

ciaaw

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NAME

ciaaw - Command line for ciaaw

SYNOPSIS

ciaaw [*OPTIONS*] [*ELEMENTS* ...]

DESCRIPTION

ciaaw is a command line interface which provides the atomic weights, the isotopic compositions and the nuclides atomic weights. If no elements is provided the full periodic table is displayed.

OPTIONS

- o --saw, -s**
Get the standard atomic weight.
- o --ice, -i**
Get the isotopic composition.
- o --naw, -n**
Get the nuclide atomic weight.
- o --mu, -m**
Get the molar masses in g/mol by multiplying the atomic weights by the molar mass constant M_u .
- o --colnames, -c**
Show the headers in the outputs.
- o --usage, -u**
Show usage text and exit.
- o --help, -h**
Show help text and exit.
- o --verbose, -V**
Display additional information when available.
- o --version, -v**
Show version information and exit.

EXAMPLE

Minimal example

```
ciaaw
ciaaw H C B O Zr Nb --saw --ice --naw --colnames
ciaaw H C B O Zr Nb -sinc
```

SEE ALSO

ciaaw(3), **codata(3)**

NAME

ciaaw - library for isotopic abundances and standard atomic weights

LIBRARY

ciaaw (-libciaaw, -lciaaw)

SYNOPSIS

```
use ciaaw
include "ciaaw.h"
import pyciaaw
```

DESCRIPTION

ciaaw is a Fortran library providing the standard and abridged atomic weights, the isotopic abundance and the isotopes' standard atomic weights. The data are taken from <http://ciaaw.org>. C API allows usage from C, or can be used as a basis for other wrappers. Python wrapper allows easy usage from Python.

What have been implemented:

- o **SAW** Standard Atomic Weights.
- o **ICE** Isotopic Composition of the Element
- o **NAW** Nuclides Atomic Weight.

The latest standard atomic weights were released in 2021 by the *ciaaw* (<https://www.ciaaw.org>). All the values for the atomic weights are provided as double precision reals. The standard atomic weights (or relative atomic mass), **A_r(E)**, are extracted from table 1 from Prohaska et al. (IUPAC Technical Report **94(5):573â600**). For the elements that feature an interval for the standard atomic weight, the mean value and the uncertainty are computed using formulas defined in [2]. The standard atomic weights are a dimensionless quantity and thus they need to be multiplied by the molar mass constant *Mu* in order to get the value in g.mol⁻¹. See CODATA for physical constants.

The latest isotopic compositions were released in 2013 by the *ciaaw* (<https://www.ciaaw.org>). All the values for the compositions are provided as double precision reals. The isotopic compositions of the element, are extracted from table 1 from Meija et al. (IUPAC Technical Report. **88(3):293â306**).

The latest atomic weights for nuclides were released in 2020 by *ciaaw* <https://www.ciaaw.org> from Huang et al. (AME 2020 **45(3):030002**). All the values for the nuclide atomic weights are provided as double precision reals.

Fortran API

- o **function get_version()result(fptr)**
Get the version
- o **character(len=:), pointer :: fptr**
Fortran pointer to a string indicating the version..
- o **function get_saw(s, abridged, uncertainty)result(res)**
Get the standard atomic weight for the element s.
- o **character(len=*), intent(in) :: s**
Element symbol.
- o **logical, intent(in), optional :: abridged**
Set to False if the abridged value is not desired. Default to TRUE.
- o **logical, intent(in), optional :: uncertainty**
Set to True if the uncertainty is desired. Default to FALSE.
- o **real(dp) :: res**
NaN if the provided element is incorrect or **-1** if the element does not have a SAW.

o function get_ice(s, A, uncertainty)result(res)

Get the isotopic composition of the element s for the mass number A.

o character(len=*), intent(in) :: s

Element symbol.

o integer(int32), intent(in) :: A

Mass number.

o logical, intent(in), optional :: uncertainty

Set to True if the uncertainty is desired. Default to FALSE.

o real(dp) :: res

NaN if the provided element or the mass number A are incorrect or **-1** if the element does not have an ICE.

o function get_nice(s)result(res)

Get the number of isotopes in ICE of the element s.

o character(len=*), intent(in) :: s

Element symbol.

o integer(int32) :: res

>0 if found or **-1** if not found.

o function get_naw(s, A, uncertainty)result(res)

Get the atomic weight of the nuclide s for the mass number A.

o character(len=*), intent(in) :: s

Element symbol.

o integer(int32), intent(in) :: A

Mass number.

o logical, intent(in), optional :: uncertainty

Flag for returning the uncertainty instead of the value. Default to FALSE.

o real(dp) :: res

NaN if the provided element or A are incorrect or **-1** if the element does not have an NAW.

o function get_nnaw(s)result(res)

Get the number of nuclides in NAW of the element s.

o character(len=*), intent(in) :: s

Element symbol.

o integer(int32) :: res

>0 if found or **-1** if not found.

C API

- char* **ciaaw_get_version**(void)
- double **ciaaw_get_saw**(char *s, int n, bool abridged, bool uncertainty)
- double **ciaaw_get_ice**(char *s, int n, int A, bool uncertainty)
- int **ciaaw_get_nice**(char *s, int n)
- double **ciaaw_get_naw**(char *s, int n, int A, bool uncertainty)
- int **ciaaw_get_nnaw**(char *s, int n)

Python wrappers

- **get_saw**(s: str, abridged: bool=True, uncertainty: bool=False)->float

- **get_ice**(s:str, A:int, uncertainty: bool=False)->float
- **get_nice**(s:str)->int
- **get_naw**(s:str, A:int, uncertainty: bool=False)->float
- **get_nnaw**(s:str)->int

NOTES

To **use** *ciaaw* within your fpm project, add the following to your fpm.toml file:

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

dp stands for double precision and it is an alias to real64 from the iso_fortran_env module.

The definitions of the acronyms:

- o **ASAW** Abridged Standard Atomic Weight
- o **SAW** Standard Atomic Weight
- o **ICE** Isotopic Composition of the Element
- o **NAW** Nuclide Atomic Weight
- o **U** Uncertainty

The definitions of the common variables:

- o **s** Element
- o **Z** Atomic number
- o **A** Mass number
- o **u** Uncertainty
- o **ab** Abridged
- o **res** Return values

EXAMPLES

Example in Fortran:

```
program example_in_f
  use ciaaw
  implicit none

  character(len=8) :: s

  ! ASAW = Abridged Standard Atomic Weight
  ! SAW  = Standard Atomic Weight
  ! ICE  = Isotopic Composition of the Element
  ! NAW  = Nuclide Atomic Weight
  ! U    = Uncertainty

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

  print '(A)', '##### CIAAW SAW #####'
  print '(A10, F10.5)', 'ASAW H   = ', get_saw("H", abridged=.true.)
  print '(A10, F10.5)', 'U ASAW H = ', get_saw("H", uncertainty=.true.)
  print '(A10, F10.5)', 'SAW H    = ', get_saw("H", abridged = .false.)
  print '(A10, F10.5)', 'U SAW H  = ', get_saw("H", abridged = .false., un
```

```

print ' (A10, F10.5)', 'ASAW T    = ', get_saw("Tc", abridged=.true.)

print ' (A)', '##### CIAAW ICE #####'
print ' (A, I3)', 'N ICE H      = ', get_nice("H")
print ' (A, F12.6)', 'ICE H 1    = ', get_ice("H", A=1)
print ' (A, ES23.16)', 'U ICE H 1 = ', get_ice("H", A=1, uncertainty=.true)
print ' (A, F12.6)', 'ICE H 2    = ', get_ice("H", A=2)
print ' (A, ES23.16)', 'U ICE H 2 = ', get_ice("H", A=2, uncertainty=.true)
print ' (A, I3)', 'N ICE Tc     = ', get_nice("Tc")
print ' (A, I3)', 'N ICE C      = ', get_nice("C")

print ' (A)', '##### CIAAW NAW #####'
print ' (A, ES23.16)', 'NAW H 2    = ', get_naw("H", A=2)
print ' (A, ES23.16)', 'U NAW H 2  = ', get_naw("H", A=2, uncertainty=.true)
print ' (A, I3)', 'N NAW Tc      = ', get_n naw("Tc")

end program

```

Example in C:

```

#include <stdlib.h>
#include <stdio.h>
#include <string.h>
#include <stdbool.h>
#include "ciaaw.h"

// ASAW = Abridged Standard Atomic Weight
// SAW  = Standard Atomic Weight
// ICE  = Isotopic Composition of the Element
// NAW  = Nuclide Atomic Weight
// U    = Uncertainty

int main(void){
    printf("%s0, "##### CIAAW VERSION #####");
    printf("version %s0, ciaaw_get_version());

    printf("%s0, "##### CIAAW SAW #####");
    printf("%s %10.5f0, "ASAW H    = ", ciaaw_get_saw("H", 1, true, false));
    printf("%s %10.5f0, "U ASAW H = ", ciaaw_get_saw("H", 1, true, true));
    printf("%s %10.5f0, "SAW H    = ", ciaaw_get_saw("H", 1, false, false));
    printf("%s %10.5f0, "U SAW H  = ", ciaaw_get_saw("H", 1, false, true));
    printf("%s %10.5f0, "ASAW Tc  = ", ciaaw_get_saw("Tc", 2, true, false));

    printf("%s0, "##### CIAAW ICE #####");
    printf("%s %d0,      "N ICE H      = ", ciaaw_get_nice("H", 1));
    printf("%s %12.6f0, "ICE H 1      = ", ciaaw_get_ice("H", 1, 1, false));
    printf("%s %23.16e0, "U ICE H 1    = ", ciaaw_get_ice("H", 1, 1, true));
    printf("%s %12.6f0, "ICE H 2      = ", ciaaw_get_ice("H", 1, 2, false));
    printf("%s %23.16e0, "U ICE H 2    = ", ciaaw_get_ice("H", 1, 2, true));
    printf("%s %d0,      "N ICE Tc     = ", ciaaw_get_nice("Tc", 2));
    printf("%s %d0,      "N ICE C      = ", ciaaw_get_nice("C", 1));

    printf("%s0, "##### CIAAW NAW #####");
    printf("%s %23.16f0, "NAW H 2      = ", ciaaw_get_naw("H", 1, 2, false));

```

```

printf("%s %23.16e0, "U NAW H 2      = ", ciaaw_get_naw("H", 1, 2, true));
printf("%s %d0,          "N NAW Tc    = ", ciaaw_get_nnaw("Tc", 2));
return EXIT_SUCCESS;
}

```

Example in Python:

```

import pyciaaw

# ASAW = Abridged Standard Atomic Weight
# SAW  = Standard Atomic Weight
# ICE  = Isotopic Composition of the Element
# NAW  = Nuclide Atomic Weight
# U    = Uncertainty

print("##### CIAAW VERSION #####")
print("version ", pyciaaw.__version__)

print("##### CIAAW SAW #####")
print("ASAW H    = ", pyciaaw.get_saw("H"))
print("U ASAW H = ", pyciaaw.get_saw("H", uncertainty=True))
print("SAW H     = ", pyciaaw.get_saw("H", abridged=False, uncertainty=False))
print("U SAW H   = ", pyciaaw.get_saw("H", abridged=False, uncertainty=True))
print("ASAW Tc   = ", pyciaaw.get_saw("Tc"))

print("##### CIAAW ICE #####")
print("N ICE H    = ", pyciaaw.get_nice("H"))
print('ICE H 1   = ', pyciaaw.get_ice("H", A=1))
print('U ICE H 1 = ', pyciaaw.get_ice("H", A=1, uncertainty=True))
print('ICE H 2   = ', pyciaaw.get_ice("H", A=2))
print('U ICE H 2 = ', pyciaaw.get_ice("H", A=2, uncertainty=True))
print("N ICE Tc   = ", pyciaaw.get_nice("Tc"))
print("N ICE C    = ", pyciaaw.get_nice("C"))

print("##### CIAAW NAW #####")
print('NAW H 2    = ', pyciaaw.get_naw("H", A=2))
print('U NAW H 2 = ', pyciaaw.get_naw("H", A=2, uncertainty=True))
print("N NAW Tc   = ", pyciaaw.get_nnaw("Tc"))

```

SEE ALSO

gsl(3), codata(3)