

Post-processing ORIGIN F71 files

OPUS and OBIWAN

ORNL is managed by UT-Battelle, LLC for the US Department of Energy



U.S. DEPARTMENT OF
ENERGY

Learning goals



Gain familiarity with the OPUS module for post-processing ORIGIN F71 files



Introduce users to the new OBIWAN command-line utility for interrogating F71 files

ORIGEN post-processing with OPUS



OPUS features

- **OPUS: ORIGIN-S Post-processing Utility for SCALE**
- Quickly and easily extract requested information from an ORIGIN calculation
- Rank most dominant nuclides or elements
- Request specific nuclides or elements
- Include totals for different nuclide groups, such as actinides, fission products, and/or activation products
- Gamma, alpha, beta, and neutron spectra
- Text output data file can be read directly for plotting
- Operate on .f71 concentration file saved by ORIGIN (not the output file)

OPUS options (plot setup)

DATA=

(DEFAULT: "ft71f001")

ORIGEN concentrations file (f71)

TYPARAMS=

type of parameter to be plotted

- **NUCLIDES** individual nuclides
- **ELEMENTS** individual elements
- **ASPECTRUM** alpha spectrum
- **BSPECTRUM** beta spectrum
- **GSPECTRUM** gamma spectrum
- **NSPECTRUM** total neutron spectrum
- **SFSPEC** spontaneous fission neutron spectrum
- **ANSPEC** neutron spectrum from (alpha,n) reactions only
- **DNSPEC** delayed neutron spectrum

VOLUME=

material volume (cm^3), when using units of g/cm^3 or $\text{at}/\text{barn-cm}$

TIME=

unit of time to be plotted

- **SECONDS**
- **MINUTES**
- **HOURS**
- **DAYS**
- **YEARS**

More details:

See **Section 5.1.7** of the SCALE manual

OPUS Options (response units and nuclide selection)

UNITS=

GRAMS	mass in grams
GATOMS	gram atoms (default unit) or moles
KILOGRAMS	mass in kilograms
ATOMS	atoms/barn-cm (requires VOLUME)
WPELEM	weight % of element (specified in SYMNUC)
GPERCM	grams/cm ³ (requires VOLUME)
CURIES	radioactivity in Ci
BECQUERELS	radioactivity in Bq
INTENSITY	spectra in particles/s/MeV
PARTICLES	spectra in particles/s
WATTS	total decay heat (W)
GAMWATTS	gamma-ray decay heat (W)
ABSORPTIONS	absorption/removal reaction rate
CAPTURES	capture reaction rate
FISSIONS	fission reaction rate
AIRM	toxicity, m ³ of air to dilute to RCG
H2OM	toxicity, m ³ of water to dilute to RCG

LIBTYPE=

LITE (light nuclide/activation)
ACT (actinide sub-library)
FISS (fission product sub-library)
FISSACT (ACT+FISS)
ALL (all nuclides across sub-libraries)

SYMNUC=

symbolic notation of requested nuclides or elements

SORT=

option to sort user-requested nuclides by their importance (YES, NO)

RESPONSE=

optional user-requested response conversion factors

NRANK=

number of nuclides/elements

OPUS options (data set selection)

NPOSITION=

list of all requested position numbers of data in ascending order (data in f71)

MINPOSITION=

minimum position number, used to request a range of positions

MAXPOSITION=

maximum position number, used to request a range of positions

TMIN=

minimum time for selection of positions (units as for TIME)

TMAX=

maximum time for selection of positions (units as for TIME)

Example inputs

```
=opus  
data= "my.f71"  
typarams=gspectrum  
units=intensity  
npos=20 end  
title="gamma spectrum at 1 year"  
end
```

```
=opus  
units=watts  
title="decay heat"  
end
```

```
=opus  
units=grams time=days  
minpos=1 maxpos=10  
symnuc=cm-242 cm-244 cm-245 cm-246 end  
title="cm mass as function of burnup"  
end
```

Gamma spectra for data
saved at position #20 of
"my.f71"

Total decay heat (automatically
selects decay time steps if none
are specified)

Nuclide inventory (grams) for selected
curium isotopes for saved positions #1–10

Example inputs

```
=opus  
units=grams  
time=year  
typarms=elements  
tmin=1 tmax=2  
title="spent fuel at 33 gwd/mthm"  
xlabel="cooling time (years)"  
symnuc=u pu np am cm end  
end
```

Elemental inventories (grams) for selected actinides for all time steps between 1–2 years decay time

```
=opus  
units=wpel  
libtyp=act  
symnuc=u pu end  
end
```

Weight percent of uranium and plutonium isotopes during decay

```
=opus  
typarms=nspe  
npos=5 end  
title="neutron spectrum at 1 year"  
end
```

Neutron spectrum for data saved on position #5

OPUS sample plot file

Radioactivity (Ci) at 5 years of cooling

pwr spent fuel - 33 gwd/mtu

cooling time (years)

Bq

nuclide

9 23

	2.738e-02	1.095e-01	2.738e-01	6.571e-01	1.000e+00	2.000e+00	3.000e+00	4.000e+00	5.000e+00
ag110m	9.793e+14	9.010e+14	7.628e+14	5.172e+14	3.654e+14	1.326e+14	4.811e+13	1.746e+13	6.336e+12
am241	5.106e+08	5.914e+08	7.520e+08	1.122e+09	1.446e+09	2.362e+09	3.232e+09	4.060e+09	4.847e+09
ba137m	1.358e+18	1.355e+18	1.350e+18	1.338e+18	1.327e+18	1.297e+18	1.268e+18	1.239e+18	1.211e+18
cf252	7.976e+10	7.806e+10	7.477e+10	6.762e+10	6.181e+10	4.756e+10	3.660e+10	2.816e+10	2.167e+10
cm242	1.374e+15	1.210e+15	9.373e+14	5.167e+14	3.034e+14	6.426e+13	1.370e+13	3.013e+12	7.516e+11
cm244	3.272e+13	3.261e+13	3.241e+13	3.194e+13	3.152e+13	3.034e+13	2.920e+13	2.810e+13	2.705e+13
cm246	4.308e+08	4.308e+08	4.308e+08	4.308e+08	4.308e+08	4.307e+08	4.306e+08	4.306e+08	4.305e+08
cm248	1.361e+04	1.361e+04	1.361e+04	1.361e+04	1.361e+04	1.361e+04	1.361e+04	1.361e+04	1.362e+04
co60	4.496e+14	4.447e+14	4.352e+14	4.138e+14	3.956e+14	3.468e+14	3.041e+14	2.666e+14	2.338e+14
cs134	1.473e+15	1.433e+15	1.356e+15	1.192e+15	1.063e+15	7.597e+14	5.431e+14	3.882e+14	2.776e+14
eu152	1.522e+10	1.515e+10	1.503e+10	1.474e+10	1.448e+10	1.376e+10	1.307e+10	1.242e+10	1.180e+10
eu154	4.422e+13	4.393e+13	4.335e+13	4.203e+13	4.089e+13	3.772e+13	3.480e+13	3.211e+13	2.962e+13
nb94	3.509e+05	3.509e+05	3.509e+05	3.509e+05	3.509e+05	3.508e+05	3.508e+05	3.508e+05	3.508e+05
pr144	1.142e+21	1.061e+21	9.171e+20	6.524e+20	4.810e+20	1.978e+20	8.135e+19	3.345e+19	1.376e+19
pu238	5.347e+10	5.413e+10	5.519e+10	5.675e+10	5.748e+10	5.801e+10	5.776e+10	5.735e+10	5.691e+10
pu239	1.508e+07	1.509e+07	1.509e+07	1.509e+07	1.509e+07	1.509e+07	1.509e+07	1.509e+07	1.509e+07
pu240	3.229e+08	3.230e+08	3.230e+08	3.231e+08	3.233e+08	3.236e+08	3.239e+08	3.242e+08	3.245e+08
f424m2	0.000e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
rh106	9.833e+21	9.298e+21	8.314e+21	6.404e+21	5.070e+21	2.566e+21	1.299e+21	6.574e+20	3.327e+20
u238	0.000e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
y90	4.971e+15	4.942e+15	4.920e+15	4.875e+15	4.835e+15	4.720e+15	4.608e+15	4.498e+15	4.391e+15
subtotal	1.098e+22	1.036e+22	9.232e+21	7.058e+21	5.553e+21	2.765e+21	1.381e+21	6.920e+20	3.477e+20
total	1.098e+22	1.036e+22	9.232e+21	7.058e+21	5.553e+21	2.765e+21	1.381e+21	6.920e+20	3.477e+20

OPUS sample plot file: Neutron spectrum

The neutron and gamma spectra (particles/s) is **divided by the energy group width (MeV)** for plotting.

This conversion (to units of particles/s –MeV) produces intensities that are more easily comparable across different energy groups and energy group structures.

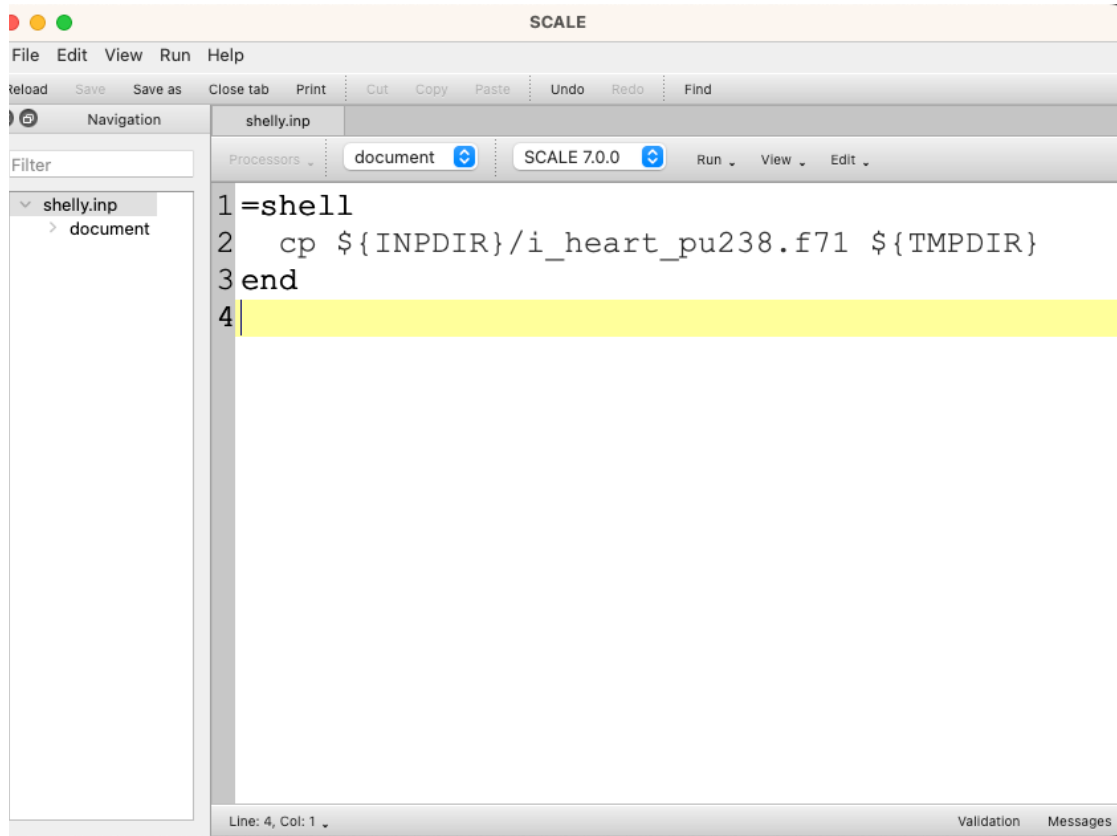
```
energy (mev)
1/ (s.MeV)
spec
1 38
1.15741e-05 days
1.000e-02 1.142e+09
4.500e-02 1.142e+09
4.500e-02 1.763e+08
1.000e-01 1.763e+08
1.000e-01 1.929e+07
2.000e-01 1.929e+07
2.000e-01 9.576e+05
3.000e-01 9.576e+05
3.000e-01 1.242e+06
4.000e-01 1.242e+06
4.000e-01 3.971e+04
6.000e-01 3.971e+04
6.000e-01 1.379e+04
8.000e-01 1.379e+04
8.000e-01 5.198e+05
1.000e+00 5.198e+05
1.000e+00 7.071e+09
1.330e+00 7.071e+09
1.330e+00 1.997e+09
1.660e+00 1.997e+09
1.660e+00 0.000e+00
2.000e+00 0.000e+00
2.000e+00 3.410e+04
2.500e+00 3.410e+04
2.500e+00 2.696e+01
3.000e+00 2.696e+01
3.000e+00 0.000e+00
4.000e+00 0.000e+00
4.000e+00 0.000e+00
5.000e+00 0.000e+00
5.000e+00 0.000e+00
6.500e+00 0.000e+00
6.500e+00 0.000e+00
8.000e+00 0.000e+00
8.000e+00 0.000e+00
1.000e+01 0.000e+00
1.000e+01 0.000e+00
2.000e+01 0.000e+00
```

Tutorial:

Post-processing F71 files with OPUS



Copying a file into the SCALE temporary directory using shell



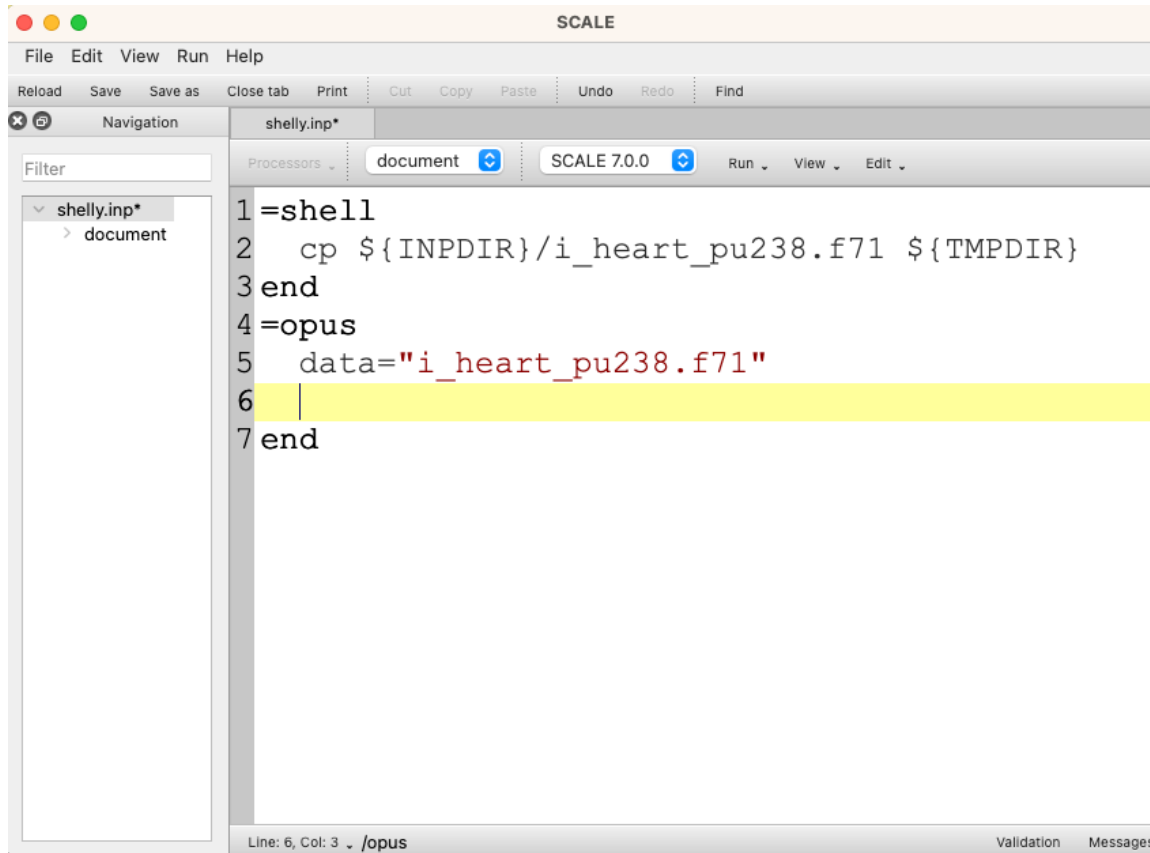
The screenshot shows the SCALE 7.0.0 application window. The menu bar includes File, Edit, View, Run, and Help. Below the menu bar is a toolbar with buttons for reload, Save, Save as, Close tab, Print, Cut, Copy, Paste, Undo, Redo, and Find. The main window is divided into a left sidebar and a main editor area. The sidebar shows a tree view with 'shelly.inp' expanded, revealing a 'document' sub-item. The main editor area displays a shell script with the following content:

```
1=shell
2  cp ${INPDIR}/i_heart_pu238.f71 ${TMPDIR}
3end
4
```

The line number 4 is highlighted in yellow. The status bar at the bottom indicates 'Line: 4, Col: 1' and has buttons for 'Validation' and 'Messages'.

- The **shell** command offers a platform-independent way to manipulate files
 - A limited set of file manipulation utilities is also provided by SHELL (e.g., GREP, AWK)
- Here, we'll copy the F71 from our Pu-238 decay exercise from our **input directory** `${INPDIR}` to our working **temporary directory** `${TMPDIR}`
 - The shell module automatically expands the environment variables `${INPDIR}` and `${TMPDIR}`

Working with our F71 file using OPUS



The screenshot shows the SCALE 7.0.0 application window. The title bar is orange with standard macOS window controls. The menu bar includes File, Edit, View, Run, and Help. Below the menu bar is a toolbar with buttons for Reload, Save, Save as, Close tab, Print, Cut, Copy, Paste, Undo, Redo, and Find. The main window is divided into a left sidebar and a main editor area. The sidebar has a 'Filter' input and a tree view showing 'shelly.inp*' and 'document'. The main editor area shows a script with the following content:

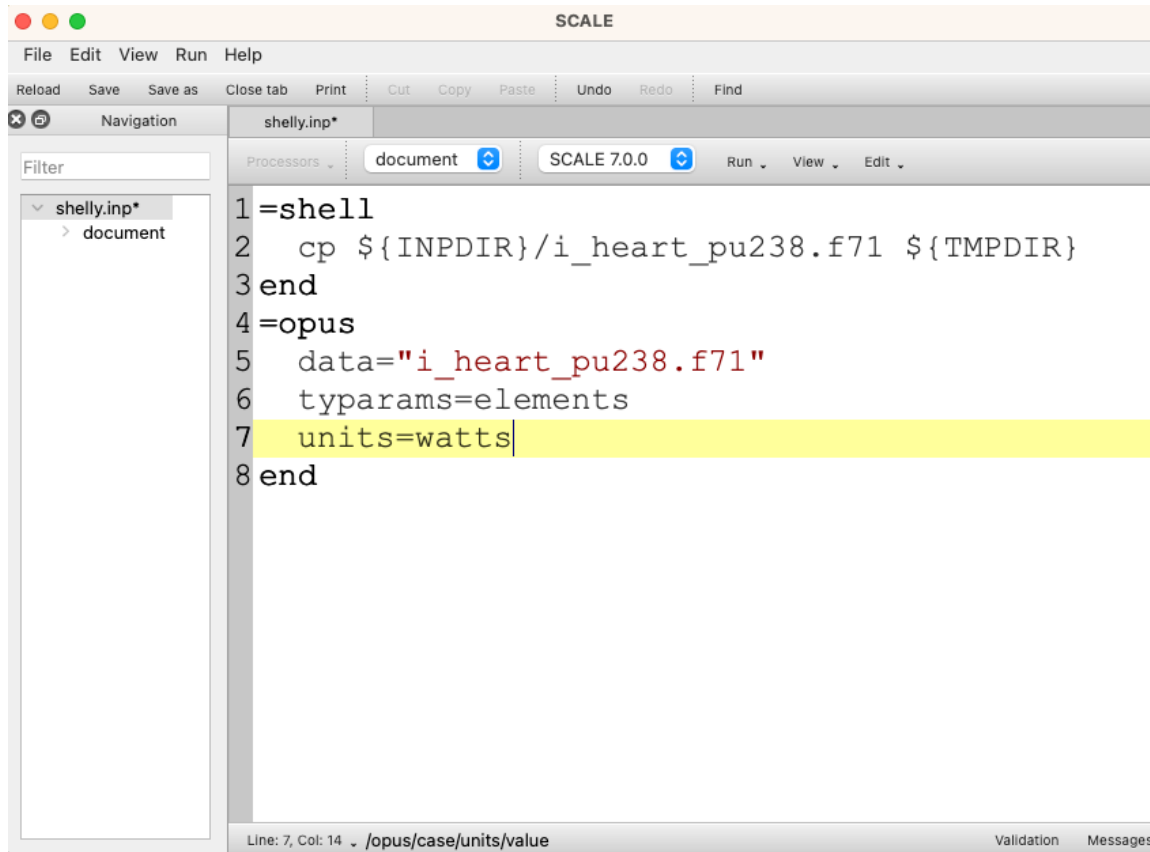
```
1=shell
2  cp ${INPDIR}/i_heart_pu238.f71 ${TMPDIR}
3end
4=opus
5  data="i_heart_pu238.f71"
6
7end
```

Line 6 is highlighted in yellow. The status bar at the bottom indicates 'Line: 6, Col: 3' and '/opus'. There are also 'Validation' and 'Messages' tabs in the status bar.

- Read data from the file you just copied into the temporary working directory:

`data="i_heart_pu238.f71"`

Getting decay heat by element



The screenshot shows the SCALE 7.0.0 application window. The menu bar includes File, Edit, View, Run, and Help. Below the menu bar is a toolbar with buttons for Reload, Save, Save as, Close tab, Print, Cut, Copy, Paste, Undo, Redo, and Find. The main window is titled 'shelly.inp*' and contains a shell script. The script is as follows:

```
1=shell
2  cp ${INPDIR}/i_heart_pu238.f71 ${TMPDIR}
3end
4=opus
5  data="i_heart_pu238.f71"
6  typarams=elements
7  units=watts
8end
```

The line 'units=watts' is highlighted in yellow. The status bar at the bottom indicates 'Line: 7, Col: 14' and the path '/opus/case/units/value'. There are also tabs for 'Validation' and 'Messages'.

- Specify quantities to be output as by **elements**:

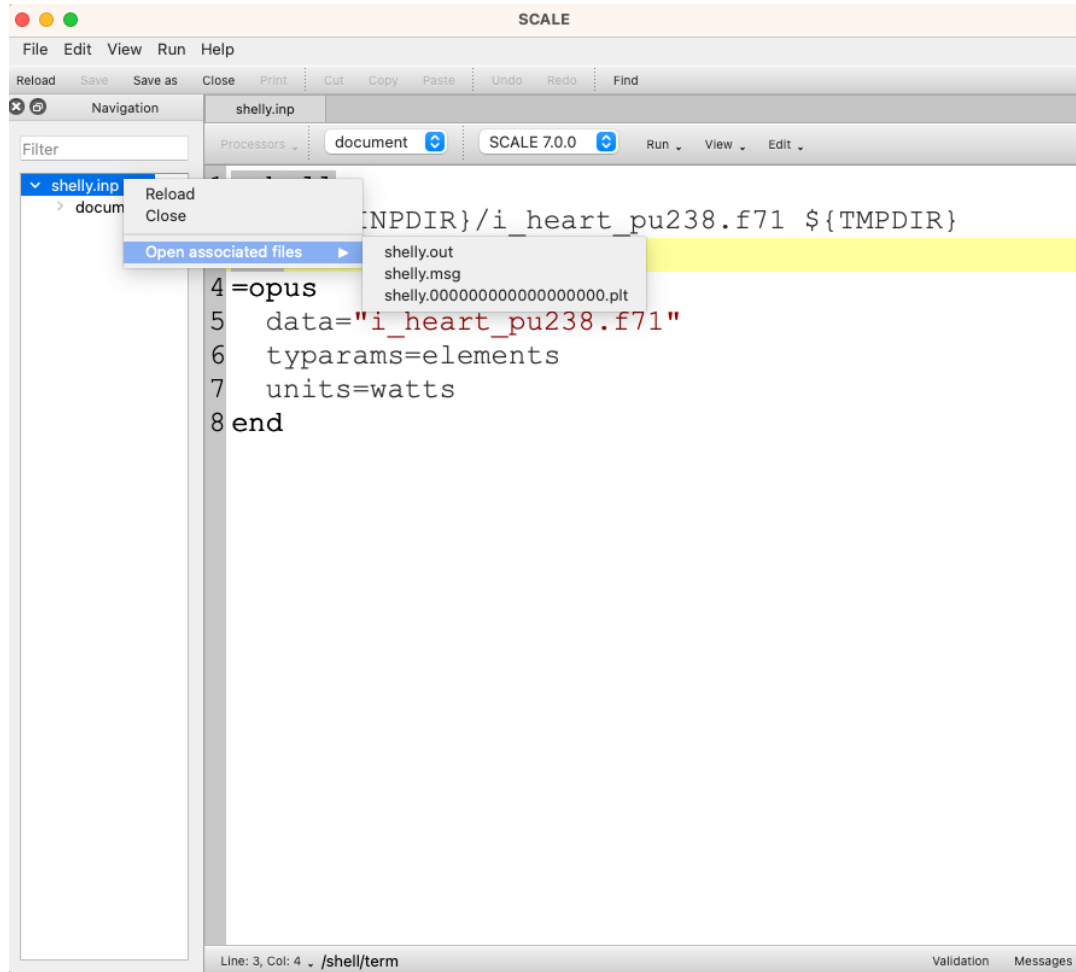
typarams=elements

- Specify output units of **Watts** (total decay heat)

units=watts

- Then hit “run”

Open the generated OPUS plot file

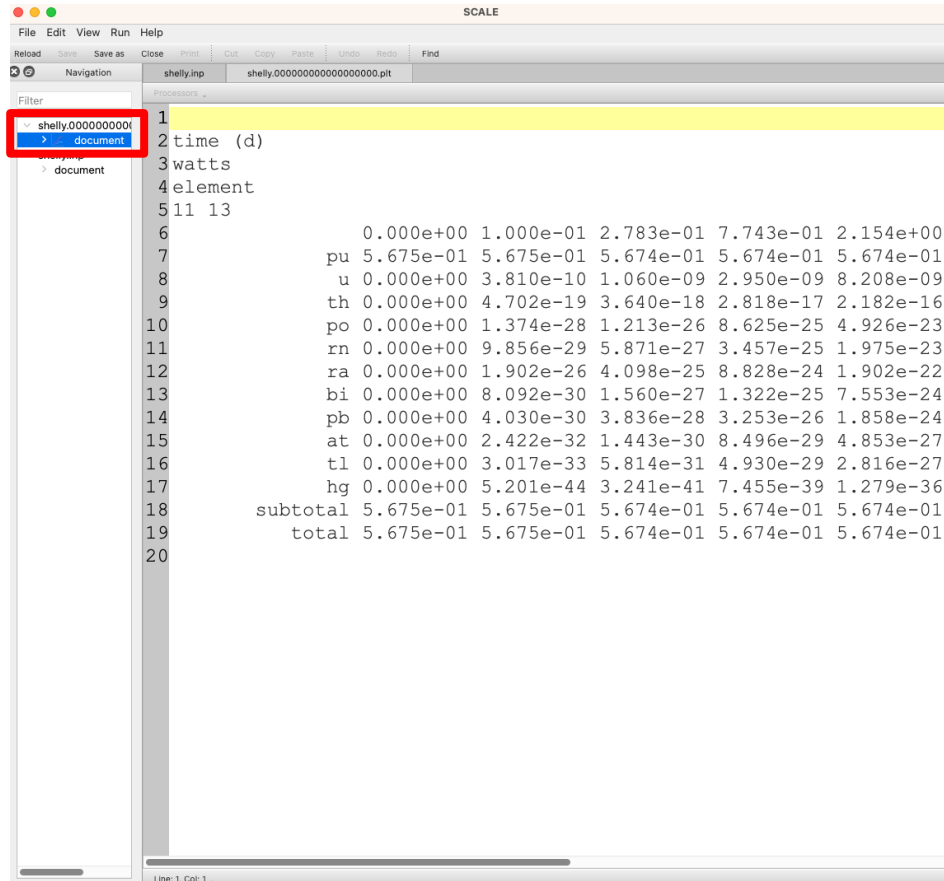


- Right-click on your input in the navigation menu
- Assuming your input ran correctly, you should have a file with the following name:

`${BASENAME}.00000000000000000000.plt`

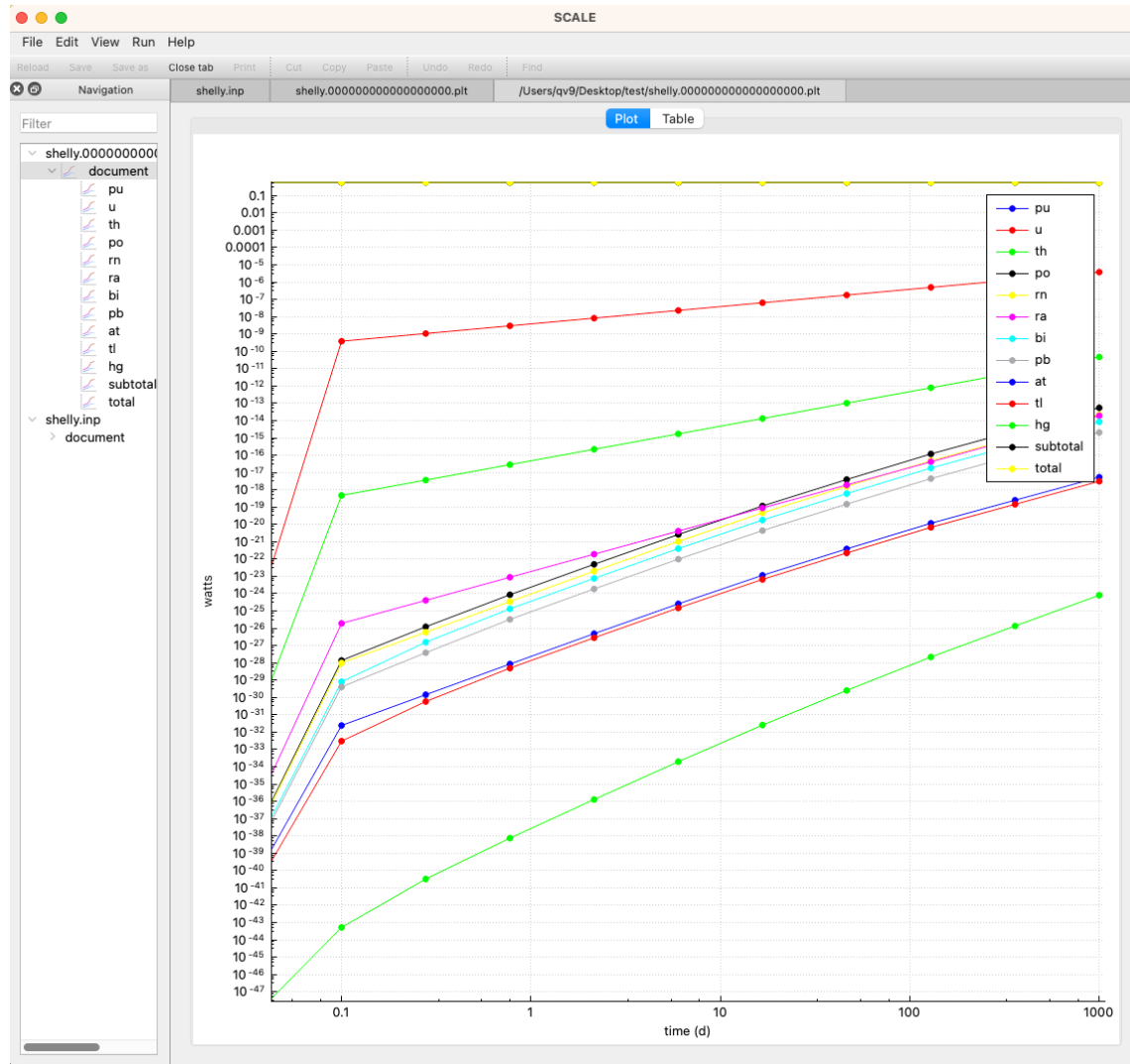
where `${BASENAME}` is the root name of your input file

Examining the OPUS plot file



- The plot file contains the decay heat for **each** time interval (in units of Watts) by element
- This column-separated format is useful for additional post-processing using Python (or copying into Excel)
- But if we also double-click “document” under the navigation panel...

OPUS and the Fulcrum plot window



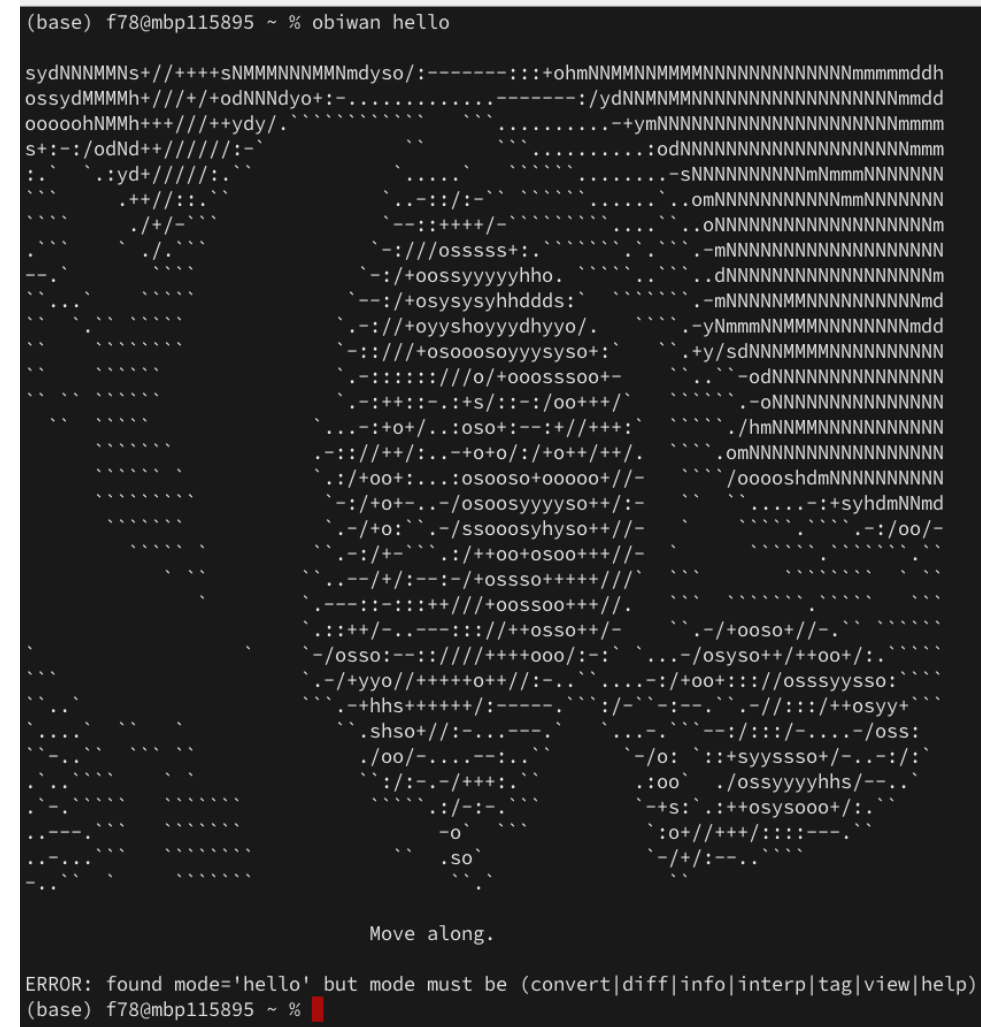
- Fulcrum natively “understands” how to process OPUS plt files
- While we selected a bare minimum of options here, OPUS can be used to screen for specific **nuclides**, **timesteps**, and **time intervals**
- OPUS can also be used to plot quantities such as **radiation emission spectra**

OBIWAN command-line interface



OBIWAN: “This **is** the tool you are looking for”

- Origen Binary Interrogation
Without A scale input
- A command-line tool for viewing,
manipulating, and converting ORIGEN
binary files
- OBIWAN is typically invoked directly from
the command line,
`${SCALE}/bin/obiwan` or in a SCALE
input inside an `=shell` block
 - But it's actually not that hard because OBIWAN
provides help screens every step of the way



Can you see him???

OBIWAN background and history

- Introduced as a “developer / power user” tool in SCALE 6.2
 - Fully functional, but not documented within the manual
- “Promoted” to a full member of the ORIGIN family (with documentation) as of SCALE 6.3

More details:

See **Section 5.2** of the SCALE manual

OBIWAN Modes

```
obiwan <mode> <options> FILE
```

Tip: Redirect STDERR
to a log file: `2>log`

- **info** – print basic info about multiple files
- **view** – view a file
- **tag** – manipulate tags on a file
- **convert** – convert between versions of files
- **diff** – diff/compare two files
- **interp** – interpolate files
- **patch** – patch data in files

The following slides provide some of the most common or useful options for the different modes. Please see the manual or the help screen for all details.

OBIWAN operating modes & capabilities

convert

- Convert f33 libraries & F71 files between different SCALE formats (6.1 $\Leftrightarrow$ 6.2+)

diff

- Compare two ORIGEN binary files

info

- View file metadata(e.g., # of positions, format, etc.)

interp

- Interpolate a file along tags or burnup values

patch

- Rewrite / "patch" data on an existing file

tag

- Introduce metadata onto a binary file (used for identification & interpolation)

view

Run OBIWAN in two ways

1. From the command line, like any other command line utility,
`/path/to/obiwan ...`
2. From within a SCALE input `shell` block

```
=shell
```

```
${PGMDIR}/obiwan ...
```

```
end
```

Running from the command line can be very powerful when combined with other command line utilities like `grep` or `awk` which are standard on Linux/Mac but SCALE also installs a version on Windows

Viewing file contents: OBIWAN info & OBIWAN view



OBIWAN info: file metadata information

```
obiwan info [-type=TYPE] FILE
```

- Displays metadata about an ORIGEN binary file
 - Library (f33), StateSet / Concentrations (f71), Yield Resource (yld)
- **Example:** Display info for all w15_ assemblies in **\${DATA}/arplibs:**

```
obiwan info [path to data]/arplibs/w15*
```

fileName	dataType	numSets	fileFormat	fileType	file/sysEndian	appVersion
w15_e05.f33	Origen::Library	17	bof	binary	little/little	6.2.0
w15_e15.f33	Origen::Library	17	bof	binary	little/little	6.2.0
w15_e20.f33	Origen::Library	17	bof	binary	little/little	6.2.0
w15_e30.f33	Origen::Library	17	bof	binary	little/little	6.2.0
w15_e40.f33	Origen::Library	17	bof	binary	little/little	6.2.0
w15_e50.f33	Origen::Library	17	bof	binary	little/little	6.2.0
w15_e60.f33	Origen::Library	17	bof	binary	little/little	6.2.0

OBIWAN view: View binary file contents

```
obiwan view <options> FILE
```

- Offers several options for viewing the data in the file, with various output formatting options
- **View** works for many ORIGIN file types:
 - **Yield** and **Decay** Resource files (yld / dec)
 - **Library** files (.f33 / .arplib)
 - **StateSet** files (.f71)
- In general, one can view nuclide-wise information, select specific positions on the library or print information about all positions, change the formatting of the nuclide IDs, ...

File types supported by OBIWAN –type=**xyz**

- **f71** "Origen::StateSet"
set of time-dependent nuclide inventory, power/flux history, and other state information
- **f33** "Origen::Library"
nuclide-to-nuclide transition data, e.g. decay constants and 1-group reaction cross sections
- **arc** "Origen::Archive"
collections of multiple related libraries, e.g. ORIGEN library for specific assembly at two different moderator densities
- **yld** "Origen::YieldResource"
fundamental fission product yield data
- **dec** "Origen::DecayResource"
fundamental decay data
- **rct** "Origen::ReactionResource"
fundamental reaction data

Most often we will view an F71 file

```
obiwan view <options> FILE.f71
```

-format=

info - information table (DEFAULT)
csv - comma-separated values
ii.json - inventory interface in JSON
tags - tags stored on each state

-units=

abso | fiss | capt | airm | apel | atom |
becq | curi | gamw | gamm | gato |
gper | gram | h2om | kilo | wpel |
watt | mevs | part | inte | ener

-cases='[]'

Restrict F71 output to specific cases
(e.g., cases='[2,3]')

-idform= String({:S}{:I}{:ZZZ}{:AAA})

{:S} - sublib integer
{:TY} - sublib name
{:I} - isomeric state integer
{:ZZZ} - up to 3 digits of atomic number (also Z, ZZ)
{:AAA} - up to 3 digits of mass number (also A, AA)
{:EE} - up to 2 characters elemental symbol (also Ee, ee)
{:M} - metastable indicator 'M' for first, 'M2' for second, etc.
(also m)

DEFAULT with -symbols=0 -> -idform='{ :S } { :I } { :ZZZ } { :AAA }'
with -symbols=1 -> -idform='{ :TY } { :ee } { :AAA } { :m }'

Example: -idform='{ :ee } { :A } { :m }' leads to "Am-242m"

OBIWAN view: -format=csv -units=???

Atom & mass-based units

gato	Gram-atoms (moles)
gram	Grams
kilo	Kilograms
apel	Atom percent of isotopes (by element)
wpel	Weight percent of isotopes (by element)
gper	Grams per cm ³
atom	Atoms per b-cm

Radiotoxicity indices (dilution factors)

airm	Raditoxicity index in air (m ³)
h2om	Raditoxicity index in water (m ³)

Activity & decay heat

becq	Becquerels
curi	Curies
watt	Total thermal output (Watts)
mevs	Total thermal power (MeV)
gamw	Thermal output from gammas (Watts)
gamm	Thermal output from gammas (MeV)

Reaction rates

abso	Total absorption
fiss	Total fission
capt	Total capture

Radiation emissions

part	Particles / second
inte	Particles / MeV-second
ener	MeV / second

Tutorial: Viewing an ORIGIN concentrations file (f71)



Exercise: Viewing an ORIGEN concentrations file (f71)

For the provided example file “**obiwan.f71**” (produced from TRITON), find answers to these questions:

1. How many “positions” are on this file?
2. How many “cases” are on this file?
3. Print nuclide concentrations of the system-average mixture:
 - In units of atoms/barn-cm
 - With 8 decimals
 - In a pretty nuclide ID format
 - For the system-averaged mixture (case -2)

Solution: Viewing an F71 file information with OBIWAN

obiwan view -format=info obiwan.f71

pos	time	power	flux	fluence	energy	initial	hm	volume	lib	pos	case	step	DC	GNA	B
(-)	(s)	(MW)	(n/cm^2-s)	(n/cm^2)	(MWd)	(MTIHM)	(cm^3)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)
1	0.00000e+00	0.00000e+00	0.00000e+00	0.00000e+00	0.00000e+00	0.00000e+00	0.00000e+00	0.00000e+00	1.26855e-01	1.41129e+04	1	1	0	DC	----
2	2.59200e+07	3.43861e+00	1.95889e+14	5.07743e+21	1.03158e+03	1.26855e-01	1.41129e+04	2	1	1	DC	----			
3	0.00000e+00	0.00000e+00	0.00000e+00	0.00000e+00	0.00000e+00	2.53700e-01	2.82259e+04	1	2	0	DC	----			
4	2.59200e+07	7.88776e+00	1.94630e+14	5.04482e+21	2.36633e+03	2.53700e-01	2.82259e+04	2	2	1	DC	----			
5	0.00000e+00	0.00000e+00	0.00000e+00	0.00000e+00	0.00000e+00	2.53700e-01	2.82259e+04	1	3	0	DC	----			
6	2.59200e+07	6.81147e+00	1.85120e+14	4.79831e+21	2.04344e+03	2.53700e-01	2.82259e+04	2	3	1	DC	----			
7	0.00000e+00	0.00000e+00	0.00000e+00	0.00000e+00	0.00000e+00	1.26850e-01	1.41129e+04	1	4	0	DC	----			
8	2.59200e+07	2.85220e+00	1.77108e+14	4.59064e+21	8.55659e+02	1.26850e-01	1.41129e+04	2	4	1	DC	----			
9	0.00000e+00	0.00000e+00	0.00000e+00	0.00000e+00	0.00000e+00	5.97238e-02	7.05647e+03	1	5	0	DC	----			
10	2.59200e+07	9.50811e-01	1.58367e+14	4.10486e+21	2.85243e+02	5.97238e-02	7.05647e+03	2	5	1	DC	----			
11	0.00000e+00	0.00000e+00	0.00000e+00	0.00000e+00	0.00000e+00	5.97237e-02	7.05646e+03	1	6	0	DC	----			
12	2.59200e+07	6.54083e-01	1.53567e+14	3.98045e+21	1.96225e+02	5.97237e-02	7.05646e+03	2	6	1	DC	----			
13	0.00000e+00	0.00000e+00	0.00000e+00	0.00000e+00	0.00000e+00	1.19447e-01	1.41129e+04	1	7	0	DC	----			
14	2.59200e+07	9.56058e-01	1.50565e+14	3.90265e+21	2.86817e+02	1.19447e-01	1.41129e+04	2	7	1	DC	----			
15	0.00000e+00	0.00000e+00	0.00000e+00	0.00000e+00	0.00000e+00	1.00000e+00	1.12903e+05	1	0	0	DC	----			
16	2.59200e+07	2.35510e+01	1.79879e+14	4.66246e+21	7.06530e+03	1.00000e+00	1.12903e+05	2	0	1	DC	----			
17	0.00000e+00	0.00000e+00	0.00000e+00	0.00000e+00	0.00000e+00	1.00000e+00	1.12903e+05	1	-2	0	DC	----			
18	2.59200e+07	2.35510e+01	1.79879e+14	4.66246e+21	7.06530e+03	1.00000e+00	1.12903e+05	2	-2	1	DC	----			

1. 18 positions
2. 7 “cases” (i.e., material regions)

Solution: Viewing F71 concentrations

```
obiwan view -format=csv -units=atom -symbols=1  
-prec=8 cases='[-2]' obiwan.f71
```

case,	-2,	-2
step,	0,	1
time,	0.0000000E+00,	2.5920000E+07
power,	0.0000000E+00,	2.3550999E+01
flux,	0.0000000E+00,	1.7987872E+14
volume,	1.1290341E+05,	1.1290341E+05
AC:ac224,	0.00000000E+00,	2.63523478E-28
AC:ac225,	0.00000000E+00,	8.55815362E-21
AC:ac226,	0.00000000E+00,	3.28139419E-23
AC:ac227,	0.00000000E+00,	9.95996899E-18
AC:ac228,	0.00000000E+00,	5.58260037E-21
AC:am239,	0.00000000E+00,	6.93199751E-21
AC:am240,	0.00000000E+00,	4.14200455E-16
AC:am241,	9.99999968E-21,	2.33198583E-08
...		