

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):573–600). 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):293–306).

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.

The C API is defined by adding a prefix to the functions from the Fortran API due to the lack of module/namespace feature in the C language. The functions are therefore following this template: (c_prefix)fortran_func.

- (ciaaw_)get_saw
- (ciaaw_)get_ice
- (ciaaw_)get_nice
- (ciaaw_)get_naw
- (ciaaw_)get_nnaw

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" }
```

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=.tru
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=.tru
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=.
print '(A, I3)',      'N NAW Tc  = ', get_nnaw("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), ciaaw_get_version(3), ciaaw_get_saw(3) ciaaw_get_ice(3), ciaaw_get_nice(3),
ciaaw_get_naw(3), ciaaw_get_naw(3)**