^5} = \Phi\sqrt{\frac{1}{F_p\,k_e}} = L\,\frac{1}{c} = m\,\frac{G}{c^3} = Q\sqrt{\frac{Gk_e}{c^6}} = \sqrt{\boldsymbol{m}}\sqrt[4]{\frac{k_eG}{c^{10}}} = C\,\frac{k_e}{c} = \boldsymbol{L}\,\frac{c}{k_e} \tag{4}$$

Or

$$T = E\,\frac{1}{c\,F_p} = \Phi\,\frac{1}{U_o} = L\,\frac{1}{c} = m\,\frac{c}{F_p} = Q\,\frac{1}{I_o} = \sqrt{\boldsymbol{m}}\,\frac{1}{c\sqrt{I_o}} = CR_o = \boldsymbol{L}\,\frac{1}{R_o} \tag{4.1}$$

3) Equivalence of PhQs (1) and space L , [1, Eqs. (67), (70)], [7, Equation (32.1)], [8, Equation (54)], (2), (3), (4):

$$L = E\,\frac{G}{c^4} = \Phi\sqrt{\frac{G}{c^2\,k_e}} = Tc = m\,\frac{G}{c^2} = Q\sqrt{\frac{Gk_e}{c^4}} = \sqrt{\boldsymbol{m}}\sqrt[4]{\frac{k_eG}{c^6}} = Ck_e = \boldsymbol{L}\,\frac{c^2}{k_e} \tag{5}$$

Or

$$L = E\,\frac{G}{c^4} = \Phi\sqrt{\frac{k_\Phi\,G}{c^4}} = Tc = m\,\frac{G}{c^2} = Q\sqrt{\frac{G}{k_\Phi\,c^2}} = \sqrt{\boldsymbol{m}}\sqrt[4]{\frac{G}{k_\Phi\,c^4}} = C\,\frac{c^2}{k_\Phi} = \boldsymbol{L}\,k_\Phi \tag{5.1}$$

Or

$$L = E\,\frac{1}{F_p} = \Phi\,\frac{c}{U_o} = Tc = m\,\frac{c^2}{F_p} = Q\,\frac{c}{I_o} = \sqrt{\boldsymbol{m}}\,\frac{1}{\sqrt{I_o}} = CcR_o = \boldsymbol{L}\,\frac{c}{R_o} \tag{5.2}$$

4) Equivalence of PhQs (1) and mass m , [1, Eqs. (49), (69)], [3], (2), (3), (4), (5):

$$m = \Phi\sqrt{\frac{k_\Phi}{G}} = E\,\frac{1}{c^2} = T\,\frac{c^3}{G} = L\,\frac{c^2}{G} = Q\sqrt{\frac{k_e}{G}} = \sqrt{\boldsymbol{m}}\sqrt[4]{\frac{c^2k_e}{G^3}} = C\,\frac{k_e\,c^2}{G} = \boldsymbol{L}\,\frac{F_p}{k_e} \tag{6}$$

Or

$$m = \Phi\frac{I_o}{c^2} = T\frac{F_p}{c} = L\frac{F_p}{c^2} = Q\frac{U_o}{c^2} = \sqrt{\boldsymbol{m}}\sqrt{\frac{U_o}{c\,G}} = C\frac{U_o^2}{c^2} = \boldsymbol{L}\frac{I_o^2}{c^2} \quad (6.1)$$

5) Equivalence of PhQs (1) and electric charge Q , [1, Equation (73)] [8, Equation (23)] (2), (3), (4), (5), (6):

$$Q = \Phi\frac{c}{k_e} = E\sqrt{\frac{1}{F_p\,k_e}} = m\sqrt{\frac{G}{k_e}} = T\sqrt{\frac{F_p\,c^2}{k_e}} = L\sqrt{\frac{F_p}{k_e}} = \sqrt{\boldsymbol{m}}\sqrt[4]{\frac{c^2}{Gk_e}} = Cc^2\sqrt{\frac{k_e}{G}} = \boldsymbol{L}\sqrt{\frac{F_p\,c^4}{k_e^3}} \quad (7)$$

Or

$$Q = \Phi\frac{k_\Phi}{c} = E\sqrt{\frac{k_\Phi}{F_p\,c^2}} = m\sqrt{\frac{k_\Phi\,G}{c^2}} = T\sqrt{k_\Phi\,F_p} = L\sqrt{\frac{k_\Phi c^2}{G}} = \sqrt{\boldsymbol{m}}\sqrt[4]{\frac{k_\Phi}{G}} = C\sqrt{\frac{c^6}{k_\Phi G}} = \boldsymbol{L}\sqrt{\frac{k_\Phi^3\,c^2}{G}} \quad (7.1)$$

Or

$$Q = \Phi\frac{1}{R_o} = E\frac{1}{U_o} = m\frac{c^2}{U_o} = TI_o = L\frac{I_o}{c} = \sqrt{\boldsymbol{m}}\sqrt{\frac{I_o}{c^2}} = CU_o = \boldsymbol{L}\frac{I_o}{R_o} \quad (7.2)$$

6) Equivalence of PhQs (1) and square root of magnetic moment $\sqrt{\boldsymbol{m}}$, [1, Equation (109)], (2), (3), (4), (5), (6), (7):

$$\sqrt{\boldsymbol{m}} = \Phi\sqrt[4]{\frac{G\,c^2}{k_e^3}} = E\sqrt[4]{\frac{c^2}{k_e\,F_p{}^3}} = T\sqrt[4]{\frac{F_p\,c^6}{k_e}} = L\sqrt[4]{\frac{F_p\,c^2}{k_e}} = m\sqrt[4]{\frac{G^3}{k_e\,c^2}} = Q\sqrt[4]{\frac{c^2\,k_e}{F_p}} = C\sqrt[4]{c^2F_p\,k_e^3} = \boldsymbol{L}\sqrt[4]{\frac{c^{14}}{k_e^5\,G}} \quad (8)$$

Or

$$\sqrt{\boldsymbol{m}} = \Phi\sqrt[4]{\frac{k_\Phi^3}{F_p}} = E\sqrt[4]{\frac{k_\Phi}{F_p{}^3}} = T\sqrt[4]{c^4F_p\,k_\Phi} = L\sqrt[4]{F_p\,k_\Phi} = m\sqrt[4]{\frac{k_\Phi\,G^3}{c^4}} = Q\sqrt[4]{\frac{G}{k_\Phi}} = C\sqrt[4]{\frac{c^{12}}{k_\Phi^3\,G}} = \boldsymbol{L}\sqrt[4]{k_\Phi^5F_p} \quad (8.1)$$

Or

$$\sqrt{\boldsymbol{m}} = \Phi\sqrt{\frac{c^2}{U_o\,R_o}} = E\sqrt[4]{\frac{G^3}{R_o\,c^{11}}} = T\sqrt[4]{\frac{F_p\,c^5}{R_o}} = L\sqrt{I_o} = m\sqrt{\frac{R_o\,c^6}{U_o^3}} = Q\sqrt{\frac{c^2}{I_o}} = C\sqrt{U_oR_oc^2} = \boldsymbol{L}\frac{c}{R_o}\sqrt{I_o} \quad (8.2)$$

7) Equivalence of PhQs (1) and electrical capacity C [1, Eqs. (115), (116)], (2), (3), (4), (5), (6), (7), (8):

$$C = L\frac{1}{k_e} = T\frac{c}{k_e} = E\frac{G}{k_e\,c^4} = \Phi\sqrt{\frac{G}{c^2\,k_e^3}} = m\frac{G}{k_e\,c^2} = Q\sqrt{\frac{G}{k_e\,c^4}} = \sqrt{\boldsymbol{m}}\sqrt[4]{\frac{G}{k_e^3\,c^6}} = \boldsymbol{L}\frac{c^2}{k_e^2} \quad (9)$$

Or

$$C = L\frac{1}{cR_o} = T\frac{1}{R_o} = E\frac{1}{U_o^2} = \Phi\frac{1}{R_o\,U_o} = m\frac{c^2}{U_o^2} = Q\frac{1}{U_o} = \sqrt{\boldsymbol{m}}\frac{1}{c\sqrt{R_o\,U_o}} = \boldsymbol{L}\frac{1}{R_o^2} \quad (9.1)$$

8) Equivalence of PhQs (1) and electrical inductance $\boldsymbol{L}$ [1, Eqs. (118), (119), (120)], (2), (3), (4), (5), (6), (7), (8), (9):

$$\boldsymbol{L} = \Phi\sqrt{\frac{Gk_e}{c^6}} = E\frac{Gk_e}{c^6} = T\frac{k_e}{c} = L\frac{k_e}{c^2} = m\frac{k_e}{F_p} = Q\sqrt{\frac{k_e^3}{F_pc^4}} = \sqrt{\boldsymbol{m}}\sqrt[4]{\frac{k_e^5\,G}{c^{14}}} = C\frac{k_e^2}{c^2} \quad (10)$$

Or

$$\boldsymbol{L} = \Phi\sqrt{\frac{1}{F_p\,k_\Phi}} = E\frac{1}{F_p\,k_\Phi} = T\frac{c}{k_\Phi} = L\frac{1}{k_\Phi} = m\frac{G}{k_\Phi\,c^2} = Q\sqrt{\frac{c^2}{F_p\,k_\Phi{}^3}} = \sqrt{\boldsymbol{m}}\sqrt[4]{\frac{1}{F_p\,k_\Phi^5}} = C\frac{c^2}{k_\Phi^2} \quad (10.1)$$

Or

$$\boldsymbol{L} = \Phi\frac{1}{I_o} = E\frac{1}{I_o^2} = TR_o = L\frac{R_o}{c} = m\frac{c^2}{I_o^2} = Q\frac{R_o}{I_o} = \sqrt{\boldsymbol{m}}\sqrt{\frac{R_o^2}{c^2\,I_o}} = CR_o^2 \quad (10.2)$$

4. Equivalence coefficients of PhQs

The equivalences of PhQs given here are accompanied by the coefficients of these equivalences:

1) Magnetic flux equivalence coefficients Φ and energy E , Eqs. (2) and (2.1):

$$k_{\Phi E} = c^2\sqrt{\frac{k_\Phi}{G}} = I_o \quad (11)$$

2) Time equivalence coefficients T and energy E, Eqs. (2) and (2.1):

$$k_{TE} = \frac{c^5}{G} = cF_p \qquad (12)$$

3) Space equivalence coefficients L and energy E, Eqs. (2) and (2.1):

$$k_{LE} = \frac{c^4}{G} = F_p \qquad (13)$$

4) Mass equivalence coefficients m and energy E, Eqs. (2) and (2.1):

$$k_{mE} = c^2 \qquad (14)$$

5) Electric charge equivalence coefficients Q and energy E, Eqs. (2) and (2.1):

$$k_{QE} = c^2\sqrt{\frac{k_e}{G}} = U_o \qquad (15)$$

6) Equivalence coefficients of square root of magnetic moment $\sqrt{\boldsymbol{m}}$ and energy E, Eqs. (2) and (2.1):

$$k_{\sqrt{\boldsymbol{m}}E} = \sqrt[4]{\frac{c^{10}\,k_e}{G^3}} = \sqrt[4]{\frac{F_p^3 R_o}{c}} \qquad (16)$$

7) Electrical capacity equivalence coefficients C and energy E, Eqs. (2) and (2.1):

$$k_{CE} = \frac{k_e\,c^4}{G} = U_o^2 \qquad (17)$$

8) Electrical inductance equivalence coefficients L and energy E, Eqs. (2) and (2.1):

$$k_{LE} = \frac{c^6}{Gk_e} = I_o^2 \qquad (18)$$

9) Energy equivalence coefficients E and magnetic flux Φ, Eqs. (3), (3.1) and (3.2):

$$k_{E\Phi} = \sqrt{\frac{Gk_e}{c^6}} = \sqrt{\frac{1}{k_\Phi\,F_p}} = \frac{1}{I_o} \qquad (19)$$

10) Time equivalence coefficients T and magnetic flux Φ, Eqs. (3), (3.1) and (3.2):

$$k_{T\Phi} = \sqrt{F_p\,k_e} = \sqrt{\frac{c^6}{k_\Phi\,G}} = U_o \qquad (20)$$

11) Space equivalence coefficients L and magnetic flux Φ, Eqs. (3), (3.1) and (3.2):

$$k_{L\Phi} = \sqrt{\frac{c^2\,k_e}{G}} = \sqrt{\frac{F_p}{k_\Phi}} = \frac{U_o}{c} \qquad (21)$$

12) Mass equivalence coefficients m and magnetic flux Φ, Eqs. (3), (3.1) and (3.2):

$$k_{m\Phi} = \sqrt{\frac{Gk_e}{c^2}} = \sqrt{\frac{G}{k_\Phi}} = \frac{c^2}{I_o} \qquad (22)$$

13) Electric charge equivalence coefficients Q and magnetic flux Φ, Eqs. (3), (3.1) and (3.2):

$$k_{Q\Phi} = \frac{k_e}{c} = \frac{c}{k_\Phi} = R_o \qquad (23)$$

14) Equivalence coefficients of square root of magnetic moment $\sqrt{\boldsymbol{m}}$ and magnetic flux Φ, Eqs. (3), (3.1) and (3.2):

$$k_{\sqrt{m}\Phi} = \sqrt[4]{\frac{k_e^3}{c^2\,G}} = \sqrt[4]{\frac{c^4}{G\,k_\Phi^3}} = \sqrt{\frac{R_o\,U_o}{c^2}} \qquad (24)$$

15) Electrical capacity equivalence coefficients C and magnetic flux Φ, Eqs. (3), (3.1) и (3.2):

$$k_{C\Phi} = \sqrt{\frac{k_e^3\,c^2}{G}} = \sqrt{\frac{c^8}{k_\Phi^3 G}} = \frac{U_o^2}{I_o} \qquad (25)$$

16) Electrical inductance equivalence coefficients L and magnetic flux Φ, Eqs. (3), (3.1) and (3.2):

$$k_{L\Phi} = \sqrt{\frac{c^6}{G k_e}} = \sqrt{\frac{k_\Phi\, c^4}{G}} = I_o \tag{26}$$

17) Energy equivalence coefficients E and time T , Eqs. (4) and (4.1):

$$k_{ET} = \frac{G}{c^5} = \frac{1}{c\, F_p} \tag{27}$$

18) Magnetic flux equivalence coefficients Φ and time T , Eqs. (4) and (4.1):

$$k_{\Phi T} = \sqrt{\frac{1}{F_p\, k_e}} = \frac{1}{U_o} \tag{28}$$

19) Space equivalence coefficients L and time T , Eqs. (4) and (4.1):

$$k_{LT} = \frac{1}{c} \tag{29}$$

20) Mass equivalence coefficients m and time T , Eqs. (4) and (4.1):

$$k_{mT} = \frac{G}{c^3} = \frac{c}{F_p} \tag{30}$$

21) Electric charge equivalence coefficients Q and time T , Eqs. (4) and (4.1):

$$k_{QT} = \sqrt{\frac{G k_e}{c^6}} = \frac{1}{I_o} \tag{31}$$

22) Equivalence coefficients of square root of magnetic moment $\sqrt{\boldsymbol{m}}$ and time T , Eqs. (4) and (4.1):

$$k_{\sqrt{\boldsymbol{m}}T} = \sqrt[4]{\frac{k_e G}{c^{10}}} = \frac{1}{c\sqrt{I_o}} \tag{32}$$

23) Electrical capacity equivalence coefficients C and time T , Eqs. (4) and (4.1):

$$k_{CT} = \frac{k_e}{c} = R_o \tag{33}$$

24) Electrical inductance equivalence coefficients L and time T , Eqs. (4) and (4.1):

$$k_{LT} = \frac{c}{k_e} = \frac{1}{R_o} \tag{34}$$

25) Energy equivalence coefficients E and space , Eqs. (5), (5,1) and (5.2):

$$k_{EL} = \frac{G}{c^4} = \frac{1}{F_p} \tag{35}$$

26) Magnetic flux equivalence coefficients Φ and space L , Eqs. (5), (5,1) and (5.2):

$$k_{\Phi L} = \sqrt{\frac{G}{c^2\, k_e}} = \frac{c}{U_o} \tag{36}$$

27) Time equivalence coefficients T and space L , Eqs. (5), (5,1) and (5.2):

$$k_{TL} = c \tag{37}$$

28) Mass equivalence coefficients m and space L , Eqs. (5), (5,1) and (5.2):

$$k_{mL} = \frac{G}{c^2} = \frac{c^2}{F_p} \tag{38}$$

29) Electric charge equivalence coefficients Q and space L , Eqs. (5), (5,1) and (5.2):

$$k_{QL} = \sqrt{\frac{G k_e}{c^4}} = \frac{c}{I_o} \tag{39}$$

30) Equivalence coefficients of the square root of the magnetic moment $\sqrt{\boldsymbol{m}}$ and space L , Eqs. (5), (5,1) and (5.2):

$$k_{\sqrt{\boldsymbol{m}}L} = \sqrt[4]{\frac{k_e G}{c^6}} = \frac{1}{\sqrt{I_o}} \tag{40}$$

31) Electrical capacity equivalence coefficients C and space, Eqs. (5), (5,1) and (5.2):

$$k_{CL}= k_e= cR_o \tag{41}$$

32) Electrical inductance equivalence coefficients $\boldsymbol{L}$ and space L , Eqs. (5), (5,1) and (5.2):

$$k_{\boldsymbol{L}L}= \frac{c^2}{k_e} = \frac{c}{R_o} \tag{42}$$

33) Magnetic flux equivalence coefficients Φ and mass m , Eqs. (6) and (6.1):

$$k_{\Phi m}= \sqrt{\frac{k_\Phi}{G}} = \frac{I_o}{c^2} \tag{43}$$

34) Energy equivalence coefficients E and mass m , Eqs. (6) and (6.1):

$$k_{Em}= \frac{1}{c^2} \tag{44}$$

35) Time equivalence coefficients T and mass m , Eqs. (6) and (6.1):

$$k_{Tm}= \frac{c^3}{G} = \frac{F_p}{c} \tag{45}$$

36) Space equivalence coefficients L and mass m , Eqs. (6) and (6.1):

$$k_{Lm}= \frac{c^2}{G} = \frac{F_p}{c^2} \tag{46}$$

37) Electric charge equivalence coefficients Q and mass m , Eqs. (6) and (6.1):

$$k_{Qm}= \sqrt{\frac{k_e}{G}} = \frac{U_o}{c^2} \tag{47}$$

38) Equivalence coefficients of the square root of the magnetic moment $\sqrt{\boldsymbol{m}}$ and mass m , Eqs. (6) and (6.1):

$$k_{\sqrt{\boldsymbol{m}}m}= \sqrt[4]{\frac{c^2 k_e}{G^3}} = \sqrt{\frac{U_o}{c\, G}} \tag{48}$$

39) Electrical capacity equivalence coefficients C and mass m , Eqs. (6) and (6.1):

$$k_{Cm}= \frac{k_e\, c^2}{G} = \frac{U_o^2}{c^2} \tag{49}$$

40) Electrical inductance equivalence coefficients $\boldsymbol{L}$ and mass m , Eqs. (6) and (6.1):

$$k_{\boldsymbol{L}m}= \frac{F_p}{k_e} = \frac{I_o^2}{c^2} \tag{50}$$

41) Magnetic flux equivalence coefficients Φ and electric charge Q , Eqs. (7), (7.1) and (7.2):

$$k_{\Phi Q}= \frac{c}{k_e} = \frac{k_\Phi}{c} = \frac{1}{R_o} \tag{51}$$

42) Energy equivalence coefficients E and electric charge Q , Eqs. (7), (7.1) and (7.2):

$$k_{EQ}= \sqrt{\frac{1}{F_p\, k_e}} = \sqrt{\frac{k_\Phi}{F_p\, c^2}} = \frac{1}{U_o} = \sqrt{\frac{G}{k_e\, c^4}} \tag{52}$$

43) Mass equivalence coefficients m and electric charge Q , Eqs. (7), (7.1) and (7.2):

$$k_{mQ}= \sqrt{\frac{G}{k_e}} = \sqrt{\frac{k_\Phi\, G}{c^2}} = \frac{c^2}{U_o} \tag{53}$$

44) Time equivalence coefficients T and electric charge Q , Eqs. (7), (7.1) and (7.2):

$$k_{TQ}= \sqrt{\frac{F_p\, c^2}{k_e}} = \sqrt{k_\Phi\, F_p} = I_o \tag{54}$$

45) Space equivalence coefficients L and electric charge Q , Eqs. (7), (7.1) and (7.2):

$$k_{LQ}=\sqrt{\frac{F_p}{k_e}}=\sqrt{\frac{k_\Phi c^2}{G}}=\frac{I_o}{c} \tag{55}$$

46) Equivalence coefficients of square root of magnetic moment $\sqrt{\boldsymbol{m}}$ and electric charge Q , Eqs. (7), (7.1) and (7.2):

$$k_{\sqrt{m}Q}=\sqrt[4]{\frac{c^2}{Gk_e}}=\sqrt[4]{\frac{k_\Phi}{G}}=\sqrt{\frac{I_o}{c^2}} \tag{56}$$

47) Electrical capacity equivalence coefficients C and electric charge Q , Eqs. (7), (7.1) and (7.2):

$$k_{CQ}=\sqrt{\frac{c^4\,k_e}{G}}=\sqrt{\frac{c^6}{k_\Phi G}}=U_o \tag{57}$$

48) Electrical inductance equivalence coefficients $\boldsymbol{L}$ and electric charge Q , Eqs. (7), (7.1) and (7.2):

$$k_{LQ}=\sqrt{\frac{F_p\,c^4}{k_e^3}}=\sqrt{\frac{k_\Phi^3\,c^2}{G}}=\frac{I_o}{R_o} \tag{58}$$

49) Magnetic flux equivalence coefficients Φ and the square root of the magnetic moment $\sqrt{\boldsymbol{m}}$, Eqs. (8), (8.1) and (8.2):

$$k_{\Phi\sqrt{m}}=\sqrt[4]{\frac{G\,c^2}{k_e^3}}=\sqrt[4]{\frac{k_\Phi^3}{F_p}}=\sqrt{\frac{c^2}{U_o\,R_o}} \tag{59}$$

50) Energy equivalence coefficients E and the square root of the magnetic moment $\sqrt{\boldsymbol{m}}$, Eqs. (8), (8.1) and (8.2):

$$k_{E\sqrt{m}}=\sqrt[4]{\frac{c^2}{k_e\,{F_p}^3}}=\sqrt[4]{\frac{k_\Phi}{{F_p}^3}}=\sqrt[4]{\frac{G^3}{R_o\,c^{11}}} \tag{60}$$

51) Time equivalence coefficients T and the square root of the magnetic moment $\sqrt{\boldsymbol{m}}$, Eqs. (8), (8.1) and (8.2):

$$k_{T\sqrt{m}}=\sqrt[4]{\frac{F_p\,c^6}{k_e}}=\sqrt[4]{c^4F_p\,k_\Phi}=\sqrt[4]{\frac{F_p\,c^5}{R_o}} \tag{61}$$

52) Space equivalence coefficients L and the square root of the magnetic moment $\sqrt{\boldsymbol{m}}$, Eqs. (8), (8.1) and (8.2):

$$k_{L\sqrt{m}}=\sqrt[4]{\frac{F_p\,c^2}{k_e}}=\sqrt[4]{F_p\,k_\Phi}=\sqrt{I_o} \tag{62}$$

53) Mass equivalence coefficients m and the square root of the magnetic moment $\sqrt{\boldsymbol{m}}$, Eqs. (8), (8.1) and (8.2):

$$k_{m\sqrt{m}}=\sqrt[4]{\frac{G^3}{k_e\,c^2}}=\sqrt[4]{\frac{k_\Phi\,G^3}{c^4}}=\sqrt{\frac{R_o\,c^6}{U_o^3}} \tag{63}$$

54) Electric charge equivalence coefficients Q and the square root of the magnetic moment $\sqrt{\boldsymbol{m}}$, Eqs. (8), (8.1) and (8.2):

$$k_{Q\sqrt{m}}=\sqrt[4]{\frac{c^2\,k_e}{F_p}}=\sqrt[4]{\frac{G}{k_\Phi}}=\sqrt{\frac{c^2}{I_o}} \tag{64}$$

55) Electrical capacity equivalence coefficients C and the square root of the magnetic moment $\sqrt{\boldsymbol{m}}$, Eqs. (8), (8.1) and (8.2):

$$k_{C\sqrt{m}}=\sqrt[4]{c^2F_p\,k_e^3}=\sqrt[4]{\frac{c^{12}}{k_\Phi^3\,G}}=\sqrt{U_oR_oc^2} \tag{65}$$

56) Electrical inductance equivalence coefficients $\boldsymbol{L}$ and the square root of the magnetic moment $\sqrt{\boldsymbol{m}}$, Eqs. (8), (8.1) and (8.2):

$$k_{\boldsymbol{L}\sqrt{m}}=\sqrt[4]{\frac{c^{14}}{k_e^5\,G}}=\sqrt[4]{k_\Phi^5F_p}=\frac{c\,\sqrt{I_o}}{R_o} \tag{66}$$

57) Space equivalence coefficients L and electrical capacity C , Eqs. (9) and (9.1):

$$k_{LC}=\frac{1}{k_e}=\frac{1}{cR_o} \tag{67}$$

58) Time equivalence coefficients T and electrical capacity C , Eqs. (9) and (9.1):

$$k_{TC}=\frac{c}{k_e}=\frac{1}{R_o} \tag{68}$$

59) Energy equivalence coefficients E and electrical capacity C , Eqs. (9) and (9.1):

$$k_{EC}=\frac{G}{k_e\,c^4}=\frac{1}{U_o^2} \tag{69}$$

60) Magnetic flux equivalence coefficients Φ and electrical capacity C , Eqs. (9) and (9.1):

$$k_{\Phi C}=\sqrt{\frac{G}{c^2\,k_e^3}}=\frac{1}{R_o\,U_o} \tag{70}$$

61) Mass equivalence coefficients m and electrical capacity C , Eqs. (9) and (9.1):

$$k_{mC}=\frac{G}{k_e\,c^2}=\frac{c^2}{U_o^2} \tag{71}$$

62) Electric charge equivalence coefficients Q and electrical capacity C , Eqs. (9) and (9.1):

$$k_{QC}=\sqrt{\frac{G}{k_e\,c^4}}=\frac{1}{U_o} \tag{72}$$

63) Equivalence coefficients of the square root of the magnetic moment $\sqrt{\boldsymbol{m}}$ and electrical capacity C , Eqs. (9) and (9.1):

$$k_{\sqrt{\boldsymbol{m}}C}=\sqrt[4]{\frac{G}{k_e^3\,c^6}}=\frac{1}{c\,\sqrt{R_o\,U_o}} \tag{73}$$

64) Electrical inductance equivalence coefficients $\boldsymbol{L}$ and electrical capacity C , Eqs. (9) and (9.1):

$$k_{\boldsymbol{L}C}=\frac{c^2}{k_e^2}=\frac{1}{R_o^2} \tag{74}$$

65) Magnetic flux equivalence coefficients Φ and electrical inductance $\boldsymbol{L}$, Eqs. (10), (10.1) and (10.2):

$$k_{\Phi\boldsymbol{L}}=\sqrt{\frac{Gk_e}{c^6}}=\sqrt{\frac{1}{F_p\,k_\Phi}}=\frac{1}{I_o} \tag{75}$$

66) Energy equivalence coefficients E and electrical inductance $\boldsymbol{L}$, Eqs. (10), (10.1) and (10.2):

$$k_{E\boldsymbol{L}}=\frac{Gk_e}{c^6}=\frac{1}{F_p\,k_\Phi}=\frac{1}{I_o^2} \tag{76}$$

67) Time equivalence coefficients T and electrical inductance $\boldsymbol{L}$, Eqs. (10), (10.1) and (10.2):

$$k_{T\boldsymbol{L}}=\frac{k_e}{c}=\frac{c}{k_\Phi}=R_o \tag{77}$$

68) Space equivalence coefficients L and electrical inductance $\boldsymbol{L}$, Eqs. (10), (10.1) and (10.2):

$$k_{L\boldsymbol{L}}=\frac{k_e}{c^2}=\frac{1}{k_\Phi}=\frac{R_o}{c} \tag{78}$$

69) Mass equivalence coefficients m and electrical inductance $\boldsymbol{L}$, Eqs. (10), (10.1) and (10.2):

$$k_{m\boldsymbol{L}}=\frac{k_e}{F_p}=\frac{G}{k_\Phi\,c^2}=\frac{c^2}{I_o^2} \tag{79}$$

70) Electric charge equivalence coefficients Q and electrical inductance $\boldsymbol{L}$, Eqs. (10), (10.1) and (10.2):

$$k_{Q\boldsymbol{L}}=\sqrt{\frac{k_e^3}{F_p c^4}}=\sqrt{\frac{c^2}{F_p\,{k_\Phi}^3}}=\frac{R_o}{I_o} \tag{80}$$

71) Equivalence coefficients of the square root of the magnetic moment $\sqrt{\boldsymbol{m}}$ and electrical inductance $\boldsymbol{L}$, Eqs. (10), (10.1) and (10.2):

$$k_{\sqrt{\boldsymbol{m}}\boldsymbol{L}}=\sqrt[4]{\frac{k_e^5\,G}{c^{14}}}=\sqrt[4]{\frac{1}{F_p\,k_\Phi^5}}=\sqrt{\frac{R_o^2}{c^2\,I_o}} \tag{81}$$

72) Electrical capacity equivalence coefficients C and electrical inductance $\boldsymbol{L}$, Eqs. (10), (10.1) and (10.2):

$$k_{C\boldsymbol{L}}=\frac{k_e^2}{c^2}=\frac{c^2}{k_\Phi^2}=R_o^2 \tag{82}$$

Here, 72 equivalence coefficients of PhQs are presented in the form of 174 types of recording of these coefficients.

Equivalence constants of PhQs consist of known PhCs:

$$c - k_e - k_\Phi - F_p - G - I_o - U_o - R_o \text{ — PhCs} \quad (82.1)$$

5. Prospects

5.1. Increase and decrease of PhQs

There is a known analogy in the change of four PhQs: space x , time T , energy E and mass m . [7]
1) Time dilation. Between time $\Delta T'$ and time ΔT in rest frame: [10] [11]

$$\Delta T' = \gamma \Delta T \quad (83)$$

Here γ is the Lorentz factor. [11] [12]
2) Length contraction. Between the length $\Delta x'$ of an object and the rest length Δx of the same object: [13] [14]

$$\Delta x' = \frac{\Delta x}{\gamma} \quad (84)$$

3) Relativistic mass. The relativistic mass m of a moving object depends on the rest mass m_o : [15] [16]

$$m = \gamma m_o \quad (85)$$

4) Relativistic energy. Formulas: total energy E , [17] [18]

$$E = mc^2 = \gamma m_o c^2 \quad (86)$$

Relativistic kinetic energy E_k :

$$E_k = (\gamma - 1) m_o c^2 \quad (87)$$

This means that by analogy with mass equivalences m , energy E , time T and space L we can observe similar equivalences between all these physical quantities, Eqs. (1): [7]

$$T - L - m - E \text{ — Equivalences} \quad (88)$$

Hence, based on the equivalence (1) of all PhQs [1], all PhQs increase or decrease as they tend toward the limiting quantities of the speed of light, the Planck force (for example: in a gravitational field [19] [20]), and other limiting quantities of PhQs. In this case, all PhQs by γ either increase or decrease:

1) Decreasing PhQs: L , f , λ . (89)

2) Increasing PhQs: T , m , E . (89.1)

Here f is temporal frequency, λ is wavelength.
Taking into account the equivalence coefficients of PhQs, Eqs. (2) – (82), we expand the list of increasing and decreasing PhQs:

1) Decreasing (with increasing λ) PhQs: L , G , U Φ , R , L , m . (90)

2) Increasing (with increasing λ) PhQs: T , C , m , E , Q. (90.1)

In this case, the PhQ of the electric current I can remain unchanged (constant) with an increase in γ .

5.2. Example: equivalence of the magnetic moment and mass of the planet Earth

Magnetic moment of planet Earth $m_\oplus$ is known. [21]
The mass of the planet Earth $m_\oplus$ is known. [22]
Mass m equivalent to the magnetic moment of the Earth $m_\oplus$ (6):

$$m = \sqrt{m_\oplus} \sqrt[4]{\frac{c^2 k_e}{G^3}} \quad (91)$$

Equivalence of $m_\oplus$–m is significantly exceeds $m_\oplus$.

5.3. Equivalence of PhCs

Equivalence coefficients of PhQ Eqs. (11) – (82) reveal the equivalence of PhCs (82.1). Equivalence coefficients of PhCs k_{Eq} for conditions at γ=1 и $\frac{1}{\gamma}$=1, matter: k_{Eq}=1.

Therefore, from equations (11) – (82) we have:

1) Equivalence of PhCs (82.1) and the speed of light c :

$$c=\sqrt[4]{\frac{G\,I_o^2}{k_\Phi}}=\sqrt[4]{GF_p}=\sqrt[4]{\frac{GU_o^2}{k_e}}=\sqrt[11]{\frac{F_p^3\,R_oG^3}{k_e}}=\sqrt[6]{Gk_eI_o^2}=\sqrt[6]{Gk_\Phi U_o^2}=U_o\sqrt{\frac{k_\Phi}{F_p}}=R_ok_\Phi=\sqrt[8]{R_o^2\,U_o^2\,G\,k_\Phi^3}=R_oU_o\sqrt{\frac{G}{k_e^3}}=\frac{k_e}{R_o}=I_o\sqrt{\frac{k_e}{F_p}}=$$
$$=\sqrt[4]{\frac{k_\Phi^3\,U_o^2\,R_o^2}{F_p}}=\sqrt{\frac{U_o^6}{k_e\,F_p^3\,R_o^2}}=\sqrt[14]{\frac{G^3\,U_o^2}{R_o^2\,k_e}}=\frac{\sqrt{F_p\,k_e^3}}{U_o\,R_o}=\sqrt[10]{\frac{I_o^2\,k_e^5\,G}{R_o^4}}=\frac{R_o}{I_o}\sqrt{F_p\,k_\Phi^3}=\sqrt[4]{\frac{I_o^2}{R_o^4\,F_p\,k_\Phi^5}}=\sqrt[13]{\frac{G^3\,k_e\,F_p^3}{R_o}}=\sqrt{k_\Phi\,k_e}=\sqrt[5]{GU_o\,I_o} \quad (92)$$

2) Equivalence of PhCs (82.1) and Coulomb constant k_e :

$$k_e=\frac{GU_o^2}{c^4}=\frac{F_p^3\,R_o\,G^3}{c^{11}}=\frac{c^6}{G\,I_o^2}=\frac{U_o^2}{F_p}=cR_o=\sqrt[3]{\frac{R_o^2\,G\,U_o^2}{c^2}}=c^2\frac{F_p}{I_o^2}=\frac{U_o^6}{c^2\,F_p^3\,R_o^2}=\frac{U_o^6\,G^3}{R_o^2\,c^{14}}=\frac{c^{13}\,R_o}{G^3\,F_p^3}=\frac{c^2\,F_p}{I_o^2}=\sqrt[3]{\frac{U_o^2\,R_o^2\,c^2}{F_p}}=\sqrt[5]{\frac{c^{10}\,R_o^4}{G\,I_o^2}}=\sqrt[3]{\frac{G\,R_o^2\,U_o^2}{c^2}}=\sqrt[3]{\frac{R_o^2\,F_p\,c^4}{I_o^2}}=\frac{cU_o}{I_o}=k_\Phi R_o^2 \quad (93)$$

3) Equivalence of PhCs (82.1) and magnetic interaction constant k_Φ :

$$k_\Phi=\frac{I_o^2\,G}{c^4}=\frac{I_o^2}{F_p}=\frac{c^2F_p}{U_o^2}=\sqrt[3]{\frac{c^8}{G\,R_o^2\,U_o^2}}=\frac{c}{R_o}=\frac{c^6}{G\,U_o^2}=\sqrt[3]{\frac{I_o^2\,G}{R_o^2\,c^2}}=\sqrt[3]{\frac{F_p\,c^4}{R_o^2\,U_o^2}}=\frac{G^3\,F_p^3}{R_o\,c^{11}}=\frac{R_o^2\,c^{16}}{U_o^6\,G^3}=\sqrt[5]{\frac{c^4\,I_o^2}{R_o^4\,F_p}}=\sqrt[3]{\frac{c^2\,I_o^2}{F_p\,R_o^2}}=\frac{k_e}{R_o^2}=\frac{c^2}{k_e} \quad (94)$$

4) Equivalence of PhCs (82.1) and gravitational constant G :

$$G=\frac{c^4\,k_\Phi}{I_o^2}=\frac{c^4}{F_p}=\frac{c^4\,k_e}{U_o^2}=\frac{c^6}{k_e\,I_o^2}=\sqrt{\frac{c^7\,k_e}{F_p^3\,R_o}}=\frac{c^6}{k_\Phi\,U_o^2}=\frac{k_e^3\,c^2}{R_o^2\,U_o^2}=\frac{k_e^3\,c^2\,I_o^2}{U_o^4}=\frac{k_\Phi^3\,c^2\,R_o^2}{I_o^2}=\sqrt[3]{\frac{k_\Phi\,R_o\,c^{11}}{F_p^3}}=\sqrt[3]{\frac{k_e\,R_o^2\,c^{14}}{U_o^6}}=\frac{c^8}{k_\Phi^3\,U_o^2\,R_o^2}=\frac{c^{10}\,R_o^4}{k_e^5\,I_o^2}=\frac{c^5}{U_o\,I_o} \quad (95)$$

5) Equivalence of PhCs (82.1) and Planck force F_p :

$$F_p=\frac{c^4}{G}=\sqrt{\frac{c^7\,k_e}{R_o\,G^2}}=\frac{I_o^2}{k_\Phi}=\frac{U_o^2}{k_e}=\frac{k_e\,I_o^2}{c^2}=\frac{I_o^2\,k_e^3}{c^4\,R_o^2}=\frac{k_\Phi^3\,U_o^2\,R_o^2}{c^4}=\frac{U_o^2\,R_o^2\,c^2}{k_e^3}=\frac{c^4\,I_o^2}{R_o^4\,k_\Phi^5}=\frac{c^2\,I_o^2}{k_\Phi^3\,R_o^2}=\frac{U_o\,I_o}{c} \quad (96)$$

6) Equivalence of PhCs (82.1) and the natural unit of electric current I_o :

$$I_o=\sqrt{\frac{c^4\,k_\Phi}{G}}=\sqrt{\frac{c^6}{Gk_e}}=\sqrt{k_\Phi\,F_p}=\frac{U_o}{R_o}=\sqrt{\frac{U_o^4\,G}{k_e^3\,c^2}}=\sqrt{\frac{c^2\,F_p}{k_e}}=\sqrt{\frac{F_p\,c^4\,R_o^2}{k_e^3}}=\sqrt{\frac{R_o^2\,k_\Phi^3\,c^2}{G}}=\sqrt{\frac{k_\Phi^5\,F_p\,R_o^4}{c^4}}=\sqrt{\frac{c^{10}\,R_o^4}{k_e^5\,G}}=\sqrt{\frac{F_p\,k_\Phi^3\,R_o^2}{c^2}} \quad (97)$$

7) Equivalence of PhCs (82.1) and the natural unit of electrical voltage U_o :

$$U_o=\sqrt{\frac{c^4\,k_e}{G}}=\sqrt{F_p\,k_e}=\sqrt{\frac{c^6}{k_\Phi\,G}}=I_oR_o=\sqrt{\frac{c^2\,F_p}{k_\Phi}}=\sqrt{\frac{k_e^3\,c^2}{G\,R_o^2}}=\sqrt{\frac{c^8}{G\,R_o^2\,k_\Phi^3}}=\sqrt[4]{\frac{I_o^2\,k_e^3\,c^2}{G}}=\sqrt[4]{\frac{I_o^2\,c^8}{G\,k_\Phi^3}}=\sqrt{\frac{k_e^3\,c^2}{G\,R_o^2}}=\sqrt{\frac{F_p\,c^4}{k_\Phi^3\,R_o^2}}=\sqrt[6]{\frac{k_e\,c^{14}\,R_o^2}{G^3}}=\sqrt[6]{\frac{k_e\,c^{16}\,R_o^2}{k_\Phi\,G^3}}=\sqrt{\frac{F_p\,k_e^3}{R_o^2\,c^2}} \quad (98)$$

8) Equivalence of PhCs (82.1) and the natural unit of electrical resistance R_o :

$$R_o=\frac{c^{11}\,k_e}{F_p^3\,G^3}=\frac{c}{k_\Phi}=\frac{k_e}{c}=\frac{U_o}{I_o}=\sqrt{\frac{k_e^3\,c^2}{GU_o^2}}=\sqrt{\frac{c^8}{Gk_\Phi^3\,U_o^2}}=\sqrt{\frac{GI_o^2}{k_\Phi^3\,c^2}}=\sqrt{\frac{k_e^3\,c^2}{GU_o^2}}=\sqrt{\frac{F_p\,c^4}{k_\Phi^3\,U_o^2}}=\frac{G^3\,F_p^3}{c^{11}\,k_\Phi}=\frac{G^3\,k_e\,F_p^3}{c^{13}}=\sqrt{\frac{G^3\,U_o^6}{c^{14}\,k_e}}=\sqrt{\frac{G^3\,k_\Phi\,U_o^6}{c^{16}}}=\sqrt{\frac{F_p\,k_e^3}{U_o^2\,c^2}}=\sqrt{\frac{I_o^2\,c^2}{F_p\,k_\Phi^3}}=\sqrt{\frac{k_e^3\,I_o^2}{F_p\,c^4}}=$$
$$=\sqrt[4]{\frac{c^4\,I_o^2}{F_p\,k_\Phi^5}}=\sqrt[4]{\frac{k_e^5\,G\,I_o^2}{c^{10}}}=\sqrt{\frac{k_e}{k_\Phi}} \quad (99)$$

In all formulas (92) – (99), the equivalence coefficient k_{Eq} (82.1) is absent, since k_{Eq}=1, and the equivalence coefficients of PhCs are the (other) constants themselves.

5.4. Future research work

If one of the most imprecise physical constants is the gravitational constant G [23], Then, to increase the accuracy of determining physical constants using Eqs. (93) – (99), formulas without G should be selected. Since any value of G from formula (95) has greater accuracy than the known G . For example:

$$G=\frac{c^4}{F_p}=\frac{c^4\,k_e}{U_o^2}=\frac{c^6}{k_e\,I_o^2}=\frac{c^5}{U_o\,I_o} \quad (100)$$

This picture of accuracy will change when the accuracy ratios among the known PhCs change.

Our traditional perception of PhQs is based on experience acquired mainly in terrestrial conditions. Therefore, going beyond experiments on planet Earth, we discover discrepancies between natural phenomena and our ideas. Equivalence of PhQs will allow us to describe these discrepancies and take a step towards explaining "dark energy", "dark matter," and the Olbers paradox.

6. Conclusion

The proposed equivalences of PhQs are deduced deductively, and we can observe them in all areas of physics and astrophysics. Examples of such observations include the increase and decrease of physical quantities: space, time, energy, and mass. Observation of known principles of physics at limiting values: the speed of light, the Planck force lead to the discovery of the proposed equivalences. Equivalence of PhQs is the principle according to which all PhQs are equivalent to each other (1): $\Phi - E - T - L - m - Q - \sqrt{\mathbf{m}} - C - \boldsymbol{L}$ — Equivalences. The description of equivalences of PhQs and the coefficients of these equivalences provides a clarification of the principles of physics and astrophysics. The equivalence coefficients from the proposed principle consist of known PhCs (82.1). This indicates that PhCs and equivalences of PhQs are a consequence of each other. PhCs form a single physical field.
One of the subsequent steps in describing these equivalences is their experimental confirmation.

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