Constants of Physics and Mathematics

a selection compiled by Stanislav Sýkora, Extra Byte, Castano Primo, Italy.

Stan's Library, ISSN 2421-1230, Vol.I., First release March 1, 2005. Permalink via DOI: 10.3247/SL2Phys07.001
Based on the latest CODATA 2010 values and their successive improvements!

Physics BOOKS | SI Units | SI Dimensions MATHEMATICAL Constants (on a separate page) Physics LINKS | Stan's HUB

This is a **constant-at-a-glance** list. You can also download a PDF version of this document for off-line use. But keep coming back, the list is growing!

Constant	Value	Dimension	Alias	Definition & Notes
Universal constants used in too many categories to constrain their scope				
Speed of light c	**2.997 924 580 e+8**	$m.s^{-1}$	m/s	**Assigned** (see SI units)
Permeability of vacuum μ_0	**12.566 370 614 359 ... e-7**	$kg.m.s^{-2}.A^{-2}$	H/m | N/A^2	$= 4\pi.10^{-7}$. **Assigned**.
Permittivity of vacuum ε_0	**8.854 187 817 620 ... e-12**	$kg^{-1}.m^{-3}.s^4.A^2$	F/m	$= 1 / (c^2 \mu_0)$. **Assigned**.
Gravitation constant G	**6.673 84[80] e-11**	$kg^{-1}.m^3.s^{-2}$		force $= G M_1 M_2 / r_{12}^2$
Planck constant h	**6.626 069 57[29] e-34**	$kg.m^2.s^{-1}$	J.s	= (energy transfer quantum)/(channel frequency)
Angular Planck constant	1.054 571 726[47] e-34	$kg.m^2.s^{-1}$	J.s	$= h/2\pi$, the **angular momentum quantum**
Charge/Quantum ratio	2.417 989 348[53] e+14	$kg^{-1}.m^{-2}.s^2.A$	A/J	= e / h
Elementary charge e	**1.602 176 565[35] e-19**	s.A	C	
Quantum/Charge ratio	4.135 667 52[10] e-15	$kg.m^2.s^{-2}.A^{-1}$	J/A	= h / e
Fine structure constant α	7.297 352 5698[24] e-3	**Dimensionless**		$= \mu_0 c e^2 / 2h$.
Inverse of fine structure constant	137.035 999 074[45]	**Dimensionless**		$= 1/\alpha = 2h / (\mu_0 c e^2)$. See ref.[1].
Boltzmann constant k	**1.380 6488[13] e-23**	$kg.m^2.s^{-2}.K^{-1}$	J/K	Sets thermodynamic temperature
Planck mass m_p	2.176 51[13] e-8	kg		$m_p^2 = (h/2\pi) c / G$
Planck time t_p	5.391 06[32] e-44	s		$= (h/2\pi) / (m_p c^2)$
Planck length l_p	1.616 199[97] e-35	m		$= c t_p$

Planck temperature	1.416 833[85] e+32	K		= $m_p c^2$ / k
Electromagnetic constants other than those already listed				
Impedance of vacuum Z_0	**376.730 313 461 ...**	$kg.m^2.s^{-3}.A^{-2}$	Ω	Derived from **assigned**'s: $Z_0^2 = \mu_0/\varepsilon_0$.
Magnetic flux quantum Φ_0	2.067 833 758[46] e-15	$kg.m^2.s^{-2}.A^{-1}$	Wb	= h / 2e
Josephson constant K_J	4.835 978 70[11] e14	$kg^{-1}.m^{-2}.s^2.A$	Hz/V	= 2e / h . Conventional: **483597.9 GHz/V**
von Klitzing constant R_K	2.581 280 744 34[84] e+4	$kg.m^2.s^{-3}.A^{-2}$	Ω	= h / e^2. Conventional: **25812.807 Ω**
Conductance quantum G_0	7.748 091 7346[25] e-5	$kg^{-1}.m^{-2}.s^3.A^2$	S	= $2e^2$ / h = 2 / R_K
Inverse of conductance quantum	1.290 640 372 17[42] e+4	$kg.m^2.s^{-3}.A^{-2}$	Ω	= R_K / 2
Electromagnetic radiation constants. For **solar constant**, see solar system				
Stefan-Boltzmann const. σ	5.670 373[21] e-8	$kg.s^{-3}.K^{-4}$	$W/m^2.K^4$	= 2 π^5 k^4 / 15 h^3 c^2
1st radiation constant c_1	3.741 771 53[17] e-16	$kg.m^4.s^{-3}$	$W.m^2$	= 2 π h c^2
2nd radiation constant c_2	1.438 7770[13] e-2	m.K		= h c / k
Wien λ displacement constant $\lambda_{max}T$	2.897 7721[26] e-3	m.K		= c_2 / 4.9651423...
Wien f displacement constant f/T	5.878 9254[53] e+10	$s^{-1}.K^{-1}$	Hz/K	
Max. luminous efficacy: absolute	683	$cd.sr.kg^{-1}.m^{-1}.s^3$	lm/W	100% efficient, ideal 555 nm light source.
Max. luminous efficacy: black-body	95	$cd.sr.kg^{-1}.m^{-1}.s^3$	lm/W	Achieved at 7000 °K
Solar luminous efficacy	93	$cd.sr.kg^{-1}.m^{-1}.s^3$	lm/W	see Wikipedia
Solar illuminance	1.280[10] e5	$cd.sr.m^{-2}$	lx	in the brightest sunlight, on Earth
Electron and atomic physics constants				
Rydberg constant R∞	1.097 373 156 8539[55] e+7	m^{-1}	m^{-1}	= c α^2 m_e / 2h
Hartree energy E_H	4.359 744 34[19] e-18	$kg.m^2.s^{-2}$	J	= α^2 m_e c^2 = 2h c R∞
Bohr radius	5.291 772 1092[17] e-11	m	m	= α / (4π R∞)
Bohr magneton μ_B	9.274 009 68[20] e-24	$m^2.A$	J/T	= (1/2)(h/2π)(e/m_e)
Bohr magneton in Hz/T	1.399624555[31] e+10	$kg^{-1}.s.A$	Hz/T	= μ_B/h = [Larmor frequency]/[g-factor]; ~ 14 GHz/T
Quantum of circulation	3.636 947 5520[24] e-4	$m^2.s^{-1}$	m^2/s	= h / 2m_e
Richardson constant	1.20173 e+6	$A.m^{-2}.K^{-2}$		= 4π$em_e k^2$ / h^3; arises in thermionic emission
Electron *(stable lepton, charge -1, spin 1/2, fermion, its antiparticle* ***positron*** *has positive charge)*				
Electron rest mass m_e	**9.109 382 91[40] e-31**	kg		= 5.485 799 0946[22] e-4 u

Electron rest energy ($m_e c^2$)	8.187 105 06[36] e-14	$kg.m^2.s^{-2}$	J	= 0.510 998 928[11] MeV
Electron charge/mass ratio	- 1.758 820 088[39] e11	$kg^{-1}.s.A$	C/kg	= e / m_e
Compton wavelength of electron $\lambda_{C,e}$	2.426 310 2389[16] e-12	m		= h / c m_e
Classical electron radius r_e	2.817 940 3267[27] e-15	m		= e^2 / ($4\pi\varepsilon_0 m_e c^2$)
Thomson cross section σ_e	0.665 245 8734[13] e-28	m^2		= $(8\pi/3)\ r_e^2$
Electron magnetic moment μ_e	**- 9.284 764 30[21] e-24**	$m^2.A$	J/T	
Electron g-factor g_e	- 2.002 319 304 361 53[53]	**Dimensionless**		= (μ_e / μ_B) / S_e
Electron magnetic moment anomaly	1.159 652 180 76[27] e-3	Dimensionless		= (abs(g_e) - 2) / 2
Electron gyromagnetic ratio $\gamma_e/2\pi$	28.024 952 66[62] e+9	$kg^{-1}.s.A$	Hz/T	= μ_e / (hS_e); ~ 28 GHz/T
Electron/Proton mass ratio	5.446 170 2178[22] e-4	**Dimensionless**		
Electron/Proton magnetic moments ratio	- 658.210 6848[54]	**Dimensionless**		
Electron/Proton magnetic moments ratio	- 658.227 597 1[72]	Dimensionless		**Shielded** in water; standard conditions

Physico-chemical constants

Atomic mass constant u	**1.660 538 921[73] e-27**	kg		Mass of ^{12}C nuclide / 12
Molar mass of ^{12}C	**12 e-3**	kg		**Assigned**
Molar mass constant	**1.0 e-3**	$kg.mol^{-1}$	kg/mol	**Assigned**
Boltzmann constant k	**1.380 6488[13] e-23**	$kg.m^2.s^{-2}.K^{-1}$	J/K	Sets thermodynamic temperature
Boltzmann constant in eV/K	8.617 3324[78] e-5	$kg.m^2.s^{-3}.A^{-1}.K^{-1}$	V/K	= k/e. Electrochemical potential ~ (k/e)T ln(c1/c2)
Avogadro's number N_A	**6.022 141 29[27] e+23**	mol^{-1}	count/mol	~ 602 **Z** *(Zetta)* particles in a mole of substance
Molar Planck constant	3.990 312 7176[28] e-10	$kg.m^2.s^{-1}.mol^{-1}$	J.s/mol	= h N_A
Molar Planck constant by c	0.119 626 565 779[84]	$kg.m^3.s^{-2}.mol^{-1}$	J.m/mol	= h c N_A
Electron molar mass	5.485 799 0946[22] e-7	$kg.mol^{-1}$	kg/mol	= m_e N_A
Electron molar charge	- 9.648 533 65[21] e+4	$s.A.mol^{-1}$	C/mol	= e N_A.
Faraday constant F	+9.648 533 65[21] e+4	$s.A.mol^{-1}$	C/mol	= |electron molar charge|.
Molar gas constant R	8.314 4621[75]	$kg.m^2.s^{-2}.K^{-1}.mol^{-1}$	J/K.mol	= k N_A
Molar volume of ideal gas V_m	22.413 968[20] e-3	$m^3.mol^{-1}$	m^3/mol	= (RT/p) at T=273.15 K, p=101325 Pa
Loschmidt constant n_0	2.686 7805[24] e+25	m^{-3}	count/m^3	= N_A / V_m at T=273.15 K, p=101325 Pa
Sackur-Tetrode constant S_0/R	- 1.164 8708[23]	**Dimensionless**		(5/2)+ln[($2\pi m_u kT/h^2$)(kT/p)] at T=1K, p=101325 Pa.

Basic nuclear physics data (those listed in CODATA)

Fermi coupling $G_F/(hc/2\pi)^3$	**3.670 336[31] e+48**	kg^{-2}		= (1.026 8365[88] e-5) / m_p^2
Fermi coupling in eV^{-2}	1.166 364[5] e+4	eV^{-2}		
Weak mixing angle $\sin^2\theta_W$	**0.2223[21]**	**Dimensionless**		= 1- $(m_W/m_Z)^2$
Nuclear magneton μ_N	5.050 783 53[11] e-27	$m^2.A$	J/T	= (1/2)(h/2π)(e/m_p)
Nuclear magneton in Hz/T	7.622 593 57[17] e+6	$kg^{-1}.s.A$	Hz/T	= μ_N/h = [Larmor frequency]/[g-factor]; ~ 7.6 MHz/T
Proton *(stable baryon, nucleon, hadron, charge +1, spin 1/2, fermion, parity +, isospin 1/2, its anti-particle antiproton has opposite charge)*				
Proton rest mass m_p	**1.672 621 777[74] e-27**	kg		1.007 276 466 812[90] u
Proton rest energy (mc^2)	1.503 277 484[66] e-10	$kg.m^2.s^{-2}$	J	938.272 046[21] MeV; quarks composition: **uud**
Proton / electron mass ratio	1836.15267245[75]	**Dimensionless**		inverse: 5.4461702178[22]e-4
Compton wavelength of proton $\lambda_{C,p}$	1.321 409 856 23[94] e-15	m		$\lambda_{C,p}$ = h / c m_p
Proton rms charge radius	**0.8775[51] e-15**	m		
Proton magnetic moment	**1.410 606 743[33] e-26**	$m^2.A$	J/T	**μ_p**
Proton g-factor	5.585 694 713[46]	Dimensionless		= μ_p / (S_p μ_N)
Proton gyromagnetic ratio	42.577 4806[10] e+6	$kg^{-1}.s.A$	Hz/T	**γ_p** = μ_p / h S_p.
Proton gyromagnetic ratio shielded	42.576 388 1[12] e+6	$kg^{-1}.s.A$	Hz/T	In H_2O, standard conditions
Proton magnetic shielding	**25.694[14] e-6**	Dimensionless		Relative value for pure water at 25 °C
Electric dipole moment	**< 8.7 e-45**	m.s.A	C.m	< 5.4 e-24 e.cm; existence not confirmed
Electric polarizibility	**1.20[6] e-48**	m^3		
Magnetic polarizibility	**1.9[5] e-49**	m^3		
Neutron *(baryon, nucleon, hadron, charge 0, spin 1/2, fermion, parity +, isospin 1/2, its anti-particle is* ***antineutron****)*				
Neutron rest mass m_n	**1.674 927 351[74] e-27**	kg		1.008 664 916 00[43] u
Neutron rest energy (mc^2)	1.505 349 631[66] e-10	$kg.m^2.s^{-2}$	J	939.565 379[21] MeV; quarks composition **udd**
Compton wavelength of neutron $\lambda_{C,n}$	1.319 590 9068[11] e-15	m		$\lambda_{C,n}$ = h / c m_n
Neutron half-life time	**881.5[15]**	s		Beta-decay into proton + e^- + ν_e
Neutron magnetic moment	**- 0.966 236 47[23] e-26**	$m^2.A$	J/T	**μ_n**
Neutron g-factor	- 3.826 085 45[90]	Dimensionless		= μ_n / (S_n μ_N)
Neutron gyromagnetic ratio	29.164 6943[69] e+6	$kg^{-1}.s.A$	Hz/T	**γ_n** = μ_n / h S_n
Electric dipole moment	**< 4.6 e-47**	m.s.A	C.m	< 2.9 e-26 e.cm; existence not confirmed
Electric polarizibility	**1.16[15] e-48**	m^3		

Magnetic polarizibility	**3.7[20] e-49**	m^3		
Deuteron *(stable nuclide, protons 1, neutrons 1, charge +1, spin 1, boson)*				
Deuteron rest mass	**3.343 583 48[15] e-27**	kg		2.013 553 212 712[77] u
Deuteron rest energy (mc^2)	3.005 062 97[13] e-10	$kg.m^2.s^{-2}$	J	1875.612 859[41] MeV
Deuteron rms charge radius	2.1424[21] e-15	m		
Deuteron magnetic moment	**0.433 073 489[10] e-26**	$m^2.A$	J/T	
Deuteron g-factor	0.857 438 2308[72]	Dimensionless		
Deuteron gyromagnetic ratio	6.535 903 381 41 e+6	$kg^{-1}.s.A$	Hz/T	
Deuteron quadrupole moment	4.581 e-50	$m^2.s.A$	$C.m^2$	$0.2859\ e(fm)^2$
Triton *(stable nuclide, protons 1, neutrons 2, charge +1, spin 1/2, fermion)*				
Triton rest mass	**5.007 356 30[22] e-27**	kg		3.015 500 7134[25] u
Triton rest energy (mc^2)	4.500 387 41[20] e-10	$kg.m^2.s^{-2}$	J	2808.921 005[62] MeV
Triton half-life time	**3.888[70] e+8**	s		= 12.32 years; beta-decay into $^3He + e^- + \nu_e$
Triton magnetic moment	**1.504 609 447[38] e-26**	$m^2.A$	J/T	
Triton g-factor	5.957 924 896[76]	Dimensionless		
Triton gyromagnetic ratio	45.413 674 6[13] e+6	$kg^{-1}.s.A$	Hz/T	
Helion *(stable nuclide, protons 2, neutrons 1, charge +2, spin 1/2, fermion, nuclide)*				
Helion rest mass	**5.006 412 34[22] e-27**	kg		3.014 932 2468[25] u
Helion rest energy (mc^2)	4.499 539 02[20] e-10	$kg.m^2.s^{-2}$	J	2808.391 482[62] MeV
Helion magnetic moment	**- 1.074 617 486[27] e-26**	$m^2.A$	J/T	Shielded
Helion g-factor	- 4.255 250 613[50]	Dimensionless		
Helion gyromagnetic ratio	32.434 101 98[90] e+6	$kg^{-1}.s.A$	Hz/T	Shielded
Alpha particle *(stable nuclide, protons 2, neutrons 2, charge +2, spin 0, magnetic moment 0, boson)*				
α-particle rest mass	**6.644 656 75[29] e-27**	kg		4.001 506 179 125[62] u
α-particle rest energy (mc^2)	5.971 919 67[26] e-10	$kg.m^2.s^{-2}$	J	3727.379 240[82] MeV
Particle physics data (source: Particle Data Group)				
Neutrinos ν (stable leptons, charge 0, exist in e,μ,τ flavors, each has matter / anti-matter version with opposite chirality, spin 1/2, fermions)				
Electron neutrino ν_e rest energy (mc^2)	max 3.5 e-13	$kg.m^2.s^{-2}$	J	**0 to 2.2** eV
Muon neutrino ν_μ rest energy (mc^2)	max 0.27 e-13	$kg.m^2.s^{-2}$	J	**0 to 0.17** MeV

Tau neutrino v_τ rest energy (mc^2)	max 24.8 e-13	$kg.m^2.s^{-2}$	J	**0 to 15.5** MeV
Muon μ± *(lepton, charge ±1, matter μ^-, antimatter μ^+, spin 1/2, fermion)*				
Muon rest energy (mc^2)	1.692 833 667[86] e-11	$kg.m^2.s^{-2}$	J	**105.658 3715[35]** MeV
Muon rest mass	1.883 531 475[96] e-28	kg		0.113 428 9267[29] u
Muon magnetic moment	**- 4.490 448 07[15] e-26**	$m^2.A$	J/T	
Muon g-factor g_μ	- 2.002 331 8418[13]	Dimensionless		$(\mu / \mu_B) * (m / m_e) /$ spin
Muon magnetic moment anomaly	1.165 920 91[63] e-3	Dimensionless		$(abs(g_\mu) - 2) / 2$
Muon gyromagnetic ratio	135.538 817[12] e+6	$kg^{-1}.s.A$	Hz/T	$= \mu_n / h S_n$
Muon half-life time	**1.52 e-6**	s		
Tau τ± *(lepton, charge ±1, matter τ^-, antimatter τ^+, spin 1/2, fermion)*				
Tau rest energy (mc^2)	2.846 78[26] e-10	$kg.m^2.s^{-2}$	J	**1776.82[16]** MeV
Tau rest mass	3.167 47[29] e-27	kg		1.907 49[17] u
Tau half-life time	**2.9 e-13**	s		
Quarks with charge +2/3 (baryon number 1/3, exist in u,c,t flavors, each has matter / anti-matter versions with some property flipped, spin 1/2, fermions)				
u (up) quark rest energy (mc^2)	3.8 e-13	$kg.m^2.s^{-2}$	J	**2.4** MeV, **stable**
c (charm) quark rest energy (mc^2)	2.03 e-10	$kg.m^2.s^{-2}$	J	**1.27** GeV, unstable
t (top) quark rest energy (mc^2)	2.743 e-8	$kg.m^2.s^{-2}$	J	**171.2** GeV, terribly unstable
Quarks with charge -1/3 (baryon number 1/3, exist in d,s,b flavors, each has matter / anti-matter versions with some property flipped, spin 1/2, fermions)				
d (down) quark rest energy (mc^2)	7.7 e-13	$kg.m^2.s^{-2}$	J	**4.8** MeV, **stable**
s (strange) quark rest energy (mc^2)	1.67 e-11	$kg.m^2.s^{-2}$	J	**104** MeV, unstable
b (bottom) quark rest energy (mc^2)	6.7 e-10	$kg.m^2.s^{-2}$	J	**4.2** GeV, unstable
Pions π± *(mesons, hadrons, charge ±1, anti-particles of each other, spin 0, boson, parity -, isospin 1)*				
Pions $\pi^\pm$ rest energy (mc^2)	2.236 1607[56] e-11	$kg.m^2.s^{-2}$	J	**139.570 18[35]** MeV
Pions $\pi^\pm$ rest mass	2.488 0643[62] e-28	kg		0.149 834 75[37] u
Pions $\pi^\pm$ half-life time	**2.6 e-8**	s		quarks composition: π^+: **ud'**, π^-: **du'**
Pion π^0 *(meson, hadron, charge 0, its own antiparticle, spin 0, boson, parity -,C-parity +, isospin 1)*				
Pion π^0 rest energy (mc^2)	2.162 5634[96] e-11	$kg.m^2.s^{-2}$	J	**134.976 60[60]** MeV
Pion π^0 rest mass	2.406 176[11] e-28	kg		0.144 903 34[64] u
Pion π^0 half-life time	**8.4 e-17**	s		quarks composition: **(uu'-dd')/&radiv;2**

Kaons $K^{\pm}$ *('strange' mesons, hadrons, charge ±1, anti-particles of each other, spin 0, boson, parity -, isospin 1/2)*				
Kaons $K^{\pm}$ rest energy (mc^2)	7.909 58[26] e-11	$kg.m^2.s^{-2}$	J	**493.677[16]** MeV
Kaons $K^{\pm}$ rest mass	8.800 591[29] e-28	kg		0.529 984[17] u
Kaons $K^{\pm}$ half-life time	**1.2380[21] e-8**	s		quarks composition: K^+: **us'**, K^-: **su'**
Kaon K^0 *('strange' meson, hadron, charge 0, self-antiparticle, spin 0, boson, isospin 1/2, parity -)*				
Kaon K^0 rest energy (mc^2)	7.972 65[38] e-11	$kg.m^2.s^{-2}$	J	**497.614[24]** MeV; quarks: see below
Kaon K^0 rest mass	8.870 77[42] e-28	kg		0.534 211[26] u
Kaon K^0_L half-life time (long)	**5.116[20] e-8**	s		quarks composition: **(ds'+sd')/√2**
Kaon K^0_S half-life time (short)	**8.953[5] e-11**	s		quarks composition: **(ds'-sd')/√2**
Eta mesons *η and η' (hadrons, charge 0, antiparticles of each other, spin integer, bosons,*				
η rest energy (mc^2)	8.777 57[38] e-11	$kg.m^2.s^{-2}$	J	**547.853[24]** MeV
η rest mass	9.766 36[42] e-28	kg		0.588 144[25] u
η half-life time	**5.0[3] e-19**	s		quarks composition: **(uu'+dd'-2ss')/√6**
η' rest energy (mc^2)	1.53434[38] e-10	$kg.m^2.s^{-2}$	J	**957.66[24]** MeV
η' rest mass	1.70718[43] e-27	kg		1.02809[26] u
η' half-life time	**3.2[2] e-21**	s		quarks composition: **(uu'+dd'+ss')/√3**
*Lambda hyperons (baryons, charge 0 or +1, spin 1/2, fermions, parity +; predicted only: top Λ_t^+, quarks **udt**, but t-quark decays before it hadronizes)*				
Λ^0 rest energy (mc^2)	1.7875211[96] e-10	$kg.m^2.s^{-2}$	J	**1.1156830[60]** GeV; charge 0
Λ^0 rest mass	1.988885[11] e-27	kg		1.1977349[64] u
Λ^0 half-life time	**2.631[20] e-10**	s		quarks composition: **uds**
Bottom Λ^0_b rest energy (mc^2)	9.0046[26] e-10	$kg.m^2.s^{-2}$	J	**5.6202[16]** GeV; charge 0
Bottom Λ^0_b rest mass	1.00189[29] e-26	kg		6.0335[17] u
Bottom Λ^0_b half-life time	**1.409[55] e-12**	s		quarks composition: **udb**
Charmed Λ^+_c rest energy (mc^2)	3.66331[22] e-10	$kg.m^2.s^{-2}$	J	**2.28646[14]** GeV; charge +1
Charmed Λ^+_c rest mass	4.07599[25] e-27	kg		2.45462[15] u
Charmed Λ^+_c half-life time	**2.000[60] e-13**	s		quarks composition: **udc**
*Sigma hyperons with spin 1/2 (barions, charge -1, 0, +1 or +2, fermions, parity +; predicted only: **udb**, **uut**, **udt**, **ddt**)*				
Σ^+ rest energy (mc^2)	1.90558[11] e-10	$kg.m^2.s^{-2}$	J	**1.189370[70]** GeV; charge +1
Σ^+ rest mass	2.12024[12] e-27	kg		1.276841[75] u

Σ^+ half-life time	**8.018[26] e-11**	s		quarks composition: **uus**
Σ^0 rest energy (mc^2)	1.910823[38] e-10	$kg.m^2.s^{-2}$	J	**1.192642[24]** GeV; charge 0
Σ^0 rest mass	2.126077[43] e-27	kg		1.280353[26] u
Σ^0 half-life time	**7.40[70] e-20**	s		quarks composition: **uds**
Σ^- rest energy (mc^2)	1.918525[48] e-10	$kg.m^2.s^{-2}$	J	**1.197449[30]** GeV; charge -1
Σ^- rest mass	2.13465[53] e-27	kg		1.285514[32] u
Σ^- half-life time	**1.479[11] e-10**	s		quarks composition: **dds**
Charmed Σ_c^{++} rest energy (mc^2)	3.93177[29] e-10	$kg.m^2.s^{-2}$	J	**2.45402[18]** GeV; charge +2
Charmed Σ_c^{++} rest mass	4.37469[32] e-27	kg		2.63450[19] u
Charmed Σ_c^{++} half-life time	**3.00[40] e-22**	s		quarks composition: **uuc**
Charmed Σ_c^{+} rest energy (mc^2)	3.92998[64] e-10	$kg.m^2.s^{-2}$	J	**2.45290[40]** GeV; charge +1
Charmed Σ_c^{+} rest mass	4.37269[71] e-27	kg		2.63330[43] u
Charmed Σ_c^{+} half-life time	**>1.4 e-22**	s		quarks composition: **udc**
Charmed Σ_c^{0} rest energy (mc^2)	3.93136[29] e-10	$kg.m^2.s^{-2}$	J	**2.45376[18]** GeV; charge 0
Charmed Σ_c^{0} rest mass	4.37422[32] e-27	kg		2.63422[19] u
Charmed Σ_c^{0} half-life time	**3.0 e-22**	s		quarks composition: **ddc**
Bottom Σ_b^{+} rest energy (mc^2)	9.3051[62] e-10	$kg.m^2.s^{-2}$	J	**5.8078[39]** GeV; charge +1
Bottom Σ_b^{+} rest mass	1.03533[69] e-26	kg		6.2349[42] u
Bottom Σ_b^{+} half-life time	?	s		quarks composition: **uub**
Bottom Σ_b^{-} rest energy (mc^2)	9.3170[43] e-10	$kg.m^2.s^{-2}$	J	**5.8152[27]** GeV; charge -1
Bottom Σ_b^{-} rest mass	1.03665[48] e-26	kg		6.2429[30] u
Bottom Σ_b^{-} half-life time	?	s		quarks composition: **ddb**
*Sigma* hyperons with spin 3/2 (barions, charge -1, 0, +1 or +2, fermions, parity +; predicted only: **uub**, **udb**, **ddb**, **uut**, **udt**, **ddt**)*				
Σ^{*+} rest energy (mc^2)	2.21549[64] e-10	$kg.m^2.s^{-2}$	J	**1.38280[40]** GeV; charge +1
Σ^{*+} rest mass	2.46506[71] e-27	kg		1.48450[43] u
Σ^{*+} half-life time	**1.840[40] e-23**	s		quarks composition: **uus**
Σ^{*0} rest energy (mc^2)	2.21693[16] e-10	$kg.m^2.s^{-2}$	J	**1.38370[10]** GeV; charge 0
Σ^{*0} rest mass	2.46667[18] e-27	kg		1.48546[11] u
Σ^{*0} half-life time	**1.80[30] e-23**	s		quarks composition: **uds**

Σ^{*-} rest energy (mc^2)	2.22254[80] e-10	$kg.m^2.s^{-2}$	J	**1.38720[50]** GeV; charge -1
Σ^{*-} rest mass	2.47291[89] e-27	kg		1.48922[54] u
Σ^{*-} half-life time	**1.670[90] e-23**	s		quarks composition: **dds**
Charmed Σ^{*++}_c rest energy (mc^2)	4.03492[96] e-10	$kg.m^2.s^{-2}$	J	**2.51840[60]** GeV; charge +2
Charmed Σ^{*++}_c rest mass	4.4894[11] e-27	kg		2.70361[64] u
Charmed Σ^{*++}_c half-life time	**4.40[60] e-23**	s		quarks composition: **uuc**
Charmed Σ^{*+}_c rest energy (mc^2)	4.0335[37] e-10	$kg.m^2.s^{-2}$	J	**2.5175[23]** GeV; charge +1
Charmed Σ^{*+}_c rest mass	4.4879[41] e-27	kg		2.7026[25] u
Charmed Σ^{*+}_c half-life time	> **3.9 e-23**	s		quarks composition: **udc**
Charmed Σ^{*0}_c rest energy (mc^2)	4.03428[80] e-10	$kg.m^2.s^{-2}$	J	**2.518** GeV; charge 0
Charmed Σ^{*0}_c rest mass	4.48874[89] e-27	kg		2.70318[54] u
Charmed Σ^{*0}_c half-life time	**4.10[50] e-23**	s		quarks composition: **ddc**
*Xi hyperons (barions, charge -1, 0, +1, spin 1/2, fermions, parity +; predicted only: **ucc**, **ubb**, **dbb**, **ucb**, **dcb**)*				
Ξ^0 rest energy (mc^2)	2.106638[32] e-10	$kg.m^2.s^{-2}$	J	**1.31486[20]** GeV; charge 0
Ξ^0 rest mass	2.34395[35] e-27	kg		1.41156[21] u
Ξ^0 half-life time	**2.900[90] e-10**	s		quarks composition: **uss**
Ξ^- rest energy (mc^2)	2.11697[21] e-10	$kg.m^2.s^{-2}$	J	**1.32131[13]** GeV; charge -1
Ξ^- rest mass	2.35544[23] e-27	kg		1.41848[14] u
Ξ^- half-life time	**1.639[15] e-10**	s		quarks composition: **dss**
Charmed Ξ_c^+ rest energy (mc^2)	3.95401[64] e-10	$kg.m^2.s^{-2}$	J	**2.46790[40]** GeV; charge +1
Charmed Ξ_c^+ rest mass	4.39943[71] e-27	kg		2.64940[43] u
Charmed Ξ_c^+ half-life time	**4.42[26] e-13**	s		quarks composition: **usc**
Charmed Ξ_c^0 rest energy (mc^2)	3.95898[64] e-10	$kg.m^2.s^{-2}$	J	**2.47100[40]** GeV; charge 0
Charmed Ξ_c^0 rest mass	4.40496[71] e-27	kg		2.65273[43] u
Charmed Ξ_c^0 half-life time	**1.12[13] e-13**	s		quarks composition: **dsc**
Double charmed Ξ_{cc}^+ rest energy (mc^2)	5.6379[14] e-10	$kg.m^2.s^{-2}$	J	**3.51890[90]** GeV; charge +1
Double charmed Ξ_{cc}^+ rest mass	6.2730[16] e-27	kg		3.77769[97] u
Double charmed Ξ_{cc}^+ half-life time	**< 3.3 e-14**	s		quarks composition: **dcc**
Bottom Ξ_b^0 rest energy (mc^2)	9.2798[48] e-10	$kg.m^2.s^{-2}$	J	**5.7920[30]** GeV; charge 0

Bottom Ξ_b^0 rest mass	1.0325[53] e-26	kg		6.2180[32] u
Bottom Ξ_b^0 half-life time	**1.42[28] e-12**	s		quarks composition: **usb**
Bottom Ξ_b^- rest energy (mc^2)	9.2815[48] e-10	$kg.m^2.s^{-2}$	J	**5.7929[30]** GeV; charge -1
Bottom Ξ_b^- rest mass	1.0335[53] e-26	kg		6.2191[32] u
Bottom Ξ_b^- half-life time	**1.42[28] e-12**	s		quarks composition: **dsb**
Ξ resonances: {**uss**, S=3/2, 1.53180[32] GeV}, {**dss**, S=3/2, 1.53500[60] GeV}, {**usc**, S=1/2, 2.57570[31] GeV}, {**dsc**, S=1/2, 2.57800[29] GeV, 1.1e-13 s},				
*Omega hyperons (barions, charge -1 or 0, spin 1/2 or 3/2, fermions, parity +; predicted only: **scc**, **scb**, **sbb**, **ccc**, **ccb**, **cbb**, **bbb**)*				
Ω^- rest energy (mc^2)	2.67956[46] e-10	$kg.m^2.s^{-2}$	J	**1.67245[29]** GeV; charge -1, spin 3/2
Ω^- rest mass	2.98141[52] e-27	kg		1.79544[31] u
Ω^- half-life time	**8.21[11] e-11**	s		quarks composition: **sss**
Charmed Ω^0_c rest energy (mc^2)	4.3219[41] e-10	$kg.m^2.s^{-2}$	J	**2.6975[26]** GeV; charge 0, spin 1/2
Charmed Ω^0_c rest mass	4.8087[28] e-27	kg		2.8959[28] u
Charmed Ω^0_c half-life time	**6.9[12] e-14**	s		quarks composition: **ssc**
Bottom Ω^-_b rest energy (mc^2)	9.700[11] e-10	$kg.m^2.s^{-2}$	J	**6.0544[68]** GeV; charge -1, spin 1/2
Bottom Ω^-_b rest mass	1.0793[12] e-26	kg		6.49967[73] u
Bottom Ω^-_b half-life time	**1.13[53] e-12**	s		quarks composition: **ssb**
$W^\pm$ gauge boson (charge ±1, matter W^-, antimatter W^+, spin 1)				
W boson rest energy (mc^2)	1.28791[24] e-8	$kg.m^2.s^{-2}$	J	**80.385[15]** GeV
W boson rest mass	1.432993[25] e-25	kg		86.296[16] u
Z gauge boson (charge 0, spin 1)				
Z boson rest energy (mc^2)	1.460986[33] e-8	$kg.m^2.s^{-2}$	J	**91.1876[21]** GeV
Z boson rest mass	1.625566[37] e-25	kg		97.8939[23] u
*Higgs boson H^0 (charge 0, spin 0, **predicted only**, **not found**)*				
H^0 rest energy (mc^2)	2.0042[34] e-8	$kg.m^2.s^{-2}$	J	**125.09[21]** GeV; ATLAS/CMS 26 Mar 2015
H^0 rest mass	2.2299[37] e-25	kg		134.29[23] u
H^0 half-life time	**1.56 e-22**	s		h/(2πΓ), predicted Γ = 4.21 MeV

Cosmic microwave background **(CMB)**

Mean apparent CMB **temperature**	**2.72548[57]**	K	Kelvin	From CMB black-body radiation spectrum
rms variations of CMB temperature	**1.8 e-7**	K		18 μK; deviations from perfect isotropy

Peak frequency density v_{max}	1.6023 e+11	Hz		160.23 GHz, corresponding to λ = 1.871 mm
Peak wavelength density λ_{max}	1.063 e-3	m		1.063 mm, corresponding to 318.7 GHz
Metrics of the known Universe (for the prefixes **M** (Mega), **G** (Giga), **Z** (Zetta), and **Y** (Yocto), click here)				
Diameter visible by Hubble telescope	**8.80[10] e+26**	m		~ 93 **G** light-years
Volume of the visible sphere	3.60[10] e+80	m^3		~ 420 **MY** light-$years^3$ *(Mega-Yocta)*
Mass contained therein	**3.56[10] e+54**	kg		~ 3.56 **MYY** kg; mostly dark energy & matter
Mean density	9.90[20] e-27	$kg.m^{-1}$	kg/m	~ 9.9 e-30 g/ml
Age, assuming Big Bang theory	**4.366[54] e+17**	s		~ 13.75±0.17 **G** years
Mean expansion rate	**2.29[13] e-18**	s^{-1}		~ 70.8±4.0 (km/s)/**M**pc *(km/s per Megaparsec)*
Number of stars	**3.0[10] e+23**	Dimensionless		~ 300 **Z** , or 0.5 mols of stars
Number of galaxies	**1.25[20] e+11**	Dimensionless		~ 125 **G**, or 0.2 pico-mols of galaxies
Number of fundamental particles	1.00[25] e+80	Dimensionless		~ 100 **MYYY** *(Mega-Yocto-Yocto-Yocto)*
Mean concentration of particles	0.28[10]	m^{-3}	counts/m^3	~ 4.5e-28 molar "solution"
Milky Way galaxy. Type **BSc** (barred spiral), lentil-shaped, 9 arms, center in the direction of Sagittarius constellation				
Diameter	1.04[10] e+21	m		100000 - 120000 light-years (30 - 37 Kpc)
Thickness	1.00[10] e+19	m		~1000 light-years (~300 pc)
Mass	2.50[50] e+42	kg		1.25[25] e+12 solar masses
Number of stars	3.0[10] e+11	Dimensionless	count	~300 e+9
Oldest known star	4.156[50] e+17	s		13.2 e+9 years
Speed with respect to CMB	5.520[60] e+5	$m.s^{-1}$		552 ± 6 km/s; the absolute galaxy motion
Angle between **galactic plane** and the ecliptic	1.05[10]	rad		~60 degrees
Milky Way arms *look like logarithmic-spirals; galaxy is a kind of vortex and its apparent features keep changing faster than the motions of its stars*				
Arms pattern rotation (apparent)	1.58[15] e+15	s		~50 million years; move like ripple patterns
Milky Way central bar				
Bar pattern rotation period (apparent)	5.20[47] e+14	s		15-18 million years; moves like a ripple pattern
Solar system data; see also NASA Planetary Fact Sheets				
Distance to Milky Way galaxy center	2.57[10] e+20	m		27200 ±1100 light-years
Rotation around galaxy center: period	7.49[39] e+15	s		225 - 250 million years

Rotation around galaxy center: orbital speed	2.20 e+5	$m.s^{-1}$	m/s	approximately opposed to absolute galaxy motion
Absolute speed with respect to CMB	3.7 e+5	$m.s^{-1}$	m/s	370 km/s; 0.123% of the speed of light
Extension (max.aphelion of a minor planet)	1.598 e+14	m		over 1068 au; planetoid (87269) 2000 OO67
Distance to nearest-neighbour system	3.970[50] e+16	m		4.2 light-years; Proxima Centauri
The Sun; spectral class G2V, main sequence (V) yellow dearf (G2). Composition: 73.46% H, 24.85% He, 0.77% O, 0.29 C, 0.16% Fe, 0.12% Ne, 0.09% N				
Mass	1.98910[20] e+30	kg		330'000 times that of Earth
Mean radius	6.9550[50] e+8	m		109.2 times that of Earth
Flattening	9 e-6	Dimensionless		(equatorial - polar)/equatorial radii
Volume	1.41226[50] e+27	m^3		1'304'000 times that of Earth
Mean density	1.408 e+3	$kg.m^{-3}$	kg/m^3	0.255 times that of Earth
Surface gravity on equator	2.74 e+2	$m.s^{-2}$	m/s^2	27.94 g
Escape velocity	6.176 e+2	$m.s^{-1}$	m/s	55.2 times that of Earth
Photosphere temperature	5778	K		In the layer emitting the light we see
Absolute visual magnitude	+4.83	Dimensionless		see stellar magnitudes (Conventional constants)
Radiance I_{sol}	2.009 e+7	$W.m^2.sr^{-1}$		total from the layer emitting the light we see
Luminose efficacy	98	$lm.kg^{-1}.m^{-2}.s^3$	lm/W	see "Electromagnetic radiation constants"
Luminosity L_{sol}	3.841[14] e+26	$kg.m^2.s^{-3}$	W	~3.75 e+28 lm
Loss of mass due to elmag radiation	4.273[16] e+9	$kg.s^{-1}$	kg/s	<electromagnetic power output> / c^2
Total neutrino emissions	1.830[50] e+38	s^{-1}	count/s	Mean value (very variable)
Age	1.4420[14] e+17	s		4.57 e+9 years
*Planet Earth in relation to the Sun and the Solar system. The orbit of Earth defines the **ecliptic plane**.*				
Earth aphelion, largest distance from Sun	1.52098232 e+11	m		1.01671388 au
Earth perihelion, smallest distance from Sun	1.47098290 e+11	m		0.98329134 au
Longitude of ascending node	6.08665006	rad		348.73936 degrees
Argument of perihelion	1.9933026	rad		114.20783 degrees
Semi-major orbital axis	1.49598261 e+11	m		1.00000261 au
Earth orbit inclination to Sun equator	0.1249	rad		7.155 degrees
Earth orbit inclination to invariable plane	0.0275533	rad		1.57869 degrees
Earth orbital excentricity	0.01671123	Dimensionless		will be about 0.015 after 5000 years

Mean anomaly of Earth orbit	3.5751716 e+2	Dimensionless		
Earth mean orbital velocity	2.9780 e+4	$m.s^{-1}$	m/s	107200 km/h
Sun visual brightess from the Earth	-26.74	Dimensionless		see stellar magnitudes (Conventional constants)
Sun angular diameter seen from the Earth	0.00919 - 0.00951	rad		Varies between 0.527 and 0.545 degrees
Solar constant (mean value for Earth)	1.36594[48] e3	$kg.s^{-3}$	W/m^2	Elmag irradiation from Sun at 1 AU distance
Solar neutrinos flux on Earth surface	6.50[10] e+14	$m^{-2}.s^{-1}$		Mean count per m^2 per second; very variable
Satellites count	1 natural	Dimesionless		994 artificial (December 2011)
Planets: see the PDF document SOLAR SYSTEM PLANETS AT A GLANCE and the NASA Planetary Fact Sheets				
Number of planets	8	Dimensionless	count	Planetary data table
*Minor planets; see also **NASA Facts Sheets**: Pluto, Chiron, Asteroids, Comets,*				
Registered, with known orbits	583'767	Dimensionless	count	Apr 2012; ~3000 are added every month
Numbered minor planets	326'266	Dimensionless	count	Apr 2012
Named minor planets	17'055	Dimensionless	count	Apr 2012
*Planet Earth (**Terra**) data, other than those listed above; see also NASA Earth Fact Sheet*				
Age	1.4327[14] e+17	s		4.54 e+9 years
Global composition in weight %	Fe 32.1, O 30.1, Si 15.1, Mg 13.9, S 2.9, Ni 1.8, Ca 1.5, Al 1.4, the rest: 1.2			
Atmospheric composition in weight %	N_2 78.08, O_2 20.95, Ar 0.93, CO_2 0.038, the rest: 0.002; extra: 1% of H_2O wapor (variable)			
Mass	5.9736 e+24	kg		
Volume	1.08321 e+21	m^3		108.321 km^3
Mean density	5.515 e+3	$kg.m^{-3}$	kg/m^3	5.515 g/cm^3
Mean radius	6.3710 e+6	m		this is volumetric mean
Equatorial radius	6.3781 e+6	m		6378.1 km; circumpherence 40075.017 km
Polar radius	6.3568 e+6	m		6356.8 km; circumpherence 40007.860 km
Flattening	0.00335	Dimensionless		f = (a-b)/a; a = equatorial, b = polar radius
Surface area	5.100720 e+14	m^2		5.100720 e+8 km^2
Dry land surface area	1.48940 e+14	m^2		1.48940 e+8 km (29.200 %)^2
Surface temperature, mean	287.2	K		14.0 °C; range 184 to 331 K (-90 to 58 °C))
Surface pressure, mean	1.01325 e+5	$kg.m^{-1}.s^{-2}$	Pa	1 atm = 101325 Pa
Equatorial surface gravity	9.780327	$m.s^{-2}$	m/s^2	0.99732 g

Escape velocity	1.1186 e+4	$m.s^{-1}$	m/s	11.186 km/s
Albedo, geometric	0.367	Dimensionless		
Albedo, Bond	0.306	Dimensionless		
Sidereal rotation period	8.616410 e+4	s		0.99726968 days, or 23 h 56 m 4.100 s
Equatorial rotation speed	465.1	$m.s^{-1}$	m/s	0.4651 km/s (4.1579 % of escape volocity))
Axial tilt	0.40763819	rad		23.355948 °, or 23 ° 26' 21“.4119
Radius of the core	3.485 e+6	m		3485 km
Average lunar month	2.5514430[5] e+6	s		29 days+ 12 hours+ 44 minutes+ 3 seconds
Conventional constants				
Molar mass constant	**0.001**	$kg.mol^{-1}$	kg/mol	**Assigned** (exact)
Molar mass of ^{12}C	**0.012**	kg		**Assigned** (exact)
Standard gravity acceleration	**9.806 65**	$m.s^{-2}$	m/s^2	**Assigned**. Called **1 g** (gee).
Standard atmosphere	**101 325**	Pa		**Assigned**. Called **1 atm** .
***Stellar magnitudes**. Reference points: **Apparent** brightness: bolometric, initially Vega was 0 (now it is +0.03). **Absolute**: the Sun is 4.83 (used to be 4.75)*				
Stellar apparent magnitude unit	**2.511 886 431 509 580 ...**	Dimensionless	a ratio	$100^{1/5} = 10^{0.4}$; also stellar **brightness**
Stellar absolute magnitude unit	**2.511 886 431 509 580 ...**	Dimensionless	a ratio	Brightness of a star when distant 10 parsecs
Conventional engineering constants. See also Math constants pertinent to Engineering definitions				
dBm				
0 dBm power	**0.001**	$kg.m^2.s^{-3}$	Watts	**1 mW; assigned**
0 dBm potential	0.774 596 669 241 483 ...	$kg.m^2.s^{-3}.A^{-1}$	Volts	1 mW into **600 Ohm** load
0 dBm current	0.001 290 994 448 736 ...	A	Amperes	1 mW into **600 Ohm** load
dBW				
0 dBW power	**1.0**	$kg.m^2.s^{-3}$	Watts	**1 W; assigned**
0 dBW potential	7.071 067 811 865 475 ...	$kg.m^2.s^{-3}.A^{-1}$	Volts	sqrt(Z_0); 1 W into **50 Ohm** load Z_0
0 dBW current	0.141 421 356 237 310 ...	A	Amperes	sqrt($1/Z_0$); 1 W into **50 Ohm** load Z_0
Conversion of dBW into dBm (additive)	+30	Dimensionless	dB	In terms of power
***Relative luminance Y of RGB color primaries**: Y = 0.2126.R + 0.7152.G + 0.0722.B. More info ...*				
Relative luminance of Red/RGB	**0.2126**	Dimensionless	a ratio	
Relative luminance of Green/RGB	**0.7152**	Dimensionless	a ratio	Human eye is most sensitive to green

Relative luminance of Blue/RGB	**0.0722**	Dimensionless	a ratio	
Music and acoustics				
Frequency of the A4 reference note	**440.0**	s^{-1}	Hz	ISO 16
Full-octave frequency ratio	**2.0** exact	Dimensionless	Ratio	C,C#,D,D#,E,F,F#,G,G#,A,A#,B,...next C
Half-tone frequency ratio $2^{1/12}$	**1.059 463 094 359 295 ...**	Dimensionless	Ratio	12 half-tones per octave, each worth 100 cents
Conversion factors for entities tolerated by SI, as well as some others				
Energy & its equivalents				
Electron volt	1.602 176 565[35] e-19	$kg.m^2.s^{-2}$	J	Basic eV-to-SI conversion
Electron volt to mass	1.782 661 845[39] e-36	kg		mass = energy/c^2
Electron volt to atomic units u	1.073 544 150[24] e-9	-	u	a mass equivalent
Electron volt to frequency	2.417 989 348[53] e+14	s^{-1}	Hz	frequency = energy/h
Electron volt to half-life time	6.582 119 28[22] e-16	s		Inverse relationship: $\tau = h/(2\pi\Gamma)$
Joul to eV	6.241 509 34[14] e+18	-	eV	Basic SI-to-eV conversion
Mass to eV	5.609 588 85[12] e+35	-	eV	energy = mass.c^2
Atomic unit u to eV	931.494 061[21] e+6	-	eV	a bit less than 1 GeV/atomic_unit
Frequency (1 Hz) to eV	4.135 667 516[91] e-15	-	eV	energy = frequency*h
Atomic mass constant u, m_u	1.660 538 921[73] e-27	kg		Mass of ^{12}C nuclide / 12
Atomic mass energy (uc^2)	1.492 417 954[66] e-10	$kg.m^2.s^{-2}$	J	931.494 061[21] MeV
Length / Distance				
Astronomical unit ua, au	1.49597870[30] e+11	m	~150 Gm	Mean Earth-to-Sun distance
Light-year **ly**	**9.4607304725808 e+15**	m	~9.5 Pm	Exact: light covers it in one Julian year
Parsec **pc** (~ 32.6 ly)	3.08567757[60] e+16	m	~30 Pm	Corresponds to au parallax of 1 second
Time				
Hour	**3.600 e+3**	s		Exact: 3600 seconds
Day	**8.6400 e+4**	s		Exact: 24 hours
Julian year	**3.1557600 e+7**	s		Exact: 365.25 days
Gregorian year (mean)	**3.1556952 e+7**	s		Exact: 365.2425 days
Tropical year (drops ~0.53 s/century)	3.155692518747072 e+7	s		365.2421896698 days in year 2000
Plane and solid angles				

1 radian in **degrees**	5.729577951308232... e+1	Dimensionless	°, degree	180/π; planar angle; 57° 17' 44.806247..."
1° degree in **radians**	1.745329251994330... e-2	Dimensionless	rad	π/180; planar angle
1' minute in **radians**	2.908882086657215 ... e-4	Dimensionless	rad	π/180/60; planar angle
1" second in **radians**	4.848136811095359 ... e-6	Dimensionless	rad	π/180/60/60; planar angle
1 steradian in **degree^2**	3.282806350011744... e+3	Dimensionless	degree^2	$(180/\pi)^2$; for solid angle infinitesimals
1 degree^2 in **steradians**	3.046174197867086... e-4	Dimensionless	sr	$(\pi/180)^2$; for solid angle infinitesimals

Formats and Notes:

Formats of numeric values

Mantissa[Uncertainty] **e**±Exponent. The uncertainty, when specified, consists in the probable error in the last two digits of mantissa, enclosed in square brackets. When omitted, the constant is either assigned (see below) or else the error is implicitely [5] units in the first omitted position. The format of the **exponent** is either **e+value** or **e-value**. When the exponent specification is missing, **e+0** is intended.

Examples:

2.34567[17] e+2 indicates a quantity with the most probable value of 234.567 and an expected error of ±0.017.

2.34567 e+2 indicates a quantity with the most probable value of 234.567 and an implicit error of ±0.0005.

Bold magenta values indicate constants whose values are assigned by convention

and therefore not subject to experimental assessment. In particular this applies to the **speed of light** which now indirectly defines the *meter*, and the **permeability of vacuum** which fixes the electromagnetic field *gauche* and indirectly defines the *ampere*. In turn, these determine the **permittivity** and **characteristic impedance of vacuum**, making them assigned as well. The values of assigned constants and some of their functions are listed also on OEIS, the **Online Encyclopedia of Integer Sequences**. See the generic comments for entry A003678 (speed of light c), as well as these entries:

A182999 (c^2), A019694 (μ0), A081799 (ε0), A213610 (Z0), A072915 (standard gravity), A213611 (standard atmosphere), A213612 (Julian year), A213613 (Gregorian year), A213614 (light-year).

Bold black values indicate physics constants which can not be directly derived from others**.**

This is potentialy subject to discussion, since the constants form an interconnected net which is carefully fitted to all available experimental data.

Vertical bar is used to separate various alias expressions for a dimension**.**

Classification does not exactly follow NIST standard but reflects the Author's opinions on what came first - whether the hen or the egg :-)

Conventional values:

a) The conventional (adopted) value of the **Josephson constant** is used to realize **voltage reference devices** [Benz 2004].

b) The conventional (adopted) value of the **von Klitzing constant** is used to realize **electric resistance reference devices** [Bachmair 2003].

The value of Hubble constant

was estimated by the group of W.Freedman in 1999 as 70±7.0 (km/s)/Megaparsec. Values as low as 50 and as high as 82 km/s/Mp were found in earlier measurements but the latest one is now believed to be in error of not more than 10% (the conversion factor for parsec, taken from the current NIST database, is 3.085678e+16 m). The value reported here corresponds to the latest adjustments adopted by NASA (see Wikipedia).

No attempt was made to report this constant's rate of change, consider too uncertain so far.

References: Constants of Physics, sorted by year and by the first author

1. Newcomb Simon,
The Elements Of The Four Inner Planets And The Fundamental Constants Of Astronomy,

Nabu Press 2011. ISBN 978-1178952315. more >>

2. Karshenboim Savely G., Peik Ekkehard,
Astrophysics, Clocks and Fundamental Constants,
Springer 2010. ISBN 978-3642060250. more >>
3. Nakamura K. et al (Particle Data Group),
Review of Particle Physics,
J.Phys.G: Nucl.Part.Phys. **37** 075021 (2010).
4. Fritzsch Harald,
The Fundamental Constants: A Mystery of Physics,
World Scientific Publishing Company 2009. ISBN 978-9812834324. more >>
5. Mohr Peter J.,Taylor Barry N., Newell David B.
CODATA recommended values of the fundamental physical constants: 2006,
Rev.Mod.Phys. **80**,633-730 (2008). DOI: 10.1103/RevModPhys.80.633.
This is the **basic source of CODATA 2010**.
6. Haensch T., Leschiutta S., Wallard A.J.,
Metrology and Fundamental Constants,
IOS Press 2007. ISBN 978-1586037840. more >>
7. Hatch E.,
A Few Simple Facts: From the Electron through the Fundamental Constants,
Lulu.com 2007. ISBN 978-1430307907. more >>
8. Gabrielse G., Hanneke D., Kinoshita T., Nio M., Odom B.,
New Determination of the Fine Structure Constant from the Electron g Value and QED,
Phys.Rev.Letters **97**, 030802 (2006).
9. Odom B., Hanneke D., D'Urso B., Gabrielse G.,
New Measurement of the Electron Magnetic Moment Using a One-Electron Quantum Cyclotron,
Phys.Rev.Letters **97**, 030801 (2006).
10. Barrow John,
The Constants of Nature:
The Numbers That Encode the Deepest Secrets of the Universe,
Vintage 2004. ISBN 978-1400032259. more >>.
11. Benz S.P., Hamilton C.A.,
Application of the Josephson Effect to Voltage Metrology,
Proc.IEEE **92**(10),1617-1629 (2004).
12. Frölich C., Lean J.,
Solar Radiative Output and its Variability: Evidence and Mechanisms,
Astron.Astrophys.Rev. **12**,273-320 (2004). DOI.
13. Karshenboim S.G., Peik E., Editors,
Astrophysics, Clocks and Fundamental Constants,
Springer Verlag 2004. ISBN 978-3540219675. more >>
14. Pap J.M., Fox P.A., Frölich C., Editors,
Solar Variability and its Effect on Climate,
in *Geophysical Monograph Series*, No.141,
American Geophysical Union 2004. ISBN 978-0875904061. more >>
15. Landwehr G.,
25 Years of quantum Hall effect: how it all came about,
Physica E **20**(1-2), 1-13 (2003).

PHYSICS | CHEMISTRY
Magnetic Resonance
MATH | COMPUTING
ELECTRONICS
PATENTS+IP
SCIENCE

More resources:
SI Units
SI Dimensions
Math constants
Unit Converters
HTML Glyphs

16. Bachmair H. et al,
The von Klitzing resistance standard,
Physica E **20**(1-2), 14-23 (2003).

17. Conroy R.S.,
Frequency standards, metrology and fundamental constants,
Contemp.Phys. **44**44(2), 99-135 (2003).

18. Finch S.,
Mathematical Constants,
Cambridge University Press 2003. ISBN 0-521-81805-2. more >>

19. Hall J.L.,Ye J.,
Optical Frequency Standards and Measurement,
IEEE Trans.Instrum.Meas. **52**(2), 227-231 (2003).

20. Hatch E.,
Common Factors of The Fundamental Constants of Particle Physics,
BookSurge Publishing 2003. ISBN 978-1594571749. more >>

21. Kragh H.,
Magic Number: A Partial History of the Fine-Structure Constant.
Arch. Hist. Exact. Sci. **57**(5),395-431 (2003).

22. Uzan J.P.,
The fundamental constants and their variation: observational and theoretical status,
Rev.Mod.Phys. **75**(2), 403-455 (2003).

23. Marciano W.J.,
Precision measurements and New Physics,
J.Phys. G **29**(1), 225-234 (2003).

24. Martins , Editor,
The Cosmology of Extra Dimensions and Varying Fundamental Constants,
Springer Verlag 2003. ISBN 978-1402011382. more >>

25. Faller J.E.,
Thirty years of progress in absolute gravimetry:
a scientific capability implemented by technological advances,
Metrologia **39**(5), 425-428 (2002).

26. Hagiwara K. et al,
Review of Particle Physics,
Phys.Rev. D **66**, 010001, 974 p. (2002).

27. Fritzsch H.,
Fundamental Constants at High Energy,
Fortschr.Phys. **50**50(5-7), 518-524 (2002).

28. Becker P.,
History and progress in the accurate determination of the Avogadro constant,
Rep.Prog.Phys. **64**(12), 1945-2008 (2001).

29. Quinn T.J.,
Recent Advance in Metrology and Fundamental Constants,
Ios Press 2001. ISBN 978-1586031671. more >>

30. Varshalovich D.A., Potekhin A.Y., Ivanchik A.V.,
Puzzle Of the Constancy Of Fundamental Constants,
Comments.At.Mol.Phys. **2**(5), D223-232 (2001).

31. Varshalovich D.A., Potekhin A.Y., Ivanchik A.V.,
Problems of Cosmological Variability of Fundamental Physical Constants,
Phys. Scr. T95, 76-80 (2001).

32. Taylor B.N,
The International System of Units (SI),
NIST Special Publication 330, 2001 Edition (supersedes the 1991 Edition).

33. Mohr P.J.,Taylor B.N.,
CODATA recommended values of the fundamental physical constants: 1998,
Rev.Mod.Phys. **72**,351-495 (2000).

34. Mohr P.J.,Taylor B.N.,
CODATA Recommended Values of the Fundamental Constants,
in *Atomic and Molecular Data and Their Applications*, Berrington K.A., Bell K.L., Editors, Vol.543,
Melville, New York: American Institute of Physics, 3-16 (2000).

35. Basov N.G., Gubin A.,
Quantum Frequency Standards,
IEEE J.Quantum Electron. **6**(6), 857-868 (2000).

36. Luo J., Hu Z.K.,
Status of measurement of the Newtonian gravitational constant G,
Class.Quantum Grav. **17**(12), 2351-2363 (2000).

37. Groom D.E. et al.,
Review of particle physics,
Eur.Phys.J. C **15**(1-4), 1-878 (2000).

38. *CODATA Recommended Values of the Fundamental Physical Constants: 1998*,
J.Phys.Chem.Ref.Data, **28**, No.6, 1999.

39. Quinn T.J.,
Practical realization of the definition of the metre (1997),
Metrologia **36**(3), 211-244 (1999).

40. Johnstone W.D.,
For Good Measure:
The Most Complete Guide to Weights and Measures and Their Metric Equivalents,
NTC Pub.Group 1998. ISBN 0-844-20851-5. more >>

41. ***The International System of Units (SI)***,
Bureau International des Poids et Measures (**BIPM**), 7th Edition, 1998.

42. Johnson P.,
The Constants of Nature: A Realist Account,
Ashgate Publishing 1997. ISBN 978-1840141023. more >>

43. Cohen E.R.,Taylor B.N.,
The Fundamental Physical Constants,
Phys.Today, Aug. 1996, bg9.

44. Cowie, Songaila,
Astrophysical Limits on the Evolution of Dimensionless Physical Constants over Cosmological Time,
Astrophysical Journal **453**, 596 (1995).

45. Sanders J., Editor,
Atomic Masses and Fundamental Constants,
Springer Verlag 1995. ISBN 978-0306350849. more >>

46. Cohen-Tannoudji G.,
Universal Constants in Physics,

McGraw-Hill 1992. ISBN 978-0070116511. more >>

47. Sisterna P., Vucetich H.,
Time variation of fundamental constants: Bounds from geophysical and astronomical data,
Physical Review D, **41**, 1034 (1990), **44**, 3096 (1991).

48. De Sabbata V., Melnikov V.N., Editors,
Gravitational Measurements, Fundamental Metrology, and Constants,
NATA ASI Series C: Vol.230
D.Reidel Pub.Co. 1988. ISBN 978-9027727091. more >>

49. Petley B.W.,
Fundamental Physical Constants and the Frontier of Measurement,
Adam Hilger 1985. ISBN 978-0852744277. more >>

50. Lucas A.A., Cutler P.H., North A.,
Quantum Metrology and Fundamental Physical Constants,
Springer Verlag 1983. ISBN 978-0306413728. more >>

51. Richard E., Crowe K.M., Cohen J.W.M.D.,
The Fundamental Constants of Physics,
Intersience Publishers 1957. more >>

52. DuMond J.W.M.,Cohen R.,
Least Squares Adjustment of the Atomic Constants,
Rev.Mod.Phys. **25**, 691 (1952).

53. Furth R.,
The Limits of Measurement,
Scientific American. **183** (1), 48 (1950).

54. Birge R.T.,
Probable Values of General Physics Constants,
Rev.Mod.Phys. **1** (Supplement), 1-73 (1929). DOI Link.

Web links, other than those appearing in the Tables

BIPM. **Bureau International des Poids et Measures**. The home of the SI System of Units.

NIST CODATA Fundamental Physical Constants.

NIST Searchable Bibliography of Fundamental Physical Constants.

NIST Units of Measurements.

Particle Data Group, an international reference organization.

Standard Model on Wikipedia.

Hyperons on Wikipedia.

IAU, **International Astronomical Union**.

Solar constant. A brief review by Claus Frölich with 9 references.

How Many Fundamental Constants Are There?, a reflection by John Baez.

Have physical constants changed with time? by S.Carlip.

Lunar and Planetary Science by NASA.

Minor planets statistics at **Minor Planets Center**.

Mathematical constants. A related resource on this website.

Solar system planets at a glance. A related resource on this website.

Constants of physics and mathematics. Link to this resource. It can be cited also as a DOI link: 10.3247/SL2Phys07.001.

F Books Lists:	Popular Science	**F** Mathematics	**F** Physics	**F** Chemistry
Patents+IP	**F** Electronics | DSP	**F** Computing	Spintronics	**F** Materials
WWW issues	**F** Instruments	Quantum Computing	**F** NMR | ESR | MRI	**F** Spectroscopy
Hint: the **F** symbols above, where present, are links to free online texts (books, courses, theses, ...)				

TOP | Physics BOOKS | SI Units | SI Dimensions MATHEMATICAL Constants (on a separate page) Physics LINKS | Stan's Library | Stan's HUB

 Designed by Stan Sýkora (last update 03/09/2018 03:43:46)