codata

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NAME

codata - fundamental physical constants

LIBRARY

Codata (**-libcodata**, **-lcodata**)

SYNOPSIS

```
use codata
include "codata.h"
import pycodata
```

DESCRIPTION

codata is a Fortran library providing the fundamental physical constants according to CODATA https://www.nist.gov/programs-projects/*codata*-values-fundamental-physical-constants. A C APIallows usage from C, or can be used as a basis for other wrappers. Python wrapper allows easy usage from Python.

The latest *codata* constants 2022 https://pml.nist.gov/cuu/Constants were integrated in stdlib https://github.com/fortran-lang/stdlib/releases/tag/v0.7.0. The constants are implemented as derived type which carries the name, the value, the uncertainty and the unit. This library is complementary to the constants defined in the stdlib by providing older values for the constants.

The latest values (2022) do not have the year as a suffix in their name. Older values can be used and they feature the year as a suffix in their name.

All *codata* (physical) constants are defined as a derived type codata_constant_type. All the *codata* constants are provided as double precision reals. The names are quite long and can be aliased with shorter names.

The derived type codata_constant_type defines 4 members:

- **o name** string
- **o value** double precision real
- **o uncertainty** double precision real
- **o unit** string

The derived type codata_constant_type defines 2 type-bound procedures:

- **o print** to print the values of the constant members;
- **o to_real** to get the value or the uncertainty to the desired precision.

A module level interface to_real is available for getting the constant value or uncertainty of a constant.

The C API exposes a structure codata_constant_ttype that defines the same members as in Fortran. The Python wrapper encapsulates the members in a dictionnary.

NOTES

To **use** *codata* within your fpm https://github.com/fortran-lang/fpm project, add the following lines to your file:

```
[dependencies]
codata = { git="https://github.com/MilanSkocic/codata.git" }
```

EXAMPLE

Example in Fortran

```
program example_in_f
use iso_fortran_env
use codata
```

```
implicit none

print '(A)', '########## EXAMPLE IN FORTRAN ##########'

print '(A)', '# VERSION'
print *, "version = ", get_version()

print '(A)', '# CONSTANTS'
print *, "c = ",  SPEED_OF_LIGHT_IN_VACUUM%value

print '(A)', '# UNCERTAINTY'
print *, "u(c) = ", SPEED_OF_LIGHT_IN_VACUUM%uncertainty

print '(A)', '# OLDER VALUES'
print '(A, F23.16)', "Mu_2022(latest) = ", MOLAR_MASS_CONSTANT%value
print '(A, F23.16)', "Mu_2018 = ", MOLAR_MASS_CONSTANT_2018%value
print '(A, F23.16)', "Mu_2014 = ",  MOLAR_MASS_CONSTANT_2014%value
print '(A, F23.16)', "Mu_2010 = ",  MOLAR_MASS_CONSTANT_2010%value
end program
```

Example in C:

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

int main(void){

printf("########## EXAMPLE IN C ##########0);

printf("%s0,"# VERSION");
printf("version = %s0, codata_get_version());

printf("%s0,"# CONSTANTS");
printf("c = %f0, SPEED_OF_LIGHT_IN_VACUUM.value);

printf("%s0,"# UNCERTAINTY");
printf("u(c) = %f0, SPEED_OF_LIGHT_IN_VACUUM.uncertainty);

printf("%s0,"# OLDER VALUES");
printf("Mu_2022(latest) = %23.16f0, MOLAR_MASS_CONSTANT.value);
printf("Mu_2018 = %23.16f0, MOLAR_MASS_CONSTANT_2018.value);
printf("Mu_2014 = %23.16f0, MOLAR_MASS_CONSTANT_2014.value);
printf("Mu_2010 = %23.16f0, MOLAR_MASS_CONSTANT_2010.value);

return 0;
}
```

Example in Python:

```
import sys
sys.path.insert(0, "../py/src/")
import pycodata

print("########## EXAMPLE IN PYTHON ##########")
print("# VERSION")
print(f"version = {pycodata.__version__}")
```

```
print("# Constants")
print(f"c =", pycodata.SPEED_OF_LIGHT_IN_VACUUM["value"])

print("# UNCERTAINTY")
print(f"u(c) = ", pycodata.SPEED_OF_LIGHT_IN_VACUUM["uncertainty"])

print("# OLDER VALUES")
print(f"Mu_2022 = ", pycodata.MOLAR_MASS_CONSTANT["value"])
print(f"Mu_2018 = ", pycodata.MOLAR_MASS_CONSTANT_2018["value"])
print(f"Mu_2014 = ", pycodata.MOLAR_MASS_CONSTANT_2014["value"])
print(f"Mu_2010 = ", pycodata.MOLAR_MASS_CONSTANT_2010["value"])
```

SEE ALSO

gsl(3)

CODATA 2022

- ALPHA_PARTICLE_ELECTRON_MASS_RATIO
- ALPHA_PARTICLE_MASS
- ALPHA_PARTICLE_MASS_ENERGY_EQUIVALENT
- ALPHA_PARTICLE_MASS_ENERGY_EQUIVALENT_IN_MEV
- ALPHA_PARTICLE_MASS_IN_U
- ALPHA_PARTICLE_MOLAR_MASS
- ALPHA_PARTICLE_PROTON_MASS_RATIO
- ALPHA_PARTICLE_RELATIVE_ATOMIC_MASS
- ALPHA_PARTICLE_RMS_CHARGE_RADIUS
- ANGSTROM_STAR
- ATOMIC_MASS_CONSTANT
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- ATOMIC_MASS_CONSTANT_ENERGY_EQUIVALENT_IN_MEV
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- ATOMIC_MASS_UNIT_HERTZ_RELATIONSHIP
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- ATOMIC_UNIT_OF_ELECTRIC_FIELD
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- ATOMIC_UNIT_OF_ELECTRIC_POTENTIAL
- ATOMIC_UNIT_OF_ELECTRIC_QUADRUPOLE_MOM
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- BOHR_MAGNETON_IN_INVERSE_METER_PER_TESLA
- BOHR_MAGNETON_IN_K_T
- BOHR_RADIUS
- BOLTZMANN_CONSTANT
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- CONVENTIONAL_VALUE_OF_COULOMB_90
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- ELECTRON_GYROMAG_RATIO_IN_MHZ_T
- ELECTRON_HELION_MASS_RATIO
- ELECTRON_MAG_MOM
- ELECTRON_MAG_MOM_ANOMALY
- ELECTRON_MAG_MOM_TO_BOHR_MAGNETON_RATIO
- ELECTRON_MAG_MOM_TO_NUCLEAR_MAGNETON_RATIO
- ELECTRON_MASS
- ELECTRON_MASS_ENERGY_EQUIVALENT
- ELECTRON_MASS_ENERGY_EQUIVALENT_IN_MEV
- ELECTRON_MASS_IN_U
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- ELECTRON_MUON_MASS_RATIO

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- MUON_MOLAR_MASS
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- RYDBERG_CONSTANT_TIMES_HC_IN_EV
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- BOHR_MAGNETON_IN_K_T_2018
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- DEUTERON_PROTON_MAG_MOM_RATIO_2018
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- NEUTRON_MOLAR_MASS_2014
- NEUTRON_MUON_MASS_RATIO_2014
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- NEUTRON_PROTON_MASS_DIFFERENCE_ENERGY_EQUIVALENT_2014
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- MUON_COMPTON_WAVELENGTH_OVER_2_PI_2010
- MUON_ELECTRON_MASS_RATIO_2010

- MUON_G_FACTOR_2010
- MUON_MAG_MOM_2010
- MUON_MAG_MOM_ANOMALY_2010
- MUON_MAG_MOM_TO_BOHR_MAGNETON_RATIO_2010
- MUON_MAG_MOM_TO_NUCLEAR_MAGNETON_RATIO_2010
- MUON_MASS_2010
- MUON_MASS_ENERGY_EQUIVALENT_2010
- MUON_MASS_ENERGY_EQUIVALENT_IN_MEV_2010
- MUON_MASS_IN_U_2010
- MUON_MOLAR_MASS_2010
- MUON_NEUTRON_MASS_RATIO_2010
- MUON_PROTON_MAG_MOM_RATIO_2010
- MUON_PROTON_MASS_RATIO_2010
- MUON_TAU_MASS_RATIO_2010
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- NATURAL_UNIT_OF_ACTION_IN_EV_S_2010
- NATURAL_UNIT_OF_ENERGY_2010
- NATURAL_UNIT_OF_ENERGY_IN_MEV_2010
- NATURAL_UNIT_OF_LENGTH_2010
- NATURAL_UNIT_OF_MASS_2010
- NATURAL_UNIT_OF_MOMUM_2010
- NATURAL_UNIT_OF_MOMUM_IN_MEV_C_2010
- NATURAL_UNIT_OF_TIME_2010
- NATURAL_UNIT_OF_VELOCITY_2010
- NEUTRON_COMPTON_WAVELENGTH_2010
- NEUTRON_COMPTON_WAVELENGTH_OVER_2_PI_2010
- NEUTRON_ELECTRON_MAG_MOM_RATIO_2010
- NEUTRON_ELECTRON_MASS_RATIO_2010
- NEUTRON_G_FACTOR_2010
- NEUTRON_GYROMAG_RATIO_2010
- NEUTRON_GYROMAG_RATIO_OVER_2_PI_2010
- NEUTRON_MAG_MOM_2010
- NEUTRON_MAG_MOM_TO_BOHR_MAGNETON_RATIO_2010
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- NEUTRON_MASS_ENERGY_EQUIVALENT_2010
- NEUTRON_MASS_ENERGY_EQUIVALENT_IN_MEV_2010
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- PLANCK_CONSTANT_OVER_2_PI_TIMES_C_IN_MEV_FM_2010
- PLANCK_LENGTH_2010
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- SHIELDED_HELION_TO_PROTON_MAG_MOM_RATIO_2010
- SHIELDED_HELION_TO_SHIELDED_PROTON_MAG_MOM_RATIO_2010
- SHIELDED_PROTON_GYROMAG_RATIO_2010
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- SHIELDED_PROTON_MAG_MOM_2010
- SHIELDED_PROTON_MAG_MOM_TO_BOHR_MAGNETON_RATIO_2010
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- WIEN_WAVELENGTH_DISPLACEMENT_LAW_CONSTANT_2010

NAME

get_version - version getter for the library

LIBRARY

Codata - (**-libcodata**, **-lcodata**)

SYNOPSIS

```
function get_version()result(fptr)
```

DESCRIPTION

This function returns the version of the codata library.

RETURN VALUE

character(len=:), pointer :: *fptr*

NOTES

The C API is defined by the following prototype: char* **codata_get_version**(void)

The python wrappers embeds the version of the version in the top level variable __version__.

EXAMPLE

Fortran

```
print *, "version = ", get_version()
```

C

```
printf("version = %s0, codata_get_version());
```

Python

```
print(f"version = {pycodata.__version__}")
```

SEE ALSO

codata(3)