Codata

0.2.1

Generated by Doxygen 1.9.1

Chapter 1

Introduction

`codata` is a (Modern) Fortran library providing the codata constants 2010, 2014 and 2018. It also provides a API for the C language. The raw codata from http://physics.nist.gov/constants are parsed line by line where the columns name, value, uncertainty and unit are formatted to be conform to Fortran double precision. The formatted (as strings) names, values, uncertainties and units are then inserted in a derived type in the generated Fortran module. The latter are then inserted into an array.

The generated Fortran module is then compiled (f2008+) into a shared and a static library `libcodata` with the Fortran and C headers. The static and shared libraries can be installed in order to be included in Fortran or C programs.

The compilation was tested on Linux (Debian), MacOS, Windows.

The sources are available on github. The online documentation is available here. A pdf version of the documentation can be found here.

1.1 Installation

See the file `INSTALL`.

1.2 Dependencies

See the file `REQUIREMENTS`.

1.3 License information

See the file `LICENSE`.

Chapter 2

Codata 0.1.0 Release Note

2.1 Changes

Implementation of:

- the parser of the codata raw data
- the generator of the Fortran modules
- the C API and C header
- the python wrapper (will be moved to its repository next release).

2.2 Download

`Codata Releases`

2.3 Contributors

Milan Skocic

2.4 Commits

Full Changelog: `https://github.com/MilanSkocic/codata/compare/....0.1.0`

Chapter 3

Codata 0.2.0 Release Note

3.1 Changes

- Bug fixes for the codata 2010.
- Bug fixes in the tests linked to the codata 2010.
- Add python wrapper for the number of constants method.

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Full Changelog: https://github.com/MilanSkocic/codata/compare/0.1.0...0.2.0

Chapter 4

Codata 0.2.1 Release Note

4.1 Changes

- Integration of Intel Fortran compiler and MSVC in cmake scripts.
- Add specifications and instructions for compiling on Windows

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Chapter 5

install

Cmake is necessary for compiling and instaling the library.

5.1 Create build directory

- mkdir build
- cd build

5.2 Generate a makefile

- On Unix-like OS: `cmake -G "Unix Makefiles" -S .. -DCMAKE_BUILD_TYPE=release -DCMAKE_INSTALL_PREFIX=/path/to/folder`
- On windows with MSYS2: `cmake -G "Unix Makefiles" -S .. -DCMAKE_BUILD_TYPE=release -DCMAKE_INSTALL_PREFIX=/path/to/folder`
- On windows with ifort and msvc: `cmake -G "NMake Makefiles" -S .. -DCMAKE_BUILD_TYPE=release -DCMAKE_INSTALL_PREFIX=/path/to/folder`

5.3 Build either with cmake

```
cmake --build .
```

5.4 Run tests

```
ctest
```

5.5 Install

```
cmake --install .
```

5.6 Dependencies

On windows when compiled with Intel Fortran compiler, the `Intel Fortran redistributable` must be installed.

Chapter 6

license

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                        Preamble
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Chapter 7

Codata Raw Data

The raw data that are processed for generating the C and Fortran source codes are the followings:

7.1 2018

```
             Fundamental Physical Constants --- Complete Listing
             2018 CODATA adjustment
  From:  http://physics.nist.gov/constants
  Quantity                                                       Value                 Uncertainty
       Unit
-----------------------------------------------------------------------------------------------------------------------------
alpha particle-electron mass ratio                          7294.299 541 42          0.000 000 24

alpha particle mass                                         6.644 657 3357 e-27      0.000 000 0020 e-27
        kg
alpha particle mass energy equivalent                       5.971 920 1914 e-10      0.000 000 0018 e-10
        J
alpha particle mass energy equivalent in MeV                3727.379 4066            0.000 0011
        MeV
alpha particle mass in u                                    4.001 506 179 127        0.000 000 000 063
        u
alpha particle molar mass                                   4.001 506 1777 e-3       0.000 000 0012 e-3
        kg mol^-1
alpha particle-proton mass ratio                            3.972 599 690 09         0.000 000 000 22

alpha particle relative atomic mass                         4.001 506 179 127        0.000 000 000 063

Angstrom star                                               1.000 014 95 e-10        0.000 000 90 e-10
        m
atomic mass constant                                        1.660 539 066 60 e-27    0.000 000 000 50 e-27
        kg
atomic mass constant energy equivalent                      1.492 418 085 60 e-10    0.000 000 000 45 e-10
        J
atomic mass constant energy equivalent in MeV               931.494 102 42           0.000 000 28
        MeV
atomic mass unit-electron volt relationship                 9.314 941 0242 e8        0.000 000 0028 e8
        eV
atomic mass unit-hartree relationship                       3.423 177 6874 e7        0.000 000 0010 e7
        E_h
atomic mass unit-hertz relationship                         2.252 342 718 71 e23     0.000 000 000 68 e23
        Hz
atomic mass unit-inverse meter relationship                 7.513 006 6104 e14       0.000 000 0023 e14
        m^-1
atomic mass unit-joule relationship                         1.492 418 085 60 e-10    0.000 000 000 45 e-10
        J
atomic mass unit-kelvin relationship                        1.080 954 019 16 e13     0.000 000 000 33 e13
        K
atomic mass unit-kilogram relationship                      1.660 539 066 60 e-27    0.000 000 000 50 e-27
        kg
atomic unit of 1st hyperpolarizability                      3.206 361 3061 e-53      0.000 000 0015 e-53
        C^3 m^3 J^-2
atomic unit of 2nd hyperpolarizability                      6.235 379 9905 e-65      0.000 000 0038 e-65
        C^4 m^4 J^-3
atomic unit of action                                       1.054 571 817... e-34    (exact)
        J s
atomic unit of charge                                       1.602 176 634 e-19       (exact)
        C
```

```
atomic unit of charge density                               1.081 202 384 57 e12     0.000 000 000 49 e12
        C m^-3
atomic unit of current                                      6.623 618 237 510 e-3    0.000 000 000 013 e-3
        A
atomic unit of electric dipole mom.                         8.478 353 6255 e-30      0.000 000 0013 e-30
        C m
atomic unit of electric field                               5.142 206 747 63 e11     0.000 000 000 78 e11
        V m^-1
atomic unit of electric field gradient                      9.717 362 4292 e21       0.000 000 0029 e21
        V m^-2
atomic unit of electric polarizability                      1.648 777 274 36 e-41    0.000 000 000 50 e-41
        C^2 m^2 J^-1
atomic unit of electric potential                           27.211 386 245 988       0.000 000 000 053
        V
atomic unit of electric quadrupole mom.                     4.486 551 5246 e-40      0.000 000 0014 e-40
        C m^2
atomic unit of energy                                       4.359 744 722 2071 e-18  0.000 000 000 0085 e-18
        J
atomic unit of force                                        8.238 723 4983 e-8       0.000 000 0012 e-8
        N
atomic unit of length                                       5.291 772 109 03 e-11    0.000 000 000 80 e-11
        m
atomic unit of mag. dipole mom.                             1.854 802 015 66 e-23    0.000 000 000 56 e-23
        J T^-1
atomic unit of mag. flux density                            2.350 517 567 58 e5      0.000 000 000 71 e5
        T
atomic unit of magnetizability                              7.891 036 6008 e-29      0.000 000 0048 e-29
        J T^-2
atomic unit of mass                                         9.109 383 7015 e-31      0.000 000 0028 e-31
        kg
atomic unit of momentum                                     1.992 851 914 10 e-24    0.000 000 000 30 e-24
        kg m s^-1
atomic unit of permittivity                                 1.112 650 055 45 e-10    0.000 000 000 17 e-10
        F m^-1
atomic unit of time                                         2.418 884 326 5857 e-17  0.000 000 000 0047 e-17
        s
atomic unit of velocity                                     2.187 691 263 64 e6      0.000 000 000 33 e6
        m s^-1
Avogadro constant                                           6.022 140 76 e23         (exact)
        mol^-1
Bohr magneton                                               9.274 010 0783 e-24      0.000 000 0028 e-24
        J T^-1
Bohr magneton in eV/T                                       5.788 381 8060 e-5       0.000 000 0017 e-5
        eV T^-1
Bohr magneton in Hz/T                                       1.399 624 493 61 e10     0.000 000 000 42 e10
        Hz T^-1
Bohr magneton in inverse meter per tesla                    46.686 447 783           0.000 000 014
        m^-1 T^-1
Bohr magneton in K/T                                        0.671 713 815 63         0.000 000 000 20
        K T^-1
Bohr radius                                                 5.291 772 109 03 e-11    0.000 000 000 80 e-11
        m
Boltzmann constant                                          1.380 649 e-23           (exact)
        J K^-1
Boltzmann constant in eV/K                                  8.617 333 262... e-5     (exact)
        eV K^-1
Boltzmann constant in Hz/K                                  2.083 661 912... e10     (exact)
        Hz K^-1
Boltzmann constant in inverse meter per kelvin              69.503 480 04...         (exact)
        m^-1 K^-1
characteristic impedance of vacuum                          376.730 313 668          0.000 000 057
        ohm
classical electron radius                                   2.817 940 3262 e-15      0.000 000 0013 e-15
        m
Compton wavelength                                          2.426 310 238 67 e-12    0.000 000 000 73 e-12
        m
conductance quantum                                         7.748 091 729... e-5     (exact)
        S
conventional value of ampere-90                             1.000 000 088 87...      (exact)
        A
conventional value of coulomb-90                            1.000 000 088 87...      (exact)
        C
conventional value of farad-90                              0.999 999 982 20...      (exact)
        F
conventional value of henry-90                              1.000 000 017 79...      (exact)
        H
conventional value of Josephson constant                    483 597.9 e9             (exact)
        Hz V^-1
conventional value of ohm-90                                1.000 000 017 79...      (exact)
        ohm
conventional value of volt-90                               1.000 000 106 66...      (exact)
        V
conventional value of von Klitzing constant                 25 812.807               (exact)
        ohm
conventional value of watt-90                               1.000 000 195 53...      (exact)
        W
Copper x unit                                               1.002 076 97 e-13        0.000 000 28 e-13
```

```
        m
deuteron-electron mag. mom. ratio                           -4.664 345 551 e-4       0.000 000 012 e-4

deuteron-electron mass ratio                                3670.482 967 88          0.000 000 13

deuteron g factor                                           0.857 438 2338           0.000 000 0022

deuteron mag. mom.                                          4.330 735 094 e-27       0.000 000 011 e-27
        J T^-1
deuteron mag. mom. to Bohr magneton ratio                   4.669 754 570 e-4        0.000 000 012 e-4

deuteron mag. mom. to nuclear magneton ratio                0.857 438 2338           0.000 000 0022

deuteron mass                                               3.343 583 7724 e-27      0.000 000 0010 e-27
        kg
deuteron mass energy equivalent                             3.005 063 231 02 e-10    0.000 000 000 91 e-10
        J
deuteron mass energy equivalent in MeV                      1875.612 942 57          0.000 000 57
        MeV
deuteron mass in u                                          2.013 553 212 745        0.000 000 000 040
        u
deuteron molar mass                                         2.013 553 212 05 e-3     0.000 000 000 61 e-3
        kg mol^-1
deuteron-neutron mag. mom. ratio                            -0.448 206 53            0.000 000 11

deuteron-proton mag. mom. ratio                             0.307 012 209 39         0.000 000 000 79

deuteron-proton mass ratio                                  1.999 007 501 39         0.000 000 000 11

deuteron relative atomic mass                               2.013 553 212 745        0.000 000 000 040

deuteron rms charge radius                                  2.127 99 e-15            0.000 74 e-15
        m
electron charge to mass quotient                            -1.758 820 010 76 e11    0.000 000 000 53 e11
        C kg^-1
electron-deuteron mag. mom. ratio                           -2143.923 4915           0.000 0056

electron-deuteron mass ratio                                2.724 437 107 462 e-4    0.000 000 000 096 e-4

electron g factor                                           -2.002 319 304 362 56    0.000 000 000 000 35

electron gyromag. ratio                                     1.760 859 630 23 e11     0.000 000 000 53 e11
        s^-1 T^-1
electron gyromag. ratio in MHz/T                            28 024.951 4242          0.000 0085
        MHz T^-1
electron-helion mass ratio                                  1.819 543 074 573 e-4    0.000 000 000 079 e-4

electron mag. mom.                                          -9.284 764 7043 e-24     0.000 000 0028 e-24
        J T^-1
electron mag. mom. anomaly                                  1.159 652 181 28 e-3     0.000 000 000 18 e-3

electron mag. mom. to Bohr magneton ratio                   -1.001 159 652 181 28    0.000 000 000 000 18

electron mag. mom. to nuclear magneton ratio                -1838.281 971 88         0.000 000 11

electron mass                                               9.109 383 7015 e-31      0.000 000 0028 e-31
        kg
electron mass energy equivalent                             8.187 105 7769 e-14      0.000 000 0025 e-14
        J
electron mass energy equivalent in MeV                      0.510 998 950 00         0.000 000 000 15
        MeV
electron mass in u                                          5.485 799 090 65 e-4     0.000 000 000 16 e-4
        u
electron molar mass                                         5.485 799 0888 e-7       0.000 000 0017 e-7
        kg mol^-1
electron-muon mag. mom. ratio                               206.766 9883             0.000 0046

electron-muon mass ratio                                    4.836 331 69 e-3         0.000 000 11 e-3

electron-neutron mag. mom. ratio                            960.920 50               0.000 23

electron-neutron mass ratio                                 5.438 673 4424 e-4       0.000 000 0026 e-4

electron-proton mag. mom. ratio                             -658.210 687 89          0.000 000 20

electron-proton mass ratio                                  5.446 170 214 87 e-4     0.000 000 000 33 e-4

electron relative atomic mass                               5.485 799 090 65 e-4     0.000 000 000 16 e-4

electron-tau mass ratio                                     2.875 85 e-4             0.000 19 e-4

electron to alpha particle mass ratio                       1.370 933 554 787 e-4    0.000 000 000 045 e-4

electron to shielded helion mag. mom. ratio                 864.058 257              0.000 010

electron to shielded proton mag. mom. ratio                 -658.227 5971            0.000 0072
```

```
electron-triton mass ratio                                  1.819 200 062 251 e-4    0.000 000 000 090 e-4
        
electron volt                                               1.602 176 634 e-19       (exact)
        J
electron volt-atomic mass unit relationship                 1.073 544 102 33 e-9     0.000 000 000 32 e-9
        u
electron volt-hartree relationship                          3.674 932 217 5655 e-2   0.000 000 000 0071 e-2
        E_h
electron volt-hertz relationship                            2.417 989 242... e14     (exact)
        Hz
electron volt-inverse meter relationship                    8.065 543 937... e5      (exact)
        m^-1
electron volt-joule relationship                            1.602 176 634 e-19       (exact)
        J
electron volt-kelvin relationship                           1.160 451 812... e4      (exact)
        K
electron volt-kilogram relationship                         1.782 661 921... e-36    (exact)
        kg
elementary charge                                           1.602 176 634 e-19       (exact)
        C
elementary charge over h-bar                                1.519 267 447... e15     (exact)
        A J^-1
Faraday constant                                            96 485.332 12...         (exact)
        C mol^-1
Fermi coupling constant                                     1.166 3787 e-5           0.000 0006 e-5
        GeV^-2
fine-structure constant                                     7.297 352 5693 e-3       0.000 000 0011 e-3
        
first radiation constant                                    3.741 771 852... e-16    (exact)
        W m^2
first radiation constant for spectral radiance              1.191 042 972... e-16    (exact)
        W m^2 sr^-1
hartree-atomic mass unit relationship                       2.921 262 322 05 e-8     0.000 000 000 88 e-8
        u
hartree-electron volt relationship                          27.211 386 245 988       0.000 000 000 053
        eV
Hartree energy                                              4.359 744 722 2071 e-18  0.000 000 000 0085 e-18
        J
Hartree energy in eV                                        27.211 386 245 988       0.000 000 000 053
        eV
hartree-hertz relationship                                  6.579 683 920 502 e15    0.000 000 000 013 e15
        Hz
hartree-inverse meter relationship                          2.194 746 313 6320 e7    0.000 000 000 0043 e7
        m^-1
hartree-joule relationship                                  4.359 744 722 2071 e-18  0.000 000 000 0085 e-18
        J
hartree-kelvin relationship                                 3.157 750 248 0407 e5    0.000 000 000 0061 e5
        K
hartree-kilogram relationship                               4.850 870 209 5432 e-35  0.000 000 000 0094 e-35
        kg
helion-electron mass ratio                                  5495.885 280 07          0.000 000 24
        
helion g factor                                             -4.255 250 615           0.000 000 050
        
helion mag. mom.                                            -1.074 617 532 e-26      0.000 000 013 e-26
        J T^-1
helion mag. mom. to Bohr magneton ratio                     -1.158 740 958 e-3       0.000 000 014 e-3
        
helion mag. mom. to nuclear magneton ratio                  -2.127 625 307           0.000 000 025
        
helion mass                                                 5.006 412 7796 e-27      0.000 000 0015 e-27
        kg
helion mass energy equivalent                               4.499 539 4125 e-10      0.000 000 0014 e-10
        J
helion mass energy equivalent in MeV                        2808.391 607 43          0.000 000 85
        MeV
helion mass in u                                            3.014 932 247 175        0.000 000 000 097
        u
helion molar mass                                           3.014 932 246 13 e-3     0.000 000 000 91 e-3
        kg mol^-1
helion-proton mass ratio                                    2.993 152 671 67         0.000 000 000 13
        
helion relative atomic mass                                 3.014 932 247 175        0.000 000 000 097
        
helion shielding shift                                      5.996 743 e-5            0.000 010 e-5
        
hertz-atomic mass unit relationship                         4.439 821 6652 e-24      0.000 000 0013 e-24
        u
hertz-electron volt relationship                            4.135 667 696... e-15    (exact)
        eV
hertz-hartree relationship                                  1.519 829 846 0570 e-16  0.000 000 000 0029 e-16
        E_h
hertz-inverse meter relationship                            3.335 640 951... e-9     (exact)
        m^-1
hertz-joule relationship                                    6.626 070 15 e-34        (exact)
        J
hertz-kelvin relationship                                   4.799 243 073... e-11    (exact)
```

```
        K
hertz-kilogram relationship                                 7.372 497 323... e-51    (exact)
        kg
hyperfine transition frequency of Cs-133                    9 192 631 770            (exact)
        Hz
inverse fine-structure constant                             137.035 999 084          0.000 000 021

inverse meter-atomic mass unit relationship                 1.331 025 050 10 e-15    0.000 000 000 40 e-15
        u
inverse meter-electron volt relationship                    1.239 841 984... e-6     (exact)
        eV
inverse meter-hartree relationship                          4.556 335 252 9120 e-8   0.000 000 000 0088 e-8
        E_h
inverse meter-hertz relationship                            299 792 458              (exact)
        Hz
inverse meter-joule relationship                            1.986 445 857... e-25    (exact)
        J
inverse meter-kelvin relationship                           1.438 776 877... e-2     (exact)
        K
inverse meter-kilogram relationship                         2.210 219 094... e-42    (exact)
        kg
inverse of conductance quantum                              12 906.403 72...         (exact)
        ohm
Josephson constant                                          483 597.848 4... e9      (exact)
        Hz V^-1
joule-atomic mass unit relationship                         6.700 535 2565 e9        0.000 000 0020 e9
        u
joule-electron volt relationship                            6.241 509 074... e18     (exact)
        eV
joule-hartree relationship                                  2.293 712 278 3963 e17   0.000 000 000 0045 e17
        E_h
joule-hertz relationship                                    1.509 190 179... e33     (exact)
        Hz
joule-inverse meter relationship                            5.034 116 567... e24     (exact)
        m^-1
joule-kelvin relationship                                   7.242 970 516... e22     (exact)
        K
joule-kilogram relationship                                 1.112 650 056... e-17    (exact)
        kg
kelvin-atomic mass unit relationship                        9.251 087 3014 e-14      0.000 000 0028 e-14
        u
kelvin-electron volt relationship                           8.617 333 262... e-5     (exact)
        eV
kelvin-hartree relationship                                 3.166 811 563 4556 e-6   0.000 000 000 0061 e-6
        E_h
kelvin-hertz relationship                                   2.083 661 912... e10     (exact)
        Hz
kelvin-inverse meter relationship                           69.503 480 04...         (exact)
        m^-1
kelvin-joule relationship                                   1.380 649 e-23           (exact)
        J
kelvin-kilogram relationship                                1.536 179 187... e-40    (exact)
        kg
kilogram-atomic mass unit relationship                      6.022 140 7621 e26       0.000 000 0018 e26
        u
kilogram-electron volt relationship                         5.609 588 603... e35     (exact)
        eV
kilogram-hartree relationship                               2.061 485 788 7409 e34   0.000 000 000 0040 e34
        E_h
kilogram-hertz relationship                                 1.356 392 489... e50     (exact)
        Hz
kilogram-inverse meter relationship                         4.524 438 335... e41     (exact)
        m^-1
kilogram-joule relationship                                 8.987 551 787... e16     (exact)
        J
kilogram-kelvin relationship                                6.509 657 260... e39     (exact)
        K
lattice parameter of silicon                                5.431 020 511 e-10       0.000 000 089 e-10
        m
lattice spacing of ideal Si (220)                           1.920 155 716 e-10       0.000 000 032 e-10
        m
Loschmidt constant (273.15 K, 100 kPa)                      2.651 645 804... e25     (exact)
        m^-3
Loschmidt constant (273.15 K, 101.325 kPa)                  2.686 780 111... e25     (exact)
        m^-3
luminous efficacy                                           683                      (exact)
        lm W^-1
mag. flux quantum                                           2.067 833 848... e-15    (exact)
        Wb
molar gas constant                                          8.314 462 618...         (exact)
        J mol^-1 K^-1
molar mass constant                                         0.999 999 999 65 e-3     0.000 000 000 30 e-3
        kg mol^-1
molar mass of carbon-12                                     11.999 999 9958 e-3      0.000 000 0036 e-3
        kg mol^-1
molar Planck constant                                       3.990 312 712... e-10    (exact)
        J Hz^-1 mol^-1
```

```
molar volume of ideal gas (273.15 K, 100 kPa)                22.710 954 64... e-3     (exact)
        m^3 mol^-1
molar volume of ideal gas (273.15 K, 101.325 kPa)            22.413 969 54... e-3     (exact)
        m^3 mol^-1
molar volume of silicon                                      1.205 883 199 e-5        0.000 000 060 e-5
        m^3 mol^-1
Molybdenum x unit                                            1.002 099 52 e-13        0.000 000 53 e-13
        m
muon Compton wavelength                                      1.173 444 110 e-14       0.000 000 026 e-14
        m
muon-electron mass ratio                                     206.768 2830             0.000 0046

muon g factor                                                -2.002 331 8418          0.000 000 0013

muon mag. mom.                                               -4.490 448 30 e-26       0.000 000 10 e-26
        J T^-1
muon mag. mom. anomaly                                       1.165 920 89 e-3         0.000 000 63 e-3

muon mag. mom. to Bohr magneton ratio                        -4.841 970 47 e-3        0.000 000 11 e-3

muon mag. mom. to nuclear magneton ratio                     -8.890 597 03            0.000 000 20

muon mass                                                    1.883 531 627 e-28       0.000 000 042 e-28
        kg
muon mass energy equivalent                                  1.692 833 804 e-11       0.000 000 038 e-11
        J
muon mass energy equivalent in MeV                           105.658 3755             0.000 0023
        MeV
muon mass in u                                               0.113 428 9259           0.000 000 0025
        u
muon molar mass                                              1.134 289 259 e-4        0.000 000 025 e-4
        kg mol^-1
muon-neutron mass ratio                                      0.112 454 5170           0.000 000 0025

muon-proton mag. mom. ratio                                  -3.183 345 142           0.000 000 071

muon-proton mass ratio                                       0.112 609 5264           0.000 000 0025

muon-tau mass ratio                                          5.946 35 e-2             0.000 40 e-2

natural unit of action                                       1.054 571 817... e-34    (exact)
        J s
natural unit of action in eV s                               6.582 119 569... e-16    (exact)
        eV s
natural unit of energy                                       8.187 105 7769 e-14      0.000 000 0025 e-14
        J
natural unit of energy in MeV                                0.510 998 950 00         0.000 000 000 15
        MeV
natural unit of length                                       3.861 592 6796 e-13      0.000 000 0012 e-13
        m
natural unit of mass                                         9.109 383 7015 e-31      0.000 000 0028 e-31
        kg
natural unit of momentum                                     2.730 924 530 75 e-22    0.000 000 000 82 e-22
        kg m s^-1
natural unit of momentum in MeV/c                            0.510 998 950 00         0.000 000 000 15
        MeV/c
natural unit of time                                         1.288 088 668 19 e-21    0.000 000 000 39 e-21
        s
natural unit of velocity                                     299 792 458              (exact)
        m s^-1
neutron Compton wavelength                                   1.319 590 905 81 e-15    0.000 000 000 75 e-15
        m
neutron-electron mag. mom. ratio                             1.040 668 82 e-3         0.000 000 25 e-3

neutron-electron mass ratio                                  1838.683 661 73          0.000 000 89

neutron g factor                                             -3.826 085 45            0.000 000 90

neutron gyromag. ratio                                       1.832 471 71 e8          0.000 000 43 e8
        s^-1 T^-1
neutron gyromag. ratio in MHz/T                              29.164 6931              0.000 0069
        MHz T^-1
neutron mag. mom.                                            -9.662 3651 e-27         0.000 0023 e-27
        J T^-1
neutron mag. mom. to Bohr magneton ratio                     -1.041 875 63 e-3        0.000 000 25 e-3

neutron mag. mom. to nuclear magneton ratio                  -1.913 042 73            0.000 000 45

neutron mass                                                 1.674 927 498 04 e-27    0.000 000 000 95 e-27
        kg
neutron mass energy equivalent                               1.505 349 762 87 e-10    0.000 000 000 86 e-10
        J
neutron mass energy equivalent in MeV                        939.565 420 52           0.000 000 54
        MeV
neutron mass in u                                            1.008 664 915 95         0.000 000 000 49
        u
neutron molar mass                                           1.008 664 915 60 e-3     0.000 000 000 57 e-3
```

```
        kg mol^-1
neutron-muon mass ratio                                     8.892 484 06            0.000 000 20

neutron-proton mag. mom. ratio                              -0.684 979 34           0.000 000 16

neutron-proton mass difference                              2.305 574 35 e-30       0.000 000 82 e-30
        kg
neutron-proton mass difference energy equivalent            2.072 146 89 e-13       0.000 000 74 e-13
        J
neutron-proton mass difference energy equivalent in MeV     1.293 332 36            0.000 000 46
        MeV
neutron-proton mass difference in u                         1.388 449 33 e-3        0.000 000 49 e-3
        u
neutron-proton mass ratio                                   1.001 378 419 31        0.000 000 000 49

neutron relative atomic mass                                1.008 664 915 95        0.000 000 000 49

neutron-tau mass ratio                                      0.528 779               0.000 036

neutron to shielded proton mag. mom. ratio                  -0.684 996 94           0.000 000 16

Newtonian constant of gravitation                           6.674 30 e-11           0.000 15 e-11
        m^3 kg^-1 s^-2
Newtonian constant of gravitation over h-bar c              6.708 83 e-39           0.000 15 e-39
        (GeV/c^2)^-2
nuclear magneton                                            5.050 783 7461 e-27     0.000 000 0015 e-27
        J T^-1
nuclear magneton in eV/T                                    3.152 451 258 44 e-8    0.000 000 000 96 e-8
        eV T^-1
nuclear magneton in inverse meter per tesla                 2.542 623 413 53 e-2    0.000 000 000 78 e-2
        m^-1 T^-1
nuclear magneton in K/T                                     3.658 267 7756 e-4      0.000 000 0011 e-4
        K T^-1
nuclear magneton in MHz/T                                   7.622 593 2291          0.000 000 0023
        MHz T^-1
Planck constant                                             6.626 070 15 e-34       (exact)
        J Hz^-1
Planck constant in eV/Hz                                    4.135 667 696... e-15   (exact)
        eV Hz^-1
Planck length                                               1.616 255 e-35          0.000 018 e-35
        m
Planck mass                                                 2.176 434 e-8           0.000 024 e-8
        kg
Planck mass energy equivalent in GeV                        1.220 890 e19           0.000 014 e19
        GeV
Planck temperature                                          1.416 784 e32           0.000 016 e32
        K
Planck time                                                 5.391 247 e-44          0.000 060 e-44
        s
proton charge to mass quotient                              9.578 833 1560 e7       0.000 000 0029 e7
        C kg^-1
proton Compton wavelength                                   1.321 409 855 39 e-15   0.000 000 000 40 e-15
        m
proton-electron mass ratio                                  1836.152 673 43         0.000 000 11

proton g factor                                             5.585 694 6893          0.000 000 0016

proton gyromag. ratio                                       2.675 221 8744 e8       0.000 000 0011 e8
        s^-1 T^-1
proton gyromag. ratio in MHz/T                              42.577 478 518          0.000 000 018
        MHz T^-1
proton mag. mom.                                            1.410 606 797 36 e-26   0.000 000 000 60 e-26
        J T^-1
proton mag. mom. to Bohr magneton ratio                     1.521 032 202 30 e-3    0.000 000 000 46 e-3

proton mag. mom. to nuclear magneton ratio                  2.792 847 344 63        0.000 000 000 82

proton mag. shielding correction                            2.5689 e-5              0.0011 e-5

proton mass                                                 1.672 621 923 69 e-27   0.000 000 000 51 e-27
        kg
proton mass energy equivalent                               1.503 277 615 98 e-10   0.000 000 000 46 e-10
        J
proton mass energy equivalent in MeV                        938.272 088 16          0.000 000 29
        MeV
proton mass in u                                            1.007 276 466 621       0.000 000 000 053
        u
proton molar mass                                           1.007 276 466 27 e-3    0.000 000 000 31 e-3
        kg mol^-1
proton-muon mass ratio                                      8.880 243 37            0.000 000 20

proton-neutron mag. mom. ratio                              -1.459 898 05           0.000 000 34

proton-neutron mass ratio                                   0.998 623 478 12        0.000 000 000 49

proton relative atomic mass                                 1.007 276 466 621       0.000 000 000 053
proton rms charge radius                                    8.414 e-16               0.019 e-16
        m
proton-tau mass ratio                                       0.528 051                0.000 036

quantum of circulation                                      3.636 947 5516 e-4       0.000 000 0011 e-4
        m^2 s^-1
quantum of circulation times 2                              7.273 895 1032 e-4       0.000 000 0022 e-4
        m^2 s^-1
reduced Compton wavelength                                  3.861 592 6796 e-13      0.000 000 0012 e-13
        m
reduced muon Compton wavelength                             1.867 594 306 e-15       0.000 000 042 e-15
        m
reduced neutron Compton wavelength                          2.100 194 1552 e-16      0.000 000 0012 e-16
        m
reduced Planck constant                                     1.054 571 817... e-34    (exact)
        J s
reduced Planck constant in eV s                             6.582 119 569... e-16    (exact)
        eV s
reduced Planck constant times c in MeV fm                   197.326 980 4...         (exact)
        MeV fm
reduced proton Compton wavelength                           2.103 089 103 36 e-16    0.000 000 000 64 e-16
        m
reduced tau Compton wavelength                              1.110 538 e-16           0.000 075 e-16
        m
Rydberg constant                                            10 973 731.568 160       0.000 021
        m^-1
Rydberg constant times c in Hz                              3.289 841 960 2508 e15   0.000 000 000 0064 e15
        Hz
Rydberg constant times hc in eV                             13.605 693 122 994       0.000 000 000 026
        eV
Rydberg constant times hc in J                              2.179 872 361 1035 e-18  0.000 000 000 0042 e-18
        J
Sackur-Tetrode constant (1 K, 100 kPa)                      -1.151 707 537 06        0.000 000 000 45

Sackur-Tetrode constant (1 K, 101.325 kPa)                  -1.164 870 523 58        0.000 000 000 45

second radiation constant                                   1.438 776 877... e-2     (exact)
        m K
shielded helion gyromag. ratio                              2.037 894 569 e8         0.000 000 024 e8
        s^-1 T^-1
shielded helion gyromag. ratio in MHz/T                     32.434 099 42            0.000 000 38
        MHz T^-1
shielded helion mag. mom.                                   -1.074 553 090 e-26      0.000 000 013 e-26
        J T^-1
shielded helion mag. mom. to Bohr magneton ratio            -1.158 671 471 e-3       0.000 000 014 e-3

shielded helion mag. mom. to nuclear magneton ratio         -2.127 497 719           0.000 000 025

shielded helion to proton mag. mom. ratio                   -0.761 766 5618          0.000 000 0089

shielded helion to shielded proton mag. mom. ratio          -0.761 786 1313          0.000 000 0033

shielded proton gyromag. ratio                              2.675 153 151 e8         0.000 000 029 e8
        s^-1 T^-1
shielded proton gyromag. ratio in MHz/T                     42.576 384 74            0.000 000 46
        MHz T^-1
shielded proton mag. mom.                                   1.410 570 560 e-26       0.000 000 015 e-26
        J T^-1
shielded proton mag. mom. to Bohr magneton ratio            1.520 993 128 e-3        0.000 000 017 e-3

shielded proton mag. mom. to nuclear magneton ratio         2.792 775 599            0.000 000 030

shielding difference of d and p in HD                       2.0200 e-8               0.0020 e-8

shielding difference of t and p in HT                       2.4140 e-8               0.0020 e-8

speed of light in vacuum                                    299 792 458              (exact)
        m s^-1
standard acceleration of gravity                            9.806 65                 (exact)
        m s^-2
standard atmosphere                                         101 325                  (exact)
        Pa
standard-state pressure                                     100 000                  (exact)
        Pa
Stefan-Boltzmann constant                                   5.670 374 419... e-8     (exact)
        W m^-2 K^-4
tau Compton wavelength                                      6.977 71 e-16            0.000 47 e-16
        m
tau-electron mass ratio                                     3477.23                  0.23

tau energy equivalent                                       1776.86                  0.12
        MeV
tau mass                                                    3.167 54 e-27            0.000 21 e-27
        kg
tau mass energy equivalent                                  2.846 84 e-10            0.000 19 e-10
        J
tau mass in u                                               1.907 54                 0.000 13
```

```
        u
tau molar mass                                              1.907 54 e-3             0.000 13 e-3
        kg mol^-1
tau-muon mass ratio                                         16.8170                  0.0011

tau-neutron mass ratio                                      1.891 15                 0.000 13

tau-proton mass ratio                                       1.893 76                 0.000 13

Thomson cross section                                       6.652 458 7321 e-29      0.000 000 0060 e-29
        m^2
triton-electron mass ratio                                  5496.921 535 73          0.000 000 27

triton g factor                                             5.957 924 931            0.000 000 012

triton mag. mom.                                            1.504 609 5202 e-26      0.000 000 0030 e-26
        J T^-1
triton mag. mom. to Bohr magneton ratio                     1.622 393 6651 e-3       0.000 000 0032 e-3

triton mag. mom. to nuclear magneton ratio                  2.978 962 4656           0.000 000 0059

triton mass                                                 5.007 356 7446 e-27      0.000 000 0015 e-27
        kg
triton mass energy equivalent                               4.500 387 8060 e-10      0.000 000 0014 e-10
        J
triton mass energy equivalent in MeV                        2808.921 132 98          0.000 000 85
        MeV
triton mass in u                                            3.015 500 716 21         0.000 000 000 12
        u
triton molar mass                                           3.015 500 715 17 e-3     0.000 000 000 92 e-3
        kg mol^-1
triton-proton mass ratio                                    2.993 717 034 14         0.000 000 000 15

triton relative atomic mass                                 3.015 500 716 21         0.000 000 000 12

triton to proton mag. mom. ratio                            1.066 639 9191           0.000 000 0021

unified atomic mass unit                                    1.660 539 066 60 e-27    0.000 000 000 50 e-27
        kg
vacuum electric permittivity                                8.854 187 8128 e-12      0.000 000 0013 e-12
        F m^-1
vacuum mag. permeability                                    1.256 637 062 12 e-6     0.000 000 000 19 e-6
        N A^-2
von Klitzing constant                                       25 812.807 45...         (exact)
        ohm
weak mixing angle                                           0.222 90                 0.000 30

Wien frequency displacement law constant                    5.878 925 757... e10     (exact)
        Hz K^-1
Wien wavelength displacement law constant                   2.897 771 955... e-3     (exact)
        m K
W to Z mass ratio                                           0.881 53                 0.000 17
```

7.2 2014

```
            2014 Fundamental Physical Constants --- Complete Listing
  From:  http://physics.nist.gov/constants
  Quantity                                                       Value                 Uncertainty
       Unit
-----------------------------------------------------------------------------------------------------------------------------
{220} lattice spacing of silicon                            192.015 5714 e-12        0.000 0032 e-12
        m
alpha particle-electron mass ratio                          7294.299 541 36          0.000 000 24

alpha particle mass                                         6.644 657 230 e-27       0.000 000 082 e-27
        kg
alpha particle mass energy equivalent                       5.971 920 097 e-10       0.000 000 073 e-10
        J
alpha particle mass energy equivalent in MeV                3727.379 378             0.000 023
        MeV
alpha particle mass in u                                    4.001 506 179 127        0.000 000 000 063
        u
alpha particle molar mass                                   4.001 506 179 127 e-3    0.000 000 000 063 e-3
        kg mol^-1
alpha particle-proton mass ratio                            3.972 599 689 07         0.000 000 000 36

Angstrom star                                               1.000 014 95 e-10        0.000 000 90 e-10
        m
atomic mass constant                                        1.660 539 040 e-27       0.000 000 020 e-27
        kg
atomic mass constant energy equivalent                      1.492 418 062 e-10       0.000 000 018 e-10
        J
```

```
atomic mass constant energy equivalent in MeV               931.494 0954             0.000 0057
        MeV
atomic mass unit-electron volt relationship                 931.494 0954 e6          0.000 0057 e6
        eV
atomic mass unit-hartree relationship                       3.423 177 6902 e7        0.000 000 0016 e7
        E_h
atomic mass unit-hertz relationship                         2.252 342 7206 e23       0.000 000 0010 e23
        Hz
atomic mass unit-inverse meter relationship                 7.513 006 6166 e14       0.000 000 0034 e14
        m^-1
atomic mass unit-joule relationship                         1.492 418 062 e-10       0.000 000 018 e-10
        J
atomic mass unit-kelvin relationship                        1.080 954 38 e13         0.000 000 62 e13
        K
atomic mass unit-kilogram relationship                      1.660 539 040 e-27       0.000 000 020 e-27
        kg
atomic unit of 1st hyperpolarizability                      3.206 361 329 e-53       0.000 000 020 e-53
        C^3 m^3 J^-2
atomic unit of 2nd hyperpolarizability                      6.235 380 085 e-65       0.000 000 077 e-65
        C^4 m^4 J^-3
atomic unit of action                                       1.054 571 800 e-34       0.000 000 013 e-34
        J s
atomic unit of charge                                       1.602 176 6208 e-19      0.000 000 0098 e-19
        C
atomic unit of charge density                               1.081 202 3770 e12       0.000 000 0067 e12
        C m^-3
atomic unit of current                                      6.623 618 183 e-3        0.000 000 041 e-3
        A
atomic unit of electric dipole mom.                         8.478 353 552 e-30       0.000 000 052 e-30
        C m
atomic unit of electric field                               5.142 206 707 e11        0.000 000 032 e11
        V m^-1
atomic unit of electric field gradient                      9.717 362 356 e21        0.000 000 060 e21
        V m^-2
atomic unit of electric polarizability                      1.648 777 2731 e-41      0.000 000 0011 e-41
        C^2 m^2 J^-1
atomic unit of electric potential                           27.211 386 02            0.000 000 17
        V
atomic unit of electric quadrupole mom.                     4.486 551 484 e-40       0.000 000 028 e-40
        C m^2
atomic unit of energy                                       4.359 744 650 e-18       0.000 000 054 e-18
        J
atomic unit of force                                        8.238 723 36 e-8         0.000 000 10 e-8
        N
atomic unit of length                                       0.529 177 210 67 e-10    0.000 000 000 12 e-10
        m
atomic unit of mag. dipole mom.                             1.854 801 999 e-23       0.000 000 011 e-23
        J T^-1
atomic unit of mag. flux density                            2.350 517 550 e5         0.000 000 014 e5
        T
atomic unit of magnetizability                              7.891 036 5886 e-29      0.000 000 0090 e-29
        J T^-2
atomic unit of mass                                         9.109 383 56 e-31        0.000 000 11 e-31
        kg
atomic unit of mom.um                                       1.992 851 882 e-24       0.000 000 024 e-24
        kg m s^-1
atomic unit of permittivity                                 1.112 650 056... e-10    (exact)
        F m^-1
atomic unit of time                                         2.418 884 326 509 e-17   0.000 000 000 014 e-17
        s
atomic unit of velocity                                     2.187 691 262 77 e6      0.000 000 000 50 e6
        m s^-1
Avogadro constant                                           6.022 140 857 e23        0.000 000 074 e23
        mol^-1
Bohr magneton                                               927.400 9994 e-26        0.000 0057 e-26
        J T^-1
Bohr magneton in eV/T                                       5.788 381 8012 e-5       0.000 000 0026 e-5
        eV T^-1
Bohr magneton in Hz/T                                       13.996 245 042 e9        0.000 000 086 e9
        Hz T^-1
Bohr magneton in inverse meters per tesla                   46.686 448 14            0.000 000 29
        m^-1 T^-1
Bohr magneton in K/T                                        0.671 714 05             0.000 000 39
        K T^-1
Bohr radius                                                 0.529 177 210 67 e-10    0.000 000 000 12 e-10
        m
Boltzmann constant                                          1.380 648 52 e-23        0.000 000 79 e-23
        J K^-1
Boltzmann constant in eV/K                                  8.617 3303 e-5           0.000 0050 e-5
        eV K^-1
Boltzmann constant in Hz/K                                  2.083 6612 e10           0.000 0012 e10
        Hz K^-1
Boltzmann constant in inverse meters per kelvin             69.503 457               0.000 040
        m^-1 K^-1
characteristic impedance of vacuum                          376.730 313 461...       (exact)
        ohm
classical electron radius                                   2.817 940 3227 e-15      0.000 000 0019 e-15
```

```
        m
Compton wavelength                                          2.426 310 2367 e-12      0.000 000 0011 e-12
        m
Compton wavelength over 2 pi                                386.159 267 64 e-15      0.000 000 18 e-15
        m
conductance quantum                                         7.748 091 7310 e-5       0.000 000 0018 e-5
        S
conventional value of Josephson constant                    483 597.9 e9             (exact)
        Hz V^-1
conventional value of von Klitzing constant                 25 812.807               (exact)
        ohm
Cu x unit                                                   1.002 076 97 e-13        0.000 000 28 e-13
        m
deuteron-electron mag. mom. ratio                           -4.664 345 535 e-4       0.000 000 026 e-4

deuteron-electron mass ratio                                3670.482 967 85          0.000 000 13

deuteron g factor                                           0.857 438 2311           0.000 000 0048

deuteron mag. mom.                                          0.433 073 5040 e-26      0.000 000 0036 e-26
        J T^-1
deuteron mag. mom. to Bohr magneton ratio                   0.466 975 4554 e-3       0.000 000 0026 e-3

deuteron mag. mom. to nuclear magneton ratio                0.857 438 2311           0.000 000 0048

deuteron mass                                               3.343 583 719 e-27       0.000 000 041 e-27
        kg
deuteron mass energy equivalent                             3.005 063 183 e-10       0.000 000 037 e-10
        J
deuteron mass energy equivalent in MeV                      1875.612 928             0.000 012
        MeV
deuteron mass in u                                          2.013 553 212 745        0.000 000 000 040
        u
deuteron molar mass                                         2.013 553 212 745 e-3    0.000 000 000 040 e-3
        kg mol^-1
deuteron-neutron mag. mom. ratio                            -0.448 206 52            0.000 000 11

deuteron-proton mag. mom. ratio                             0.307 012 2077           0.000 000 0015

deuteron-proton mass ratio                                  1.999 007 500 87         0.000 000 000 19

deuteron rms charge radius                                  2.1413 e-15              0.0025 e-15
        m
electric constant                                           8.854 187 817... e-12    (exact)
        F m^-1
electron charge to mass quotient                            -1.758 820 024 e11       0.000 000 011 e11
        C kg^-1
electron-deuteron mag. mom. ratio                           -2143.923 499            0.000 012

electron-deuteron mass ratio                                2.724 437 107 484 e-4    0.000 000 000 096 e-4

electron g factor                                           -2.002 319 304 361 82    0.000 000 000 000 52

electron gyromag. ratio                                     1.760 859 644 e11        0.000 000 011 e11
        s^-1 T^-1
electron gyromag. ratio over 2 pi                           28 024.951 64            0.000 17
        MHz T^-1
electron-helion mass ratio                                  1.819 543 074 854 e-4    0.000 000 000 088 e-4

electron mag. mom.                                          -928.476 4620 e-26       0.000 0057 e-26
        J T^-1
electron mag. mom. anomaly                                  1.159 652 180 91 e-3     0.000 000 000 26 e-3

electron mag. mom. to Bohr magneton ratio                   -1.001 159 652 180 91    0.000 000 000 000 26

electron mag. mom. to nuclear magneton ratio                -1838.281 972 34         0.000 000 17

electron mass                                               9.109 383 56 e-31        0.000 000 11 e-31
        kg
electron mass energy equivalent                             8.187 105 65 e-14        0.000 000 10 e-14
        J
electron mass energy equivalent in MeV                      0.510 998 9461           0.000 000 0031
        MeV
electron mass in u                                          5.485 799 090 70 e-4     0.000 000 000 16 e-4
        u
electron molar mass                                         5.485 799 090 70 e-7     0.000 000 000 16 e-7
        kg mol^-1
electron-muon mag. mom. ratio                               206.766 9880             0.000 0046

electron-muon mass ratio                                    4.836 331 70 e-3         0.000 000 11 e-3

electron-neutron mag. mom. ratio                            960.920 50               0.000 23

electron-neutron mass ratio                                 5.438 673 4428 e-4       0.000 000 0027 e-4

electron-proton mag. mom. ratio                             -658.210 6866            0.000 0020
```

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electron-proton mass ratio                                  5.446 170 213 52 e-4     0.000 000 000 52 e-4

electron-tau mass ratio                                     2.875 92 e-4             0.000 26 e-4

electron to alpha particle mass ratio                       1.370 933 554 798 e-4    0.000 000 000 045 e-4

electron to shielded helion mag. mom. ratio                 864.058 257              0.000 010

electron to shielded proton mag. mom. ratio                 -658.227 5971            0.000 0072

electron-triton mass ratio                                  1.819 200 062 203 e-4    0.000 000 000 084 e-4

electron volt                                               1.602 176 6208 e-19      0.000 000 0098 e-19
        J
electron volt-atomic mass unit relationship                 1.073 544 1105 e-9       0.000 000 0066 e-9
        u
electron volt-hartree relationship                          3.674 932 248 e-2        0.000 000 023 e-2
        E_h
electron volt-hertz relationship                            2.417 989 262 e14        0.000 000 015 e14
        Hz
electron volt-inverse meter relationship                    8.065 544 005 e5         0.000 000 050 e5
        m^-1
electron volt-joule relationship                            1.602 176 6208 e-19      0.000 000 0098 e-19
        J
electron volt-kelvin relationship                           1.160 452 21 e4          0.000 000 67 e4
        K
electron volt-kilogram relationship                         1.782 661 907 e-36       0.000 000 011 e-36
        kg
elementary charge                                           1.602 176 6208 e-19      0.000 000 0098 e-19
        C
elementary charge over h                                    2.417 989 262 e14        0.000 000 015 e14
        A J^-1
Faraday constant                                            96 485.332 89            0.000 59
        C mol^-1
Faraday constant for conventional electric current          96 485.3251              0.0012
        C_90 mol^-1
Fermi coupling constant                                     1.166 3787 e-5           0.000 0006 e-5
        GeV^-2
fine-structure constant                                     7.297 352 5664 e-3       0.000 000 0017 e-3

first radiation constant                                    3.741 771 790 e-16       0.000 000 046 e-16
        W m^2
first radiation constant for spectral radiance              1.191 042 953 e-16       0.000 000 015 e-16
        W m^2 sr^-1
hartree-atomic mass unit relationship                       2.921 262 3197 e-8       0.000 000 0013 e-8
        u
hartree-electron volt relationship                          27.211 386 02            0.000 000 17
        eV
Hartree energy                                              4.359 744 650 e-18       0.000 000 054 e-18
        J
Hartree energy in eV                                        27.211 386 02            0.000 000 17
        eV
hartree-hertz relationship                                  6.579 683 920 711 e15    0.000 000 000 039 e15
        Hz
hartree-inverse meter relationship                          2.194 746 313 702 e7     0.000 000 000 013 e7
        m^-1
hartree-joule relationship                                  4.359 744 650 e-18       0.000 000 054 e-18
        J
hartree-kelvin relationship                                 3.157 7513 e5            0.000 0018 e5
        K
hartree-kilogram relationship                               4.850 870 129 e-35       0.000 000 060 e-35
        kg
helion-electron mass ratio                                  5495.885 279 22          0.000 000 27

helion g factor                                             -4.255 250 616           0.000 000 050

helion mag. mom.                                            -1.074 617 522 e-26      0.000 000 014 e-26
        J T^-1
helion mag. mom. to Bohr magneton ratio                     -1.158 740 958 e-3       0.000 000 014 e-3

helion mag. mom. to nuclear magneton ratio                  -2.127 625 308           0.000 000 025

helion mass                                                 5.006 412 700 e-27       0.000 000 062 e-27
        kg
helion mass energy equivalent                               4.499 539 341 e-10       0.000 000 055 e-10
        J
helion mass energy equivalent in MeV                        2808.391 586             0.000 017
        MeV
helion mass in u                                            3.014 932 246 73         0.000 000 000 12
        u
helion molar mass                                           3.014 932 246 73 e-3     0.000 000 000 12 e-3
        kg mol^-1
helion-proton mass ratio                                    2.993 152 670 46         0.000 000 000 29

hertz-atomic mass unit relationship                         4.439 821 6616 e-24      0.000 000 0020 e-24
        u
hertz-electron volt relationship                            4.135 667 662 e-15       0.000 000 025 e-15
```

```
        eV
hertz-hartree relationship                                  1.519 829 846 0088 e-16  0.000 000 000 0090 e-16
        E_h
hertz-inverse meter relationship                            3.335 640 951... e-9     (exact)
        m^-1
hertz-joule relationship                                    6.626 070 040 e-34       0.000 000 081 e-34
        J
hertz-kelvin relationship                                   4.799 2447 e-11          0.000 0028 e-11
        K
hertz-kilogram relationship                                 7.372 497 201 e-51       0.000 000 091 e-51
        kg
inverse fine-structure constant                             137.035 999 139          0.000 000 031

inverse meter-atomic mass unit relationship                 1.331 025 049 00 e-15    0.000 000 000 61 e-15
        u
inverse meter-electron volt relationship                    1.239 841 9739 e-6       0.000 000 0076 e-6
        eV
inverse meter-hartree relationship                          4.556 335 252 767 e-8    0.000 000 000 027 e-8
        E_h
inverse meter-hertz relationship                            299 792 458              (exact)
        Hz
inverse meter-joule relationship                            1.986 445 824 e-25       0.000 000 024 e-25
        J
inverse meter-kelvin relationship                           1.438 777 36 e-2         0.000 000 83 e-2
        K
inverse meter-kilogram relationship                         2.210 219 057 e-42       0.000 000 027 e-42
        kg
inverse of conductance quantum                              12 906.403 7278          0.000 0029
        ohm
Josephson constant                                          483 597.8525 e9          0.0030 e9
        Hz V^-1
joule-atomic mass unit relationship                         6.700 535 363 e9         0.000 000 082 e9
        u
joule-electron volt relationship                            6.241 509 126 e18        0.000 000 038 e18
        eV
joule-hartree relationship                                  2.293 712 317 e17        0.000 000 028 e17
        E_h
joule-hertz relationship                                    1.509 190 205 e33        0.000 000 019 e33
        Hz
joule-inverse meter relationship                            5.034 116 651 e24        0.000 000 062 e24
        m^-1
joule-kelvin relationship                                   7.242 9731 e22           0.000 0042 e22
        K
joule-kilogram relationship                                 1.112 650 056... e-17    (exact)
        kg
kelvin-atomic mass unit relationship                        9.251 0842 e-14          0.000 0053 e-14
        u
kelvin-electron volt relationship                           8.617 3303 e-5           0.000 0050 e-5
        eV
kelvin-hartree relationship                                 3.166 8105 e-6           0.000 0018 e-6
        E_h
kelvin-hertz relationship                                   2.083 6612 e10           0.000 0012 e10
        Hz
kelvin-inverse meter relationship                           69.503 457               0.000 040
        m^-1
kelvin-joule relationship                                   1.380 648 52 e-23        0.000 000 79 e-23
        J
kelvin-kilogram relationship                                1.536 178 65 e-40        0.000 000 88 e-40
        kg
kilogram-atomic mass unit relationship                      6.022 140 857 e26        0.000 000 074 e26
        u
kilogram-electron volt relationship                         5.609 588 650 e35        0.000 000 034 e35
        eV
kilogram-hartree relationship                               2.061 485 823 e34        0.000 000 025 e34
        E_h
kilogram-hertz relationship                                 1.356 392 512 e50        0.000 000 017 e50
        Hz
kilogram-inverse meter relationship                         4.524 438 411 e41        0.000 000 056 e41
        m^-1
kilogram-joule relationship                                 8.987 551 787... e16     (exact)
        J
kilogram-kelvin relationship                                6.509 6595 e39           0.000 0037 e39
        K
lattice parameter of silicon                                543.102 0504 e-12        0.000 0089 e-12
        m
Loschmidt constant (273.15 K, 100 kPa)                      2.651 6467 e25           0.000 0015 e25
        m^-3
Loschmidt constant (273.15 K, 101.325 kPa)                  2.686 7811 e25           0.000 0015 e25
        m^-3
mag. constant                                               12.566 370 614... e-7    (exact)
        N A^-2
mag. flux quantum                                           2.067 833 831 e-15       0.000 000 013 e-15
        Wb
molar gas constant                                          8.314 4598               0.000 0048
        J mol^-1 K^-1
molar mass constant                                         1 e-3                    (exact)
        kg mol^-1
```

```
molar mass of carbon-12                                     12 e-3                   (exact)
        kg mol^-1
molar Planck constant                                       3.990 312 7110 e-10      0.000 000 0018 e-10
        J s mol^-1
molar Planck constant times c                               0.119 626 565 582        0.000 000 000 054
        J m mol^-1
molar volume of ideal gas (273.15 K, 100 kPa)               22.710 947 e-3           0.000 013 e-3
        m^3 mol^-1
molar volume of ideal gas (273.15 K, 101.325 kPa)           22.413 962 e-3           0.000 013 e-3
        m^3 mol^-1
molar volume of silicon                                     12.058 832 14 e-6        0.000 000 61 e-6
        m^3 mol^-1
Mo x unit                                                   1.002 099 52 e-13        0.000 000 53 e-13
        m
muon Compton wavelength                                     11.734 441 11 e-15       0.000 000 26 e-15
        m
muon Compton wavelength over 2 pi                           1.867 594 308 e-15       0.000 000 042 e-15
        m
muon-electron mass ratio                                    206.768 2826             0.000 0046

muon g factor                                               -2.002 331 8418          0.000 000 0013

muon mag. mom.                                              -4.490 448 26 e-26       0.000 000 10 e-26
        J T^-1
muon mag. mom. anomaly                                      1.165 920 89 e-3         0.000 000 63 e-3

muon mag. mom. to Bohr magneton ratio                       -4.841 970 48 e-3        0.000 000 11 e-3

muon mag. mom. to nuclear magneton ratio                    -8.890 597 05            0.000 000 20

muon mass                                                   1.883 531 594 e-28       0.000 000 048 e-28
        kg
muon mass energy equivalent                                 1.692 833 774 e-11       0.000 000 043 e-11
        J
muon mass energy equivalent in MeV                          105.658 3745             0.000 0024
        MeV
muon mass in u                                              0.113 428 9257           0.000 000 0025
        u
muon molar mass                                             0.113 428 9257 e-3       0.000 000 0025 e-3
        kg mol^-1
muon-neutron mass ratio                                     0.112 454 5167           0.000 000 0025

muon-proton mag. mom. ratio                                 -3.183 345 142           0.000 000 071

muon-proton mass ratio                                      0.112 609 5262           0.000 000 0025

muon-tau mass ratio                                         5.946 49 e-2             0.000 54 e-2

natural unit of action                                      1.054 571 800 e-34       0.000 000 013 e-34
        J s
natural unit of action in eV s                              6.582 119 514 e-16       0.000 000 040 e-16
        eV s
natural unit of energy                                      8.187 105 65 e-14        0.000 000 10 e-14
        J
natural unit of energy in MeV                               0.510 998 9461           0.000 000 0031
        MeV
natural unit of length                                      386.159 267 64 e-15      0.000 000 18 e-15
        m
natural unit of mass                                        9.109 383 56 e-31        0.000 000 11 e-31
        kg
natural unit of mom.um                                      2.730 924 488 e-22       0.000 000 034 e-22
        kg m s^-1
natural unit of mom.um in MeV/c                             0.510 998 9461           0.000 000 0031
        MeV/c
natural unit of time                                        1.288 088 667 12 e-21    0.000 000 000 58 e-21
        s
natural unit of velocity                                    299 792 458              (exact)
        m s^-1
neutron Compton wavelength                                  1.319 590 904 81 e-15    0.000 000 000 88 e-15
        m
neutron Compton wavelength over 2 pi                        0.210 019 415 36 e-15    0.000 000 000 14 e-15
        m
neutron-electron mag. mom. ratio                            1.040 668 82 e-3         0.000 000 25 e-3

neutron-electron mass ratio                                 1838.683 661 58          0.000 000 90

neutron g factor                                            -3.826 085 45            0.000 000 90

neutron gyromag. ratio                                      1.832 471 72 e8          0.000 000 43 e8
        s^-1 T^-1
neutron gyromag. ratio over 2 pi                            29.164 6933              0.000 0069
        MHz T^-1
neutron mag. mom.                                           -0.966 236 50 e-26       0.000 000 23 e-26
        J T^-1
neutron mag. mom. to Bohr magneton ratio                    -1.041 875 63 e-3        0.000 000 25 e-3

neutron mag. mom. to nuclear magneton ratio                 -1.913 042 73            0.000 000 45
neutron mass                                                1.674 927 471 e-27       0.000 000 021 e-27
        kg
neutron mass energy equivalent                              1.505 349 739 e-10       0.000 000 019 e-10
        J
neutron mass energy equivalent in MeV                       939.565 4133             0.000 0058
        MeV
neutron mass in u                                           1.008 664 915 88         0.000 000 000 49
        u
neutron molar mass                                          1.008 664 915 88 e-3     0.000 000 000 49 e-3
        kg mol^-1
neutron-muon mass ratio                                     8.892 484 08             0.000 000 20

neutron-proton mag. mom. ratio                              -0.684 979 34            0.000 000 16

neutron-proton mass difference                              2.305 573 77 e-30        0.000 000 85 e-30

neutron-proton mass difference energy equivalent            2.072 146 37 e-13        0.000 000 76 e-13

neutron-proton mass difference energy equivalent in MeV     1.293 332 05             0.000 000 48

neutron-proton mass difference in u                         0.001 388 449 00         0.000 000 000 51

neutron-proton mass ratio                                   1.001 378 418 98         0.000 000 000 51

neutron-tau mass ratio                                      0.528 790                0.000 048

neutron to shielded proton mag. mom. ratio                  -0.684 996 94            0.000 000 16

Newtonian constant of gravitation                           6.674 08 e-11            0.000 31 e-11
        m^3 kg^-1 s^-2
Newtonian constant of gravitation over h-bar c              6.708 61 e-39            0.000 31 e-39
        (GeV/c^2)^-2
nuclear magneton                                            5.050 783 699 e-27       0.000 000 031 e-27
        J T^-1
nuclear magneton in eV/T                                    3.152 451 2550 e-8       0.000 000 0015 e-8
        eV T^-1
nuclear magneton in inverse meters per tesla                2.542 623 432 e-2        0.000 000 016 e-2
        m^-1 T^-1
nuclear magneton in K/T                                     3.658 2690 e-4           0.000 0021 e-4
        K T^-1
nuclear magneton in MHz/T                                   7.622 593 285            0.000 000 047
        MHz T^-1
Planck constant                                             6.626 070 040 e-34       0.000 000 081 e-34
        J s
Planck constant in eV s                                     4.135 667 662 e-15       0.000 000 025 e-15
        eV s
Planck constant over 2 pi                                   1.054 571 800 e-34       0.000 000 013 e-34
        J s
Planck constant over 2 pi in eV s                           6.582 119 514 e-16       0.000 000 040 e-16
        eV s
Planck constant over 2 pi times c in MeV fm                 197.326 9788             0.000 0012
        MeV fm
Planck length                                               1.616 229 e-35           0.000 038 e-35
        m
Planck mass                                                 2.176 470 e-8            0.000 051 e-8
        kg
Planck mass energy equivalent in GeV                        1.220 910 e19            0.000 029 e19
        GeV
Planck temperature                                          1.416 808 e32            0.000 033 e32
        K
Planck time                                                 5.391 16 e-44            0.000 13 e-44
        s
proton charge to mass quotient                              9.578 833 226 e7         0.000 000 059 e7
        C kg^-1
proton Compton wavelength                                   1.321 409 853 96 e-15    0.000 000 000 61 e-15
        m
proton Compton wavelength over 2 pi                         0.210 308 910 109 e-15   0.000 000 000 097 e-15
        m
proton-electron mass ratio                                  1836.152 673 89          0.000 000 17

proton g factor                                             5.585 694 702            0.000 000 017

proton gyromag. ratio                                       2.675 221 900 e8         0.000 000 018 e8
        s^-1 T^-1
proton gyromag. ratio over 2 pi                             42.577 478 92            0.000 000 29
        MHz T^-1
proton mag. mom.                                            1.410 606 7873 e-26      0.000 000 0097 e-26
        J T^-1
proton mag. mom. to Bohr magneton ratio                     1.521 032 2053 e-3       0.000 000 0046 e-3

proton mag. mom. to nuclear magneton ratio                  2.792 847 3508           0.000 000 0085

proton mag. shielding correction                            25.691 e-6               0.011 e-6

proton mass                                                 1.672 621 898 e-27       0.000 000 021 e-27
        kg
```

```
proton mass energy equivalent                               1.503 277 593 e-10       0.000 000 018 e-10
        J
proton mass energy equivalent in MeV                        938.272 0813             0.000 0058
        MeV
proton mass in u                                            1.007 276 466 879        0.000 000 000 091
        u
proton molar mass                                           1.007 276 466 879 e-3    0.000 000 000 091 e-3
        kg mol^-1
proton-muon mass ratio                                      8.880 243 38             0.000 000 20

proton-neutron mag. mom. ratio                              -1.459 898 05            0.000 000 34

proton-neutron mass ratio                                   0.998 623 478 44         0.000 000 000 51

proton rms charge radius                                    0.8751 e-15              0.0061 e-15
        m
proton-tau mass ratio                                       0.528 063                0.000 048

quantum of circulation                                      3.636 947 5486 e-4       0.000 000 0017 e-4
        m^2 s^-1
quantum of circulation times 2                              7.273 895 0972 e-4       0.000 000 0033 e-4
        m^2 s^-1
Rydberg constant                                            10 973 731.568 508       0.000 065
        m^-1
Rydberg constant times c in Hz                              3.289 841 960 355 e15    0.000 000 000 019 e15
        Hz
Rydberg constant times hc in eV                             13.605 693 009           0.000 000 084
        eV
Rydberg constant times hc in J                              2.179 872 325 e-18       0.000 000 027 e-18
        J
Sackur-Tetrode constant (1 K, 100 kPa)                      -1.151 7084              0.000 0014

Sackur-Tetrode constant (1 K, 101.325 kPa)                  -1.164 8714              0.000 0014

second radiation constant                                   1.438 777 36 e-2         0.000 000 83 e-2
        m K
shielded helion gyromag. ratio                              2.037 894 585 e8         0.000 000 027 e8
        s^-1 T^-1
shielded helion gyromag. ratio over 2 pi                    32.434 099 66            0.000 000 43
        MHz T^-1
shielded helion mag. mom.                                   -1.074 553 080 e-26      0.000 000 014 e-26
        J T^-1
shielded helion mag. mom. to Bohr magneton ratio            -1.158 671 471 e-3       0.000 000 014 e-3

shielded helion mag. mom. to nuclear magneton ratio         -2.127 497 720           0.000 000 025

shielded helion to proton mag. mom. ratio                   -0.761 766 5603          0.000 000 0092

shielded helion to shielded proton mag. mom. ratio          -0.761 786 1313          0.000 000 0033

shielded proton gyromag. ratio                              2.675 153 171 e8         0.000 000 033 e8
        s^-1 T^-1
shielded proton gyromag. ratio over 2 pi                    42.576 385 07            0.000 000 53
        MHz T^-1
shielded proton mag. mom.                                   1.410 570 547 e-26       0.000 000 018 e-26
        J T^-1
shielded proton mag. mom. to Bohr magneton ratio            1.520 993 128 e-3        0.000 000 017 e-3

shielded proton mag. mom. to nuclear magneton ratio         2.792 775 600            0.000 000 030

speed of light in vacuum                                    299 792 458              (exact)
        m s^-1
standard acceleration of gravity                            9.806 65                 (exact)
        m s^-2
standard atmosphere                                         101 325                  (exact)
        Pa
standard-state pressure                                     100 000                  (exact)
        Pa
Stefan-Boltzmann constant                                   5.670 367 e-8            0.000 013 e-8
        W m^-2 K^-4
tau Compton wavelength                                      0.697 787 e-15           0.000 063 e-15
        m
tau Compton wavelength over 2 pi                            0.111 056 e-15           0.000 010 e-15
        m
tau-electron mass ratio                                     3477.15                  0.31

tau mass                                                    3.167 47 e-27            0.000 29 e-27
        kg
tau mass energy equivalent                                  2.846 78 e-10            0.000 26 e-10
        J
tau mass energy equivalent in MeV                           1776.82                  0.16
        MeV
tau mass in u                                               1.907 49                 0.000 17
        u
tau molar mass                                              1.907 49 e-3             0.000 17 e-3
        kg mol^-1
tau-muon mass ratio                                         16.8167                  0.0015
```

```
tau-neutron mass ratio                                      1.891 11                 0.000 17

tau-proton mass ratio                                       1.893 72                 0.000 17

Thomson cross section                                       0.665 245 871 58 e-28    0.000 000 000 91 e-28
        m^2
triton-electron mass ratio                                  5496.921 535 88          0.000 000 26

triton g factor                                             5.957 924 920            0.000 000 028

triton mag. mom.                                            1.504 609 503 e-26       0.000 000 012 e-26
        J T^-1
triton mag. mom. to Bohr magneton ratio                     1.622 393 6616 e-3       0.000 000 0076 e-3

triton mag. mom. to nuclear magneton ratio                  2.978 962 460            0.000 000 014

triton mass                                                 5.007 356 665 e-27       0.000 000 062 e-27
        kg
triton mass energy equivalent                               4.500 387 735 e-10       0.000 000 055 e-10
        J
triton mass energy equivalent in MeV                        2808.921 112             0.000 017
        MeV
triton mass in u                                            3.015 500 716 32         0.000 000 000 11
        u
triton molar mass                                           3.015 500 716 32 e-3     0.000 000 000 11 e-3
        kg mol^-1
triton-proton mass ratio                                    2.993 717 033 48         0.000 000 000 22

unified atomic mass unit                                    1.660 539 040 e-27       0.000 000 020 e-27
        kg
von Klitzing constant                                       25 812.807 4555          0.000 0059
        ohm
weak mixing angle                                           0.2223                   0.0021

Wien frequency displacement law constant                    5.878 9238 e10           0.000 0034 e10
        Hz K^-1
Wien wavelength displacement law constant                   2.897 7729 e-3           0.000 0017 e-3
        m K
```

7.3 2010

```
             2010 Fundamental Physical Constants --- Complete Listing
  From:  http://physics.nist.gov/constants
  Quantity                                                       Value                Uncertainty
       Unit
-----------------------------------------------------------------------------------------------------------------------------
{220} lattice spacing of silicon                            192.015 5714 e-12        0.000 0032 e-12
        m
alpha particle-electron mass ratio                          7294.299 5361            0.000 0029

alpha particle mass                                         6.644 656 75 e-27        0.000 000 29 e-27
        kg
alpha particle mass energy equivalent                       5.971 919 67 e-10        0.000 000 26 e-10
        J
alpha particle mass energy equivalent in MeV                3727.379 240             0.000 082
        MeV
alpha particle mass in u                                    4.001 506 179 125        0.000 000 000 062
        u
alpha particle molar mass                                   4.001 506 179 125 e-3    0.000 000 000 062 e-3
        kg mol^-1
alpha particle-proton mass ratio                            3.972 599 689 33         0.000 000 000 36

Angstrom star                                               1.000 014 95 e-10        0.000 000 90 e-10
        m
atomic mass constant                                        1.660 538 921 e-27       0.000 000 073 e-27
        kg
atomic mass constant energy equivalent                      1.492 417 954 e-10       0.000 000 066 e-10
        J
atomic mass constant energy equivalent in MeV               931.494 061              0.000 021
        MeV
atomic mass unit-electron volt relationship                 931.494 061 e6           0.000 021 e6
        eV
atomic mass unit-hartree relationship                       3.423 177 6845 e7        0.000 000 0024 e7
        E_h
atomic mass unit-hertz relationship                         2.252 342 7168 e23       0.000 000 0016 e23
        Hz
atomic mass unit-inverse meter relationship                 7.513 006 6042 e14       0.000 000 0053 e14
        m^-1
atomic mass unit-joule relationship                         1.492 417 954 e-10       0.000 000 066 e-10
        J
atomic mass unit-kelvin relationship                        1.080 954 08 e13         0.000 000 98 e13
        K
```

```
atomic mass unit-kilogram relationship                      1.660 538 921 e-27       0.000 000 073 e-27
        kg
atomic unit of 1st hyperpolarizability                      3.206 361 449 e-53       0.000 000 071 e-53
        C^3 m^3 J^-2
atomic unit of 2nd hyperpolarizability                      6.235 380 54 e-65        0.000 000 28 e-65
        C^4 m^4 J^-3
atomic unit of action                                       1.054 571 726 e-34       0.000 000 047 e-34
        J s
atomic unit of charge                                       1.602 176 565 e-19       0.000 000 035 e-19
        C
atomic unit of charge density                               1.081 202 338 e12        0.000 000 024 e12
        C m^-3
atomic unit of current                                      6.623 617 95 e-3         0.000 000 15 e-3
        A
atomic unit of electric dipole mom.                         8.478 353 26 e-30        0.000 000 19 e-30
        C m
atomic unit of electric field                               5.142 206 52 e11         0.000 000 11 e11
        V m^-1
atomic unit of electric field gradient                      9.717 362 00 e21         0.000 000 21 e21
        V m^-2
atomic unit of electric polarizability                      1.648 777 2754 e-41      0.000 000 0016 e-41
        C^2 m^2 J^-1
atomic unit of electric potential                           27.211 385 05            0.000 000 60
        V
atomic unit of electric quadrupole mom.                     4.486 551 331 e-40       0.000 000 099 e-40
        C m^2
atomic unit of energy                                       4.359 744 34 e-18        0.000 000 19 e-18
        J
atomic unit of force                                        8.238 722 78 e-8         0.000 000 36 e-8
        N
atomic unit of length                                       0.529 177 210 92 e-10    0.000 000 000 17 e-10
        m
atomic unit of mag. dipole mom.                             1.854 801 936 e-23       0.000 000 041 e-23
        J T^-1
atomic unit of mag. flux density                            2.350 517 464 e5         0.000 000 052 e5
        T
atomic unit of magnetizability                              7.891 036 607 e-29       0.000 000 013 e-29
        J T^-2
atomic unit of mass                                         9.109 382 91 e-31        0.000 000 40 e-31
        kg
atomic unit of mom.um                                       1.992 851 740 e-24       0.000 000 088 e-24
        kg m s^-1
atomic unit of permittivity                                 1.112 650 056... e-10    (exact)
        F m^-1
atomic unit of time                                         2.418 884 326 502 e-17   0.000 000 000 012 e-17
        s
atomic unit of velocity                                     2.187 691 263 79 e6      0.000 000 000 71 e6
        m s^-1
Avogadro constant                                           6.022 141 29 e23         0.000 000 27 e23
        mol^-1
Bohr magneton                                               927.400 968 e-26         0.000 020 e-26
        J T^-1
Bohr magneton in eV/T                                       5.788 381 8066 e-5       0.000 000 0038 e-5
        eV T^-1
Bohr magneton in Hz/T                                       13.996 245 55 e9         0.000 000 31 e9
        Hz T^-1
Bohr magneton in inverse meters per tesla                   46.686 4498              0.000 0010
        m^-1 T^-1
Bohr magneton in K/T                                        0.671 713 88             0.000 000 61
        K T^-1
Bohr radius                                                 0.529 177 210 92 e-10    0.000 000 000 17 e-10
        m
Boltzmann constant                                          1.380 6488 e-23          0.000 0013 e-23
        J K^-1
Boltzmann constant in eV/K                                  8.617 3324 e-5           0.000 0078 e-5
        eV K^-1
Boltzmann constant in Hz/K                                  2.083 6618 e10           0.000 0019 e10
        Hz K^-1
Boltzmann constant in inverse meters per kelvin             69.503 476               0.000 063
        m^-1 K^-1
characteristic impedance of vacuum                          376.730 313 461...       (exact)
        ohm
classical electron radius                                   2.817 940 3267 e-15      0.000 000 0027 e-15
        m
Compton wavelength                                          2.426 310 2389 e-12      0.000 000 0016 e-12
        m
Compton wavelength over 2 pi                                386.159 268 00 e-15      0.000 000 25 e-15
        m
conductance quantum                                         7.748 091 7346 e-5       0.000 000 0025 e-5
        S
conventional value of Josephson constant                    483 597.9 e9             (exact)
        Hz V^-1
conventional value of von Klitzing constant                 25 812.807               (exact)
        ohm
Cu x unit                                                   1.002 076 97 e-13        0.000 000 28 e-13
        m
deuteron-electron mag. mom. ratio                           -4.664 345 537 e-4       0.000 000 039 e-4
```

```
deuteron-electron mass ratio                              3670.482 9652          0.000 0015

deuteron g factor                                         0.857 438 2308         0.000 000 0072

deuteron mag. mom.                                        0.433 073 489 e-26     0.000 000 010 e-26
        J T^-1
deuteron mag. mom. to Bohr magneton ratio                 0.466 975 4556 e-3     0.000 000 0039 e-3

deuteron mag. mom. to nuclear magneton ratio              0.857 438 2308         0.000 000 0072

deuteron mass                                             3.343 583 48 e-27      0.000 000 15 e-27
        kg
deuteron mass energy equivalent                           3.005 062 97 e-10      0.000 000 13 e-10
        J
deuteron mass energy equivalent in MeV                    1875.612 859           0.000 041
        MeV
deuteron mass in u                                        2.013 553 212 712      0.000 000 000 077
        u
deuteron molar mass                                       2.013 553 212 712 e-3  0.000 000 000 077 e-3
        kg mol^-1
deuteron-neutron mag. mom. ratio                          -0.448 206 52          0.000 000 11

deuteron-proton mag. mom. ratio                           0.307 012 2070         0.000 000 0024

deuteron-proton mass ratio                                1.999 007 500 97       0.000 000 000 18

deuteron rms charge radius                                2.1424 e-15            0.0021 e-15
        m
electric constant                                         8.854 187 817... e-12  (exact)
        F m^-1
electron charge to mass quotient                          -1.758 820 088 e11     0.000 000 039 e11
        C kg^-1
electron-deuteron mag. mom. ratio                         -2143.923 498          0.000 018

electron-deuteron mass ratio                              2.724 437 1095 e-4     0.000 000 0011 e-4

electron g factor                                         -2.002 319 304 361 53  0.000 000 000 000 53

electron gyromag. ratio                                   1.760 859 708 e11      0.000 000 039 e11
        s^-1 T^-1
electron gyromag. ratio over 2 pi                         28 024.952 66          0.000 62
        MHz T^-1
electron-helion mass ratio                                1.819 543 0761 e-4     0.000 000 0017 e-4

electron mag. mom.                                        -928.476 430 e-26      0.000 021 e-26
        J T^-1
electron mag. mom. anomaly                                1.159 652 180 76 e-3   0.000 000 000 27 e-3

electron mag. mom. to Bohr magneton ratio                 -1.001 159 652 180 76  0.000 000 000 000 27

electron mag. mom. to nuclear magneton ratio              -1838.281 970 90       0.000 000 75

electron mass                                             9.109 382 91 e-31      0.000 000 40 e-31
        kg
electron mass energy equivalent                           8.187 105 06 e-14      0.000 000 36 e-14
        J
electron mass energy equivalent in MeV                    0.510 998 928          0.000 000 011
        MeV
electron mass in u                                        5.485 799 0946 e-4     0.000 000 0022 e-4
        u
electron molar mass                                       5.485 799 0946 e-7     0.000 000 0022 e-7
        kg mol^-1
electron-muon mag. mom. ratio                             206.766 9896           0.000 0052

electron-muon mass ratio                                  4.836 331 66 e-3       0.000 000 12 e-3

electron-neutron mag. mom. ratio                          960.920 50             0.000 23

electron-neutron mass ratio                               5.438 673 4461 e-4     0.000 000 0032 e-4

electron-proton mag. mom. ratio                           -658.210 6848          0.000 0054

electron-proton mass ratio                                5.446 170 2178 e-4     0.000 000 0022 e-4

electron-tau mass ratio                                   2.875 92 e-4           0.000 26 e-4

electron to alpha particle mass ratio                     1.370 933 555 78 e-4   0.000 000 000 55 e-4

electron to shielded helion mag. mom. ratio               864.058 257            0.000 010

electron to shielded proton mag. mom. ratio               -658.227 5971          0.000 0072

electron-triton mass ratio                                1.819 200 0653 e-4     0.000 000 0017 e-4

electron volt                                             1.602 176 565 e-19     0.000 000 035 e-19
        J
```

```
electron volt-atomic mass unit relationship                 1.073 544 150 e-9        0.000 000 024 e-9
        u
electron volt-hartree relationship                          3.674 932 379 e-2        0.000 000 081 e-2
        E_h
electron volt-hertz relationship                            2.417 989 348 e14        0.000 000 053 e14
        Hz
electron volt-inverse meter relationship                    8.065 544 29 e5          0.000 000 18 e5
        m^-1
electron volt-joule relationship                            1.602 176 565 e-19       0.000 000 035 e-19
        J
electron volt-kelvin relationship                           1.160 4519 e4            0.000 0011 e4
        K
electron volt-kilogram relationship                         1.782 661 845 e-36       0.000 000 039 e-36
        kg
elementary charge                                           1.602 176 565 e-19       0.000 000 035 e-19
        C
elementary charge over h                                    2.417 989 348 e14        0.000 000 053 e14
        A J^-1
Faraday constant                                            96 485.3365              0.0021
        C mol^-1
Faraday constant for conventional electric current          96 485.3321              0.0043
        C_90 mol^-1
Fermi coupling constant                                     1.166 364 e-5            0.000 005 e-5
        GeV^-2
fine-structure constant                                     7.297 352 5698 e-3       0.000 000 0024 e-3

first radiation constant                                    3.741 771 53 e-16        0.000 000 17 e-16
        W m^2
first radiation constant for spectral radiance              1.191 042 869 e-16       0.000 000 053 e-16
        W m^2 sr^-1
hartree-atomic mass unit relationship                       2.921 262 3246 e-8       0.000 000 0021 e-8
        u
hartree-electron volt relationship                          27.211 385 05            0.000 000 60
        eV
Hartree energy                                              4.359 744 34 e-18        0.000 000 19 e-18
        J
Hartree energy in eV                                        27.211 385 05            0.000 000 60
        eV
hartree-hertz relationship                                  6.579 683 920 729 e15    0.000 000 000 033 e15
        Hz
hartree-inverse meter relationship                          2.194 746 313 708 e7     0.000 000 000 011 e7
        m^-1
hartree-joule relationship                                  4.359 744 34 e-18        0.000 000 19 e-18
        J
hartree-kelvin relationship                                 3.157 7504 e5            0.000 0029 e5
        K
hartree-kilogram relationship                               4.850 869 79 e-35        0.000 000 21 e-35
        kg
helion-electron mass ratio                                  5495.885 2754            0.000 0050

helion g factor                                             -4.255 250 613           0.000 000 050

helion mag. mom.                                            -1.074 617 486 e-26      0.000 000 027 e-26
        J T^-1
helion mag. mom. to Bohr magneton ratio                     -1.158 740 958 e-3       0.000 000 014 e-3

helion mag. mom. to nuclear magneton ratio                  -2.127 625 306           0.000 000 025

helion mass                                                 5.006 412 34 e-27        0.000 000 22 e-27
        kg
helion mass energy equivalent                               4.499 539 02 e-10        0.000 000 20 e-10
        J
helion mass energy equivalent in MeV                        2808.391 482             0.000 062
        MeV
helion mass in u                                            3.014 932 2468           0.000 000 0025
        u
helion molar mass                                           3.014 932 2468 e-3       0.000 000 0025 e-3
        kg mol^-1
helion-proton mass ratio                                    2.993 152 6707           0.000 000 0025

hertz-atomic mass unit relationship                         4.439 821 6689 e-24      0.000 000 0031 e-24
        u
hertz-electron volt relationship                            4.135 667 516 e-15       0.000 000 091 e-15
        eV
hertz-hartree relationship                                  1.519 829 846 0045 e-16  0.000 000 000 0076 e-16
        E_h
hertz-inverse meter relationship                            3.335 640 951... e-9     (exact)
        m^-1
hertz-joule relationship                                    6.626 069 57 e-34        0.000 000 29 e-34
        J
hertz-kelvin relationship                                   4.799 2434 e-11          0.000 0044 e-11
        K
hertz-kilogram relationship                                 7.372 496 68 e-51        0.000 000 33 e-51
        kg
inverse fine-structure constant                             137.035 999 074          0.000 000 044

inverse meter-atomic mass unit relationship                 1.331 025 051 20 e-15    0.000 000 000 94 e-15
```

```
        u
inverse meter-electron volt relationship                    1.239 841 930 e-6        0.000 000 027 e-6
        eV
inverse meter-hartree relationship                          4.556 335 252 755 e-8    0.000 000 000 023 e-8
        E_h
inverse meter-hertz relationship                            299 792 458              (exact)
        Hz
inverse meter-joule relationship                            1.986 445 684 e-25       0.000 000 088 e-25
        J
inverse meter-kelvin relationship                           1.438 7770 e-2           0.000 0013 e-2
        K
inverse meter-kilogram relationship                         2.210 218 902 e-42       0.000 000 098 e-42
        kg
inverse of conductance quantum                              12 906.403 7217          0.000 0042
        ohm
Josephson constant                                          483 597.870 e9           0.011 e9
        Hz V^-1
joule-atomic mass unit relationship                         6.700 535 85 e9          0.000 000 30 e9
        u
joule-electron volt relationship                            6.241 509 34 e18         0.000 000 14 e18
        eV
joule-hartree relationship                                  2.293 712 48 e17         0.000 000 10 e17
        E_h
joule-hertz relationship                                    1.509 190 311 e33        0.000 000 067 e33
        Hz
joule-inverse meter relationship                            5.034 117 01 e24         0.000 000 22 e24
        m^-1
joule-kelvin relationship                                   7.242 9716 e22           0.000 0066 e22
        K
joule-kilogram relationship                                 1.112 650 056... e-17    (exact)
        kg
kelvin-atomic mass unit relationship                        9.251 0868 e-14          0.000 0084 e-14
        u
kelvin-electron volt relationship                           8.617 3324 e-5           0.000 0078 e-5
        eV
kelvin-hartree relationship                                 3.166 8114 e-6           0.000 0029 e-6
        E_h
kelvin-hertz relationship                                   2.083 6618 e10           0.000 0019 e10
        Hz
kelvin-inverse meter relationship                           69.503 476               0.000 063
        m^-1
kelvin-joule relationship                                   1.380 6488 e-23          0.000 0013 e-23
        J
kelvin-kilogram relationship                                1.536 1790 e-40          0.000 0014 e-40
        kg
kilogram-atomic mass unit relationship                      6.022 141 29 e26         0.000 000 27 e26
        u
kilogram-electron volt relationship                         5.609 588 85 e35         0.000 000 12 e35
        eV
kilogram-hartree relationship                               2.061 485 968 e34        0.000 000 091 e34
        E_h
kilogram-hertz relationship                                 1.356 392 608 e50        0.000 000 060 e50
        Hz
kilogram-inverse meter relationship                         4.524 438 73 e41         0.000 000 20 e41
        m^-1
kilogram-joule relationship                                 8.987 551 787... e16     (exact)
        J
kilogram-kelvin relationship                                6.509 6582 e39           0.000 0059 e39
        K
lattice parameter of silicon                                543.102 0504 e-12        0.000 0089 e-12
        m
Loschmidt constant (273.15 K, 100 kPa)                      2.651 6462 e25           0.000 0024 e25
        m^-3
Loschmidt constant (273.15 K, 101.325 kPa)                  2.686 7805 e25           0.000 0024 e25
        m^-3
mag. constant                                               12.566 370 614... e-7    (exact)
        N A^-2
mag. flux quantum                                           2.067 833 758 e-15       0.000 000 046 e-15
        Wb
molar gas constant                                          8.314 4621               0.000 0075
        J mol^-1 K^-1
molar mass constant                                         1 e-3                    (exact)
        kg mol^-1
molar mass of carbon-12                                     12 e-3                   (exact)
        kg mol^-1
molar Planck constant                                       3.990 312 7176 e-10      0.000 000 0028 e-10
        J s mol^-1
molar Planck constant times c                               0.119 626 565 779        0.000 000 000 084
        J m mol^-1
molar volume of ideal gas (273.15 K, 100 kPa)               22.710 953 e-3           0.000 021 e-3
        m^3 mol^-1
molar volume of ideal gas (273.15 K, 101.325 kPa)           22.413 968 e-3           0.000 020 e-3
        m^3 mol^-1
molar volume of silicon                                     12.058 833 01 e-6        0.000 000 80 e-6
        m^3 mol^-1
Mo x unit                                                   1.002 099 52 e-13        0.000 000 53 e-13
        m
```

```
muon Compton wavelength                                     11.734 441 03 e-15       0.000 000 30 e-15
        m
muon Compton wavelength over 2 pi                           1.867 594 294 e-15       0.000 000 047 e-15
        m
muon-electron mass ratio                                    206.768 2843             0.000 0052

muon g factor                                               -2.002 331 8418          0.000 000 0013

muon mag. mom.                                              -4.490 448 07 e-26       0.000 000 15 e-26
        J T^-1
muon mag. mom. anomaly                                      1.165 920 91 e-3         0.000 000 63 e-3

muon mag. mom. to Bohr magneton ratio                       -4.841 970 44 e-3        0.000 000 12 e-3

muon mag. mom. to nuclear magneton ratio                    -8.890 596 97            0.000 000 22

muon mass                                                   1.883 531 475 e-28       0.000 000 096 e-28
        kg
muon mass energy equivalent                                 1.692 833 667 e-11       0.000 000 086 e-11
        J
muon mass energy equivalent in MeV                          105.658 3715             0.000 0035
        MeV
muon mass in u                                              0.113 428 9267           0.000 000 0029
        u
muon molar mass                                             0.113 428 9267 e-3       0.000 000 0029 e-3
        kg mol^-1
muon-neutron mass ratio                                     0.112 454 5177           0.000 000 0028

muon-proton mag. mom. ratio                                 -3.183 345 107           0.000 000 084

muon-proton mass ratio                                      0.112 609 5272           0.000 000 0028

muon-tau mass ratio                                         5.946 49 e-2             0.000 54 e-2

natural unit of action                                      1.054 571 726 e-34       0.000 000 047 e-34
        J s
natural unit of action in eV s                              6.582 119 28 e-16        0.000 000 15 e-16
        eV s
natural unit of energy                                      8.187 105 06 e-14        0.000 000 36 e-14
        J
natural unit of energy in MeV                               0.510 998 928            0.000 000 011
        MeV
natural unit of length                                      386.159 268 00 e-15      0.000 000 25 e-15
        m
natural unit of mass                                        9.109 382 91 e-31        0.000 000 40 e-31
        kg
natural unit of mom.um                                      2.730 924 29 e-22        0.000 000 12 e-22
        kg m s^-1
natural unit of mom.um in MeV/c                             0.510 998 928            0.000 000 011
        MeV/c
natural unit of time                                        1.288 088 668 33 e-21    0.000 000 000 83 e-21
        s
natural unit of velocity                                    299 792 458              (exact)
        m s^-1
neutron Compton wavelength                                  1.319 590 9068 e-15      0.000 000 0011 e-15
        m
neutron Compton wavelength over 2 pi                        0.210 019 415 68 e-15    0.000 000 000 17 e-15
        m
neutron-electron mag. mom. ratio                            1.040 668 82 e-3         0.000 000 25 e-3

neutron-electron mass ratio                                 1838.683 6605            0.000 0011

neutron g factor                                            -3.826 085 45            0.000 000 90

neutron gyromag. ratio                                      1.832 471 79 e8          0.000 000 43 e8
        s^-1 T^-1
neutron gyromag. ratio over 2 pi                            29.164 6943              0.000 0069
        MHz T^-1
neutron mag. mom.                                           -0.966 236 47 e-26       0.000 000 23 e-26
        J T^-1
neutron mag. mom. to Bohr magneton ratio                    -1.041 875 63 e-3        0.000 000 25 e-3

neutron mag. mom. to nuclear magneton ratio                 -1.913 042 72            0.000 000 45

neutron mass                                                1.674 927 351 e-27       0.000 000 074 e-27
        kg
neutron mass energy equivalent                              1.505 349 631 e-10       0.000 000 066 e-10
        J
neutron mass energy equivalent in MeV                       939.565 379              0.000 021
        MeV
neutron mass in u                                           1.008 664 916 00         0.000 000 000 43
        u
neutron molar mass                                          1.008 664 916 00 e-3     0.000 000 000 43 e-3
        kg mol^-1
neutron-muon mass ratio                                     8.892 484 00             0.000 000 22

neutron-proton mag. mom. ratio                              -0.684 979 34            0.000 000 16
```

```
neutron-proton mass difference                           2.305 573 92 e-30        0.000 000 76 e-30

neutron-proton mass difference energy equivalent         2.072 146 50 e-13        0.000 000 68 e-13

neutron-proton mass difference energy equivalent in MeV  1.293 332 17             0.000 000 42

neutron-proton mass difference in u                      0.001 388 449 19         0.000 000 000 45

neutron-proton mass ratio                                1.001 378 419 17         0.000 000 000 45

neutron-tau mass ratio                                   0.528 790                0.000 048

neutron to shielded proton mag. mom. ratio               -0.684 996 94            0.000 000 16

Newtonian constant of gravitation                        6.673 84 e-11            0.000 80 e-11
        m^3 kg^-1 s^-2
Newtonian constant of gravitation over h-bar c           6.708 37 e-39            0.000 80 e-39
        (GeV/c^2)^-2
nuclear magneton                                         5.050 783 53 e-27        0.000 000 11 e-27
        J T^-1
nuclear magneton in eV/T                                 3.152 451 2605 e-8       0.000 000 0022 e-8
        eV T^-1
nuclear magneton in inverse meters per tesla             2.542 623 527 e-2        0.000 000 056 e-2
        m^-1 T^-1
nuclear magneton in K/T                                  3.658 2682 e-4           0.000 0033 e-4
        K T^-1
nuclear magneton in MHz/T                                7.622 593 57             0.000 000 17
        MHz T^-1
Planck constant                                          6.626 069 57 e-34        0.000 000 29 e-34
        J s
Planck constant in eV s                                  4.135 667 516 e-15       0.000 000 091 e-15
        eV s
Planck constant over 2 pi                                1.054 571 726 e-34       0.000 000 047 e-34
        J s
Planck constant over 2 pi in eV s                        6.582 119 28 e-16        0.000 000 15 e-16
        eV s
Planck constant over 2 pi times c in MeV fm              197.326 9718             0.000 0044
        MeV fm
Planck length                                            1.616 199 e-35           0.000 097 e-35
        m
Planck mass                                              2.176 51 e-8             0.000 13 e-8
        kg
Planck mass energy equivalent in GeV                     1.220 932 e19            0.000 073 e19
        GeV
Planck temperature                                       1.416 833 e32            0.000 085 e32
        K
Planck time                                              5.391 06 e-44            0.000 32 e-44
        s
proton charge to mass quotient                           9.578 833 58 e7          0.000 000 21 e7
        C kg^-1
proton Compton wavelength                                1.321 409 856 23 e-15    0.000 000 000 94 e-15
        m
proton Compton wavelength over 2 pi                      0.210 308 910 47 e-15    0.000 000 000 15 e-15
        m
proton-electron mass ratio                               1836.152 672 45          0.000 000 75

proton g factor                                          5.585 694 713            0.000 000 046

proton gyromag. ratio                                    2.675 222 005 e8         0.000 000 063 e8
        s^-1 T^-1
proton gyromag. ratio over 2 pi                          42.577 4806              0.000 0010
        MHz T^-1
proton mag. mom.                                         1.410 606 743 e-26       0.000 000 033 e-26
        J T^-1
proton mag. mom. to Bohr magneton ratio                  1.521 032 210 e-3        0.000 000 012 e-3

proton mag. mom. to nuclear magneton ratio               2.792 847 356            0.000 000 023

proton mag. shielding correction                         25.694 e-6               0.014 e-6

proton mass                                              1.672 621 777 e-27       0.000 000 074 e-27
        kg
proton mass energy equivalent                            1.503 277 484 e-10       0.000 000 066 e-10
        J
proton mass energy equivalent in MeV                     938.272 046              0.000 021
        MeV
proton mass in u                                         1.007 276 466 812        0.000 000 000 090
        u
proton molar mass                                        1.007 276 466 812 e-3    0.000 000 000 090 e-3
        kg mol^-1
proton-muon mass ratio                                   8.880 243 31             0.000 000 22

proton-neutron mag. mom. ratio                           -1.459 898 06            0.000 000 34

proton-neutron mass ratio                                0.998 623 478 26         0.000 000 000 45
```

```
proton rms charge radius                                    0.8775 e-15              0.0051 e-15
        m
proton-tau mass ratio                                       0.528 063                0.000 048

quantum of circulation                                      3.636 947 5520 e-4       0.000 000 0024 e-4
        m^2 s^-1
quantum of circulation times 2                              7.273 895 1040 e-4       0.000 000 0047 e-4
        m^2 s^-1
Rydberg constant                                            10 973 731.568 539       0.000 055
        m^-1
Rydberg constant times c in Hz                              3.289 841 960 364 e15    0.000 000 000 017 e15
        Hz
Rydberg constant times hc in eV                             13.605 692 53            0.000 000 30
        eV
Rydberg constant times hc in J                              2.179 872 171 e-18       0.000 000 096 e-18
        J
Sackur-Tetrode constant (1 K, 100 kPa)                      -1.151 7078              0.000 0023

Sackur-Tetrode constant (1 K, 101.325 kPa)                  -1.164 8708              0.000 0023

second radiation constant                                   1.438 7770 e-2           0.000 0013 e-2
        m K
shielded helion gyromag. ratio                              2.037 894 659 e8         0.000 000 051 e8
        s^-1 T^-1
shielded helion gyromag. ratio over 2 pi                    32.434 100 84            0.000 000 81
        MHz T^-1
shielded helion mag. mom.                                   -1.074 553 044 e-26      0.000 000 027 e-26
        J T^-1
shielded helion mag. mom. to Bohr magneton ratio            -1.158 671 471 e-3       0.000 000 014 e-3

shielded helion mag. mom. to nuclear magneton ratio         -2.127 497 718           0.000 000 025

shielded helion to proton mag. mom. ratio                   -0.761 766 558           0.000 000 011

shielded helion to shielded proton mag. mom. ratio          -0.761 786 1313          0.000 000 0033

shielded proton gyromag. ratio                              2.675 153 268 e8         0.000 000 066 e8
        s^-1 T^-1
shielded proton gyromag. ratio over 2 pi                    42.576 3866              0.000 0010
        MHz T^-1
shielded proton mag. mom.                                   1.410 570 499 e-26       0.000 000 035 e-26
        J T^-1
shielded proton mag. mom. to Bohr magneton ratio            1.520 993 128 e-3        0.000 000 017 e-3

shielded proton mag. mom. to nuclear magneton ratio         2.792 775 598            0.000 000 030

speed of light in vacuum                                    299 792 458              (exact)
        m s^-1
standard acceleration of gravity                            9.806 65                 (exact)
        m s^-2
standard atmosphere                                         101 325                  (exact)
        Pa
standard-state pressure                                     100 000                  (exact)
        Pa
Stefan-Boltzmann constant                                   5.670 373 e-8            0.000 021 e-8
        W m^-2 K^-4
tau Compton wavelength                                      0.697 787 e-15           0.000 063 e-15
        m
tau Compton wavelength over 2 pi                            0.111 056 e-15           0.000 010 e-15
        m
tau-electron mass ratio                                     3477.15                  0.31

tau mass                                                    3.167 47 e-27            0.000 29 e-27
        kg
tau mass energy equivalent                                  2.846 78 e-10            0.000 26 e-10
        J
tau mass energy equivalent in MeV                           1776.82                  0.16
        MeV
tau mass in u                                               1.907 49                 0.000 17
        u
tau molar mass                                              1.907 49 e-3             0.000 17 e-3
        kg mol^-1
tau-muon mass ratio                                         16.8167                  0.0015

tau-neutron mass ratio                                      1.891 11                 0.000 17

tau-proton mass ratio                                       1.893 72                 0.000 17

Thomson cross section                                       0.665 245 8734 e-28      0.000 000 0013 e-28
        m^2
triton-electron mass ratio                                  5496.921 5267            0.000 0050

triton g factor                                             5.957 924 896            0.000 000 076

triton mag. mom.                                            1.504 609 447 e-26       0.000 000 038 e-26
        J T^-1
triton mag. mom. to Bohr magneton ratio                     1.622 393 657 e-3        0.000 000 021 e-3
triton mag. mom. to nuclear magneton ratio                  2.978 962 448            0.000 000 038

triton mass                                                 5.007 356 30 e-27        0.000 000 22 e-27
        kg
triton mass energy equivalent                               4.500 387 41 e-10        0.000 000 20 e-10
        J
triton mass energy equivalent in MeV                        2808.921 005             0.000 062
        MeV
triton mass in u                                            3.015 500 7134           0.000 000 0025
        u
triton molar mass                                           3.015 500 7134 e-3       0.000 000 0025 e-3
        kg mol^-1
triton-proton mass ratio                                    2.993 717 0308           0.000 000 0025

unified atomic mass unit                                    1.660 538 921 e-27       0.000 000 073 e-27
        kg
von Klitzing constant                                       25 812.807 4434          0.000 0084
        ohm
weak mixing angle                                           0.2223                   0.0021

Wien frequency displacement law constant                    5.878 9254 e10           0.000 0053 e10
        Hz K^-1
Wien wavelength displacement law constant                   2.897 7721 e-3           0.000 0026 e-3
        m K
```

Chapter 8

requirements

gcc>=4.6 or msvc>=14

gfortran>=4.6 or ifort>=18

cmake>=3.20

Chapter 9

Modules Index

9.1 Modules List

Here is a list of all modules with brief descriptions:

Chapter 10

Data Type Index

10.1 Data Types List

Here are the data types with brief descriptions:

Chapter 11

File Index

11.1 File List

Here is a list of all files with brief descriptions:

Chapter 12

Module Documentation

12.1 codata Module Reference

Codata constants.

Functions/Subroutines

- subroutine, public codata_set_year (year)

  Set the revision year for the codata constants.
- pure character(len=4) function, public codata_get_year ()

  Get the set year for the codata constants.
- integer function, public codata_get_number_constants ()

  Get the number of constants.
- subroutine, public codata_print ()

  Display all constants.
- character(len=:) function, allocatable, public codata_get_name_by_index (index)

  Get the name of the constant by index.
- real(real64) function, public codata_get_value_by_index (index)

  Get the value of the constant by index.
- real(real64) function, public codata_get_uncertainty_by_index (index)

  Get the vauncertaintylue of the constant by index.
- character(len=:) function, allocatable, public codata_get_unit_by_index (index)

  Get the unit of the constant by index.
- real(real64) function, public codata_get_value (name)

  Get the value of the constant by name.
- real(real64) function, public codata_get_uncertainty (name)

  Get the uncertainty of the constant by name.
- character(len=25) function, public codata_get_unit (name)

  Get the unit of the constant by name.

12.1.1 Detailed Description

Codata constants.

Codata constants wrapped in an array of derived type with members name, value, uncertainty and unit. Methods for getting the member values are available.

12.1.2 Function/Subroutine Documentation

12.1.2.1 codata_get_name_by_index()

```
character(len=:)  function, allocatable, public codata::codata_get_name_by_index (
            integer, intent(in) index )
```

Get the name of the constant by index.

Parameters

in	*index*	Index of the position.

Returns

name or empty if not found.

12.1.2.2 codata_get_number_constants()

```
integer function, public codata::codata_get_number_constants
```

Get the number of constants.

Returns

Number of constants

12.1.2.3 codata_get_uncertainty()

```
real(real64) function, public codata::codata_get_uncertainty (
            character(len=*), intent(in) name )
```

Get the uncertainty of the constant by name.

Parameters

in	*name*	Name of the constant

Returns

value or NaN if not found

12.1.2.4 codata_get_uncertainty_by_index()

```
real(real64) function, public codata::codata_get_uncertainty_by_index (
            integer, intent(in) index )
```

Get the vauncertaintylue of the constant by index.

Parameters

in	*index*	Index of the position.

Returns

value or NaN if not found.

12.1.2.5 codata_get_unit()

```
character(len=25) function, public codata::codata_get_unit (
            character(len=*), intent(in) name )
```

Get the unit of the constant by name.

Parameters

in	*name*	Name of the constant

Returns

unit or None if not found

12.1.2.6 codata_get_unit_by_index()

```
character(len=:)  function, allocatable, public codata::codata_get_unit_by_index (
            integer, intent(in) index )
```

Get the unit of the constant by index.

Parameters

in	*index*	Index of the position.

Returns

name or empty if not found.

12.1.2.7 codata_get_value()

```
real(real64) function, public codata::codata_get_value (
            character(len=*), intent(in) name )
```

Get the value of the constant by name.

Parameters

in	*name*	Name of the constant

Returns

value or NaN if not found

12.1.2.8 codata_get_value_by_index()

```
real(real64) function, public codata::codata_get_value_by_index (
            integer, intent(in) index )
```

Get the value of the constant by index.

Parameters

in	*index*	Index of the position.

Returns

value or NaN if not found.

12.1.2.9 codata_get_year()

```
pure character(len=4) function, public codata::codata_get_year
```

Get the set year for the codata constants.

Returns

Year of the codata constants

12.1.2.10 codata_print()

```
subroutine, public codata::codata_print
```

Display all constants.

12.1.2.11 codata_set_year()

```
subroutine, public codata::codata_set_year (
            character(len=*), intent(in) year )
```

Set the revision year for the codata constants.

Parameters

in	*year*	Year of the revision.

12.2 codata_2010 Module Reference

Codata constants.

Variables

- type(codata_t_constant), dimension(335), target, public codata_constants_2010 = [codata_2010_10 ,codata_2010_20 ,codata_2010_30 ,codata_2010_40 ,codata_2010_50 ,codata_2010_60 ,codata_2010_70 ,codata_2010_80 ,codata_2010_90 ,codata_2010_100 ,codata_2010_110 ,codata_2010_120 ,codata_↩ 2010_130 ,codata_2010_140 ,codata_2010_150 ,codata_2010_160 ,codata_2010_170 ,codata_2010_180 ,codata_2010_190 ,codata_2010_200 ,codata_2010_210 ,codata_2010_220 ,codata_2010_230 ,codata_↩ 2010_240 ,codata_2010_250 ,codata_2010_260 ,codata_2010_270 ,codata_2010_280 ,codata_2010_290 ,codata_2010_300 ,codata_2010_310 ,codata_2010_320 ,codata_2010_330 ,codata_2010_335]

12.2.1 Detailed Description

Codata constants.

Autogenerated from NIST table.

12.2.2 Variable Documentation

12.2.2.1 codata_constants_2010

```
type(codata_t_constant), dimension(335), target, public codata_2010::codata_constants_2010
= [codata_2010_10 ,codata_2010_20 ,codata_2010_30 ,codata_2010_40 ,codata_2010_50 ,codata↩
_2010_60 ,codata_2010_70 ,codata_2010_80 ,codata_2010_90 ,codata_2010_100 ,codata_2010_110
,codata_2010_120 ,codata_2010_130 ,codata_2010_140 ,codata_2010_150 ,codata_2010_160 ,codata↩
_2010_170 ,codata_2010_180 ,codata_2010_190 ,codata_2010_200 ,codata_2010_210 ,codata_2010_220
,codata_2010_230 ,codata_2010_240 ,codata_2010_250 ,codata_2010_260 ,codata_2010_270 ,codata↩
_2010_280 ,codata_2010_290 ,codata_2010_300 ,codata_2010_310 ,codata_2010_320 ,codata_2010_330
,codata_2010_335 ]
```

12.3 codata_2014 Module Reference

Codata constants.

Variables

- type(codata_t_constant), dimension(335), target, public codata_constants_2014 = [codata_2014_10 ,codata_2014_20 ,codata_2014_30 ,codata_2014_40 ,codata_2014_50 ,codata_2014_60 ,codata_2014_70 ,codata_2014_80 ,codata_2014_90 ,codata_2014_100 ,codata_2014_110 ,codata_2014_120 ,codata_↩2014_130 ,codata_2014_140 ,codata_2014_150 ,codata_2014_160 ,codata_2014_170 ,codata_2014_180 ,codata_2014_190 ,codata_2014_200 ,codata_2014_210 ,codata_2014_220 ,codata_2014_230 ,codata_↩2014_240 ,codata_2014_250 ,codata_2014_260 ,codata_2014_270 ,codata_2014_280 ,codata_2014_290 ,codata_2014_300 ,codata_2014_310 ,codata_2014_320 ,codata_2014_330 ,codata_2014_335]

12.3.1 Detailed Description

Codata constants.

Autogenerated from NIST table.

12.3.2 Variable Documentation

12.3.2.1 codata_constants_2014

```
type(codata_t_constant), dimension(335), target, public codata_2014::codata_constants_2014
= [codata_2014_10 ,codata_2014_20 ,codata_2014_30 ,codata_2014_40 ,codata_2014_50 ,codata↩
_2014_60 ,codata_2014_70 ,codata_2014_80 ,codata_2014_90 ,codata_2014_100 ,codata_2014_110
,codata_2014_120 ,codata_2014_130 ,codata_2014_140 ,codata_2014_150 ,codata_2014_160 ,codata↩
_2014_170 ,codata_2014_180 ,codata_2014_190 ,codata_2014_200 ,codata_2014_210 ,codata_2014_220
,codata_2014_230 ,codata_2014_240 ,codata_2014_250 ,codata_2014_260 ,codata_2014_270 ,codata↩
_2014_280 ,codata_2014_290 ,codata_2014_300 ,codata_2014_310 ,codata_2014_320 ,codata_2014_330
,codata_2014_335 ]
```

12.4 codata_2018 Module Reference

Codata constants.

Variables

- type(codata_t_constant), dimension(354), target, public codata_constants_2018 = [codata_2018_10 ,codata_2018_20 ,codata_2018_30 ,codata_2018_40 ,codata_2018_50 ,codata_2018_60 ,codata_2018_70 ,codata_2018_80 ,codata_2018_90 ,codata_2018_100 ,codata_2018_110 ,codata_2018_120 ,codata_↩ 2018_130 ,codata_2018_140 ,codata_2018_150 ,codata_2018_160 ,codata_2018_170 ,codata_2018_180 ,codata_2018_190 ,codata_2018_200 ,codata_2018_210 ,codata_2018_220 ,codata_2018_230 ,codata_↩ 2018_240 ,codata_2018_250 ,codata_2018_260 ,codata_2018_270 ,codata_2018_280 ,codata_2018_290 ,codata_2018_300 ,codata_2018_310 ,codata_2018_320 ,codata_2018_330 ,codata_2018_340 ,codata_↩ 2018_350 ,codata_2018_354]

12.4.1 Detailed Description

Codata constants.

Autogenerated from NIST table.

12.4.2 Variable Documentation

12.4.2.1 codata_constants_2018

```
type(codata_t_constant), dimension(354), target, public codata_2018::codata_constants_2018
= [codata_2018_10 ,codata_2018_20 ,codata_2018_30 ,codata_2018_40 ,codata_2018_50 ,codata↩
_2018_60 ,codata_2018_70 ,codata_2018_80 ,codata_2018_90 ,codata_2018_100 ,codata_2018_110
,codata_2018_120 ,codata_2018_130 ,codata_2018_140 ,codata_2018_150 ,codata_2018_160 ,codata↩
_2018_170 ,codata_2018_180 ,codata_2018_190 ,codata_2018_200 ,codata_2018_210 ,codata_2018_220
,codata_2018_230 ,codata_2018_240 ,codata_2018_250 ,codata_2018_260 ,codata_2018_270 ,codata↩
_2018_280 ,codata_2018_290 ,codata_2018_300 ,codata_2018_310 ,codata_2018_320 ,codata_2018_330
,codata_2018_340 ,codata_2018_350 ,codata_2018_354 ]
```

12.5 codata_base Module Reference

Base module.

Variables

- type(codata_t_constant), dimension(:), pointer, public codata_constants

  Pointer to the codata table.
- logical, public codata_is_set = .false.

  flag for indicating if the codata year is set
- character(len=4), public codata_year = "2018"

  year that was set

12.5.1 Detailed Description

Base module.

Here are defined all common variables needed for the codata module.

12.5.2 Variable Documentation

12.5.2.1 codata_constants

```
type(codata_t_constant), dimension(:), pointer, public codata_base::codata_constants
```

Pointer to the codata table.

Pointer that will point to the adequat codata table according to the choosen year. By default, it points to the last update of codata values.

12.5.2.2 codata_is_set

```
logical, public codata_base::codata_is_set = .false.
```

flag for indicating if the codata year is set

12.5.2.3 codata_year

```
character(len=4), public codata_base::codata_year = "2018"
```

year that was set

12.6 codata_capi Module Reference

C API for the codata constants.

Functions/Subroutines

- subroutine codata_capi_set_year (char_p, length)

  Set the revision year for the codata constants.
- type(c_ptr) function codata_capi_get_year ()

  Get the set year for the codata constants return Year of the codata constants.
- integer(c_int) function codata_capi_get_number_constants ()

  Get the number of constants.
- subroutine codata_capi_print ()

  Display all constants.
- type(c_ptr) function codata_capi_get_name_by_index (index)

  Get the name of the constant by index.
- real(c_double) function codata_capi_get_value_by_index (index)

  Get the value of the constant by index.
- real(c_double) function codata_capi_get_uncertainty_by_index (index)

  Get the uncertainty of the constant by index.
- type(c_ptr) function codata_capi_get_unit_by_index (index)

  Get the unit of the constant by index.
- real(c_double) function codata_capi_get_value (char_p, length)

  Get the value of the constant by name.
- real(c_double) function codata_capi_get_uncertainty (char_p, length)

  Get the uncertainty of the constant by name.
- type(c_ptr) function codata_capi_get_unit (char_p, length)

  Get the unit of the constant by name.

Variables

- character(len=:), allocatable, target capi_name

  Allocatable for a Fortran string representing the name of the constant.
- character(len=:), pointer capi_name_ptr

  Fortran pointer to the string representing the name of the constant.
- character(len=:), allocatable, target capi_unit

  Allocatable for a Fortran string representing the unit of the constant.
- character(len=:), pointer capi_unit_ptr

  Fortran pointer to the string representing the unit of the constant.
- character(len=:), allocatable, target capi_year

  Allocatable for a Fortran string representing the codata year.
- character(len=:), pointer capi_year_ptr

  Fortran pointer to the string representing the codata year.

12.6.1 Detailed Description

C API for the codata constants.

Provide C compatible getters and setters for accessing the codata constants.

12.6.2 Function/Subroutine Documentation

12.6.2.1 codata_capi_get_name_by_index()

```
type(c_ptr) function codata_capi::codata_capi_get_name_by_index (
            integer(c_int), intent(in), value index )
```

Get the name of the constant by index.

Parameters

in	*index*	Index of the position.

Returns

name or empty if not found.

12.6.2.2 codata_capi_get_number_constants()

```
integer(c_int) function codata_capi::codata_capi_get_number_constants
```

Get the number of constants.

Returns

Number of constants

12.6.2.3 codata_capi_get_uncertainty()

```
real(c_double) function codata_capi::codata_capi_get_uncertainty (
            type(c_ptr), intent(in), value char_p,
            integer(c_int), intent(in), value length )
```

Get the uncertainty of the constant by name.

Parameters

in	*char_p*	Name of the constant
in	*length*	Length of the string

Returns

value or NaN if not found

12.6.2.4 codata_capi_get_uncertainty_by_index()

```
real(c_double) function codata_capi::codata_capi_get_uncertainty_by_index (
            integer(c_int), intent(in), value index )
```

Get the uncertainty of the constant by index.

Parameters

in	*index*	Index of the position.

Returns

value or NaN if not found.

12.6.2.5 codata_capi_get_unit()

```
type(c_ptr) function codata_capi::codata_capi_get_unit (
            type(c_ptr), intent(in), value char_p,
            integer(c_int), intent(in), value length )
```

Get the unit of the constant by name.

Parameters

in	*char←_p*	Name of the constant
in	*length*	Length of the string

Returns

unit or None if not found

12.6.2.6 codata_capi_get_unit_by_index()

```
type(c_ptr) function codata_capi::codata_capi_get_unit_by_index (
            integer(c_int), intent(in), value index )
```

Get the unit of the constant by index.

Parameters

in	*index*	Index of the position.

Returns

name or empty if not found.

12.6.2.7 codata_capi_get_value()

```
real(c_double) function codata_capi::codata_capi_get_value (
            type(c_ptr), intent(in), value char_p,
            integer(c_int), intent(in), value length )
```

Get the value of the constant by name.

Parameters

in	*char←↩ _p*	Name of the constant
in	*length*	Length of the string

Returns

value or NaN if not found

12.6.2.8 codata_capi_get_value_by_index()

```
real(c_double) function codata_capi::codata_capi_get_value_by_index (
            integer(c_int), intent(in), value index )
```

Get the value of the constant by index.

Parameters

in	*index*	Index of the position.

Returns

value or NaN if not found.

12.6.2.9 codata_capi_get_year()

```
type(c_ptr) function codata_capi::codata_capi_get_year
```

Get the set year for the codata constants return Year of the codata constants.

12.6.2.10 codata_capi_print()

```
subroutine codata_capi::codata_capi_print
```

Display all constants.

12.6.2.11 codata_capi_set_year()

```
subroutine codata_capi::codata_capi_set_year (
            type(c_ptr), intent(in), value char_p,
            integer(c_int), intent(in), value length )
```

Set the revision year for the codata constants.

Parameters

in	*char↵ _p*	Year of the revision.
in	*length*	Length of the string.

12.6.3 Variable Documentation

12.6.3.1 capi_name

```
character(len=:), allocatable, target codata_capi::capi_name
```

Allocatable for a Fortran string representing the name of the constant.

It is used for interoperability Fortran and C strings.

12.6.3.2 capi_name_ptr

```
character(len=:), pointer codata_capi::capi_name_ptr
```

Fortran pointer to the string representing the name of the constant.

It is used for interoperability Fortran and C strings.

12.6.3.3 capi_unit

```
character(len=:), allocatable, target codata_capi::capi_unit
```

Allocatable for a Fortran string representing the unit of the constant.

It is used for interoperability Fortran and C strings.

12.6.3.4 capi_unit_ptr

```
character(len=:), pointer codata_capi::capi_unit_ptr
```

Fortran pointer to the string representing the unit of the constant.

It is used for interoperability Fortran and C strings.

12.6.3.5 capi_year

```
character(len=:), allocatable, target codata_capi::capi_year
```

Allocatable for a Fortran string representing the codata year.

It is used for interoperability Fortran and C strings.

12.6.3.6 capi_year_ptr

```
character(len=:), pointer codata_capi::capi_year_ptr
```

Fortran pointer to the string representing the codata year.

It is used for interoperability Fortran and C strings.

Chapter 13

Data Type Documentation

13.1 codata_file_props Struct Reference

Properties of the file for the codata raw data.

Data Fields

- int n
- int index_header_end
- char codata_path [18]
- char year [5]
- char fmodule_path [18]

13.1.1 Detailed Description

Properties of the file for the codata raw data.

13.1.2 Field Documentation

13.1.2.1 codata_path

```
char codata_file_props::codata_path[18]
```

Filepath to the raw codata constants.

13.1.2.2 fmodule_path

```
char codata_file_props::fmodule_path[18]
```

Filepath of the generated Fortran module.

13.1.2.3 index_header_end

```
int codata_file_props::index_header_end
```

Number of lines for the header.

13.1.2.4 n

```
int codata_file_props::n
```

Number of lines.

13.1.2.5 year

```
char codata_file_props::year[5]
```

Year of release of the codata constants.

The documentation for this struct was generated from the following file:

- src/generator.c

Chapter 14

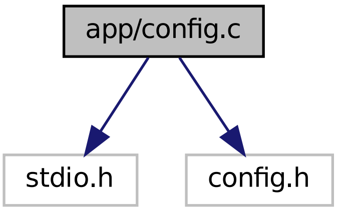
File Documentation

14.1 app/config.c File Reference

Provides the configuration of the codata library.

```
#include <stdio.h>
#include "config.h"
```

Include dependency graph for config.c:



Functions

- int main (int argc, char **argv)

14.1.1 Detailed Description

Provides the configuration of the codata library.

14.1.2 Function Documentation

14.1.2.1 main()

```
int main (
            int argc,
            char ** argv )
```

14.2 doxygen/introduction/install.md File Reference

14.3 doxygen/introduction/license.md File Reference

14.4 doxygen/introduction/raw_codata.md File Reference

14.5 doxygen/introduction/requirements.md File Reference

14.6 doxygen/releases/0.1.0-notes.md File Reference

14.7 doxygen/releases/0.2.0-notes.md File Reference

14.8 doxygen/releases/0.2.1-notes.md File Reference

14.9 README.md File Reference

14.10 src/codata.f90 File Reference

Codata module.

Modules

- module codata

  Codata constants.

Functions/Subroutines

- subroutine, public codata::codata_set_year (year)

  Set the revision year for the codata constants.
- pure character(len=4) function, public codata::codata_get_year ()

  Get the set year for the codata constants.
- integer function, public codata::codata_get_number_constants ()

  Get the number of constants.
- subroutine, public codata::codata_print ()

  Display all constants.
- character(len=:) function, allocatable, public codata::codata_get_name_by_index (index)

  Get the name of the constant by index.
- real(real64) function, public codata::codata_get_value_by_index (index)

  Get the value of the constant by index.
- real(real64) function, public codata::codata_get_uncertainty_by_index (index)

  Get the vauncertaintylue of the constant by index.
- character(len=:) function, allocatable, public codata::codata_get_unit_by_index (index)

  Get the unit of the constant by index.
- real(real64) function, public codata::codata_get_value (name)

  Get the value of the constant by name.
- real(real64) function, public codata::codata_get_uncertainty (name)

  Get the uncertainty of the constant by name.
- character(len=25) function, public codata::codata_get_unit (name)

  Get the unit of the constant by name.

14.10.1 Detailed Description

Codata module.

14.11 src/codata.h File Reference

C header for the codata library.

Functions

- void codata_capi_set_year (char ∗year, int length)

  Set the revision year for the codata constants.
- char ∗ codata_capi_get_year ()

  Get the set year for the codata constants return Year of the codata constants.
- int codata_capi_get_number_constants ()

  Get the number of constants.
- void codata_capi_print ()

  Display all constants.
- double codata_capi_get_value (char ∗name, int length)

  Get the value of the constant by name.
- double codata_capi_get_uncertainty (char ∗name, int length)

  Get the uncertainty of the constant by name.

- char ∗ codata_capi_get_unit (char ∗name, int length)

  Get the unit of the constant by name.
- double codata_capi_get_value_by_index (int index)

  Get the value of the constant by index.
- double codata_capi_get_uncertainty_by_index (int index)

  Get the uncertainty of the constant by index.
- char ∗ codata_capi_get_name_by_index (int index)

  Get the name of the constant by index.
- char ∗ codata_capi_get_unit_by_index (int index)

  Get the unit of the constant by index.

14.11.1 Detailed Description

C header for the codata library.

14.11.2 Function Documentation

14.11.2.1 codata_capi_get_name_by_index()

```
char* codata_capi_get_name_by_index (
              int index )
```

Get the name of the constant by index.

Parameters

in	*index*	Index of the position.

Returns

name or None if not found.

14.11.2.2 codata_capi_get_number_constants()

```
int codata_capi_get_number_constants ( )
```

Get the number of constants.

Returns

Number of the constants.

14.11.2.3 codata_capi_get_uncertainty()

```
double codata_capi_get_uncertainty (
            char * name,
            int length )
```

Get the uncertainty of the constant by name.

Parameters

in	*name*	Name of the constant
in	*length*	Length of the string

Returns

value or NaN if not found

14.11.2.4 codata_capi_get_uncertainty_by_index()

```
double codata_capi_get_uncertainty_by_index (
            int index )
```

Get the uncertainty of the constant by index.

Parameters

in	*index*	Index of the position.

Returns

value or NaN if not found.

14.11.2.5 codata_capi_get_unit()

```
char* codata_capi_get_unit (
            char * name,
            int length )
```

Get the unit of the constant by name.

Parameters

in	*name*	Name of the constant
in	*length*	Length of the string

Returns

unit or None if not found

14.11.2.6 codata_capi_get_unit_by_index()

```
char* codata_capi_get_unit_by_index (
            int index )
```

Get the unit of the constant by index.

Parameters

in	*index*	Index of the position.

Returns

unit or None if not found.

14.11.2.7 codata_capi_get_value()

```
double codata_capi_get_value (
            char * name,
            int length )
```

Get the value of the constant by name.

Parameters

in	*name*	Name of the constant
in	*length*	Length of the string

Returns

value or NaN if not found

Examples

example_in_c.c.

14.11.2.8 codata_capi_get_value_by_index()

```
double codata_capi_get_value_by_index (
            int index )
```

Get the value of the constant by index.

Parameters

in	*index*	Index of the position.

Returns

value or NaN if not found.

14.11.2.9 codata_capi_get_year()

```
char* codata_capi_get_year ( )
```

Get the set year for the codata constants return Year of the codata constants.

Examples

example_in_c.c.

14.11.2.10 codata_capi_print()

```
void codata_capi_print ( )
```

Display all constants.

Examples

example_in_c.c.

14.11.2.11 codata_capi_set_year()

```
void codata_capi_set_year (
             char * year,
             int length )
```

Set the revision year for the codata constants.

Parameters

in	*year*	Year of the revision.
in	*length*	Length of the string.

Examples

example_in_c.c.

14.12 src/codata_2010.f90 File Reference

Codata module - autogenerated.

Modules

- module codata_2010

  Codata constants.

Variables

- type(codata_t_constant), dimension(335), target, public codata_2010::codata_constants_2010 = [codata↩_2010_10 ,codata_2010_20 ,codata_2010_30 ,codata_2010_40 ,codata_2010_50 ,codata_2010_60 ,codata_2010_70 ,codata_2010_80 ,codata_2010_90 ,codata_2010_100 ,codata_2010_110 ,codata_↩2010_120 ,codata_2010_130 ,codata_2010_140 ,codata_2010_150 ,codata_2010_160 ,codata_2010_170 ,codata_2010_180 ,codata_2010_190 ,codata_2010_200 ,codata_2010_210 ,codata_2010_220 ,codata_↩2010_230 ,codata_2010_240 ,codata_2010_250 ,codata_2010_260 ,codata_2010_270 ,codata_2010_280 ,codata_2010_290 ,codata_2010_300 ,codata_2010_310 ,codata_2010_320 ,codata_2010_330 ,codata_↩2010_335]

14.12.1 Detailed Description

Codata module - autogenerated.

14.13 src/codata_2014.f90 File Reference

Codata module - autogenerated.

Modules

- module codata_2014

  Codata constants.

Variables

- type(codata_t_constant), dimension(335), target, public codata_2014::codata_constants_2014 = [codata↩_2014_10 ,codata_2014_20 ,codata_2014_30 ,codata_2014_40 ,codata_2014_50 ,codata_2014_60 ,codata_2014_70 ,codata_2014_80 ,codata_2014_90 ,codata_2014_100 ,codata_2014_110 ,codata_↩2014_120 ,codata_2014_130 ,codata_2014_140 ,codata_2014_150 ,codata_2014_160 ,codata_2014_170 ,codata_2014_180 ,codata_2014_190 ,codata_2014_200 ,codata_2014_210 ,codata_2014_220 ,codata_↩2014_230 ,codata_2014_240 ,codata_2014_250 ,codata_2014_260 ,codata_2014_270 ,codata_2014_280 ,codata_2014_290 ,codata_2014_300 ,codata_2014_310 ,codata_2014_320 ,codata_2014_330 ,codata_↩2014_335]

14.13.1 Detailed Description

Codata module - autogenerated.

14.14 src/codata_2018.f90 File Reference

Codata module - autogenerated.

Modules

- module codata_2018

  Codata constants.

Variables

- type(codata_t_constant), dimension(354), target, public codata_2018::codata_constants_2018 = [codata_2018_10 ,codata_2018_20 ,codata_2018_30 ,codata_2018_40 ,codata_2018_50 ,codata_2018_60 ,codata_2018_70 ,codata_2018_80 ,codata_2018_90 ,codata_2018_100 ,codata_2018_110 ,codata_2018_120 ,codata_2018_130 ,codata_2018_140 ,codata_2018_150 ,codata_2018_160 ,codata_2018_170 ,codata_2018_180 ,codata_2018_190 ,codata_2018_200 ,codata_2018_210 ,codata_2018_220 ,codata_2018_230 ,codata_2018_240 ,codata_2018_250 ,codata_2018_260 ,codata_2018_270 ,codata_2018_280 ,codata_2018_290 ,codata_2018_300 ,codata_2018_310 ,codata_2018_320 ,codata_2018_330 ,codata_2018_340 ,codata_2018_350 ,codata_2018_354]

14.14.1 Detailed Description

Codata module - autogenerated.

14.15 src/codata_base.f90 File Reference

Base for the codata module.

Modules

- module codata_base

  Base module.

Variables

- type(codata_t_constant), dimension(:), pointer, public codata_base::codata_constants

  Pointer to the codata table.
- logical, public codata_base::codata_is_set = .false.

  flag for indicating if the codata year is set
- character(len=4), public codata_base::codata_year = "2018"

  year that was set

14.15.1 Detailed Description

Base for the codata module.

14.16 src/codata_capi.f90 File Reference

Codata module - C API.

Modules

- module codata_capi

  C API for the codata constants.

Functions/Subroutines

- subroutine codata_capi::codata_capi_set_year (char_p, length)

  Set the revision year for the codata constants.
- type(c_ptr) function codata_capi::codata_capi_get_year ()

  Get the set year for the codata constants return Year of the codata constants.
- integer(c_int) function codata_capi::codata_capi_get_number_constants ()

  Get the number of constants.
- subroutine codata_capi::codata_capi_print ()

  Display all constants.
- type(c_ptr) function codata_capi::codata_capi_get_name_by_index (index)

  Get the name of the constant by index.
- real(c_double) function codata_capi::codata_capi_get_value_by_index (index)

  Get the value of the constant by index.
- real(c_double) function codata_capi::codata_capi_get_uncertainty_by_index (index)

  Get the uncertainty of the constant by index.
- type(c_ptr) function codata_capi::codata_capi_get_unit_by_index (index)

  Get the unit of the constant by index.
- real(c_double) function codata_capi::codata_capi_get_value (char_p, length)

  Get the value of the constant by name.
- real(c_double) function codata_capi::codata_capi_get_uncertainty (char_p, length)

  Get the uncertainty of the constant by name.
- type(c_ptr) function codata_capi::codata_capi_get_unit (char_p, length)

  Get the unit of the constant by name.

Variables

- character(len=:), allocatable, target codata_capi::capi_name

  Allocatable for a Fortran string representing the name of the constant.
- character(len=:), pointer codata_capi::capi_name_ptr

  Fortran pointer to the string representing the name of the constant.
- character(len=:), allocatable, target codata_capi::capi_unit

  Allocatable for a Fortran string representing the unit of the constant.
- character(len=:), pointer codata_capi::capi_unit_ptr

  Fortran pointer to the string representing the unit of the constant.
- character(len=:), allocatable, target codata_capi::capi_year

  Allocatable for a Fortran string representing the codata year.
- character(len=:), pointer codata_capi::capi_year_ptr

  Fortran pointer to the string representing the codata year.

14.16.1 Detailed Description

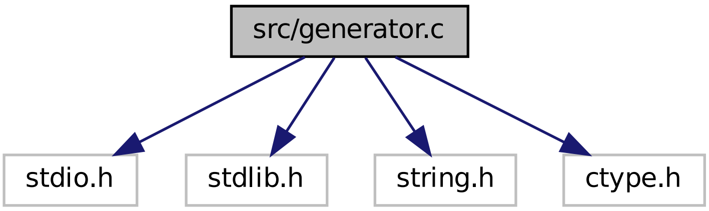
Codata module - C API.

14.17 src/generator.c File Reference

Generator for Fortran module.

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <ctype.h>
```

Include dependency graph for generator.c:



Data Structures

- struct codata_file_props

  Properties of the file for the codata raw data.

Functions

- void format_names (char ∗line, char ∗name)

  Format names simply by copying them.
- void format_values (char ∗line, char ∗value)

  Format values to be conform to Fortran double precision.
- void format_uncertainties (char ∗line, char ∗uncertainty)

  Format the uncertainties to be conform to Fortran double precsion.
- void format_units (char ∗line, char ∗unit)

  Format the units to be conform to Fortran strings.
- void clean_line (char ∗buf, size_t buffer_size)

  Fill the buffer with white space.
- int read_line (FILE ∗f, char ∗buf, size_t buffer_size)

  Read the line from f and copy in buf.
- void ltrim (char ∗buf, size_t buffer_size)

  Remove all white space from the left.

- void rtrim (char ∗buf, size_t buffer_size)

    Remove all white space from the right.
- int is_blank_line (char ∗buf, size_t buffer_size)

    Test if the line is a blank line.
- void get_props (struct codata_file_props ∗props)

    Get the properties of the codata file.
- void print_props (struct codata_file_props ∗props)

    Print the codata file properties.
- void write_file_doc (FILE ∗fcode)

    Generate the Fortran file documentation.
- void write_module_doc (FILE ∗fcode)

    Generate the Fortran module documentation.
- void write_module_declaration (FILE ∗fcode, struct codata_file_props ∗props)

    Generate the Fortran module declaration.
- void write_all_constants (FILE ∗fcodata, FILE ∗fcode, struct codata_file_props ∗props)

    Generate all constants in the Fortran module.
- void write_module_end (FILE ∗fcode, struct codata_file_props ∗props)

    Generate the end of the Fortran module.
- int main (int argc, char ∗∗argv)

    Generated Fortran module.

14.17.1 Detailed Description

Generator for Fortran module.

The raw data from NIST are parsed line by line where the columns name, value, uncertainty and unit are formatted to be conform to Fortran. The formatted (as strings) names, values, uncertainties and units are then inserted in a derived type in the generated Fortran module. The raw codata from `http://physics.nist.gov/constants` are converted into Fortran code.

14.17.2 Function Documentation

14.17.2.1 clean_line()

```
void clean_line (
            char ∗ buf,
            size_t buffer_size )
```

Fill the buffer with white space.

Parameters

buf	Line to be cleaned
buffer_size	Size of the line.

14.17.2.2 format_names()

```
void format_names (
            char * line,
            char * name )
```

Format names simply by copying them.

Parameters

line	Line to be parsed.
name	String where the name will be copied.

14.17.2.3 format_uncertainties()

```
void format_uncertainties (
            char * line,
            char * uncertainty )
```

Format the uncertainties to be conform to Fortran double precsion.

Parameters

line	Line to be parsed.
uncertainty	String where the uncertainty will be copied.

14.17.2.4 format_units()

```
void format_units (
            char * line,
            char * unit )
```

Format the units to be conform to Fortran strings.

Parameters

line	Line to be parsed.
unit	String where the unit will be copied.

14.17.2.5 format_values()

```
void format_values (
             char * line,
             char * value )
```

Format values to be conform to Fortran double precision.

Parameters

line	Line to be parsed.
value	String where the value will be copied.

14.17.2.6 get_props()

```
void get_props (
             struct codata_file_props * props )
```

Get the properties of the codata file.

Parameters

props	Properties of the codata file.

14.17.2.7 is_blank_line()

```
int is_blank_line (
             char * buf,
             size_t buffer_size )
```

Test if the line is a blank line.

Parameters

buf	Line to be tested.
buffer_size	Size of the line.

Returns

int Flag indicating if blank(=1) or not (=0).

14.17.2.8 ltrim()

```
void ltrim (
             char * buf,
             size_t buffer_size )
```

Remove all white space from the left.

Parameters

buf	Line to be left trimmed.
buffer_size	Size of the line.

14.17.2.9 main()

```
int main (
              int argc,
              char ** argv )
```

Generated Fortran module.

Parameters

argc	Number of arguments
argv	List of arguments

Returns

int Exit flag.

Examples

example_in_c.c.

14.17.2.10 print_props()

```
void print_props (
              struct codata_file_props * props )
```

Print the codata file properties.

Parameters

props	Properties of the codata file.

14.17.2.11 read_line()

```
int read_line (
              FILE * f,
              char * buf,
              size_t buffer_size )
```

Read the line from f and copy in buf.

Parameters

f	File pointer where the line will be parsed.
buf	String where the line will be copied.
buffer_size	Size of the buffer.

Returns

int Flag if the line is empty(=1) or not empty(=0).

14.17.2.12 rtrim()

```
void rtrim (
            char * buf,
            size_t buffer_size )
```

Remove all white space from the right.

Parameters

buf	Line to be right trimmed.
buffer_size	Size of the line.

14.17.2.13 write_all_constants()

```
void write_all_constants (
            FILE * fcodata,
            FILE * fcode,
            struct codata_file_props * props )
```

Generate all constants in the Fortran module.

Parameters

fcodata	File pointer to the codata file.
fcode	File pointer to the Fortran module.
props	Properties of the codata file.

14.17.2.14 write_file_doc()

```
void write_file_doc (
            FILE * fcode )
```

Generate the Fortran file documentation.

Parameters

fcode	File pointer of the Fortran module.

14.17.2.15 write_module_declaration()

```
void write_module_declaration (
            FILE * fcode,
            struct codata_file_props * props )
```

Generate the Fortran module declaration.

Parameters

fcode	File pointer of the Fortran module.
props	Properties of the codata file.

14.17.2.16 write_module_doc()

```
void write_module_doc (
            FILE * fcode )
```

Generate the Fortran module documentation.

Parameters

fcode	File pointer of the Fortran module.

14.17.2.17 write_module_end()

```
void write_module_end (
            FILE * fcode,
            struct codata_file_props * props )
```

Generate the end of the Fortran module.

Parameters

fcode	File pointer to the Fortran module.
props	Properties of the codata file.

Chapter 15

Example Documentation

15.1 example_in_fortran.f90

```fortran
program example_in_fortran
    use codata
    implicit none

    character(len=4) :: year = "2014"

    ! call directly codata, the values used will be the last i.e. 2018
    call codata_print()
    print *, "Codata 2018: ", codata_get_value("alpha particle mass")
    print *, codata_get_year()

    ! Or set the codata values that you want
    call codata_set_year(year)
    print *, "Codata 2014: ", codata_get_value("alpha particle mass")


    print *, codata_get_year()

end program
```

15.2 example_in_c.c

```c
#include <stdio.h>
#include <string.h>
#include "codata.h"
int main(int argc, char **argv){
    char year[5] = "2014";

    // avoid compiler complaining
    if (argc>1){
        printf("%d %s", argc, argv[1]);
    }
    /* call directly codata, the values used will be the last i.e. 2018 */
    codata_capi_print();
    char name[] = "alpha particle mass";
    printf("Codata 2018: %+23.16e\n", codata_capi_get_value(name, strlen(name)));
    printf("%s\n", codata_capi_get_year());
    /* Or set the codata values that you want */
    codata_capi_set_year(year, 4);
    printf("Codata 2014: %+23.16e\n", codata_capi_get_value(name, strlen(name)));
    printf("%s\n", codata_capi_get_year());

    return 0;
}
```

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