Pi-Theory of the fundamental physical constants: metrological aspects

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The article presents the results of exact analytical calculations of values of fundamental physical constants – given the finite formulas and calculations. Presents comparison of some of the data CODATA 2010 with theoretical calculations.

1. Introduction

The author of this article proceed from the famous assumptions John A. Wheeler, that the direction of development of physics can be no physics $\rightarrow$ pregeometry and pregeometry $\rightarrow$ physics.

Conceptually, Pi-Theory of the fundamental physical constants (hereinafter Pi-Theory) is constructed in the area of development pregeometry $\rightarrow$ physics.

PI-Theory is based on the following assumptions:

1. Physical reality – is a single parametric space-time material environment (hereinafter the Environment).
2. Wednesday dwells only in the boundaries of extreme values of its parameters.
3. Each of the parameters of Environment has a finite range of your changes.
4. The maximum rate of change of parameters of the Environment has a limit.

The aim of this article is to present for physical community of concrete results PI-Theory in the field of fundamental Metrology - in determining the values of the fundamental physical constants (FPC). Issues related with section PI-Theory “Pregeometry” and subsection “Cosmology” section “Physics”, the article will not considered.

2. The final formulas and the calculated results

Clarification: if the designation of the parameter has a lower index of “ π ”, that is, first of all, means that it is parameter PI-Theory, and secondly, that this parameter has a theoretical value that can be used instead the true value of the parameter.

Table 1. Presents the calculation formulas for determining the values of the dimensionless FPC.

N	Name of parameter	Symbol	Calculation formula
1	scalar parameter of structure of space - time	$f_{\pi s}$	$f_{\pi s} = \sqrt[3]{\frac{f_{\pi se}^{\ 4}}{f_{\pi s0}}}$
2	scalar parameter of structure of space - time	$\vec{\vec{f}}_{\pi s}$	$\vec{\vec{f}}_{\pi s} = \sqrt[4]{f_{\pi s0} \cdot f_{\pi se}^{\ 3}}$
3	coefficient of asymmetry	k_{π}	$k_{\pi} = \sqrt[4]{\frac{\vec{\vec{f}}_{\pi s}}{f_{\pi s}}}$
4	coefficient of absolute stability	$k_{\pi st}$	$k_{\pi st} = k_{\pi}^{9}$
5	scalar parameter of elementary charge*	α_{π}	$\alpha_{\pi} = \alpha_{\pi e} / k_{\pi}$
6	constant of scale invariance	ψ_{π}	$\psi_{\pi} = \frac{8\pi^6}{\sqrt{\pi}} \cdot f_{\pi s}^3 \cdot \alpha_{\pi}^6$
7	the constant of parametric communication	β_{π}	$\beta_{\pi} = f_{\pi s} / \alpha_{\pi}$

N	Name of parameter	Symbol	Calculation formula
8	scalar parameter of the strong charge	$\alpha_{\pi s}$	$(\sqrt{2}\pi)^3 \cdot \pi^2 \cdot \alpha_{\pi x} \cdot \beta_{\pi} = (1+\triangle y_{\pi} \cdot \alpha_{\pi x})^3$
9	the coefficient of electroweak asymmetry	$k_{\pi w}$	$k_{\pi w} = k_{\pi} \cdot \frac{\alpha_{\pi e} \cdot \beta_{\pi e}}{f_{\pi s}} \cdot \frac{(1+\triangle y_{\pi} \cdot \alpha_{\pi})^3}{(1+\triangle y_{\pi e} \cdot \alpha_{\pi})^3}$
10	scalar parameter the weak charge	$\alpha_{\pi w}$	$\alpha_{\pi w} = k_{\pi w}^3 - 1$
11	electromagnetic constant asymmetry	$\Delta_{\pi a}$	$\Delta_{\pi a} = \alpha_{\pi e} - a_{\pi ex}$
12	electron magnetic moment anomaly	$a_{\pi e}$	$a_{\pi e} = \alpha_{\pi e}\left(1 - \frac{1}{k_{\pi}}\right) + a_{\pi ex}$
13	electron-proton mass ratio	$r_{\pi ep}$	$r_{\pi ep} = \frac{f_{\pi s} \cdot (1+\triangle y_{\pi} \cdot \alpha_{\pi})^3}{\sqrt[3]{\pi^2}} \cdot \left(1 - \frac{\alpha_{\pi}}{\alpha_{\pi s}}\right) \cdot k_{\pi st}$
14	electron-neutron mass ratio	$r_{\pi en}$	$r_{\pi en} = \frac{f_{\pi s} \cdot (1+\triangle y_{\pi} \cdot \alpha_{\pi})^3}{\sqrt[3]{\pi^2}} \cdot \frac{a_{\pi e} + \alpha_{\pi w}}{a_{\pi e} + \Delta_{\pi a}}$
15	neutron-proton mass ratio	$r_{\pi np}$	$r_{\pi np} = \left(1 - \frac{\alpha_{\pi}}{\alpha_{\pi s}}\right) \cdot \frac{a_{\pi e} + \Delta_{\pi a}}{a_{\pi e} + \alpha_{\pi w}} \cdot k_{\pi st}$
16	proton-neutron magnetic moment ratio	$r_{\pi\mu,pn}$	$r_{\pi\mu,pn} = -\frac{(\pi-1)^2}{\pi} \cdot \frac{(1+\alpha_{\pi w})^2}{(1+\Delta_{\pi a})^2}$
17	scalar parameter of substance quantity**	$p_{\pi s}$	

* – at the same time, the parameter is the root of the cubic equation (line 8).
** – the cosmological parameter. The formula is not given.

Table 2. Presents the results of theoretical calculations dimensionless FPC of Table 1.

N	Name of parameter	Symbol	The numerical value
1	scalar parameter of structure of space - time	$f_{\pi s}$	1.161 712 977 019 596 928 970 254 552 9785 x 10^{-3}
2	scalar parameter of structure of space - time	$\overleftrightarrow{f}_{\pi s}$	1.161 713 355 141 817 542 167 276 310 5792 x 10^{-3}
3	coefficient of asymmetry	k_{π}	1.000 000 081 371 686 023 215 889 742 4093
4	coefficient of absolute stability	$k_{\pi st}$	1.000 000 732 345 412 577 634 571 480 5245
5	scalar parameter of elementary charge	α_{π}	1.161 409 733 400 893 939 488 207 987 9548 x 10^{-3}
6	constant of scale invariance	ψ_{π}	1.669 642 831 928 813 892 580 472 149 4893 x 10^{-23}
7	the constant of parametric communication	β_{π}	1.000 261 099 601 615 200 373 179 794 6565
8	scalar parameter of the strong charge	$\alpha_{\pi s}$	15.711 152 080 759 781 419 544 767 260 121
9	the coefficient of electroweak asymmetry	$k_{\pi w}$	1.000 000 081 819 691 595 185 909 818 4577
10	scalar parameter the weak charge	$\alpha_{\pi w}$	2.454 590 948 689 440 753 881 892 x 10^{-7}
11	electromagnetic constant asymmetry	$\Delta_{\pi a}$	1.757 552 613 321 940 865 158 064 x 10^{-6}
12	electron magnetic moment anomaly	$a_{\pi e}$	1.159 652 180 787 571 998 623 049 923 493 x 10^{-3}
13	electron-proton mass ratio	$r_{\pi ep}$	5.446 170 218 699 090 667 403 109 649 777 x 10^{-4}
14	electron-neutron mass ratio	$r_{\pi en}$	5.438 673 446 906 118 561 918 007 850 167 x 10^{-4}
15	neutron-proton mass ratio	$r_{\pi np}$	1.001 378 419 180 000 000 000 000 000 000
16	proton-neutron magnetic moment ratio	$r_{\pi\mu,pn}$	-1.459 898 124 622 977 783 495 815 120
17	scalar parameter of substance quantity	$p_{\pi s}$	0.999 778 555 773 040 424 750 928 133 967

Table 3. Presents the calculation formulas for determining the values of the dimensional of FPC.

N	Name of parameter	Symbol	Calculation formula	Unit SGS
1	Compton wavelength	$\lambda_{\pi C0}$	$\lambda_{\pi C0} = 2 \cdot \sqrt{\frac{\psi_\pi}{\alpha_\pi \cdot \beta_\pi}}$	sm
2	Rydberg constant	$R_{\pi\infty 0}$	$R_{\pi\infty 0} = \frac{2\pi^2 \cdot \alpha_\pi^2}{\lambda_{\pi C0}}$	sm^{-1}
3	the coefficient of concordance	$\kappa_{\pi R}$	$\kappa_{\pi R} = \frac{R_{\pi\infty 0}}{\bar{R}_\infty}$	
4	Rydberg constant	$R_{\pi\infty}$	$R_{\pi\infty} = \frac{R_{\pi\infty 0}}{\kappa_{\pi R}}$	sm^{-1}
5	Compton wavelength	$\lambda_{\pi C}$	$\lambda_{\pi C} = 2\pi^2 \cdot \alpha_\pi^2 / R_{\pi\infty}$	sm
6	electron mass	$m_{\pi e}$	$m_{\pi e} = \pi^2 \cdot f_{\pi s}^3 \cdot \lambda_{\pi C}^2 \cdot \rho_{\pi Se}$	g
7	proton mass	$m_{\pi p}$	$m_{\pi p} = m_{\pi e} / r_{ep}$	g
8	proton Compton wavelength	$\lambda_{\pi C,p}$	$\lambda_{\pi C,p} = r_{ep} \cdot \lambda_{\pi C}$	sm
9	neutron mass	$m_{\pi n}$	$m_{\pi n} = m_{\pi e} / r_{en}$	g
10	neutron Compton wavelength	$\lambda_{\pi C,n}$	$\lambda_{\pi C,n} = r_{en} \cdot \lambda_{\pi C}$	sm
11	Planck mass	$m_{\pi P}$	$m_{\pi P} = m_{\pi e} / \psi_\pi$	g
12	Planck length	$l_{\pi P}$	$l_{\pi P} = \lambda_{\pi C} \cdot \psi_\pi$	sm
13	Planck time	$t_{\pi P}$	$t_{\pi P} = l_{\pi P} / c$	s
14	Planck constant	h_π	$h_\pi = m_{\pi P} \cdot l_{\pi P} \cdot c$	g sm^2 s^{-1}
15	Newtonian constant of gravitation	G_π	$G_\pi = h_\pi \cdot c / m_{\pi P}^2$	g^{-1} sm^3 s^{-2}
16	atomic mass constant	$m_{\pi u}$	$m_{\pi u} = \frac{8\pi^4 \cdot p_{\pi s}}{(2\pi - 1)^4 \cdot (1 + 2\pi \cdot f_{\pi s})} \cdot m_{\pi p}$	g

Table 4. Presents the results of theoretical calculations the values of the dimensional of FPC of Table 3. In the calculations we used: data of the table 2; the Rydberg's constant $R_\infty = 1{,}097\ 373\ 156\ 8539(55) \cdot 10^5 \left[sm^{-1} \right]$ (CODATA 2010); the speed of light $2{,}99792458 \cdot 10^{10} \left[sm \cdot s^{-1} \right]$; surface density of the mass of the electron $\rho_{\pi Se}$, the numerical value of the which in Pi-Theory is set to unity: $\rho_{\pi Se} = 1 \left[g \cdot sm^{-2} \right]$.

N	Name of parameter	Symbol	The numerical value (SGS)	Unit SGS
1	Compton wavelength	$\lambda_{\pi C0}$	2.397 686 311 973 620 014 643 x 10^{-10}	sm
2	Rydberg constant	$R_{\pi\infty 0}$	1.110 473 757 591 524 062 283 x 10^5	sm^{-1}
3	The coefficient of concordance	$\kappa_{\pi R}$	1.011 938 145 7946	
4	Rydberg constant	$R_{\pi\infty}$	1.097 373 156 8539 x 10^5	sm^{-1}
5	Compton wavelength	$\lambda_{\pi C}$	2.426 310 240 7357 x 10^{-10}	sm
6	electron mass	$m_{\pi e}$	9.109 382 325 3402 x 10^{-28}	g
7	proton mass	$m_{\pi p}$	1.672 621 669 8229 x 10^{-24}	g
8	proton Compton wavelength	$\lambda_{\pi C,p}$	1.321 409 857 4420 x 10^{-13}	sm

N	Name of parameter	Symbol	The numerical value (SGS)	Unit SGS
9	neutron mass	$m_{\pi n}$	1.674 927 243 6135 x 10^{-24}	g
10	neutron Compton wavelength	$\lambda_{\pi C,n}$	1.319 590 908 0246 x 10^{-13}	sm
11	Planck mass	$m_{\pi P}$	5.455 886 822 7026 x 10^{-5}	g
12	Planck length	$l_{\pi P}$	4.051 071 501 4798 x 10^{-33}	sm
13	Planck time	$t_{\pi P}$	1.351 291 999 9741 x 10^{-43}	s
14	Planck constant	h_{π}	6.626 069 154 6014 x 10^{-27}	g sm^2 s^{-1}
15	Newtonian constant of gravitation	G_{π}	6.673 381 632 9142 x 10^{-8}	g^{-1} sm^3 s^{-2}
16	atomic mass constant	$m_{\pi u}$	1.660 539 172 2265 x 10^{-24}	g

3. A table comparing the data CODATA 2010 with theoretical calculations

In accordance with the list of parameters of the tables 1 and 3, see: values FPC recommended CODATA (2010) for international use - of publication on the NIST website by address http://physics.nist.gov/cuu/Constants/index.html; the calculation results from tables 2 and 4; the results of data comparison (column 6), δ_r – the relative uncertainty.

Parameter *a*, CODATA	The numerical value SGS, CODATA 2010	Relative std. uncert. u_r	Parameter *a**, Pi-Theory	The numerical value SGS, Pi-Theory	$\delta_r = \frac{\bar{a} - a*}{a*}$
1	2	3	4	5	6
α	7.297 352 5698(24) x 10^{-3}	3.2 x 10^{-10}	$\alpha_{\pi} \cdot 2\pi$	7.297 352 572 519 857 x 10^{-3}	-3.7 x 10^{-10}
a_e	1.159 652 180 76(27) x 10^{-3}	2.3 x 10^{-10}	$a_{\pi e}$	1.159 652 180 787 572 x 10^{-3}	-0.2 x 10^{-10}
m_e / m_p	5.446 170 2178(22) x 10^{-4}	4.1 x 10^{-10}	$r_{\pi ep}$	5.446 170 218 699 091 x 10^{-4}	-1.6 x 10^{-10}
m_e / m_n	5.438 673 4461(32) x 10^{-4}	5.8 x 10^{-10}	$r_{\pi en}$	5.438 673 446 906 119 x 10^{-4}	-1.4 x 10^{-10}
m_n / m_p	1.001 378 419 17(45)	4.5 x 10^{-10}	$r_{\pi np}$	1.001 378 419 179 999	-0.1 x 10^{-10}
μ_p / μ_n	-1.459 898 06(34)	2.4 x 10^{-7}	$r_{\pi\mu,pn}$	-1.459 898 124 622 978	-0.4 x 10^{-7}
R_{∞}	1.097 373 156 8539(55) x 10^5	5.0 x 10^{-12}	$R_{\pi\infty}$	1.097 373 156 8539 x 10^5	0
λ_C	2.426 310 2389(16) x 10^{-10}	6.5 x 10^{-10}	$\lambda_{\pi C}$	2.426 310 240 7357 x 10^{-10}	-7.5 x 10^{-10}
m_e	9.109 382 91(40) x 10^{-28}	4.4 x 10^{-8}	$m_{\pi e}$	9.109 382 325 3402 x 10^{-28}	-6.4 x 10^{-8}
m_p	1.672 621 777(74) x 10^{-24}	4.4 x 10^{-8}	$m_{\pi p}$	1.672 621 669 8229 x 10^{-24}	6.4 x 10^{-8}
$\lambda_{C,p}$	1.321 409 856 23(94) x 10^{-13}	7.1 x 10^{-10}	$\lambda_{\pi C,p}$	1.321 409 857 4420 x 10^{-13}	-9.1 x 10^{-10}
m_n	1.674 927 351(74) x 10^{-24}	4.4 x 10^{-8}	$m_{\pi n}$	1.674 927 243 6135 x 10^{-24}	6.4 x 10^{-8}
$\lambda_{C,n}$	1.319 590 9068(11) x 10^{-13}	8.2 x 10^{-10}	$\lambda_{\pi C,n}$	1.319 590 908 0246 x 10^{-13}	-9.2 x 10^{-10}
m_P	2.176 51(13) x 10^{-5}	6.0 x 10^{-5}	$m_{\pi P} / \sqrt{2\pi}$	2.176 583 930 6611 x 10^{-5}	-3.4 x 10^{-5}
l_P	1.616 199(97) x 10^{-33}	6.0 x 10^{-5}	$l_{\pi P} / \sqrt{2\pi}$	1.616 143 702 8696 x 10^{-33}	3.4 x 10^{-5}
t_P	5.391 06(32) x 10^{-44}	6.0 x 10^{-5}	$t_{\pi P} / \sqrt{2\pi}$	5.390 875 119 5788 x 10^{-44}	3,4 x 10^{-5}
h	6.626 069 57(29) x 10^{-27}	4.4 x 10^{-8}	h_{π}	6.626 069 154 6014 x 10^{-27}	6.2 x 10^{-8}
G	6.673 84(80) x 10^{-8}	1.2 x 10^{-4}	G_{π}	6.673 381 632 9142 x 10^{-8}	0.6 x 10^{-4}
m_u	1.660 538 921(73) x 10^{-24}	4.4 x 10^{-8}	$m_{\pi u}$	1.660 539 172 2265 x 10^{-24}	-15.1 x 10^{-8}