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IMPROVING THE ACCURACY OF THE NUMERICAL VALUES OF THE ESTIMATES SOME FUNDAMENTAL PHYSICAL CONSTANTS

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ПІДВИЩЕННЯ ТОЧНОСТІ ЧИСЛОВИХ ЗНАЧЕНЬ ОЦІНОК ДЕЯКИХ ФУНДАМЕНТАЛЬНИХ ФІЗИЧНИХ КОНСТАНТ

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Abstract. *At the 26th General Conference on Measures and Weights, it was decided to switch from natural standards in the international system of SI units to standards that are based on fundamental physical constants. This solution raises the requirement for the accuracy of the numerical values of the fundamental physical constants. A technique is proposed for improving the accuracy of numerical values of the estimates: of Planck's constant over 2pi, of gravitational constant, of electric charge, of Planck temperature, of Planck acceleration, of Planck force, of Planck energy, of electron mass, of proton mass, of neutron mass, of Rydberg constant times hc in J, of Rydberg constant times c in Hz, of von Klitzing constant, of constant Hartree energy, of Josephson constant based on their representation through Planck's constants: of length, of mass, of time. Increasing of the accuracy numerical values of Planck's length's and the Planck's mass is based on the fractal similarity of the golden algebraic fractals of the main characteristics of the hypothetical Planck particle and muon. Also, to improve the accuracy of the numerical values of the fundamental physical constants, the following physical laws are applied: the ratio of the Bohr radius to the Compton electron wavelength over 2pi is equal to the fine structure constant. The moment of the mass of any elementary particle, defined through its Compton wavelength over 2pi, is equal to the moment of Planck's mass. It is shown that the moments of the mass of all elementary particles, which are determined through their Compton wavelength over 2pi, are equal to each other. The fine structure constant can be determined through the Bohr radius and the Rydberg constant. A formula for the electric charge is proposed and justified as a function of the moment of mass of any elementary particle. The numerical estimates are refined: of the Planck current, of the Planck voltage, of the Planck impedance, of the Planck electric capacitance, of the Planck inductance, of the Planck magnetic induction. A determination technique and a numerical estimate of the total energy luminosity of a hypothetical Planck particle are given. A method for linking the main characteristics of a hypothetical Planck particle to the main characteristics of the muon is proposed and justified. Since most of the fundamental physical constants can be determined through Planck's constants: of the length, of the mass, of the time, then these fundamental constants are functionally dependent on the corresponding characteristics of the muon.*

Keywords: *Planck's constant, fundamental physical constants, fractals, the accuracy units of measure.*

Анотація. *На 26-й Генеральній конференції з мір та ваг було вирішено перейти від натуральних стандартів в міжнародній системі одиниць СІ до стандартів, що ґрунтуються на фундаментальних фізичних константах. Це рішення підвищує вимогу до точності чисельних значень фундаментальних фізичних констант. Запропоновано методику підвищення точності чисельних значень оцінок: константи Планка, поділеної на 2pi, гравітаційної константи, електричного заряду, температури Планка, прискорення Планка, сили Планка, енергії Планка, маси електрона, маси протона, маси нейтрона, енергетичної константи Ридберга, частотної константи Ридберга, константи фон Клітцінга, константи енергії Хартрі, константи Джозефсона. Методика заснована на представленні цих констант через константи Планка: довжини, маси, часу. Збільшення точності чисельних значень довжини Планка та маси Планка засновано на фрактальній подібності золотих алгебраїчних фракталів основних характеристик гіпотетичної частинки Планка та мюону. Крім того, для підвищення точності чисельних значень фундаментальних фізичних констант застосовуються наступні фізичні закони: відношення радіуса Бора до Комптонівської довжини хвилі електрона, поділеної на 2pi, дорівнює постійній тонкої структури. Момент маси будь-якої елементарної частинки, визначений через її Комптонівську довжину хвилі поділену на 2pi, дорівнює моменту маси Планка.*

Показано, що моменти маси всіх елементарних частинок, які визначаються через їх Комптонівську довжину хвилі, поділену на 2pi, є рівні між собою. Постійна тонкої структури може бути визначена через радіус Бора та константу Ридберга. Запропонована та обґрунтована формула для електричного заряду, як функції моменту маси будь-якої елементарної частинки. Уточнені чисельні оцінки: струму Планка, напруги Планка, імпедансу Планка, електричної ємності Планка, індуктивності Планка, магнітної індукції Планка. Дана методика визначення і чисельна оцінка повної енергетичної світимості гіпотетичної частинки Планка. Запропоновано і обґрунтовано методику прив'язки основних характеристик гіпотетичної частинки Планка до основних характеристик мюона. Так як більшість фундаментальних фізичних констант можна визначити через константи Планка: довжини, маси, часу, то ці фундаментальні константи є функціонально залежними від відповідних характеристик мюона.

Ключові слова: константа Планка, фундаментальні фізичні константи, фрактали, одиниці вимірювання точності.

1 INTRODUCTION

Some fundamental physical constants can be expressed in terms of Planck's constants: of the length l_p, of the mass m_p, of the time t_p. According to CODATA [1], their numerical values have the following values:

$$l_p = 1.616\ 229(38)\cdot 10^{-35} m; \quad m_p = 2.176\ 470(51)\cdot 10^{-8} kg; \quad t_p = 5.391\ 16(13)\cdot 10^{-44} s. \tag{1}$$

From (1) it follows that the accuracy of the numerical values l_p and m_p is 10^{-6}, and the accuracy of the numerical value t_p is 10^{-5}.

The speed of light in vacuum c, taking into account (1):

$$c = \frac{l_p}{t_p} = 299\ 792\ 438\ \mathrm{m}^1 s^{-1}. \tag{2}$$

The speed of light in a vacuum according to CODATA-2014 [1]:

$$c = 299\ 792\ 458\ \mathrm{m}^1 s^{-1}. \tag{3}$$

The Planck charge q_p:

$$q_p = \frac{e}{\sqrt{\alpha}} = 1.875\ 5459\cdot 10^{-18} C, \tag{4}$$

where:

e – the elementary electric charge according to CODATA-2014 [1]:

$$e = 1.602\ 176\ 6208(98)\cdot 10^{-19} C, \tag{5}$$

α – the fine structure constant according to CODATA-2014 [1]:

$$\alpha = 7.297\ 352\ 5664\cdot 10^{-3}(0.000\ 000\ 0017\cdot 10^{-3}). \tag{6}$$

It is known [2] that:

$$q_p^2 = 10^7 m_p l_p = 3.517\ 673\ 932\cdot 10^{-36} C^2, [kgm]; \tag{7}$$

$$e^2 = 10^7 \alpha m_p l_p = 2.566\ 970\ 689\cdot 10^{-38} C^2, [kgm]. \tag{8}$$

The Planck constant over 2pi $\hbar$ with (1,3,5,6,8):

$$\hbar = \frac{m_p l_p^2}{t_p} = 1.054\ 572\ 0440\cdot 10^{-34} Js, \tag{9}$$

or:

$$\hbar = m_p l_p c = 1.054\ 572\ 1144\cdot 10^{-34} Js, \tag{10}$$

or:

$$\hbar = \frac{e^2 c}{10^7 \alpha} = 1.054\ 571\ 8001 \cdot 10^{-34} Js. \quad (11)$$

The Planck constant over 2pi $\hbar$ according to CODATA-2014 [1]:

$$\hbar = 1.054\ 571\ 800(13) \cdot 10^{-34} Js. \quad (12)$$

The gravitational constant G taking into account (1, 3, 5, 6, 12):

$$G = \frac{l_p^3}{m_p t_p^2} = 6.674\ 082\ 298 \cdot 10^{-11} m^3 kg^{-1} s^{-2}, \quad (13)$$

or:

$$G = \frac{l_p c^2}{m_p} = 6.674\ 083\ 188 \cdot 10^{-11} m^3 kg^{-1} s^{-2}, \quad (14)$$

or:

$$G = \frac{\hbar c}{m_p^2} = 6.674\ 081\ 199 \cdot 10^{-11} m^3 kg^{-1} s^{-2}, \quad (15)$$

or:

$$G = \frac{l_p^2 c^3}{\hbar} = 6.674\ 085\ 179 \cdot 10^{-11} m^3 kg^{-1} s^{-2}, \quad (16)$$

or:

$$G = \frac{t_p^2 c^5}{\hbar} = 6.674\ 086\ 069 \cdot 10^{-11} m^3 kg^{-1} s^{-2}, \quad (17)$$

or:

$$G = 10^7 \alpha \frac{l_p^2 c^2}{e^2} = 6.674\ 085\ 177 \cdot 10^{-11} m^3 kg^{-1} s^{-2}. \quad (18)$$

The Gravitational constant according to CODATA-2014 [1]:

$$G = 6.674\ 08(31) \cdot 10^{-11} m^3 kg^{-1} s^{-2}. \quad (19)$$

The Planck acceleration a_p:

$$a_p = \frac{l_p}{t_p^2} = 5.560\ 815\ 075 \cdot 10^{51} m^1 \mathrm{s}^{-2}, \quad (20)$$

or:

$$a_p = \frac{c}{t_p} = 5.560\ 815\ 4460 \cdot 10^{51} m^1 \mathrm{s}^{-2}. \quad (21)$$

The Planck force F_p:

$$F_p = m_p a_p = \frac{m_p l_p}{t_p^2} = 1.210\ 294\ 719 \cdot 10^{44} kg^1 m^1 s^{-2}, \quad (22)$$

or:

$$F_p = m_p a_p = \frac{m_p c}{t_p} = 1.210\ 294\ 799 \cdot 10^{44} kg^1 m^1 s^{-2}. \quad (23)$$

The Planck energy E_p:

$$E_p = m_p c^2 = 1.956\ 113\ 684 \cdot 10^9 J, \quad (24)$$

or:

$$E_p = F_p l_p = \frac{m_p l_p^2}{t_p^2} = 1.956\ 113\ 423 \cdot 10^9 J, \quad (25)$$

or:

$$E_p = F_p l_p = \frac{m_p c l_p}{t_p} = 1.956\ 113\ 553 \cdot 10^9 J, \quad (26)$$

or:

$$E_p = \frac{\hbar}{t_p} = 1.956\ 112\ 970 \cdot 10^9 J, \quad (27)$$

or:

$$E_p = \frac{e^2 c}{10^7 \alpha t_p} = 1.956\ 112\ 970 \cdot 10^9 J. \quad (28)$$

The Planck power P_p with (25):

$$P_p = \frac{E_p}{t_p} = 3.628\ 372\ 528 \cdot 10^{52} W, \quad (29)$$

or with (23):

$$P_p = F_p c = 3.628\ 372\ 230 \cdot 10^{52} W. \quad (30)$$

The Planck temperature T_p:

$$T_p = \frac{E_p}{k}, \quad (31)$$

where $E_p -$ the Planck energy, $k -$ the Boltzmann constant, according to CODATA-2014 [1]:

$$k = 1.380\ 648\ 52(79) \cdot 10^{-23} JK^{-1}, \quad (32)$$

then with (24):

$$T_p = \frac{E_p}{k} = 1.416\ 807\ 867 \cdot 10^{32} K, \quad (33)$$

then with (25):

$$T_p = \frac{E_p}{k} = 1.416\ 807\ 678 \cdot 10^{32} K, \quad (34)$$

then with (26):

$$T_p = \frac{E_p}{k} = 1.416\ 807\ 772 \cdot 10^{32} K, \quad (35)$$

then with (27, 28):

$$T_p = \frac{E_p}{k} = 1.416\ 807\ 349 \cdot 10^{32} K. \quad (36)$$

The Planck temperature according to CODATA-2014 [1]:

$$T_p = \frac{E_p}{k} = 1.416\ 808(33) \cdot 10^{32} (33) K. \quad (37)$$

The total energy luminosity S_p of a hypothetical Planck particle according to the law of Stephen - Boltzmann:

$$S_p = \delta T_p^4 = 2.284\ 837 \cdot 10^{121} W^1 m^{-2}, \quad (38)$$

where δ is the Stefan-Boltzmann constant to CODATA-2014 [1]:

$$\delta = \frac{\pi^2}{60} \cdot \frac{k^4}{c^2 \hbar^3} = 5.670\ 367(13) \cdot 10^{-8} W^1 m^{-2} K^{-4}. \quad (39)$$

Obviously S_p on the basis of (29) can be represented in the form:

$$S_p = \frac{\pi^2}{60} \cdot \frac{P_p}{l_p^2} = 2.284\ 833 \cdot 10^{121} W^1 m^{-2}. \quad (40)$$

The main of Planck units of the electromagnetism [2],taking into account the accuracy of the Planck constants(of the length, of the mass, of the time):

The current of Planck I_p :

$$I_p = \frac{q_p}{t_p} = 3.478\ 929 \cdot 10^{25}\ A, \left[kg^{\frac{1}{2}} m^{\frac{1}{2}} s^{-1} \right]. \quad (41)$$

The voltage of Planck V_p :

$$V_p = \frac{E_p}{q_p} = \frac{m_p c^2}{q_p} = 1.042\ 96 \cdot 10^{27}\ V, \left[kg^{\frac{1}{2}} m^{\frac{3}{2}} s^{-2} \right]. \quad (42)$$

The impedance of Planck Z_p :

$$Z_p = \frac{V_p}{I_p} = 29.979\ 26\ \Omega, \left[m^1 s^{-1} \right]. \quad (43)$$

Obviously, the true value Z_p is:

$$Z_p = \frac{c}{10^7} = 29.979\ 2458\ \Omega, \left[m^1 s^{-1} \right]. \quad (44)$$

The characteristic impedance of vacuum Z_0 to CODATA-2014 [1]:

$$Z_0 = 4\pi Z_p = 4\pi \frac{c}{10^7} = 376.730313461770...\ \Omega.. \quad (45)$$

The electric capacitance of Planck C_p :

$$C_p = \frac{q_p}{V_p} = 1.798\ 30 \cdot 10^{-45}\ F, \left[m^{-1} s^2 \right]. \quad (46)$$

The inductance of Planck L_p :

$$L_p = \frac{2E_p}{I_p^2} = \frac{2m_p c^2}{I_p^2} = 3.232\ 459 \cdot 10^{-42}\ H, \left[\Omega^1 s^1 \right], [m]. \quad (47)$$

The module of the magnetic induction of Planck B_p :

$$B_p = \frac{F_p}{q_p c} = 2.152\ 498 \cdot 10^{52}\ Tl,\ [kg^{\frac{1}{2}} m^{\frac{-1}{2}} s^{-1}]. \quad (48)$$

The module of the magnetic field strength of Planck H_p :

$$H_p = \frac{B_p}{\mu_0} = 1.7129 \cdot 10^{59}\ [A^1 m^{-1}],\ [kg^{\frac{1}{2}} m^{\frac{-1}{2}} s^{-1}], \tag{49}$$

where μ_0 - this is the magnetic constant, from [1]: $\mu_0 = 1.256\ 637\ 0614... \cdot 10^{-6}\ [H^1 m^{-1}]$.

Obviously, the gravitational constant G and the Planck constant over 2pi $\hbar$, taking into account the formulas (11, 13, 22, 33, 44) can be represented in the form:

$$G = \frac{c^4}{F_p} = 6.674\ 084\ 08 \cdot 10^{-11} m^3 kg^{-1} s^{-2}, \tag{50}$$

or:

$$G = \frac{k^2 T_p^2}{m_p^2 F_p} = 6.674\ 085\ 338 \cdot 10^{-11} m^3 kg^{-1} s^{-2}, \tag{51}$$

$$\hbar = \frac{e^2 Z_p}{\alpha} = 1.054\ 571\ 8001 \cdot 10^{-34} Js. \tag{52}$$

Analysis of the formulas (1-52) shows that the numerical estimates of the values of the fundamental constants that can be obtained on the basis of the Planck constants: l_p, m_p, t_p, differ significantly from their standard values, which are presented in CODATA [1]. To improve the accuracy of these fundamental constants, it is necessary to increase the accuracy of the Planck constants: l_p, m_p, t_p.

2 THE CHOICE OF STANDARDS OF FUNDAMENTAL CONSTANTS

To select standards of fundamental constants, we use the following criteria:

1. The accuracy of the numerical value of the fundamental constant should have the maximum possible value. That is, the number of decimal places after the decimal separator should be the largest.

2. The standard uncertainty of the fundamental constant should have the minimum possible value.

3. The numerical value of the fundamental constant is determined (confirmed) experimentally.

The following fundamental constants correspond to such criteria [1]:

- the speed of light in vacuum: $c = 2.997\ 924\ 58 \cdot 10^8 m^1 s^{-1}$ (exact);
- the impedance of Planck: $Z_p = 29.979\ 2458\ \Omega$ (exact);
- the characteristic impedance of vacuum: $Z_0 = 376.730\ 313\ 461\ 770...\ \Omega$ (exact); the magnetic constant: $\mu_0 = 1.256\ 637\ 0614... \cdot 10^{-6} [H^1 m^{-1}]$ (exact);
- the Rydberg constant: $R_\infty = 109\ 73731.568508\ (0.000065) m^{-1}$;
- the proton Compton wavelength over 2pi: $\lambda_C^{p^+} = 2.103\ 089\ 101\ 09(97) \cdot 10^{-16} m$;
- the Bohr radius: $a_0 = 5.291\ 772\ 1067(12) \cdot 10^{-11} m$;
- the neutron Compton wavelength over 2pi: $\lambda_C^{n^0} = 2.100\ 194\ 1536(14) \cdot 10^{-16} m$; the fine-structure constant: $\alpha = 7.297\ 352\ 5664(17) \cdot 10^{-3}$;
- the electron Compton wavelength over 2pi: $\lambda_C^{e} = 3.861\ 592\ 6764\ (18) \cdot 10^{-13} m$;
- the elementary charge: $e = 1.602\ 176\ 6208(98) \cdot 10^{-19} C$;
- the muon Compton wavelength over 2pi: $\lambda_C^{\mu^-} = 1.867\ 594\ 308(42) \cdot 10^{-15} m$;

- the muon mass: $m_{\mu^-} = 1.883\ 531\ 594(48) \cdot 10^{-28}$ kg;
- the Boltzmann constant: $k = 1.380\ 648\ 52(79) \cdot 10^{-23} J^1 K^{-1}$;
- the proton Compton wavelength over 2pi: $ƛ_C^{p^+} = 2.103\ 089\ 101\ 09(97) \cdot 10^{-16}$ m;
- the neutron Compton wavelength over 2pi: $ƛ_C^{n^0} = 2.100\ 194\ 1536(14) \cdot 10^{-16}$ m; the Boltzmann constant: $k = 1.380\ 648\ 52(79) \cdot 10^{-23} J^1 K^{-1}$.

To improve the accuracy of Planck's constants: l_p, m_p, t_p, we use a concept whose essence is that these constants are relied on as unknown values. Then to determine them requires three independent equations (source), in which the accuracy characteristics of the operands are higher than the accuracy characteristics of the standard values of the Planck constants: l_p, m_p, t_p.

Obviously, the first equation is:

$$c = \frac{l_p}{t_p} = 299\,792\ 458\ m^1 s^{-1},\ \text{(exact)}. \tag{53}$$

The second equation is defined on the basis of patterns: an electric charge - a function of the mass moment [2]. Then:

$$e^2 = 10^7 \alpha m_p l_p = 2.566\ 969\,924\,238\ 10... \cdot 10^{-38} C^2, [\text{kgm}]. \tag{54}$$

From (54) it follows that:

$$m_p l_p = \frac{e^2}{10^7 \alpha} = 3.517\ 672\ 883\ 255\ 617\ 770... \cdot 10^{-43}\ \text{kgm}. \tag{55}$$

Given that the accuracy of the values of the fine structure constant and the elementary charge is 10^{-10}, it can be presumed that the accuracy of the estimate of the value of the Planck mass moment is also 10^{-10}, then:

$$m_p l_p = \frac{e^2}{10^7 \alpha} = 3.517\ 672\ 8833 \cdot 10^{-43}\ \text{kgm}. \tag{56}$$

The third independent source for estimating the values of Planck's constants: l_p, m_p, t_p is determined on the basis of a pattern [3,4]: Planck's constants: masses m_p and lengths l_p are golden algebraic fractals of the main characteristics of a muon: its mass m^{μ^-} and its Compton wavelength over 2pi $ƛ_C^{\mu^-}$, then:

$$m_p^{\mu^-} = 2.176\ 638\ 834\ 506\ 326... \cdot 10^{-8}\ \text{kg}; \tag{57}$$

$$l_p^{\mu^-} = 1.616\ 103\ 153\ 231\ 184... \cdot 10^{-35}\ \text{m}. \tag{58}$$

Based on formulas (53) and (58), we obtain the value of the Planck time constant $t_p^{\mu^-}$:

$$t_p^{\mu^-} = \frac{l_p^{\mu^-}}{c} = 5.390\ 739\ 860\ 544\ 403... \cdot 10^{-44}\ \text{s}. \tag{59}$$

Given that the accuracy of constants m^{μ^-} and $ƛ_C^{\mu^-}$ is 10^{-9}, it can be assumed that the accuracy of the evaluation of constants: $m_p^{\mu^-}$, $l_p^{\mu^-}$ and $t_p^{\mu^-}$ is also 10^{-9}, then:

$$m_p^{\mu^-} = 2.176\ 638\ 835 \cdot 10^{-8}\ \text{kg}; \tag{60}$$

$$l_p^{\mu^-} = 1.616\ 103\ 153 \cdot 10^{-35} \text{ m;} \quad (61)$$

$$t_p^{\mu^-} = 5.390\ 739\ 861 \cdot 10^{-44} \text{ s.} \quad (62)$$

Let the value of the moment of the Planck mass $m_p l_p$, which is given in formula (56) is a standard, then we make a comparison of the Planck constants - the length and the mass according to formulas (1) and (60,61).

The value of the moment of the mass of Planck by the formula (1):

$$m_p l_p = 3.517\ 673\ 931\ 63 \cdot 10^{-43} \text{ kgm.} \quad (63)$$

Taking into account the accuracy of the values of the constants in the formula (1):

$$m_p l_p = 3.517\ 674 \cdot 10^{-43} \text{ kgm.} \quad (64)$$

The value of the moment of the mass of Planck by the formulas (60,61):

$$m_p^{\mu^-} l_p^{\mu^-} = 3.517\ 672\ 883\ 891... \cdot 10^{-43} \text{ kgm.} \quad (65)$$

Taking into account the accuracy of the values of the constants in the formulas (60,61):

$$m_p^{\mu^-} l_p^{\mu^-} = 3.517\ 672\ 884 \cdot 10^{-43} \text{ kgm.} \quad (66)$$

The analysis of formulas (56), (64) and (66) shows that the concept of the fractal connection of the hypothetical Planck particle and muon can be used as a third independent source to increase the accuracy of the values Planck's constants of the mass, of the length, of the time. In [2] it was shown that the moment of the Planck mass is equal to the moment of the mass of the electron, which is defined through the Bohr radius, then the equality is true:

$$m_p l_p = m_e a_0 \alpha, \quad (67)$$

where: $a_0, \alpha, m_e -$ it is, respectively: the Bohr radius, the fine-structure constant, the electron mass. According to [1] the mass of electron equals:

$$m_e = 9.109\ 383\ 56(11) \cdot 10^{-31} \text{ kg.} \quad (68)$$

It is known that the Compton wavelength over 2pi $ƛ_C$ of any elementary particle with a mass m is equal to:

$$ƛ_C = \frac{\hbar}{mc}. \quad (69)$$

Whence the moment of particle mass:

$$ƛ_C m = \frac{\hbar}{c}. \quad (70)$$

From formulas (67) and (70) it follows that:

$$m_p l_p = m_e ƛ_C^e. \quad (71)$$

That is:

$$ƛ_C^e = a_0 \alpha, \quad (72)$$

or:

$$\alpha = \frac{ƛ_C^e}{a_0}. \quad (73)$$

From formulas (69) and (71) it also follows that:

$$m_p l_p = m_e ƛ_C^e = m_{p^+} ƛ_C^{p^+} = m_{n^0} ƛ_C^{n^0} = m_{\mu^-} ƛ_C^{n^-} = ... = m ƛ_C = \frac{\hbar}{c}. \quad (74)$$

The mass moments of all elementary particles, which are determined through their Compton wavelength over 2pi, are equal to each other and equal to the Planck mass moment.

From formulas (55,56) and (74) it follows that:

$$e^2 = 10^7 \alpha m_p l_p = 10^7 \alpha m_e \lambda\!\!\!^{-}{}_C^e = 10^7 \alpha m_{p^+} \lambda\!\!\!^{-}{}_C^{p^+} = 10^7 \alpha m_{\mu^-} \lambda\!\!\!^{-}{}_C^{\mu^-} = ... = 10^7 \alpha m \lambda\!\!\!^{-}{}_C = 10^7 \alpha \frac{\hbar}{c}. \qquad (75)$$

That is, formula (74) confirms the pattern [2] that the electric charge is a function of the mass moment. It also means that there is an opportunity to improve the accuracy of Planck's constants estimates: of the mass, of the length, of the time to a value of 10^{-9}, and the composition of these constants - the mass moment - to a value of 10^{-10}.

3 IMPROVING THE ACCURACY OF THE NUMERICAL VALUES OF THE ESTIMATES OF SOME FUNDAMENTAL PHYSICAL CONSTANTS

The Rydberg constant is one of the most accurately measured fundamental constants. Obviously, it is convenient to use this constant to estimate the accuracy of other fundamental physical constants, for example, the fine structure constant. Let us specify the value of the fine structure constant in terms of the Rydberg constant and the Bohr radius. The Bohr radius has the same accuracy value as the fine structure constant, but its standard uncertainty value is less. Then:

$$\alpha = 4\pi a_0 R_\infty = 0.007\ 297\ 352\ 5663\ 119\ 669\ 893\ 690... \qquad (76)$$

On the basis of formula (72), we specify the estimate the value of the fine structure constant:

$$\alpha = \sqrt{4\pi \lambda\!\!\!^{-}{}_C^e R_\infty} = 0.007\ 297\ 352\ 5663\ 908\ ... \qquad (77)$$

Analysis of the values of the fine structure constant: of the standard according to CODATA-2014 by the formula (6), as well as by formulas (76) and (77) shows that the weight of the tenth digit of the standard value of the fine structure constant (number 4) is greater than by the formulas (76, 77).

The elementary electric charge, expressed in terms of the Rydberg constant:

$$e = \sqrt{10^7 m_e \frac{\alpha^3}{4\pi R_\infty}}. \qquad (78)$$

The Planck's constant over 2pi, expressed in terms of the Rydberg constant:

$$\hbar = m_e c \lambda\!\!\!^{-}{}_C^e = m_e c \frac{\alpha^2}{4\pi R_\infty}. \qquad (79)$$

The value R_y of the Rydberg constant times hc in J:

$$R_y = 2\pi\hbar c R_\infty = 2\pi m_e c \frac{\alpha^2}{4\pi R_\infty} c R_\infty = \frac{m_e c^2 \alpha^2}{2} = 2.179\ 872\ 325\ 506...\cdot 10^{-18}\ \text{J}. \qquad (80)$$

The value R_y of the Rydberg unit of energy or Rydberg constant times hc in J according to CODATA-2014 [1]:

$$R_y = 2.179\ 872\ 325(27)\cdot 10^{-18}\ \text{J}. \qquad (81)$$

The value R_c of the Rydberg constant times c in Hz:

$$R_c = \frac{m_e k_e^2 e^4}{4\pi\hbar^3} = \frac{m_e^3 10^{-14} 10^{14} \alpha^2 (\lambda\!\!\!^{-}{}_C^e)^2 c^4}{4\pi m_e^3 (\lambda\!\!\!^{-}{}_C^e)^3 c^3} = \frac{c\alpha^2}{4\pi \lambda\!\!\!^{-}{}_C^e} = 3.289\ 841\ 960\ 363\ 475\ 100...\cdot 10^{15}\ \text{Hz}, \qquad (82)$$

where k_e it is the electric force constant, or the Coulombs constant:

$$k_e = 10^7 c^2, \qquad (83)$$

but with (77):

$$R_\infty = \frac{\alpha^2}{4\pi ƛ_C^e}, \tag{84}$$

then:

$$R_c = cR_\infty = 3.289\ 841\ 960\ 355\ 208\ 712\ 664 \cdot 10^{15}\ \text{Hz}. \tag{85}$$

The value R_c of the Rydberg constant times c in *Hz* according to CODATA-2014 [1]:

$$R_c = 3.289\ 841\ 960\ 355(19) \cdot 10^{15}\ \text{Hz}. \tag{86}$$

The value of the quantum of the electrical resistance, or the von Klitzing constant R_K :

$$R_K = \frac{2\pi\hbar}{e^2} = \frac{2\pi m_e ƛ_C^e c}{10^7 \alpha m_e ƛ_C^e} = \frac{2\pi c}{10^7 \alpha} = \frac{2\pi Z_p}{\alpha} = 25\ 812.807\ 455\ 431\ 940\ 925\ 6190...\Omega,\ \left[m^1 s^{-1}\right]. \tag{87}$$

The value of the quantum of the electrical resistance, or the von Klitzing constant R_K according to CODATA-2014 [1]:

$$R_K = 25\ 812.807\ 4555\ (0.000\ 0059)\Omega,\ \left[m^1 s^{-1}\right]. \tag{88}$$

The Josephson constant K_J, as the reciprocal of the magnetic flux quantum:

$$K_J = \frac{e}{\pi\hbar} = \frac{10^7 \alpha e}{\pi e^2 c} = \frac{10^7 \alpha}{\pi e c} = \frac{\alpha}{\pi e Z_p} = 483\ 597.852\ 473\ 798... \cdot 10^9 \text{Hz}^1 \text{V}^{-1}, \left[\text{kg}^{-\frac{1}{2}} \text{m}^{-\frac{3}{2}} \text{s}^1\right]. \tag{89}$$

Since taking into account formula (42), the dimension of the Josephson constant:

$$\left[\text{Hz}^1 \text{V}^{-1}\right] = \left[\text{s}^{-1} (\text{kg}^{-\frac{1}{2}} \text{m}^{-\frac{3}{2}} \text{s}^2)\right] = \left[\text{kg}^{-\frac{1}{2}} \text{m}^{-\frac{3}{2}} \text{s}^1\right]. \tag{90}$$

The value of the Josephson constant according to CODATA-2014 [1]:

$$K_J = 483\ 597.8525(0.0030) \cdot 10^9 \text{Hz}^1 \text{V}^{-1}. \tag{91}$$

The constant atomic unit of energy, or the constant Hartree energy E_h :

$$E_h = \frac{\hbar^2}{m_e a_0^2} = m_e c^2 \alpha^2 = 2R_y = 4.359\ 744\ 651\ 012... \cdot 10^{-18}\ \text{J}. \tag{92}$$

The value of the constant Hartree energy according to CODATA-2014 [1]:

$$E_h = 4.359\ 744\ 650(54) \cdot 10^{-18}\ \text{J}. \tag{93}$$

We calculate the estimates of the moment of the mass: of the proton, of the neutron, of the muon, of the electron through their Compton wavelength over 2pi:

- the proton:

$$m_{p^+} ƛ_C^{p^+} = 3.517\ 672\ 883\ 928\ 269\ 668\ 82 \cdot 10^{-43}\ \text{kgm}, \tag{94}$$

- taking into account the accuracy of the proton mass values and its Compton wavelength over 2pi:

$$m_{p^+} ƛ_C^{p^+} = 3.517\ 672\ 884 \cdot 10^{-43}\ \text{kgm}, \tag{95}$$

- the neutron:

$$m_{n^0} ƛ_C^{n^0} = 3.517\ 672\ 882\ 298\ 233\ 5456 \cdot 10^{-43}\ \text{kgm}, \tag{96}$$

– taking into account the accuracy of the neutron mass values and its Compton wavelength over 2pi:

$$m_{n^0}\lambda_C^{n^0} = 3.517\ 672\ 882 \cdot 10^{-43}\ \text{kgm}, \tag{97}$$

– the muon:

$$m_{\mu^-}\lambda_C^{\mu^-} = 3.517\ 672\ 883\ 892\ 566\ 952 \cdot 10^{-43}\ \text{kgm}, \tag{98}$$

– taking into account the accuracy of the muon mass values and its Compton wavelength over 2pi:

$$m_{\mu^-}\lambda_C^{\mu^-} = 3.517\ 672\ 884 \cdot 10^{-43}\ \text{kgm}, \tag{99}$$

– the electron:

$$m_e\lambda_C^e = 3.517\ 672\ 884\ 181\ 455\ 9984 \cdot 10^{-43}\ \text{kgm}, \tag{100}$$

– taking into account the accuracy of the electron mass values and its Compton wavelength over 2pi:

$$m_e\lambda_C^e = 3.517\ 672\ 88 \cdot 10^{-43}\ \text{kgm}. \tag{101}$$

Analysis of formulas (94–101) shows that the accuracy of estimates of the mass moments of the proton, of the neutron, of the muon, of the electron through their Compton wavelength over 2pi does not exceed the value 1, that is:

$$m\lambda_C = 3.517\ 672\ 88 \cdot 10^{-43}\ \text{kgm}. \tag{102}$$

Increase the accuracy of estimating the mass values: of the proton, of the neutron, of the electron. For this we use physical law: equality of moments of particle mass through their Compton wavelength over 2pi, of the formula (75), and the fact that the accuracy of Compton wavelength over 2pi of the elementary particles and the accuracy of the moments of their mass is higher than the accuracy of the values of the mass itself:

$$m_{p^+} = \frac{e^2}{10^7\alpha\lambda_C^{p^+}} = 1.672\ 621\ 897\ 680\ 1600... \cdot 10^{-27}\ \text{kg}, \tag{103}$$

$$m_{n^0} = \frac{e^2}{10^7\alpha\lambda_C^{n^0}} = 1.674\ 927\ 471\ 455\ 855\ 10... \cdot 10^{-27}\ \text{kg}, \tag{104}$$

$$m_e = \frac{e^2}{10^7\alpha\lambda_C^e} = 9.109\ 383\ 557\ 602\ 4446... \cdot 10^{-31}\ \text{kg}. \tag{105}$$

Taking into account the accuracy of the operands in formulas (103,104,105), the mass estimates of the proton, of the neutron, of the electron are as follows:

$$m_{p^+} = 1.672\ 621\ 897\ 680 \cdot 10^{-27}\ \text{kg}, \tag{106}$$

$$m_{n^0} = 1.674\ 927\ 471\ 46 \cdot 10^{-27}\ \text{kg}, \tag{107}$$

$$m_e = 9.109\ 383\ 557\ 60 \cdot 10^{-31}\ \text{kg}. \tag{108}$$

Obviously, the new estimates of the mass moments of the proton, of the neutron and of the electron, taking into account the estimates of the values of their mass in formulas (106,107,108), will be close to the value of the mass moment by formula (56).

Let us specify the values of the estimates of the Rydberg constant time hc in *J* and constant Hartree energy taking into account the calculated value of the electron mass estimate:

$$R_y = 2.179\ 872\ 324\ 932\ 125... \cdot 10^{-18}\ \text{J}. \tag{109}$$

$$E_h = 4.359\ 744\ \ 649\ \ 864\ \ 251...\cdot 10^{-18}\ \text{J}. \quad (110)$$

Based on estimates of the values of Planck's constants – of the mass, of the length and of the time, as fractals of the main characteristics of the muon, and which are represented by the formulas (57,58,59), we calculate the estimates of the constants:

– the Planck acceleration $a_p^{\mu^-}$:

$$a_p^{\mu^-} = \frac{l_p^{\mu^-}}{(t_p^{\mu^-})^2} = 5.561\ 248\ 840\ 708\ 248\ 850...\cdot 10^{51}\ \text{m}^1\text{s}^{-2}, \quad (111)$$

– the Planck force $F_p^{\mu^-}$:

$$F_p^{\mu^-} = m_p^{\mu^-} a_p^{\mu^-} = 1.210\ 483\ 019\ 503\ 885\ 939\ ...\cdot 10^{44}\ \text{kg}^1\text{m}^1\text{s}^{-2}, \quad (112)$$

– the Planck energy $E_p^{\mu^-}$:

$$E_p^{\mu^-} = m_p^{\mu^-} c^2 = 1.956\ 265\ 424\ 752\ 231\ 7250...\cdot 10^{9}\ \text{J}, \quad (113)$$

or:

$$E_p^{\mu^-} = F_p^{\mu^-} l_p^{\mu^-} = 1.956\ 265\ 424\ 753\ 837\ 78210...\cdot 10^{9}\ \text{J}, \quad (114)$$

or:

$$E_p^{\mu^-} = \frac{\hbar^{\mu^-}}{t_p^{\mu^-}} = \frac{m_p^{\mu^-} l_p^{\mu^-} c}{t_p^{\mu^-}} = 1.956\ 265\ 424\ 753\ 034\ 8884...\cdot 10^{9}\ \text{J}, \quad (115)$$

or:

$$E_p^{\mu^-} = \frac{e^2 c}{10^7 \alpha t_p^{\mu^-}} = 1.956\ 265\ 424\ 398\ 811\ 5895...\cdot 10^{9}\ \text{J}. \quad (116)$$

The analysis of the values of the Planck energy constant estimates using the formulas (113-116) shows that their accuracy does not exceed the value of 10^{-9}, then the average value of the Planck energy constant estimate is:

$$E_p^{\mu^-} = 1.956\ 265\ 425 \cdot 10^{9}\ \text{J}. \quad (117)$$

Since the accuracy of the estimation of the main characteristics of the muon is 10^{-9}, it can be assumed that the accuracy of estimates of the Planck acceleration constants and the Planck force is also the value of 10^{-9}, that is:

$$a_p^{\mu^-} = 5.561\ 248\ 841 \cdot 10^{51}\ \text{m}^1\text{s}^{-2}, \quad (118)$$

$$F_p^{\mu^-} = 1.210\ 483\ 020 \cdot 10^{44}\ \text{kg}^1\text{m}^1\text{s}^{-2}. \quad (119)$$

The Planck power $P_p^{\mu^-}$:

$$P_p^{\mu^-} = \frac{E_p^{\mu^-}}{t_p^{\mu^-}} = 3.628\ 936\ 796\ 446\ 415\ 0420...\cdot 10^{52}\ \text{J}^1\text{s}^{-1}, \quad (120)$$

or:

$$P_p^{\mu^-} = F_p^{\mu^-} c = 3.628\ \ 936\ \ 797\ \ 841\ \ 829\ \ 669...\cdot 10^{52}\ \text{J}^1\text{s}^{-1}. \quad (121)$$

The average value of the estimate of the Planck power with accuracy 10^{-9} is:

$$P_p^{\mu^-} = 3.628\ 936\ 797 \cdot 10^{52}\ \text{J}^1\text{s}^{-1}. \quad (122)$$

The estimate of the value of the linear density of the Planck mass $\rho_{pl}^{\mu^-}$:

$$\rho_{pl}^{\mu^-} = \frac{m_p^{\mu^-}}{l_p^{\mu^-}} = 1.346\ 843\ 999\ 501\ 846\ 250... \cdot 10^{27}\ \text{kg}^1\text{m}^{-1}. \quad (123)$$

Or taking into account the accuracy 10^{-9} of the Planck constants, which are determined on the basis of the characteristics of the muon:

$$\rho_{pl}^{\mu^-} = \frac{m_p^{\mu^-}}{l_p^{\mu^-}} = 1.346\ 844\ 000 \cdot 10^{27}\ \text{kg}^1\text{m}^{-1}. \quad (124)$$

The estimate of the value of the surface density of the Planck mass $\rho_{ps}^{\mu^-}$:

$$\rho_{ps}^{\mu^-} = \frac{m_p^{\mu^-}}{(l_p^{\mu^-})^2} = 8.333\ 898\ 716\ 851\ 442\ 584... \cdot 10^{61}\ \text{kg}^1\text{m}^{-2}. \quad (125)$$

Or taking into account the accuracy 10^{-9} of the Planck constants, which are determined on the basis of the characteristics of the muon:

$$\rho_{ps}^{\mu^-} = \frac{m_p^{\mu^-}}{(l_p^{\mu^-})^2} = 8.333\ 898\ 717 \cdot 10^{61}\ \text{kg}^1\text{m}^{-2}. \quad (126)$$

The estimate of the value of the density of the Planck mass $\rho_{pv}^{\mu^-}$:

$$\rho_{pv}^{\mu^-} = \frac{m_p^{\mu^-}}{(l_p^{\mu^-})^3} = 5.156\ 786\ 372\ 321\ 281\ 887... \cdot 10^{96}\ \text{kg}^1\text{m}^{-3}. \quad (127)$$

Or taking into account the accuracy 10^{-9} of the Planck constants, which are determined on the basis of the characteristics of the muon:

$$\rho_{pv}^{\mu^-} = \frac{m_p^{\mu^-}}{(l_p^{\mu^-})^3} = 5.156\ 786\ 372 \cdot 10^{96}\ \text{kg}^1\text{m}^{-3}. \quad (128)$$

Estimates of values: of the linear density of the Planck mass ρ_{pl}, of the surface density of the Planck mass ρ_{ps}, of the density of the Planck mass ρ_{pv} based on the Planck constants according to CODATA-2014 and taking into account the accuracy values 10^{-5} of the Planck mass :

$$\rho_{pl} = \frac{m_p}{l_p} = 1.346\ 64 \cdot 10^{27}\ \text{kg}^1\text{m}^{-1}, \quad (129)$$

$$\rho_{ps} = \frac{m_p}{(l_p)^2} = 8.331\ 96 \cdot 10^{61}\ \text{kg}^1\text{m}^{-2}, \quad (130)$$

$$\rho_{pv} = \frac{m_p}{(l_p)^3} = 5.155\ 18 \cdot 10^{96}\ \text{kg}^1\text{m}^{-3}. \quad (131)$$

Estimates of the main of Planck units of the electromagnetism which are determined on the basis of the characteristics of the muon:

The current of Planck $I_p^{\mu^-}$:

$$I_p^{\mu^-} = \frac{q_p}{t_p^{\mu^-}} = 3.479\ 199\ 648 \cdot 10^{25}\ \text{A},\ \left[\text{kg}^{\frac{1}{2}}\text{m}^{\frac{1}{2}}\text{s}^{-1}\right]. \quad (132)$$

The voltage of Planck $V_p^{\mu^-}$:

$$V_p^{\mu^-} = \frac{E_p^{\mu^-}}{q_p} = \frac{m_p^{\mu^-} c^2}{q_p} = 1.043\ 037\ 815 \cdot 10^{27}\ \text{V},\left[\text{kg}^{\frac{1}{2}}\text{m}^{\frac{3}{2}}\text{s}^{-2}\right]. \quad (133)$$

The impedance of Planck $Z_p^{\mu^-}$:

$$Z_p^{\mu^-} = \frac{V_p^{\mu^-}}{I_p^{\mu^-}} = 29.979\ 2458\ \Omega,\left[\text{m}^1\text{s}^{-1}\right]. \quad (134)$$

The electric capacitance of Planck $C_p^{\mu^-}$:

$$C_p^{\mu^-} = \frac{q_p}{V_p^{\mu^-}} = 1.798\ 157\ 26370 \cdot 10^{-45}\ \text{F},\left[\text{m}^{-1}\text{s}^2\right]. \quad (135)$$

The inductance of Planck $L_p^{\mu^-}$:

$$L_p^{\mu^-} = \frac{2E_p^{\mu^-}}{(I_p^{\mu^-})^2} = \frac{2m_p^{\mu^-} c^2}{(I_p^{\mu^-})^2} = 3.232\ 206\ 307 \cdot 10^{-42}\ H,\left[\Omega^1\text{s}^1\right],\left[\text{m}\right]. \quad (136)$$

The module of the magnetic induction of Planck $B_p^{\mu^-}$:

$$B_p^{\mu^-} = \frac{F_p^{\mu^-}}{q_p c} = 2.152\ 832\ 659 \cdot 10^{52}\ \text{Tl},\ [\text{kg}^{\frac{1}{2}}\text{m}^{\frac{-1}{2}}\text{s}^{-1}]. \quad (137)$$

The module of the magnetic field strength of Planck $H_p^{\mu^-}$:

$$H_p^{\mu^-} = \frac{B_p^{\mu^-}}{\mu_0} = 1.713\ 169\ 797 \cdot 10^{59}\ [\text{A}^1\text{m}^{-1}],\ [\text{kg}^{\frac{1}{2}}\text{m}^{\frac{-1}{2}}\text{s}^{-1}]. \quad (138)$$

The estimate of the Planck temperature $T_p^{\mu^-}$, which is determined on the basis of the characteristics of the muon:

$$T_p^{\mu^-} = \frac{E_p^{\mu^-}}{k} = 1.416\ 917\ 77 \cdot 10^{32}\ \text{K}. \quad (139)$$

The estimate of the total energy luminosity $S_p^{\mu^-}$ of a hypothetical Planck particle, which is determined on the basis of the characteristics of the muon:

$$S_p^{\mu^-} = \delta(T_p^{\mu^-})^4 = 2.285\ 545 \cdot 10^{121}\ \text{W}^1\text{m}^{-2}. \quad (140)$$

Estimates of the Planck constant over 2pi $\hbar$, which are determined on the basis of the characteristics of the muon:

$$\hbar = \frac{m_p^{\mu^-}(l_p^{\mu^-})^2}{t_p^{\mu^-}} = 1.054\ 571\ 800 \cdot 10^{-34}\ \text{Js}, \quad (141)$$

or:

$$\hbar = m_p^{\mu^-} l_p^{\mu^-} c = 1.054\ 571\ 800 \cdot 10^{-34}\ \text{Js}, \tag{142}$$

and too:

$$\hbar = m_e c \bar{\lambda}_C^e = m_e c \frac{\alpha^2}{4\pi R_\infty} = 1.054\ 571\ 8001 \cdot 10^{-34}\ \text{Js}. \tag{143}$$

Comparative analysis of formulas (9, 10) on the one hand and formulas (141, 142, 143) on the other hand with a Standardizing formula (12) shows that Planck's constants: of the length, of the mass, of the time, which are determined based on the characteristics of the muon, are more preferable in the application, than their standard values.

The accuracy of the operands in formulas (11, 143) is not lower than 10^{-10}, then taking into account formulas (141, 142), the estimate of the Planck constant over 2pi $\hbar$ can be represented as:

$$\hbar = 1.054\ 571\ 8001 \cdot 10^{-34}\ \text{Js}. \tag{144}$$

Estimates of the Gravitational constant G, which are determined on the basis of the characteristics of the muon:

$$G = \frac{(l_p^{\mu^-})^3}{m_p^{\mu^-} (t_p^{\mu^-})^2} = 6.673\ 045\ 869 \cdot 10^{-11} \text{m}^3 \text{kg}^{-1} \text{s}^{-2}, \tag{145}$$

or:

$$G = \frac{l_p^{\mu^-} c^2}{m_p^{\mu^-}} = 6.673\ 045\ 869 \cdot 10^{-11} \text{m}^3 \text{kg}^{-1} \text{s}^{-2}, \tag{146}$$

or:

$$G = \frac{\hbar c}{(m_p^{\mu^-})^2} = 6.673\ 045\ 867 \cdot 10^{-11} \text{m}^3 \text{kg}^{-1} \text{s}^{-2}, \tag{147}$$

or:

$$G = \frac{(l_p^{\mu^-})^2 c^3}{\hbar} = 6.673\ 045\ 871 \cdot 10^{-11} \text{m}^3 \text{kg}^{-1} \text{s}^{-2}, \tag{148}$$

or:

$$G = \frac{(t_p^{\mu^-})^2 c^5}{\hbar} = 6.673\ 045\ 871 \cdot 10^{-11} \text{m}^3 \text{kg}^{-1} \text{s}^{-2}, \tag{149}$$

or:

$$G = 10^7 \alpha \frac{(l_p^{\mu^-})^2 c^2}{e^2} = 6.673\ 045\ 870 \cdot 10^{-11} \text{m}^3 \text{kg}^{-1} \text{s}^{-2}, \tag{150}$$

or:

$$G = \frac{c^4}{F_p^{\mu^-}} = 6.673\ 045\ 869 \cdot 10^{-11} \text{m}^3 \text{kg}^{-1} \text{s}^{-2}, \tag{151}$$

or:

$$G = \frac{k^2 (T_p^{\mu^-})^2}{(m_p^{\mu^-})^2 F_p^{\mu^-}} = 6.673\ 045\ 871 \cdot 10^{-11} \text{m}^3 \text{kg}^{-1} \text{s}^{-2}. \tag{152}$$

The average value of the estimate of the Gravitational constant by the formulas (145 - 152):

$$G = 6.673\ 045\ 870 \cdot 10^{-11} \mathrm{m}^3 \mathrm{kg}^{-1} \mathrm{s}^{-2}. \quad (153)$$

Specify the estimated value of the elementary electric charge:

$$e = \sqrt{10^7 m_e \frac{\alpha^3}{4\pi R_\infty}} = 1.602\ 176\ 620\ 8020 \cdot 10^{-19}\ \mathrm{C}. \quad (154)$$

Or taking into account the accuracy of the operands:

$$e = 1.602\ 176\ 620\ 80 \cdot 10^{-19}\ \mathrm{C}. \quad (155)$$

Estimation of the basic characteristics of the hypothetical Planck particle based on the characteristics of the muon increases the accuracy of the values of some fundamental physical constants.

4 RESULTS

Table 1 presents the final results of research to improve the accuracy of some fundamental physical constants.

Name of the constant	Constant value CODATA-2014	Constants proposed in the research	The unit of measure
Gravitational constant	$6.674\ 08 \cdot 10^{-11}$	$6.673\ 045\ 870 \cdot 10^{-11}$	$m^{-3}\ kg^{-1}\ s^{-2}$
Planck constant	$1.054\ 571\ 800 \cdot 10^{-34}$	$1.054\ 571\ 8001 \cdot 10^{-34}$	$m^2\ kg^1\ s^{-2}$
Elementary charge	$1.602\ 176\ 620\ 8 \cdot 10^{-19}$	$1.602\ 176\ 620\ 80 \cdot 10^{-19}$	C
Planck length	$1.616\ 229 \cdot 10^{-35}$	$1.616\ 103\ 153 \cdot 10^{-35}$	m
Planck mass	$2.176\ 470 \cdot 10^{-8}$	$2.176\ 638\ 835 \cdot 10^{-8}$	kg
Planck time	$5.39116 \cdot 10^{-44}$	$5.390\ 739\ 861 \cdot 10^{-44}$	s
Planck temperature	$1.416\ 808 \cdot 10^{32}$	$1.416\ 917\ 77 \cdot 10^{32}$	K
Electron mass	$9.109\ 383\ 56 \cdot 10^{-31}$	$9.109\ 383\ 557\ 60 \cdot 10^{-31}$	kg
Proton mass	$1.672\ 621\ 898 \cdot 10^{-27}$	$1.672\ 621\ 897\ 680 \cdot 10^{-27}$	kg
Neutron mass	$1.674\ 927\ 471 \cdot 10^{-27}$	$1.674\ 927\ 471\ 46 \cdot 10^{-27}$	kg
Rydberg constant in *J*	$2.179\ 872\ 325 \cdot 10^{-18}$	$2.179\ 872\ 324\ 93 \cdot 10^{-18}$	J
Rydberg constant in Hz	$3.289\ 841\ 960\ 355 \cdot 10^{15}$	$3.289\ 841\ 960\ 355\ 2 \cdot 10^{15}$	Hz
Von Klitzing constant	25 812.807 4555	25 812.807 4554 31940	Ω
Constant Hartree energy	$4.359\ 744\ 650 \cdot 10^{-18}$	$4.359\ 744\ 649\ 86 \cdot 10^{-18}$	J
Josephson constant	$483\ 597.8525 \cdot 10^9$	$483\ 597.852\ 474 \cdot 10^9$	$Hz^1\ V^{-1}$

5 CONCLUSIONS

Since units of measurement of most constants and variables of gravitational and electromagnetic interactions can be expressed in units of measurement: of the length, of the mass and of the time, that is, through: meter, kilogram and second, it is convenient to choose Planck constants: of the length, of the mass, of the time as the basis of fundamental physical constants. However, in the practical use of these constants problems arise: 1) their low accuracy; 2) indirect, not direct connection with the characteristics of real elementary particles. To eliminate these problems, it is proposed to establish a direct relationship between the characteristics of the hypothetical Planck particle and the characteristics of the muon. Since the characteristics of the muon and the hypothetical Planck particle are golden algebraic fractals, this relationship can be established on the basis of the similarity coefficients of golden algebraic fractals. This approach improves the accuracy of the Planck length and of the Planck mass by three orders of magnitude, and of the Planck time by four orders of magnitude. Improving the accuracy of measurements of the characteristics of the muon will automatically increase the accuracy of all fundamental constants, which are determined on the basis of the Planck constants: of the length, of the mass, of the time.

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