Theoretical determination of the values of the fundamental physical constants: brand new unified approach

© V.B. Smolenskii 2014

abstract: describes a fundamentally new unified approach theoretical determination of the values of the fundamental physical constants. Founded by the author of this article Pi-Theory of the fundamental physical constants (Pi-Theory) allows to determine the are all are dimensional constant with the accuracy of Rydberg's constant and dimensionless constants with any required accuracy. There are presented the results of analytical calculations. Comparison of the adduced data CODATA 2010 with datas of the Theory of fully confirms the theoretical calculations of the Theory. When theoretical determining the of the fine structure constant and abnormal magnetic moment of the electron is no need to use the method of successive approximations of the perturbation theory.

keywords: CODATA, NIST, Pi-Theory, Newton, Planck, Rydberg, Avogadro, electron, proton, neutron.

Table 1. There are presented the results of analytical calculations of the values of the dimensionless fundamental physical constants.

Quantity	Symbol	Value (Pi-Pheory)
	Elementary constants	
electromagnetic constant asymmetry	$\Delta_{\pi a}$	1.757 552 613 321 940 865 158 064 461 x 10^{-6}
parameter of structure of space-time	$f_{\pi s}$	1.161 712 977 019 596 928 970 254 552 x 10^{-3}
parameter of elementary charge	$\kappa_{\pi e}$	1.161 409 733 400 893 939 488 207 987 x 10^{-3}
	Compound constants	
constant of scale invariance	ψ_{π}	1.669 642 831 928 813 892 580 472 149 x 10^{-23}
electron magnetic moment anomaly	$a_{\pi \mathrm{e}}$	1,159 652 180 787 571 998 623 049 923 x 10^{-3}
electron-proton mass ratio	$r_{\pi \mathrm{ep}}$	5,446 170 218 699 090 667 403 109 650 x 10^{-4}
electron-neutron mass ratio	$r_{\pi \mathrm{en}}$	5,438 673 446 906 118 561 918 007 850 x 10^{-4}
neutron-proton mass ratio	$r_{\pi \mathrm{np}}$	1,001 378 419 180 000 000 000 000 000
proton-neutron magnetic moment ratio	$r_{\pi\mu,\mathrm{pn}}$	-1,459 898 124 622 977 783 495 815 120

Note to table 1: basic constants $\Delta_{\pi a}$, $f_{\pi s}$ and $\kappa_{\pi e}$ are the result of careful analytical solution of three independent equations of the Theory! All other fundamental physical constants consist only of these three elementary for constants.

Table 2. Presents the results of analytical calculations of the values of the fundamental physical constants. In the calculations used the data table 1, the of Rydberg's constant $R_{\infty} = 1{,}097\ 373\ 156\ 8539(55) \cdot 10^5\ \mathrm{sm}^{-1}$, the speed of light $c = 2{,}997\ 924\ 58 \cdot 10^{10}\ \mathrm{sm} \cdot \mathrm{s}^{-1}$ (CODATA, 2010) and the surface the density of the mass of the electron, the value of which in Pi-Theory is set to unity: $\rho_{\mathrm{Se}} = 1\ g \cdot sm^{-2}$.

Quantity	Symbol	Formula (Pi-Theory)	Value (SGS)	Unit (SGS)
1	2	3	4	5
fine-structure constant	α_{π}	$\alpha_{\pi} = 2\pi \cdot \kappa_{\pi e}$	7.297 352 572 519 857 x 10^{-3}	-
electron magnetic moment anomaly	$a_{\pi \mathrm{e}}$	$a_{\pi \mathrm{e}} = \kappa_{\pi e} - \Delta_{\pi a}$	1.159 652 180 787 572 x 10^{-3}	-

Quantity	Symbol	Formula (Pi-Theory)	Value (SGS)	Unit (SGS)
1	2	3	4	5
Compton wavelength	$\lambda_{\pi\mathrm{C}}$	$\lambda_{\pi\mathrm{C}} = 2\pi^2 \cdot \kappa_{\pi e}^2 / \bar{R}_\infty$	2.426 310 240 7357 x 10^{-10}	sm
classical electron radius	$r_{\pi\mathrm{e}}$	$r_{\pi\mathrm{e}} = \kappa_{\pi e} \cdot \lambda_{\pi\mathrm{C}}$	2.817 940 329 8407 x 10^{-13}	sm
Bohr radius	$a_{\pi 0}$	$a_{\pi 0} = \lambda_{\pi C} / 2\pi \cdot \alpha_\pi$	0.529 177 211 1187 x 10^{-8}	sm
electron mass	$m_{\pi\mathrm{e}}$	$m_{\pi\mathrm{e}} = \pi^2 \cdot f_{\pi\mathrm{s}}^3 \cdot \lambda_{\pi\mathrm{C}}^2 \cdot \rho_{\mathrm{Se}}$	9.109 382 325 3402 x 10^{-28}	g
electron-proton mass ratio	$r_{\pi\mathrm{ep}}$	$r_{\pi\mathrm{ep}} \equiv m_\mathrm{e} / m_\mathrm{p}$	5.446 170 218 699 091 x 10^{-4}	-
proton mass	$m_{\pi\mathrm{p}}$	$m_{\pi\mathrm{p}} = m_{\pi\mathrm{e}} / r_{\mathrm{ep}}$	1.672 621 669 8229 x 10^{-24}	g
proton Compton wavelength	$\lambda_{\pi\mathrm{C,p}}$	$\lambda_{\pi\mathrm{C,p}} = r_{\mathrm{ep}} \cdot \lambda_{\pi\mathrm{C}}$	1.321 409 857 4420 x 10^{-13}	sm
electron-neutron mass ratio	$r_{\pi\mathrm{en}}$	$r_{\pi\mathrm{en}} \equiv m_\mathrm{e} / m_\mathrm{n}$	5.438 673 446 906 119 x 10^{-4}	-
neutron mass	$m_{\pi\mathrm{n}}$	$m_{\pi\mathrm{n}} = m_{\pi\mathrm{e}} / r_{\mathrm{en}}$	1.674 927 243 6135 x 10^{-24}	g
neutron Compton wavelength	$\lambda_{\pi\mathrm{C,n}}$	$\lambda_{\pi\mathrm{C,n}} = r_{\mathrm{en}} \cdot \lambda_{\pi\mathrm{C}}$	1.319 590 908 0246 x 10^{-13}	sm
neutron-proton mass ratio	$r_{\pi\mathrm{np}}$	$r_{\pi\mathrm{np}} = r_{\pi\mathrm{ep}} / r_{\pi\mathrm{en}}$	1.001 378 419 179 999	-
proton-neutron magnetic moment ratio	$r_{\pi\mu,\mathrm{pn}}$	$r_{\pi\mu,\mathrm{pn}} \equiv \mu_\mathrm{p} / \mu_\mathrm{n}$	$-1.459\ 898\ 124\ 622\ 978$	-
Planck length	$l_{\pi\mathrm{P}}$	$l_{\pi\mathrm{P}} = \lambda_{\pi\mathrm{C}} \cdot \psi_\pi / \sqrt{2\pi}$	1.616 143 702 8696 x 10^{-33}	sm
Planck mass	$m_{\pi\mathrm{P}}$	$m_{\pi\mathrm{P}} = m_{\pi\mathrm{e}} / \sqrt{2\pi} \cdot \psi_\pi$	2.176 583 930 6611 x 10^{-5}	g
Planck time	$t_{\pi\mathrm{P}}$	$t_{\pi\mathrm{P}} = l_{\pi\mathrm{P}} / c$	5.390 875 119 5790 x 10^{-44}	s
quantum of circulation	$q_{\pi c}$	$q_{\pi c} = \lambda_{\pi\mathrm{C}} \cdot c$	7.273 895 109 4073	$\mathrm{sm^2\ s^{-1}}$
Planck constant	h_π	$h_\pi = m_{\pi\mathrm{e}} \cdot \lambda_{\pi\mathrm{C}} \cdot c$	6.626 069 154 6014 x 10^{-27}	$\mathrm{g\ sm^2\ s^{-1}}$
elementary charge	e_π	$e_\pi = \left(\kappa_{\pi e} \cdot h_\pi \cdot c\right)^{1/2}$	4.803 204 354 1649 x 10^{-10}	$\mathrm{g^{1/2}\ sm^{3/2}\ s^{-1}}$
Newtonian constant of gravitation	G_π	$G_\pi = h_\pi \cdot c / m_{\pi\mathrm{P}}^2$	6.673 381 632 9142 x 10^{-8}	$\mathrm{g^{-1}\ sm^3\ s^{-2}}$
Avogadro constant	$N_{\pi\mathrm{A}}$	$N_{\pi\mathrm{A}} = 1 / m_{\pi u}$	6.022 140 379 0140 x 10^{23}	$\mathrm{g^{-1}}$

Table 3. In accordance with the list of table 2, shows sample values of the fundamental physical constants recommended CODATA (2010) for international use – publishing on the website NIST (http://physics.nist.gov/cuu/Constants/index.html); results of calculations from table 2; the results of data comparison are presented in column 6, δ_r – the relative uncertainty.

Parameter *a*, symbol CODATA	Value, (SGS) CODATA 2010	Relative std. uncert. u_r	Parameter *a**, symbol Pi-Theory	Value, (SGS) Pi-Theory	$\delta_r = \frac{a^* - \bar{a}}{\bar{a}}$
1	2	3	4	5	6
α	7.297 352 5698(24) x 10^{-3}	3.2 x 10^{-10}	α_π	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}	$a_{\pi\mathrm{e}}$	1.159 652 180 787 572 x 10^{-3}	0.2 x 10^{-10}
λ_C	2.426 310 2389(16) x 10^{-10}	6.5 x 10^{-10}	$\lambda_{\pi\mathrm{C}}$	2.426 310 240 7357 x 10^{-10}	7.5 x 10^{-10}
r_e	2.817 940 3267(27) x 10^{-13}	9.7 x 10^{-10}	$r_{\pi\mathrm{e}}$	2.817 940 329 8407 x 10^{-13}	11.1 x 10^{-10}
a_0	0.529 177 210 92(17) x 10^{-8}	3.2 x 10^{-10}	$a_{\pi 0}$	0.529 177 211 1187 x 10^{-8}	3.7 x 10^{-10}
m_e	9.109 382 91(40) x 10^{-28}	4.4 x 10^{-8}	$m_{\pi\mathrm{e}}$	9.109 382 325 3402 x 10^{-28}	-6.4 x 10^{-8}
$m_{\pi\mathrm{e}} / r_{\mathrm{ep}}$	5.446 170 2178(22) x 10^{-4}	4.1 x 10^{-10}	$r_{\pi\mathrm{ep}}$	5.446 170 218 699 091 x 10^{-4}	1.6 x 10^{-10}
m_p	1.672 621 777(74) x 10^{-24}	4.4 x 10^{-8}	$m_{\pi\mathrm{p}}$	1.672 621 669 8229 x 10^{-24}	-6.4 x 10^{-8}

Parameter *a*, symbol CODATA	Value, (SGS) CODATA 2010	Relative std. uncert. u_r	Parameter *a**, symbol Pi-Theory	Value, (SGS) Pi-Theory	$\delta_r = \frac{a^* - \bar{a}}{\bar{a}}$
1	2	3	4	5	6
$\lambda_{C,p}$	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_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	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_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}
l_P	1.616 199(97) x 10^{-33}	6.0 x 10^{-5}	$l_{\pi P}$	1.616 143 702 8696 x 10^{-33}	- 3.4 x 10^{-5}
m_P	2.176 51(13) x 10^{-5}	6.0 x 10^{-5}	$m_{\pi P}$	2.176 583 930 6611 x 10^{-5}	3.4 x 10^{-5}
t_P	5.391 06(32) x 10^{-44}	6.0 x 10^{-5}	$t_{\pi P}$	5.390 875 119 5790 x 10^{-44}	- 3.4 x 10^{-5}
h / m_e	7.273 895 1040(47)	6.5 x 10^{-10}	$q_{\pi c}$	7.273 895 109 4073	7.4 x 10^{-10}
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}
e	4.803 204 27(12) x 10^{-10}	2.5 x 10^{-8}	e_π	4.803 204 354 1649 x 10^{-10}	- 1.7 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}
N_A	6.022 141 29(27) x 10^{23}	4.4 x 10^{-8}	$N_{\pi A}$	6.022 140 379 0140 x 10^{23}	15.1 x 10^{-8}

Explanatory notes on the definition of values α and a_e

In view of the fact that $\Delta_{\pi a}$ and $\kappa_{\pi e}$ are independent from each other, then of the to condition

$$a_{\pi e} = \kappa_{\pi e} - \Delta_{\pi a} \tag{1}$$

There are the following options:

1. From the condition (1) $\kappa_{\pi e}$ can be written unknown value κ_x, if $\Delta_{\pi a}$ and a_e are known:

$$\kappa_x = a_e + \Delta_{\pi a} \tag{2}$$

and then the fine structure constant α_x:

$$\alpha_x = 2\pi \cdot \kappa_x . \tag{3}$$

2. From the condition (1), $a_{\pi e}$ can be written unknown value a_{ex}, if $\Delta_{\pi a}$ and κ_e are known:

$$a_{ex} = \kappa_e - \Delta_{\pi a} \tag{4}$$

where $\kappa_e = \alpha / 2\pi$, then magnetic moment of the electron anomaly a_{ex} :

$$a_{ex} = \alpha / 2\pi - \Delta_{\pi a} . \tag{5}$$

Values α_x and are a_{ex} determined by direct calculation, therefore the method of successive approximations of the perturbation theory the Pi-Theory is not used.

Note that all the mentioned in this article fundamental physical constants are defined with the precision of a Rydberg's constant.

E-mail: alphapi@yandex.ru