Codata

0.4.0

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Chapter 1

Introduction

codata is a Fortran library providing the lastest codata constants (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 compilation was tested on Linux (Debian), MacOS and Windows.

Links:

- Sources: https://github.com/MilanSkocic/codata.
- Online documentation: https://milanskocic.github.io/codata/index.html.
- PDF documentation: https://milanskocic.github.io/codata/codata/refman.pdf.
- Python wrapper: https://milanskocic.github.io/codata/pycodata/index.html.

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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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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Full Changelog: https://github.com/MilanSkocic/codata/compare/0.2.0...0.2.1

Chapter 5

Codata 0.3.0 Release Note

5.1 Changes

- Only last codata constants.

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Full Changelog: https://github.com/MilanSkocic/codata/compare/0.2.1...0.3.0

Chapter 6

Codata 0.4.0 Release Note

6.1 Changes

- Bring back pywrapper in the codata repository to sync versions.
- Improvements of the documentation.

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Full Changelog: https://github.com/MilanSkocic/codata/compare/0.3.0...0.4.0

Chapter 7

install

Cmake is necessary for compiling and instaling the library.

7.1 Create build directory

- mkdir build
- cd build

7.2 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`

7.3 Build either with cmake

```
cmake --build .
```

7.4 Run tests

```
ctest
```

7.5 Install

```
cmake --install .
```

7.6 Dependencies

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

Chapter 8

license

```
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an absolute waiver of all civil liability in connection with the
Program, unless a warranty or assumption of liability accompanies a
copy of the Program in return for a fee.

                     END OF TERMS AND CONDITIONS

            How to Apply These Terms to Your New Programs

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possible use to the public, the best way to achieve this is to make it
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to attach them to the start of each source file to most effectively
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Also add information on how to contact you by electronic and paper mail.

  If the program does terminal interaction, make it output a short
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The hypothetical commands `show w' and `show c' should show the appropriate
parts of the General Public License. Of course, your program's commands
might be different; for a GUI interface, you would use an "about box".

  You should also get your employer (if you work as a programmer) or school,
if any, to sign a "copyright disclaimer" for the program, if necessary.
For more information on this, and how to apply and follow the GNU GPL, see

Chapter 9

Codata Raw Data

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

```
              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. J T^-1	4.330 735 094 e-27	0.000 000 011 e-27
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 kg	3.343 583 7724 e-27	0.000 000 0010 e-27
deuteron mass energy equivalent J	3.005 063 231 02 e-10	0.000 000 000 91 e-10
deuteron mass energy equivalent in MeV MeV	1875.612 942 57	0.000 000 57
deuteron mass in u u	2.013 553 212 745	0.000 000 000 040
deuteron molar mass kg mol^-1	2.013 553 212 05 e-3	0.000 000 000 61 e-3
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 m	2.127 99 e-15	0.000 74 e-15
electron charge to mass quotient C kg^-1	-1.758 820 010 76 e11	0.000 000 000 53 e11
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 s^-1 T^-1	1.760 859 630 23 e11	0.000 000 000 53 e11
electron gyromag. ratio in MHz/T MHz T^-1	28 024.951 4242	0.000 0085
electron-helion mass ratio	1.819 543 074 573 e-4	0.000 000 000 079 e-4
electron mag. mom. J T^-1	-9.284 764 7043 e-24	0.000 000 0028 e-24
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 kg	9.109 383 7015 e-31	0.000 000 0028 e-31
electron mass energy equivalent J	8.187 105 7769 e-14	0.000 000 0025 e-14
electron mass energy equivalent in MeV MeV	0.510 998 950 00	0.000 000 000 15
electron mass in u u	5.485 799 090 65 e-4	0.000 000 000 16 e-4
electron molar mass kg mol^-1	5.485 799 0888 e-7	0.000 000 0017 e-7
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 m^2 s^-1	3.636 947 5516 e-4	0.000 000 0011 e-4
quantum of circulation times 2 m^2 s^-1	7.273 895 1032 e-4	0.000 000 0022 e-4
reduced Compton wavelength m	3.861 592 6796 e-13	0.000 000 0012 e-13
reduced muon Compton wavelength m	1.867 594 306 e-15	0.000 000 042 e-15
reduced neutron Compton wavelength m	2.100 194 1552 e-16	0.000 000 0012 e-16
reduced Planck constant J s	1.054 571 817... e-34	(exact)
reduced Planck constant in eV s eV s	6.582 119 569... e-16	(exact)
reduced Planck constant times c in MeV fm MeV fm	197.326 980 4...	(exact)
reduced proton Compton wavelength m	2.103 089 103 36 e-16	0.000 000 000 64 e-16
reduced tau Compton wavelength m	1.110 538 e-16	0.000 075 e-16
Rydberg constant m^-1	10 973 731.568 160	0.000 021
Rydberg constant times c in Hz Hz	3.289 841 960 2508 e15	0.000 000 000 0064 e15
Rydberg constant times hc in eV eV	13.605 693 122 994	0.000 000 000 026
Rydberg constant times hc in J J	2.179 872 361 1035 e-18	0.000 000 000 0042 e-18
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 m K	1.438 776 877... e-2	(exact)
shielded helion gyromag. ratio s^-1 T^-1	2.037 894 569 e8	0.000 000 024 e8
shielded helion gyromag. ratio in MHz/T MHz T^-1	32.434 099 42	0.000 000 38
shielded helion mag. mom. J T^-1	-1.074 553 090 e-26	0.000 000 013 e-26
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 s^-1 T^-1	2.675 153 151 e8	0.000 000 029 e8
shielded proton gyromag. ratio in MHz/T MHz T^-1	42.576 384 74	0.000 000 46
shielded proton mag. mom. J T^-1	1.410 570 560 e-26	0.000 000 015 e-26
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 m s^-1	299 792 458	(exact)
standard acceleration of gravity m s^-2	9.806 65	(exact)
standard atmosphere Pa	101 325	(exact)
standard-state pressure Pa	100 000	(exact)
Stefan-Boltzmann constant W m^-2 K^-4	5.670 374 419... e-8	(exact)
tau Compton wavelength m	6.977 71 e-16	0.000 47 e-16
tau-electron mass ratio	3477.23	0.23
tau energy equivalent MeV	1776.86	0.12
tau mass kg	3.167 54 e-27	0.000 21 e-27
tau mass energy equivalent J	2.846 84 e-10	0.000 19 e-10
tau mass in u u	1.907 54	0.000 13
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

Chapter 10

requirements

gcc>=4.6 or msvc>=14

gfortran>=4.6 or ifort>=18

cmake>=3.10

Chapter 11

Modules Index

11.1 Modules List

Here is a list of all modules with brief descriptions:

Chapter 12

Data Type Index

12.1 Data Types List

Here are the data types with brief descriptions:

Chapter 13

File Index

13.1 File List

Here is a list of all files with brief descriptions:

Chapter 14

Module Documentation

14.1 codata Module Reference

Codata constants.

Functions/Subroutines

- 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.

14.1.1 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.

14.1.2 Function/Subroutine Documentation

14.1.2.1 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.

14.1.2.2 codata_get_number_constants()

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

Get the number of constants.

Returns

Number of constants

14.1.2.3 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

14.1.2.4 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.

14.1.2.5 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

14.1.2.6 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.

14.1.2.7 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

14.1.2.8 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.

14.1.2.9 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

14.1.2.10 codata_print()

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

Display all constants.

14.2 codata_capi Module Reference

C API for the codata constants.

Functions/Subroutines

- 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.

14.2.1 Detailed Description

C API for the codata constants.

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

14.2.2 Function/Subroutine Documentation

14.2.2.1 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.

14.2.2.2 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

14.2.2.3 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

14.2.2.4 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.

14.2.2.5 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

14.2.2.6 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.

14.2.2.7 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

14.2.2.8 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.

14.2.2.9 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.

14.2.2.10 codata_capi_print()

```
subroutine codata_capi::codata_capi_print
```

Display all constants.

14.2.3 Variable Documentation

14.2.3.1 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.

14.2.3.2 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.

14.2.3.3 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.

14.2.3.4 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.

14.2.3.5 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.

14.2.3.6 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.

14.3 codata_data Module Reference

Codata constants - autogenerated.

Variables

- type(codata_t_constant), dimension(10), parameter codata10 = [codata_t_constant("alpha particle-electron mass ratio", 7294.29954142d0, 0.00000024d0, " ") , codata_t_constant("alpha particle mass", 6.6446573357d-27, 0.0000000020d-27, "kg") , codata_t_constant("alpha particle mass energy equivalent", 5.9719201914d-10, 0.0000000018d-10, "J") , codata_t_constant("alpha particle mass energy equivalent in MeV", 3727.3794066d0, 0.0000011d0, "MeV") , codata_t_constant("alpha particle mass in u", 4.001506179127d0, 0.000000000063d0, "u") , codata_t_constant("alpha particle molar mass", 4.↩ 0015061777d-3, 0.0000000012d-3, "kg mol^-1") , codata_t_constant("alpha particle-proton mass ratio", 3.97259969009d0, 0.00000000022d0, " ") , codata_t_constant("alpha particle relative atomic mass", 4.↩ 001506179127d0, 0.000000000063d0, " ") , codata_t_constant("Angstrom star", 1.00001495d-10, 0.↩ 00000090d-10, "m") , codata_t_constant("atomic mass constant", 1.66053906660d-27, 0.00000000050d-27, "kg")]
- type(codata_t_constant), dimension(354), public codata_constants = [codata10 ,codata20 ,codata30 ,codata40 ,codata50 ,codata60 ,codata70 ,codata80 ,codata90 ,codata100 ,codata110 ,codata120 ,codata130 ,codata140 ,codata150 ,codata160 ,codata170 ,codata180 ,codata190 ,codata200 ,codata210 ,codata220 ,codata230 ,codata240 ,codata250 ,codata260 ,codata270 ,codata280 ,codata290 ,codata300 ,codata310 ,codata320 ,codata330 ,codata340 ,codata350 ,codata354]

14.3.1 Detailed Description

Codata constants - autogenerated.

14.3.2 Variable Documentation

14.3.2.1 codata10

```
type(codata_t_constant), dimension(10), parameter codata_data::codata10 = [ codata_t_constant("alpha
particle-electron mass ratio", 7294.29954142d0, 0.00000024d0, " ") , codata_t_constant("alpha
particle mass", 6.6446573357d-27, 0.0000000020d-27, "kg") , codata_t_constant("alpha particle
mass energy equivalent", 5.9719201914d-10, 0.0000000018d-10, "J") , codata_t_constant("alpha
particle mass energy equivalent in MeV", 3727.3794066d0, 0.0000011d0, "MeV") , codata_t↩
_constant("alpha particle mass in u", 4.001506179127d0, 0.000000000063d0, "u") , codata↩
_t_constant("alpha particle molar mass", 4.0015061777d-3, 0.0000000012d-3, "kg mol^-1") ,
codata_t_constant("alpha particle-proton mass ratio", 3.97259969009d0, 0.00000000022d0, " ")
, codata_t_constant("alpha particle relative atomic mass", 4.001506179127d0, 0.000000000063d0,
" ") , codata_t_constant("Angstrom star", 1.00001495d-10, 0.00000090d-10, "m") , codata_t_↩
constant("atomic mass constant", 1.66053906660d-27, 0.00000000050d-27, "kg") ]
```

14.3.2.2 codata_constants

```
type(codata_t_constant), dimension(354), public codata_data::codata_constants = [codata10
,codata20 ,codata30 ,codata40 ,codata50 ,codata60 ,codata70 ,codata80 ,codata90 ,codata100
,codata110 ,codata120 ,codata130 ,codata140 ,codata150 ,codata160 ,codata170 ,codata180 ,codata190
,codata200 ,codata210 ,codata220 ,codata230 ,codata240 ,codata250 ,codata260 ,codata270 ,codata280
,codata290 ,codata300 ,codata310 ,codata320 ,codata330 ,codata340 ,codata350 ,codata354 ]
```

Chapter 15

Data Type Documentation

15.1 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]

15.1.1 Detailed Description

Properties of the file for the codata raw data.

15.1.2 Field Documentation

15.1.2.1 codata_path

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

Filepath to the raw codata constants.

15.1.2.2 fmodule_path

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

Filepath of the generated Fortran module.

15.1.2.3 index_header_end

```
int codata_file_props::index_header_end
```

Number of lines for the header.

15.1.2.4 n

```
int codata_file_props::n
```

Number of lines.

15.1.2.5 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 16

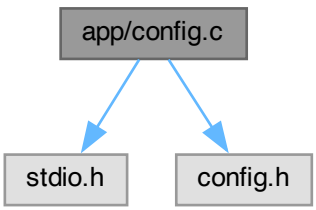
File Documentation

16.1 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)

16.1.1 Detailed Description

Provides the configuration of the codata library.

16.1.2 Function Documentation

16.1.2.1 main()

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

16.2 doxygen/introduction/install.md File Reference

16.3 doxygen/introduction/license.md File Reference

16.4 doxygen/introduction/raw_codata.md File Reference

16.5 doxygen/introduction/requirements.md File Reference

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

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

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

16.9 doxygen/releases/0.3.0-notes.md File Reference

16.10 doxygen/releases/0.4.0-notes.md File Reference

16.11 README.md File Reference

16.12 src/codata.f90 File Reference

Codata module.

Modules

- module codata

  Codata constants.

Functions/Subroutines

- 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.

16.12.1 Detailed Description

Codata module.

16.13 src/codata.h File Reference

C header for the codata library.

Functions

- 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.

16.13.1 Detailed Description

C header for the codata library.

16.13.2 Function Documentation

16.13.2.1 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.

16.13.2.2 codata_capi_get_number_constants()

```
int codata_capi_get_number_constants ( )
```

Get the number of constants.

Returns

Number of the constants.

16.13.2.3 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

16.13.2.4 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.

16.13.2.5 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

16.13.2.6 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.

16.13.2.7 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.

16.13.2.8 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.

16.13.2.9 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.

16.13.2.10 codata_capi_print()

```
void codata_capi_print ( )
```

Display all constants.

Examples

example_in_c.c.

16.14 codata.h

Go to the documentation of this file.

```
00001
00013 extern char *codata_capi_get_year();
00014
00019 extern int codata_capi_get_number_constants();
00020
00021
00025 extern void codata_capi_print();
00026
00027
00034 extern double codata_capi_get_value(char *name, int length);
00035
00042 extern double codata_capi_get_uncertainty(char *name, int length);
00043
00050 extern char * codata_capi_get_unit(char *name, int length);
00051
00057 extern double codata_capi_get_value_by_index(int index);
00058
00064 extern double codata_capi_get_uncertainty_by_index(int index);
00065
00066
00072 extern char* codata_capi_get_name_by_index(int index);
00073
00079 extern char* codata_capi_get_unit_by_index(int index);
```

16.15 src/codata_capi.f90 File Reference

Codata module - C API.

Modules

- module codata_capi

  C API for the codata constants.

Functions/Subroutines

- 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.

16.15.1 Detailed Description

Codata module - C API.

16.16 src/codata_data.f90 File Reference

Codata module - autogenerated.

Modules

- module codata_data

  Codata constants - autogenerated.

Variables

- type(codata_t_constant), dimension(10), parameter codata_data::codata10 = [codata_t_constant("alpha particle-electron mass ratio", 7294.29954142d0, 0.00000024d0, " ") , codata_t_constant("alpha particle mass", 6.6446573357d-27, 0.0000000020d-27, "kg") , codata_t_constant("alpha particle mass energy equivalent", 5.9719201914d-10, 0.0000000018d-10, "J") , codata_t_constant("alpha particle mass energy equivalent in MeV", 3727.3794066d0, 0.0000011d0, "MeV") , codata_t_constant("alpha particle mass in u", 4.001506179127d0, 0.000000000063d0, "u") , codata_t_constant("alpha particle molar mass", 4.↩ 0015061777d-3, 0.0000000012d-3, "kg mol^-1") , codata_t_constant("alpha particle-proton mass ratio", 3.97259969009d0, 0.00000000022d0, " ") , codata_t_constant("alpha particle relative atomic mass", 4.↩ 001506179127d0, 0.000000000063d0, " ") , codata_t_constant("Angstrom star", 1.00001495d-10, 0.↩ 00000090d-10, "m") , codata_t_constant("atomic mass constant", 1.66053906660d-27, 0.00000000050d-27, "kg")]
- type(codata_t_constant), dimension(354), public codata_data::codata_constants = [codata10 ,codata20 ,codata30 ,codata40 ,codata50 ,codata60 ,codata70 ,codata80 ,codata90 ,codata100 ,codata110 ,codata120 ,codata130 ,codata140 ,codata150 ,codata160 ,codata170 ,codata180 ,codata190 ,codata200 ,codata210 ,codata220 ,codata230 ,codata240 ,codata250 ,codata260 ,codata270 ,codata280 ,codata290 ,codata300 ,codata310 ,codata320 ,codata330 ,codata340 ,codata350 ,codata354]

16.16.1 Detailed Description

Codata module - autogenerated.

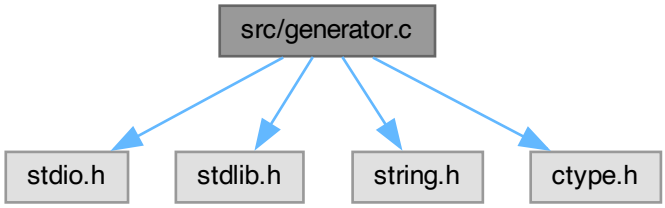
16.17 src/generator.c File Reference

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.

16.17.1 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.

16.17.2 Function Documentation

16.17.2.1 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.

16.17.2.2 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.

16.17.2.3 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.

16.17.2.4 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.

16.17.2.5 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.

16.17.2.6 get_props()

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

Get the properties of the codata file.

Parameters

props	Properties of the codata file.

16.17.2.7 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).

16.17.2.8 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.

16.17.2.9 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.

16.17.2.10 print_props()

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

Print the codata file properties.

Parameters

props	Properties of the codata file.

16.17.2.11 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).

16.17.2.12 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.

16.17.2.13 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.

16.17.2.14 write_file_doc()

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

Generate the Fortran file documentation.

Parameters

fcode	File pointer of the Fortran module.

16.17.2.15 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.

16.17.2.16 write_module_doc()

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

Generate the Fortran module documentation.

Parameters

fcode	File pointer of the Fortran module.

16.17.2.17 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 17

Example Documentation

17.1 example_in_fortran.f90

```
00001 program example_in_fortran
00002     use codata
00003     implicit none
00004
00005     character(len=4) :: year = "2014"
00006
00007     ! call directly codata, the values used will be the last i.e. 2018
00008     call codata_print()
00009     print *, "Codata ", codata_get_year(), codata_get_value("alpha particle mass")
00010     print *, codata_get_year()
00011
00012 end program
```

17.2 example_in_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 %s: %+23.16e\n", codata_capi_get_year(), codata_capi_get_value(name, strlen(name)));
    printf("%s\n", codata_capi_get_year());


    return 0;

}
```

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