

From ENSDF to NuDat: Search, Filter and Visualize Nuclear Data

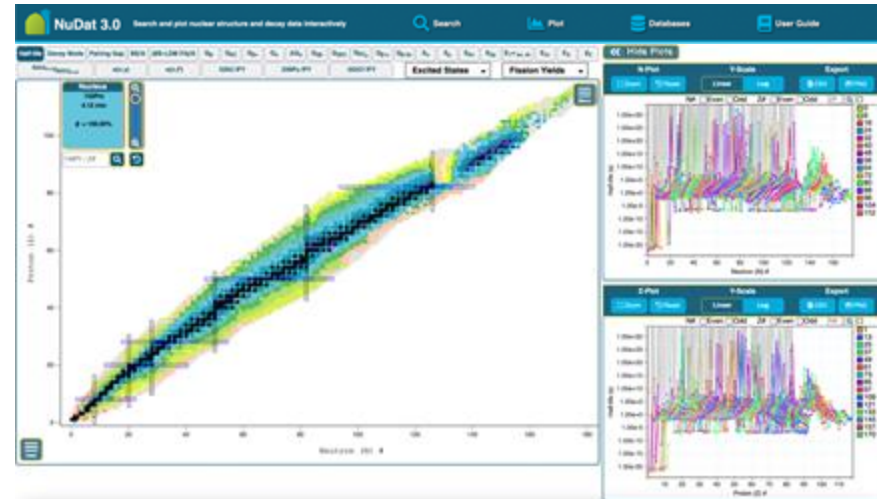
Donnie Mason
National Nuclear Data Center
Elizabeth Ricard-McCutchan
Alejandro A. Sonzogni

NuDat Overview

NuDat is the main application used to query and visualize nuclear data from **ENSDF**

Search and visualize:

- Wallet Cards
 - Half-life
 - Decay Modes
 - Ground/Isomeric level energy, J^{π}
- ENSDF
 - Excited States
 - B_2
- Atomic Mass Evaluation
 - Q-Values/Separation Energies
- ENDF
 - Fission Yields
 - Cross Sections



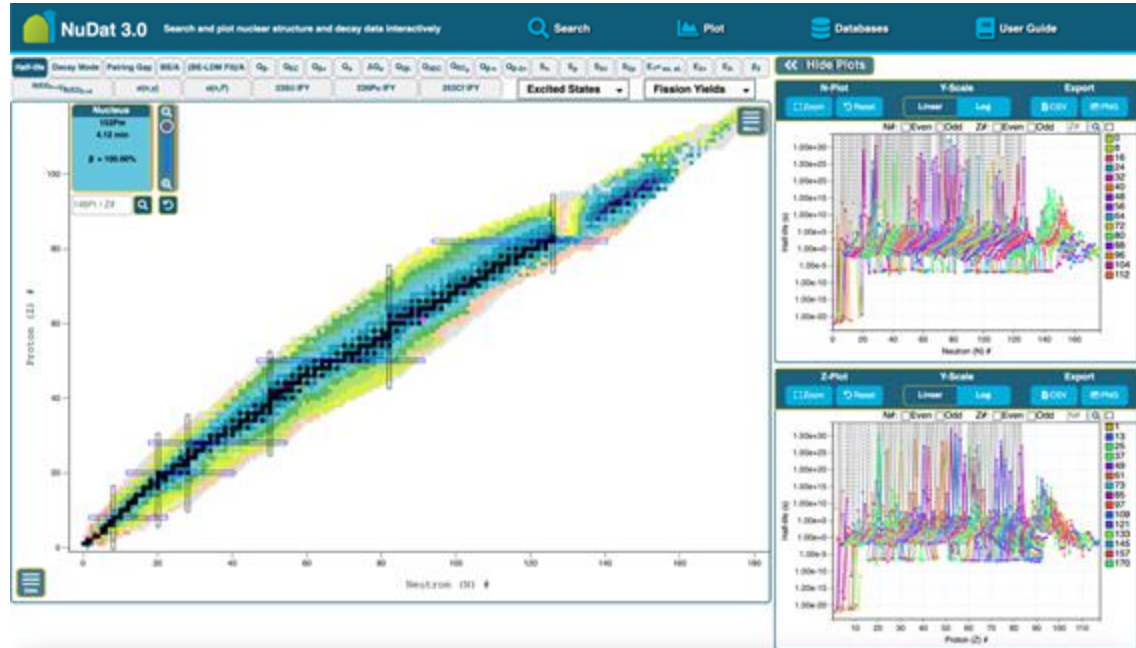
 www.nndc.bnl.gov/nudat

NuDat 3.0

NuDat 3.0 supports exploring nuclear data using responsive visualizations

Fully interactive nuclide chart and 1-D plots

Smooth pan and zoom using intuitive gestures

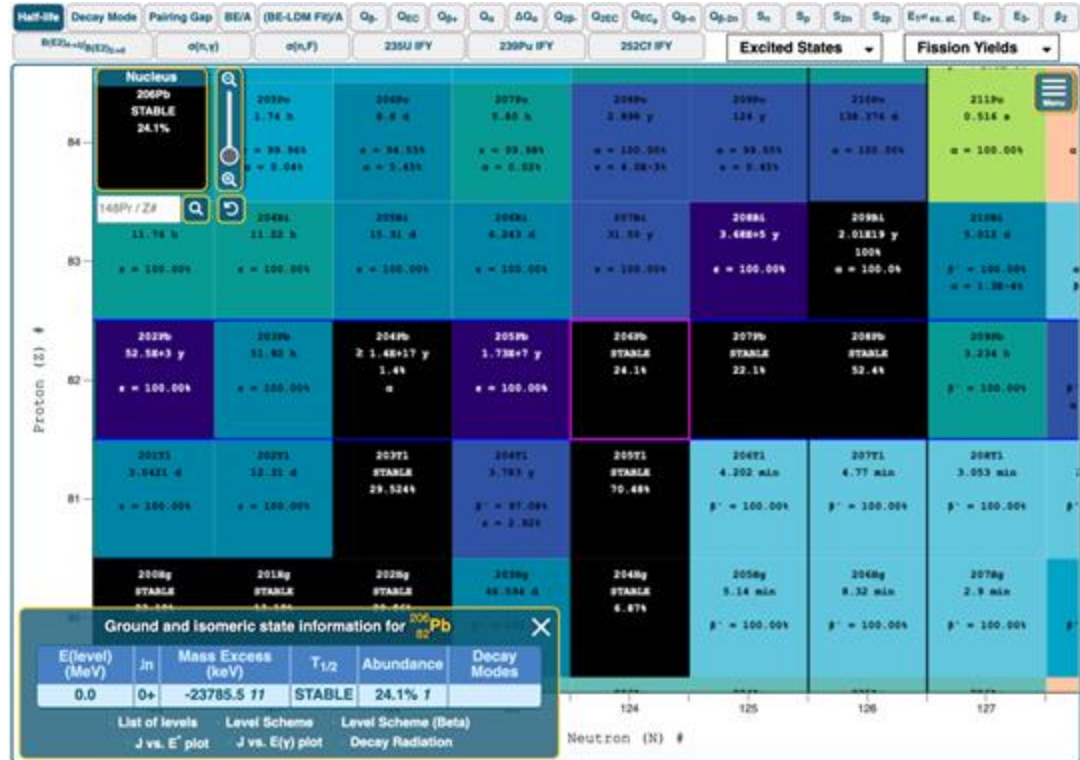


NuDat 3.0

NuDat 3.0 supports exploring nuclear data using responsive visualizations

Features:

- Interactive chart of nuclides
- 1-D neutron and proton plots
- Data Filtering
- Export Data (CSV, PNG, Link)
- Additional Resources

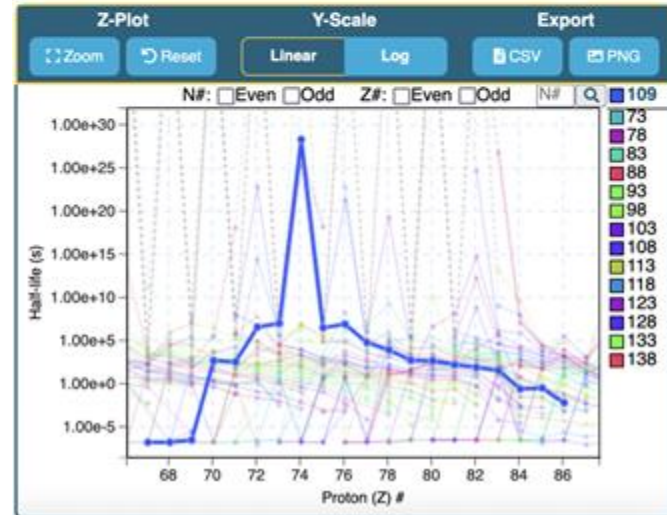
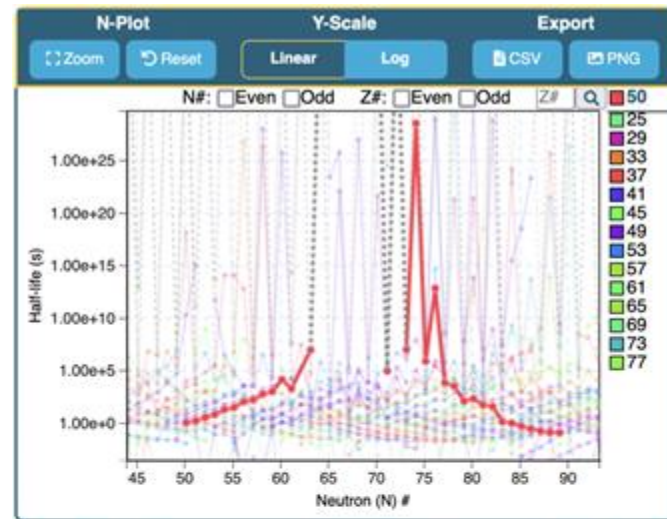


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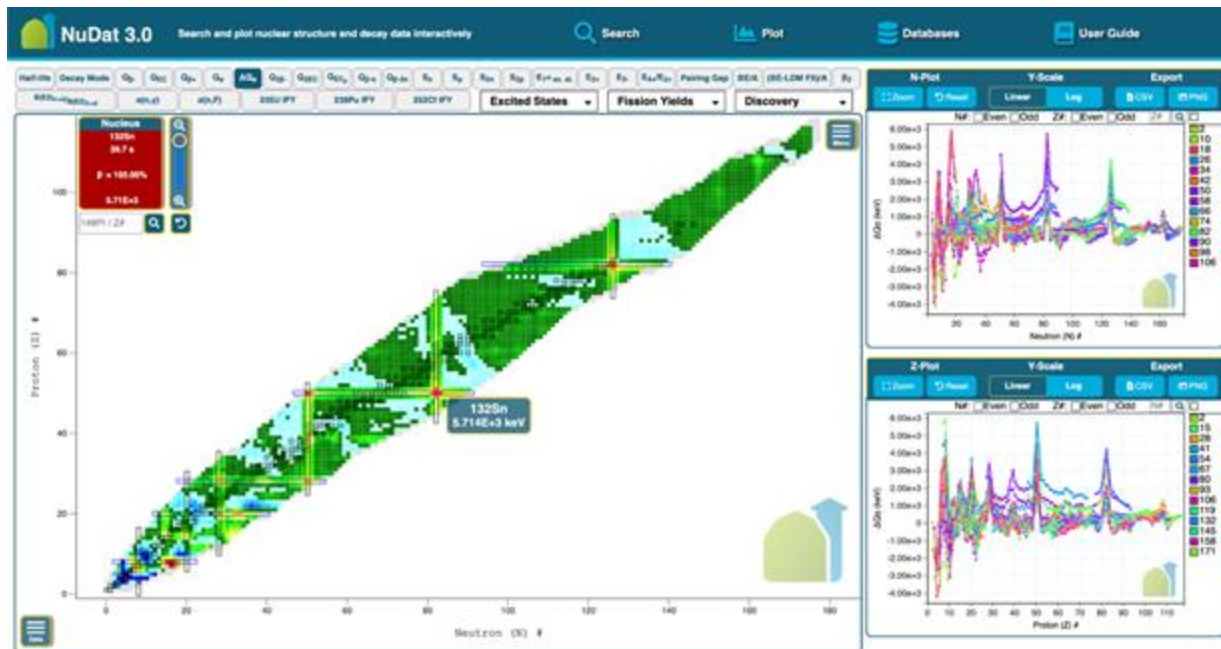
Synchronized 1-D Plots

$$\Delta Q_{\alpha} = 0.5 \times (Q_{\alpha}(Z+2, N+2) - Q_{\alpha}(Z, N)), \text{ in}$$

Optionally sync plots:

1-D plots update to the current view of the chart of nuclides

Visualize patterns in regions of chart, such as peaks



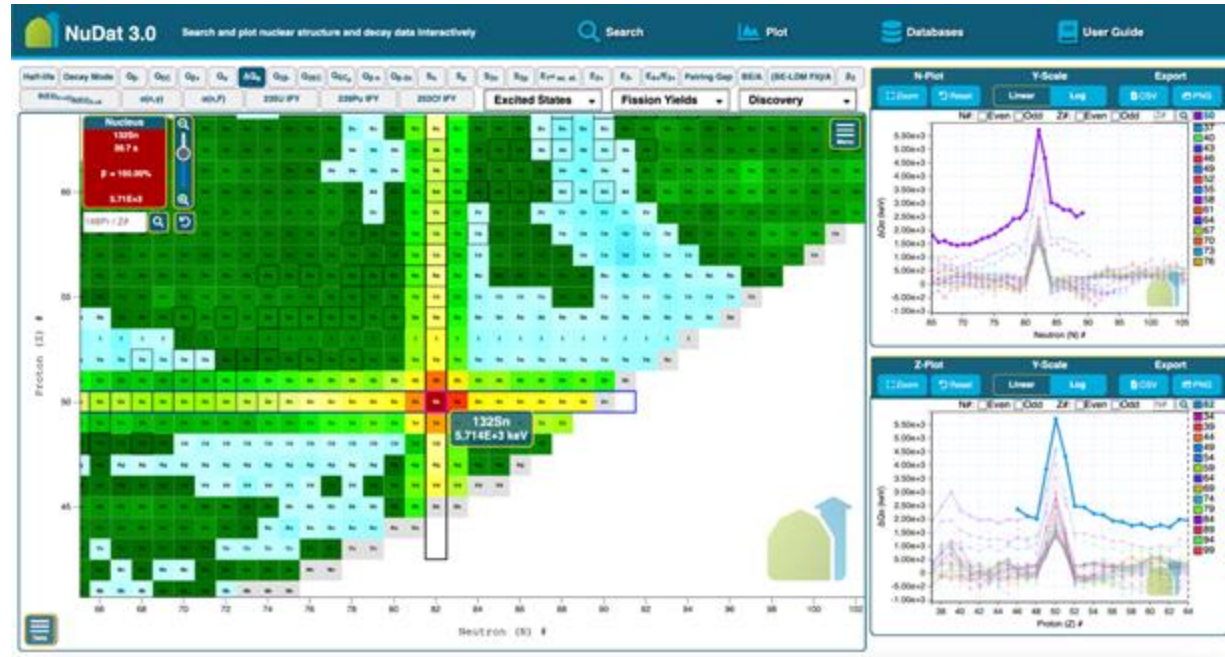
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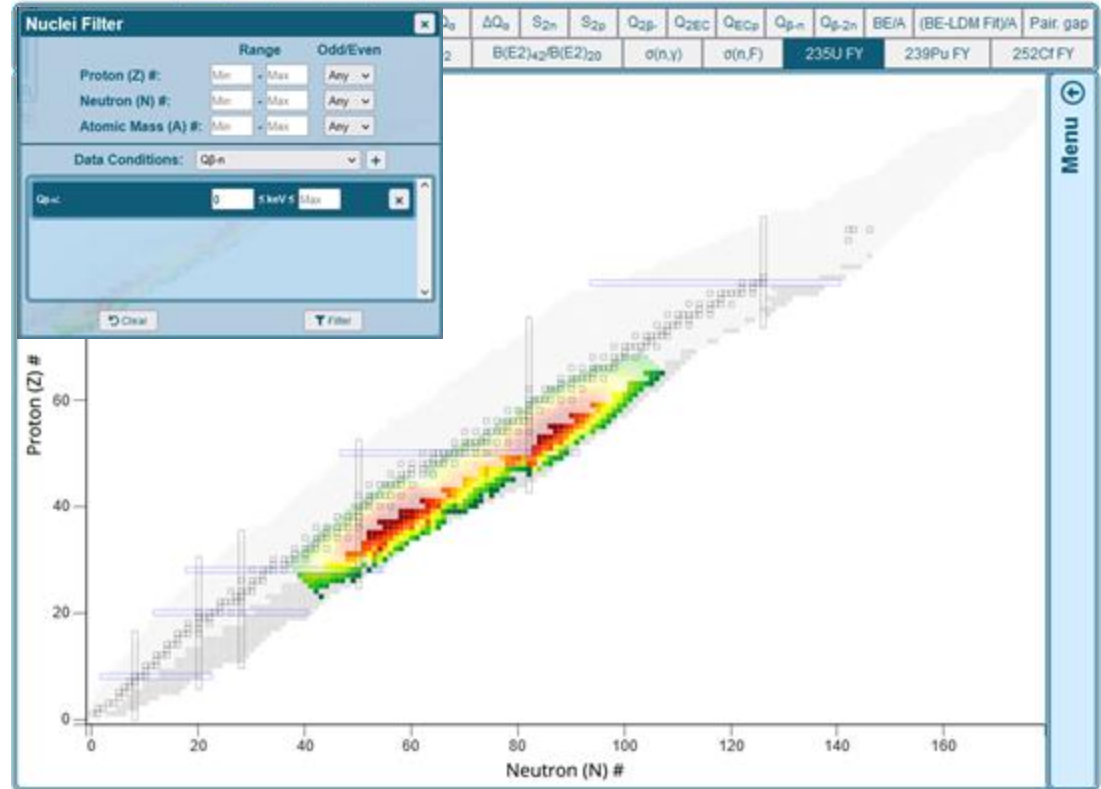


NuDat 3.0

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- 1-D neutron and proton plots
- **Data Filtering**
- Export Data (CSV, PNG, Link)
- Additional Resources



NuDat Data Filter

Customizable filter:

- Number of protons
- Number of neutrons
- Atomic mass
- NuDat observables
 - Half-life
 - Decay mode
 - Q-Values
 - Separation energies
 - And more

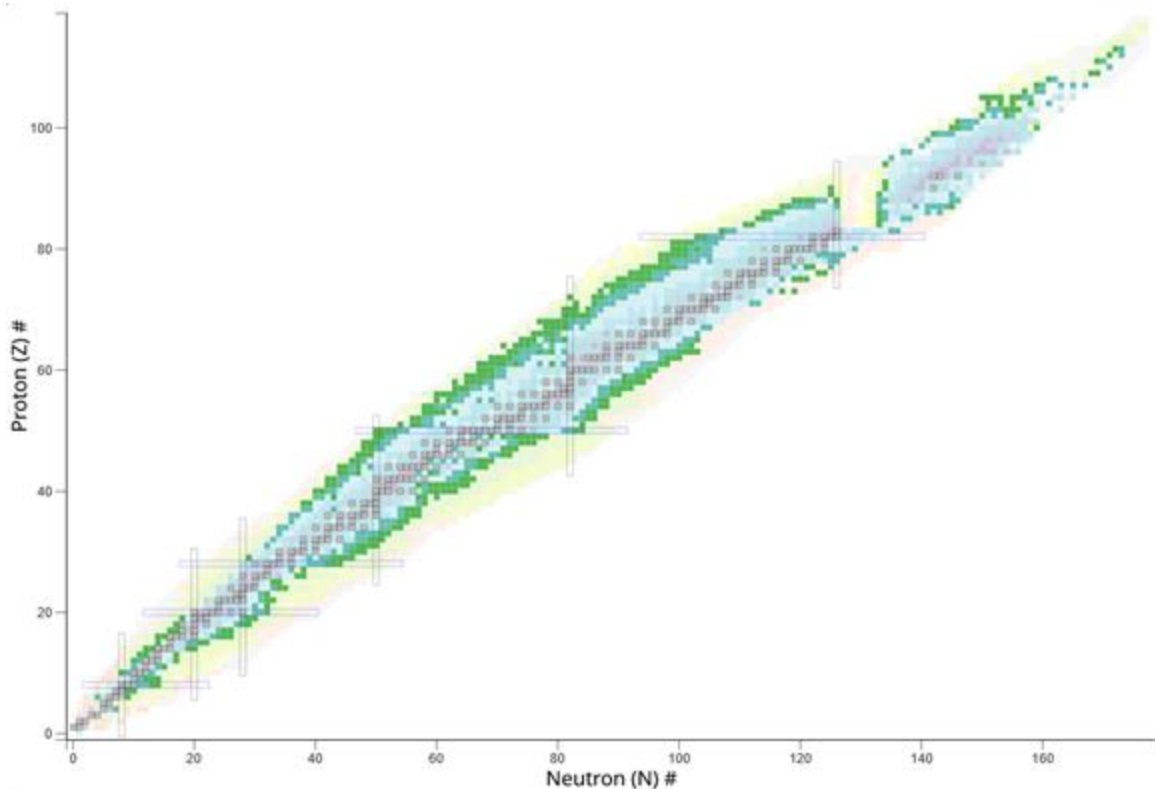
The screenshot shows a web-based interface titled "Nuclei Filter". It features a table for defining filter criteria:

	Range	Odd/Even
Proton (Z) #:	Min - Max	Any ▾
Neutron (N) #:	Min - Max	Any ▾
Atomic Mass (A) #:	Min - Max	Any ▾

Below the table, there is a "Data Conditions:" section with a dropdown menu currently set to "Half-life" and a "+" button to add more conditions. A large, empty rectangular area below this section is intended for a list of selected conditions. At the bottom of the interface, there are two buttons: "Clear" and "Filter".

NuDat Data Filter

Half-life



Nuclides with half-life
from 1s to 1m

Nuclei Filter [x]

	Range	Odd/Even
Proton (Z) #:	Min - Max	Any
Neutron (N) #:	Min - Max	Any
Atomic Mass (A) #:	Min - Max	Any

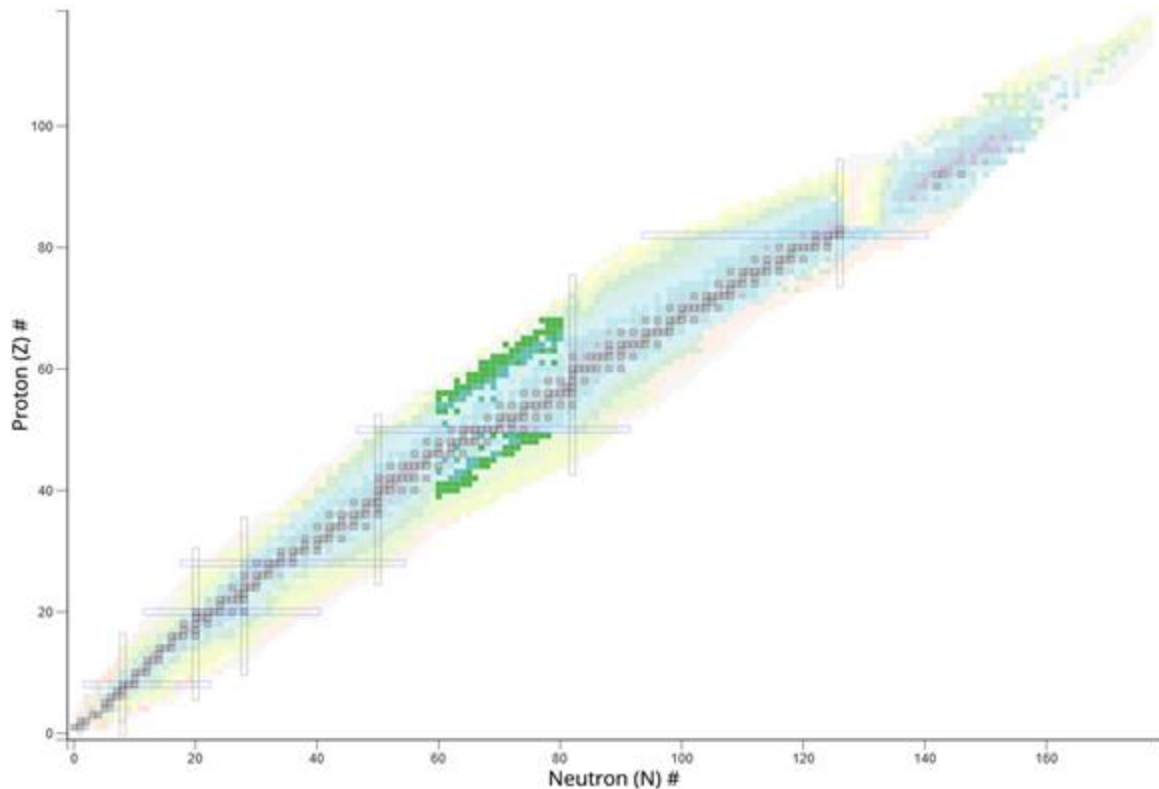
Data Conditions: Half-life [v] +

Half-life: 1 S - 1 M [x]

[Clear] [Filter]

NuDat Data Filter

Half-life



Nuclides with half-life
from 1s to 1m

+

of neutrons 60-80

Nuclei Filter [x]

	Range	Odd/Even
Proton (Z) #:	Min - Max	Any
Neutron (N) #:	60 - 80	Any
Atomic Mass (A) #:	Min - Max	Any

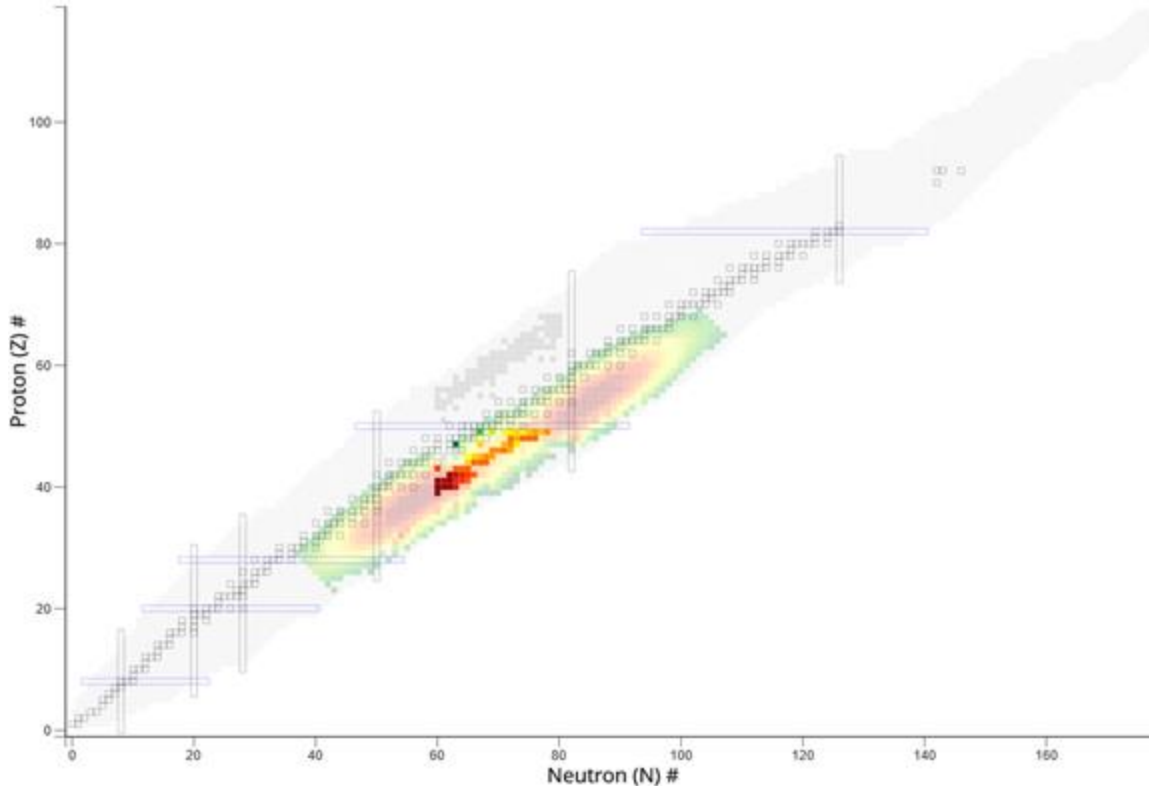
Data Conditions: Half-life [v] +

Half life: 1 S - 1 M [x]

[Clear] [Filter]

NuDat Data Filter

Thermal Neutron Fission Yields for ^{235}U



Nuclides with half-life
from 1s to 1m

+

of neutrons 60-80

Nuclei Filter [X]

	Range	Odd/Even
Proton (Z) #:	Min - Max	Any
Neutron (N) #:	60 - 80	Any
Atomic Mass (A) #:	Min - Max	Any

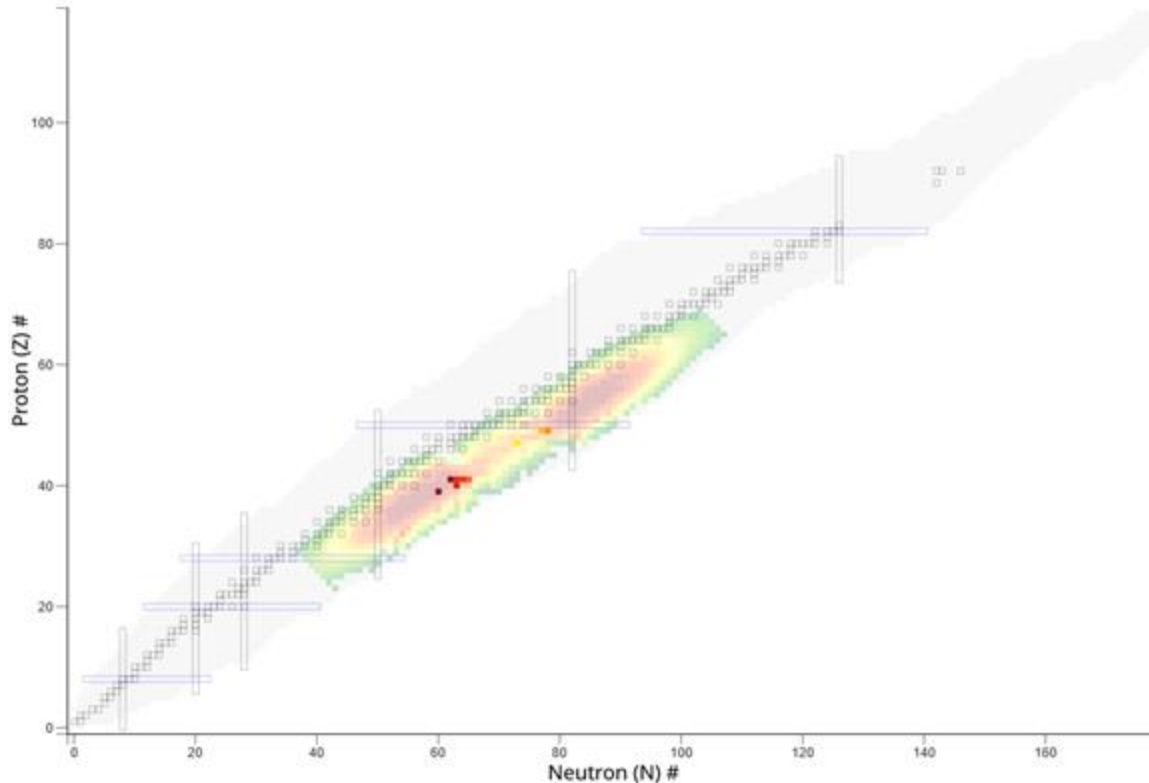
Data Conditions: Half-life [v] +

Half life: 1 S - 1 M [X]

[Clear] [Filter]

NuDat Data Filter

Thermal Neutron Fission Yields for ^{235}U



Nuclides with half-life
from 1s to 1m

+

of neutrons 60-80

$$Q(\beta) - n > 0$$

Nuclei Filter [x]

	Range	Odd/Even
Proton (Z) #:	Min - Max	Any
Neutron (N) #:	Min - Max	Any
Atomic Mass (A) #:	Min - Max	Any

Data Conditions: $Q\beta - n$ +

Half-life: 1 S · 1 M x

$Q\beta - n$: 0 ≤ keV ≤ Max x

[Clear] [Filter]

NuDat Data Export

Export all datasets and nuclides

Customizable data export:

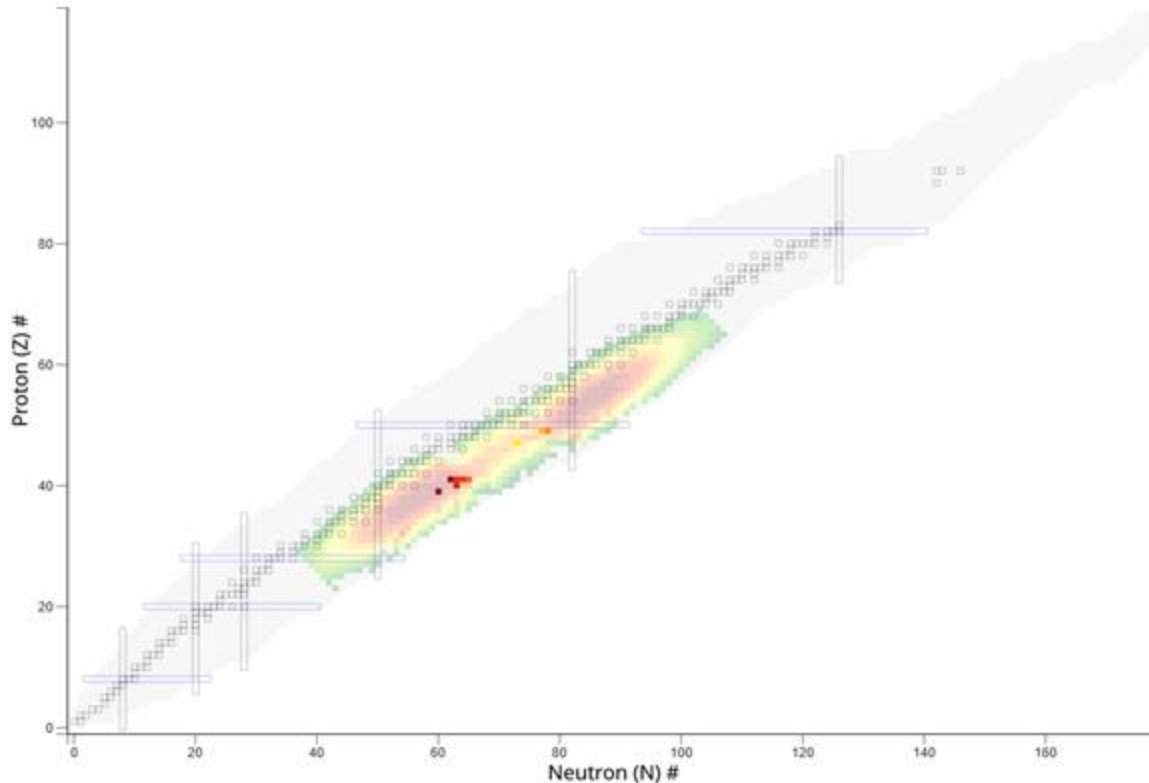
- JSON/CSV formats
- Specify which datasets to export
- Export filtered observables
- Export filtered nuclides

The image shows a large table of nuclear data. The columns include: Abundance, Half-life, Jπ, Decay Mode, Mass Excess, Q_{β-}, Q_{EC}, Q_{β+}, S_n, S_p, Q_α, ΔQ_α, S_{2n}, and S_{2p}. The rows list various nuclides with their corresponding values for these properties.

The 'Export CSV' dialog box is shown. It has a title bar with a close button. Below the title bar are three buttons: 'Select All Datasets', 'Select Filtered Datasets', and 'Clear Datasets'. The main area is divided into two columns: 'Selected Datasets' and 'Available Datasets'. The 'Selected Datasets' list includes: Abundance, Half-life, Jπ, Decay Mode, Mass Excess, Q_{β-}, Q_{EC}, Q_{β+}, S_n, S_p, Q_α, ΔQ_α, S_{2n}, and S_{2p}. The 'Available Datasets' list is currently empty. At the bottom right, there is a 'Filter Nuclides:' label with an empty input field. At the bottom center, there are two buttons: 'Export' and 'Cancel'.

NuDat Data Export

Thermal Neutron Fission Yields for ^{235}U



Nuclides with half-life
from 1s to 1m

+

of neutrons 60-80

$Q(\beta) - n > 0$

Nuclei Filter

	Range	Odd/Even
Proton (Z) #:	Min - Max	Any
Neutron (N) #:	Min - Max	Any
Atomic Mass (A) #:	Min - Max	Any

Data Conditions: $Q\beta - n$

Half-life: 1 S · 1 M

$Q\beta - n$: 0 ≤ keV ≤ Max

Clear Filter

NuDat Data Export

z	n	name	levelEnergy(MeV)	halflife	betaMinusOneNeutronEmission(keV)
39	60	99Y	0	1.484 s 7	2567 11
40	63	103Zr	0	1.32 s 11	418 10
41	62	103Nb	0	1.5 s 2	461 9
41	65	106Nb	0	1.02 s 5	3057 9
41	65	106Nb	0.2048	0.82 us 6	3057 9
41	64	105Nb	0	2.95 s 6	2357 10
41	63	104Nb	0	4.9 s 3	1072 9
41	63	104Nb	0.215	0.94 s 4	1072 9
47	73	120Ag	0	1.23 s 4	2.5E+24
47	73	120Ag	0.203	0.40 s 3	2.5E+24
49	77	126In	0	1.53 s 1	13 4
49	77	126In	0.102	1.64 s 5	13 4
49	78	127In	0	1.09 s 1	1064 15
49	78	127In	0.462	3.67 s 4	1064 15
49	78	127In	1.863	1.04 s 10	1064 15

Export filtered datasets and nuclides

Export CSV
✕

Select Datasets

Selected Datasets

Half-life

$Q_{\beta-n}$

Available Datasets

Abundance

J_{π}

Decay Mode

Mass Excess

$Q_{\beta-}$

Q_{EC}

$Q_{\beta+}$

S_n

S_p

Q_{α}

ΔQ_{α}

S_{2n}

S_{2p}

$Q_{2\beta-}$

Filter Nuclides:

NuDat Data Export

z	n	name	levelEnergy(MeV)	halflife	betaMinusOneNeutronEmission(keV)	FY235U
39	60	99Y	0	1.484 s 7	2567 11	0.0195 12
40	63	103Zr	0	1.32 s 11	418 10	0.005 3
41	62	103Nb	0	1.5 s 2	461 9	0.014 3
41	65	106Nb	0	1.02 s 5	3057 9	1.6E-4 10
41	65	106Nb	0.2048	0.82 us 6	3057 9	1.6E-4 10
41	64	105Nb	0	2.95 s 6	2357 10	0.00139 11
41	63	104Nb	0	4.9 s 3	1072 9	0.0029 18
41	63	104Nb	0.215	0.94 s 4	1072 9	0.0029 18
47	73	120Ag	0	1.23 s 4	2.5E+2 4	4.E-6 3
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49	77	126In	0	1.53 s 1	13 4	1.6E-5 11
49	77	126In	0.102	1.64 s 5	13 4	1.6E-5 11
49	78	127In	0	1.09 s 1	1064 15	6.E-5 3
49	78	127In	0.462	3.67 s 4	1064 15	6.E-5 3
49	78	127In	1.863	1.04 s 10	1064 15	6.E-5 3

Add columns from available datasets

Export CSV
✕

Select Datasets

Selected Datasets

Half-life
Q_{β-n}
235U FY

Available Datasets

Abundance
J_π
Decay Mode
Mass Excess
Q_{β-}
Q_{EC}
Q_{β+}
S_n
S_p
Q_α
ΔQ_α
S_{2n}
S_{2p}
Q_{2β-}

Filter Nuclides:

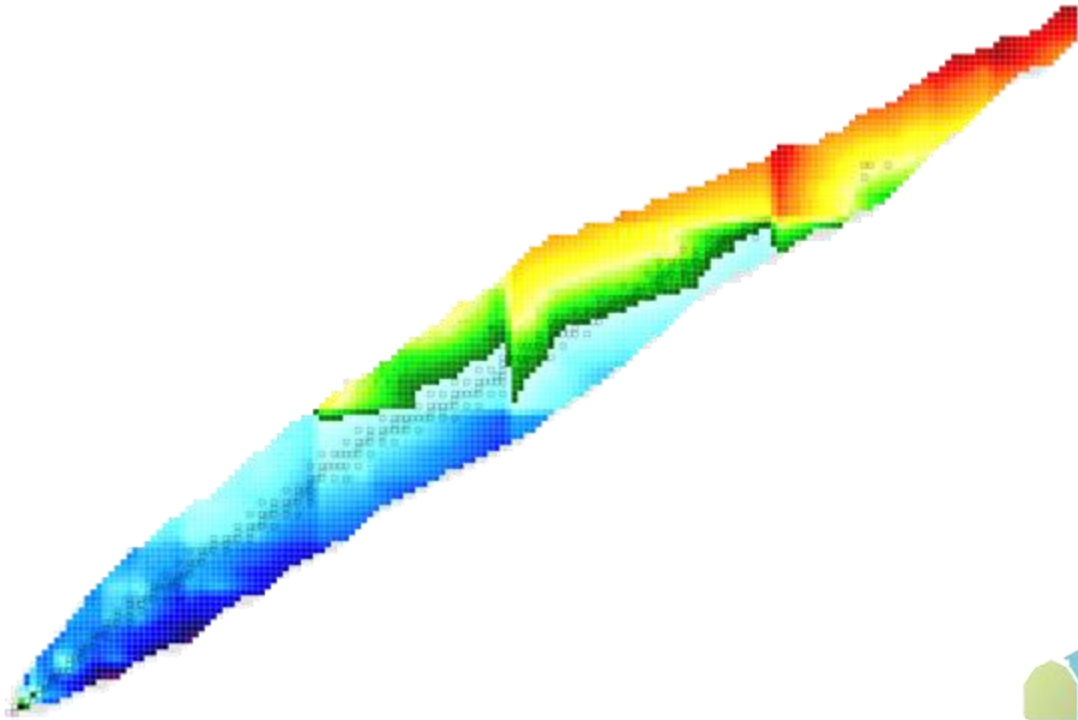
NuDat SVG Export

Customizable SVG export:

- Export chart of nuclides
 - Full chart
 - Current view
 - Z/N Ranges
- Include text
 - None
 - Element symbol
 - Nuclide name
 - Dataset details
- Shadow (flat or blur)
- Color Key
- Magic Numbers



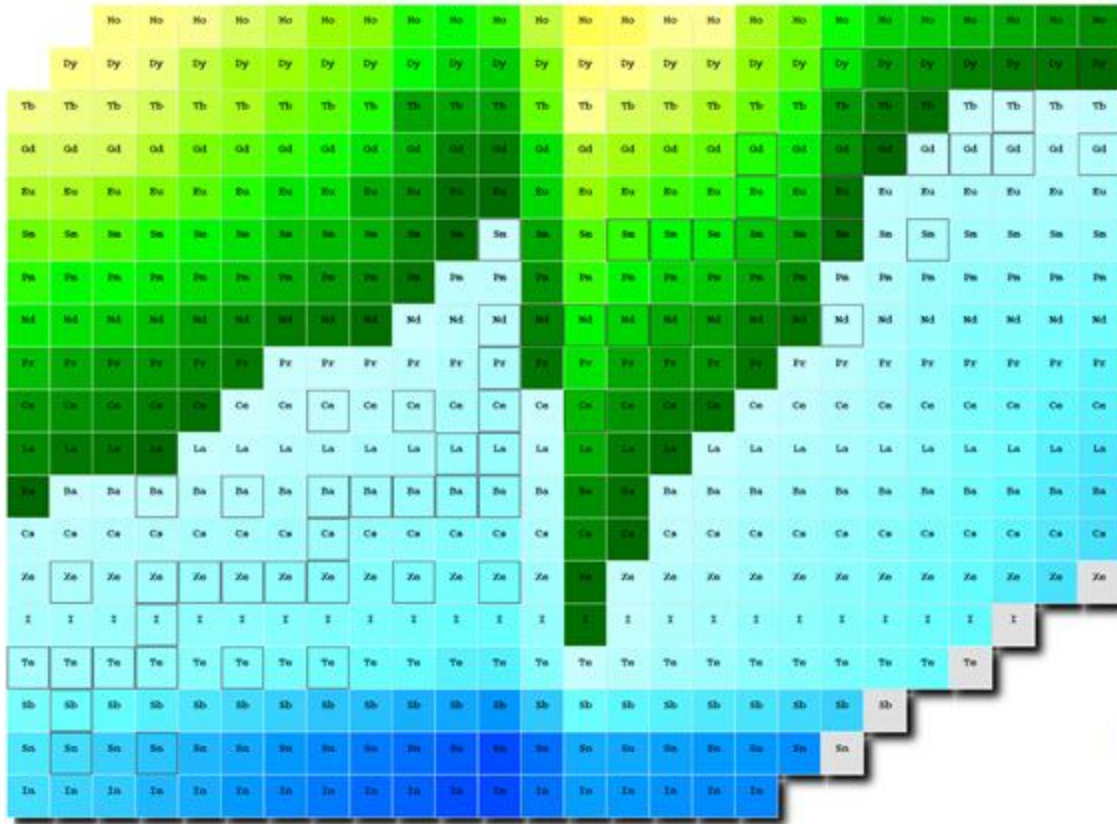
NuDat SVG Export



Q(α) full chart
without text



NuDat SVG Export

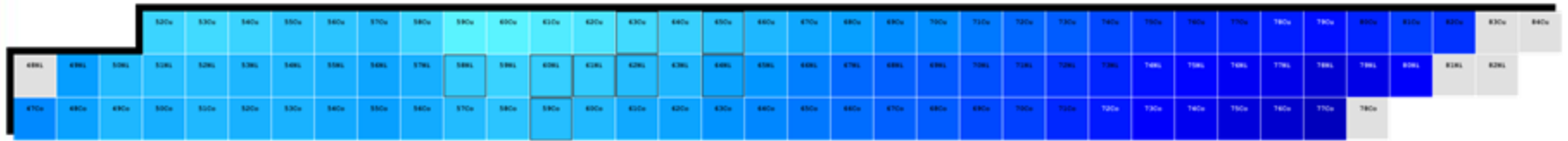


$Q(\alpha)$ current view
with element symbols
and bottom-right shadow

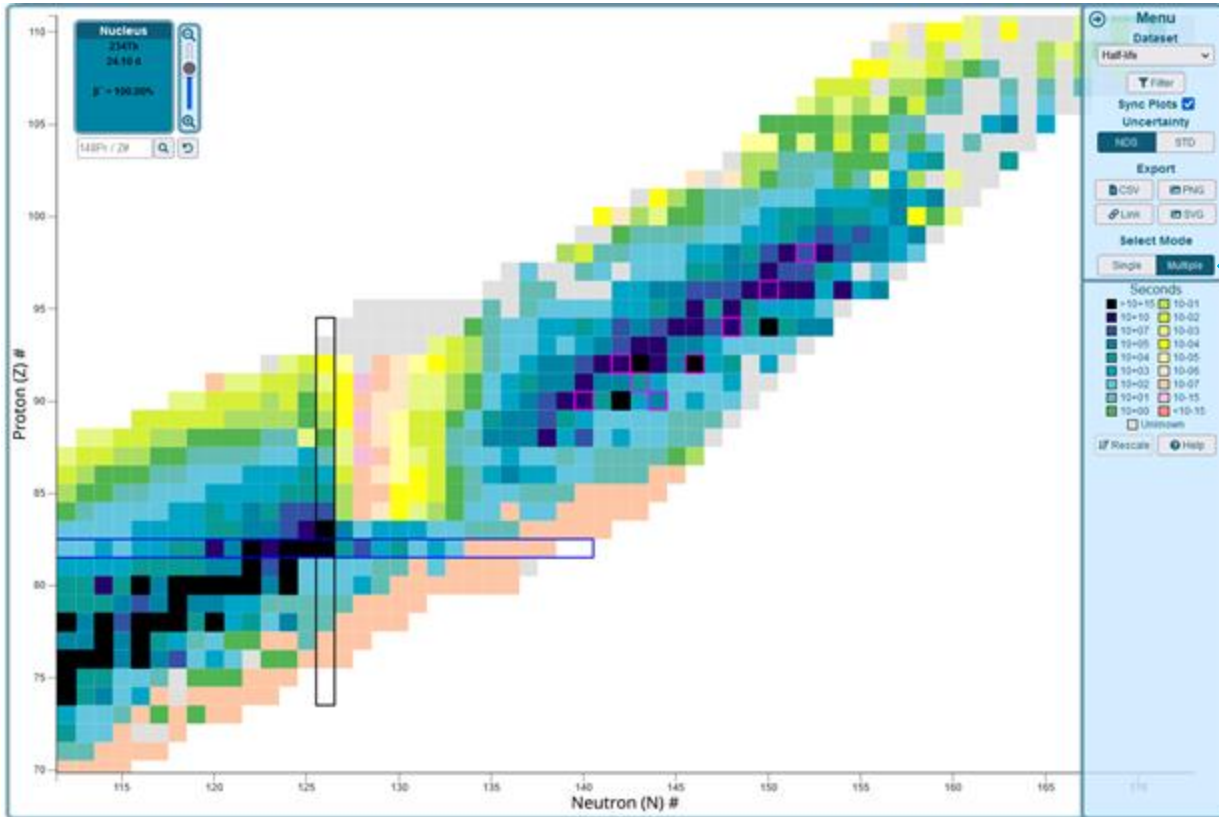


NuDat SVG Export

Q(α) chart z/n range
with element symbols
and top-left shadow



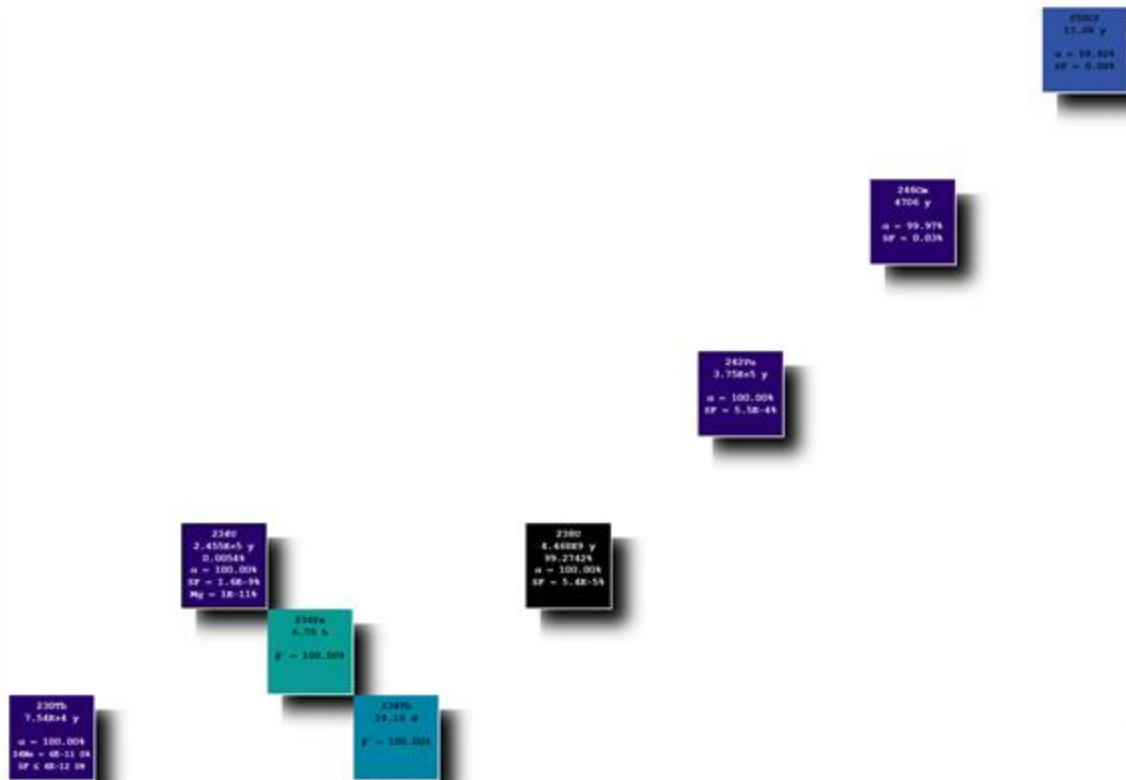
NuDat SVG Export



Select specific nuclides using the "Multiple" select mode



NuDat SVG Export



Export SVG

Full Chart Current View Ranges Selected Nuclides

Z Range: [] - []

N Range: [] - []

A Range: [] - []

Text: None Symbols Names Details

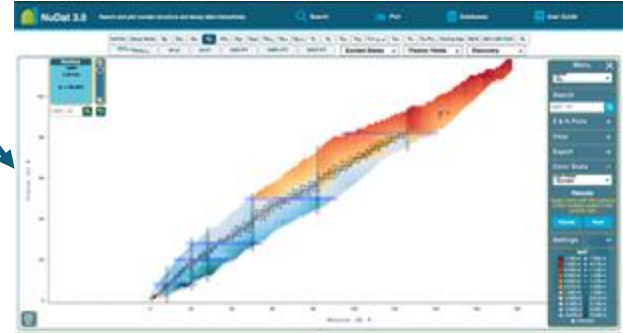
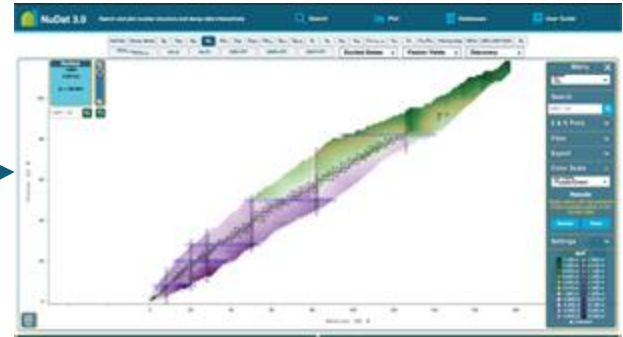
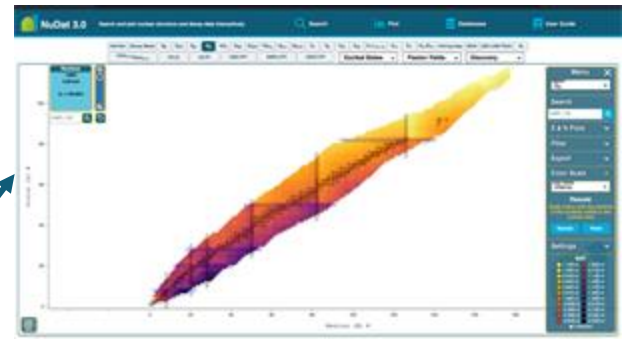
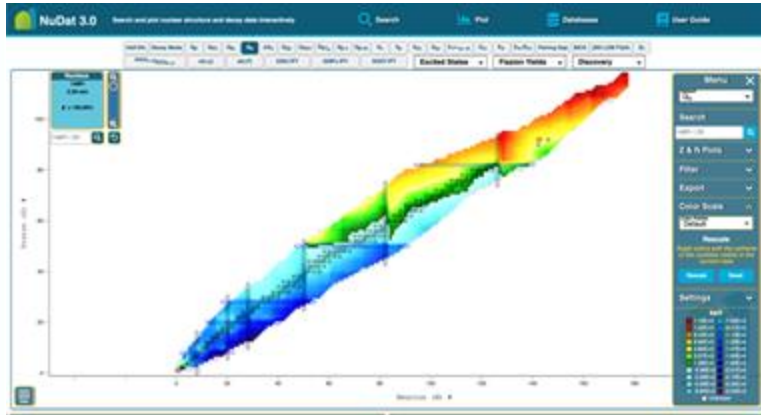
Shadow: *Bottom-right*

Blur:

Color Legend: Magic Numbers:

Export Cancel

Additional Color Palettes



Accessible

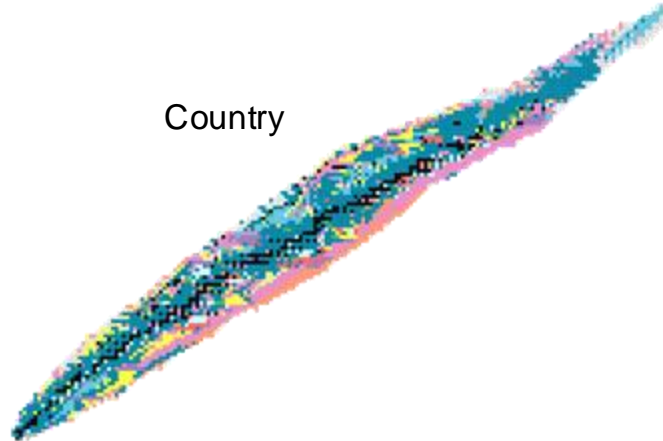
Discovery of Isotopes

Collaboration with Michael Thoennessen and Jun Chen at MSU / FRIB

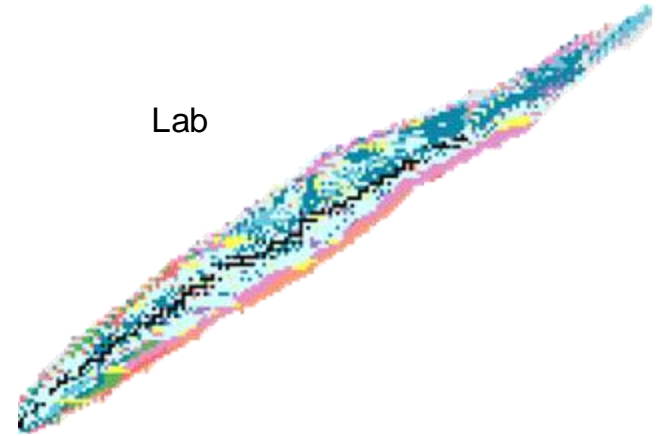
Included Discovery Datasets:

- Year
- Method
- Country
- Lab

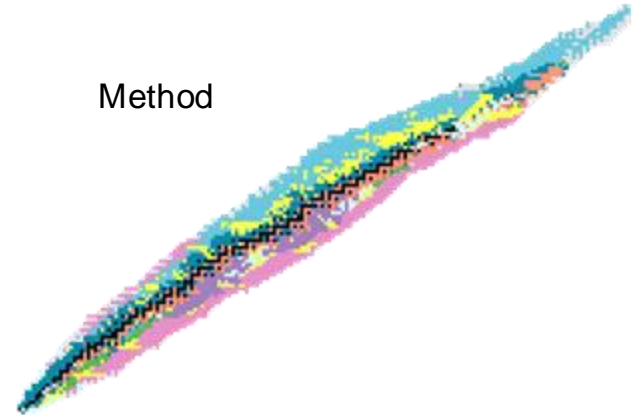
Country



Lab



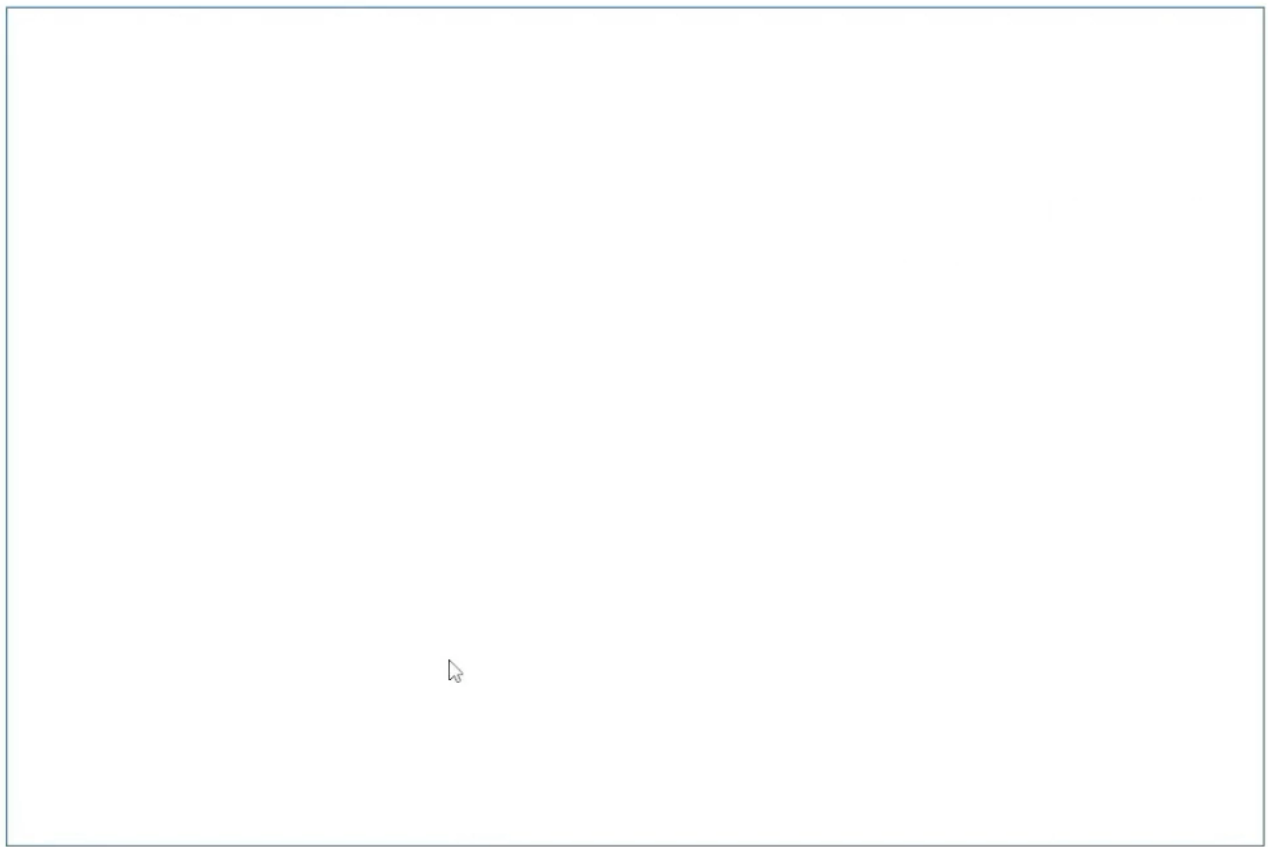
Method





1890 ●

Year of Discovery Timelapse

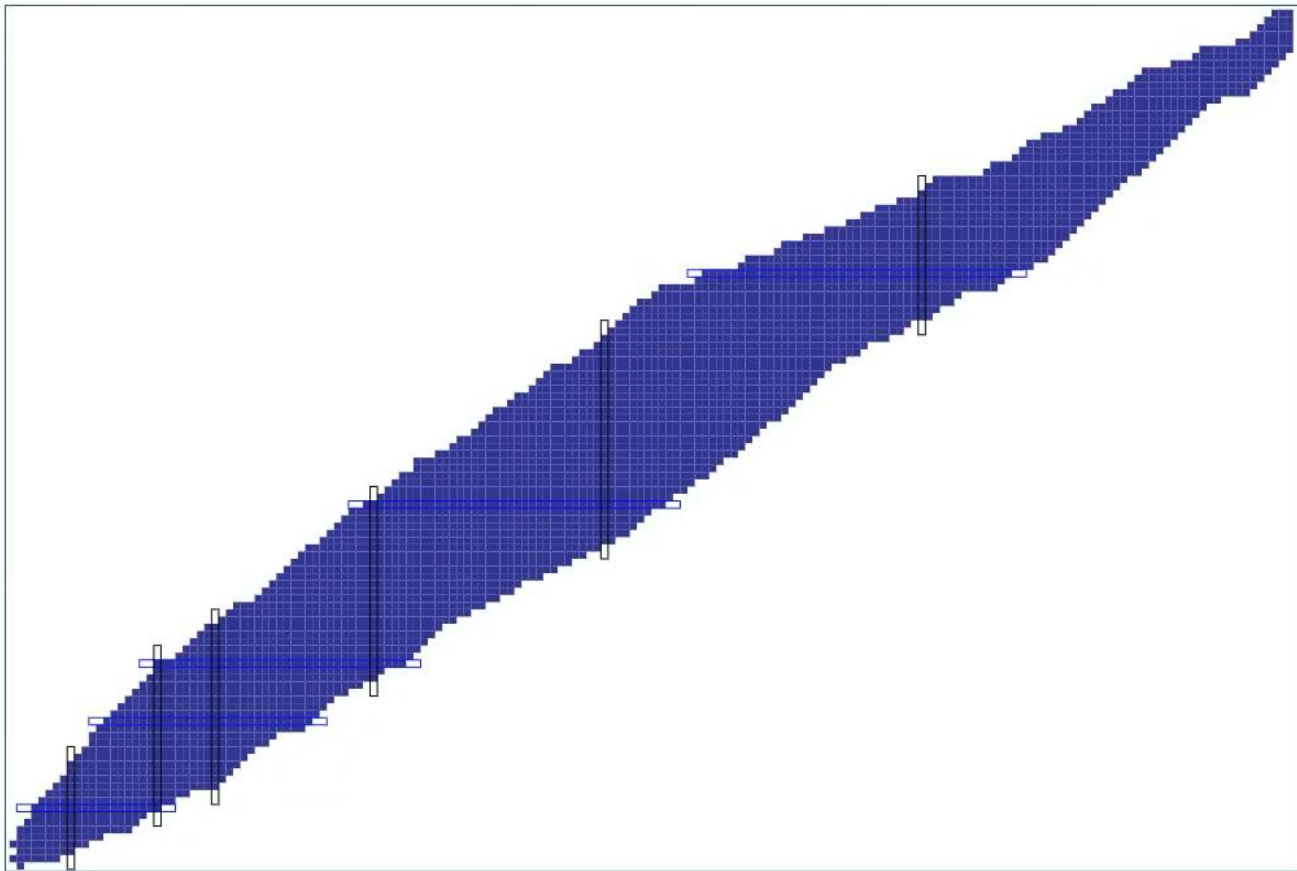




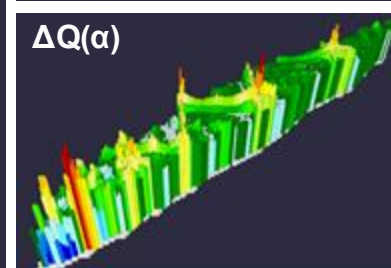
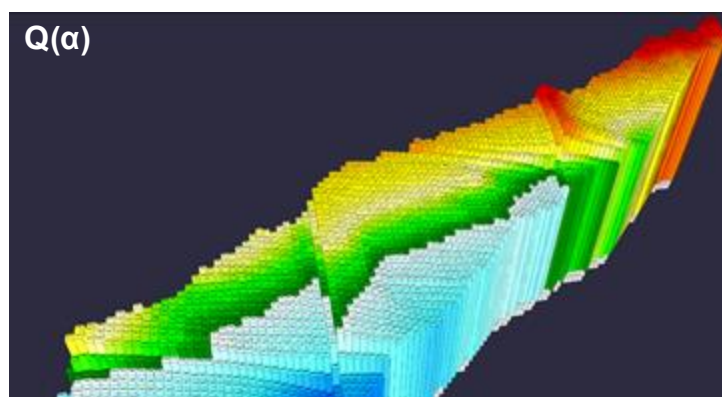
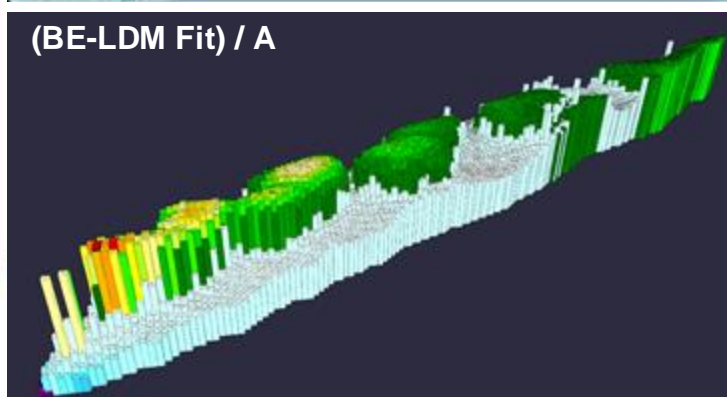
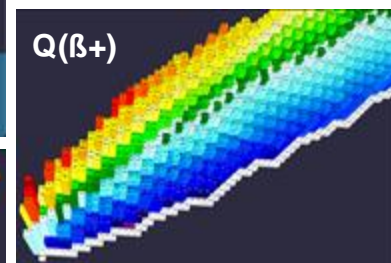
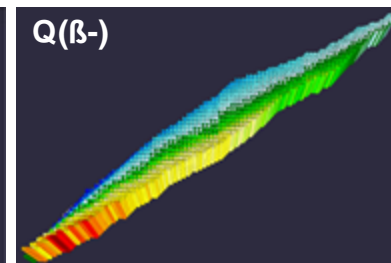
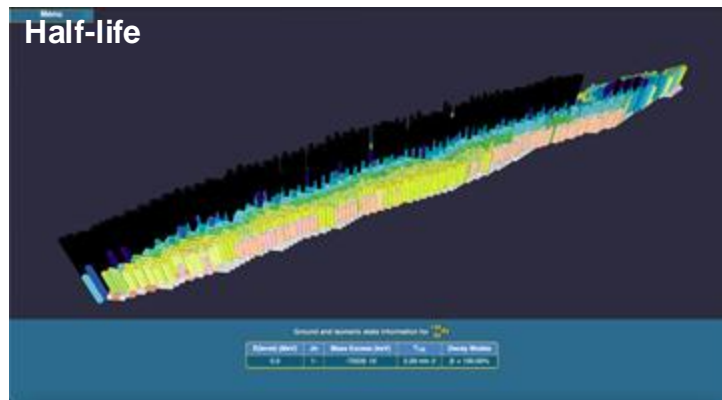
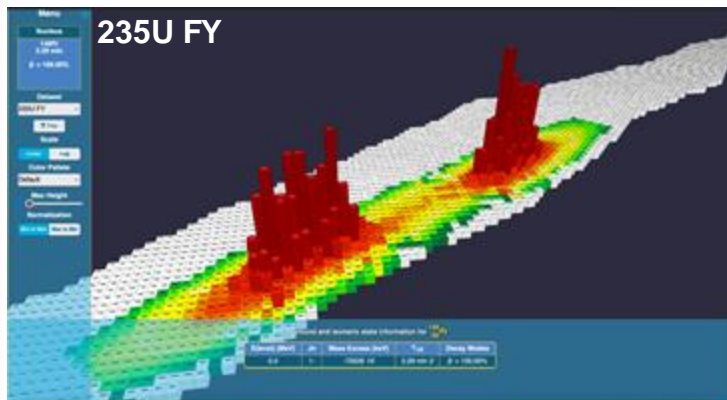
2021-10-27



Searched Nuclides Timelapse



3D Chart of Nuclides (Coming soon)



Menu

Nucleus

^{148}Pr
2.29 min
 $\beta^- = 100.00\%$

Dataset

Half-life

Filter

Scale

Linear **Log**

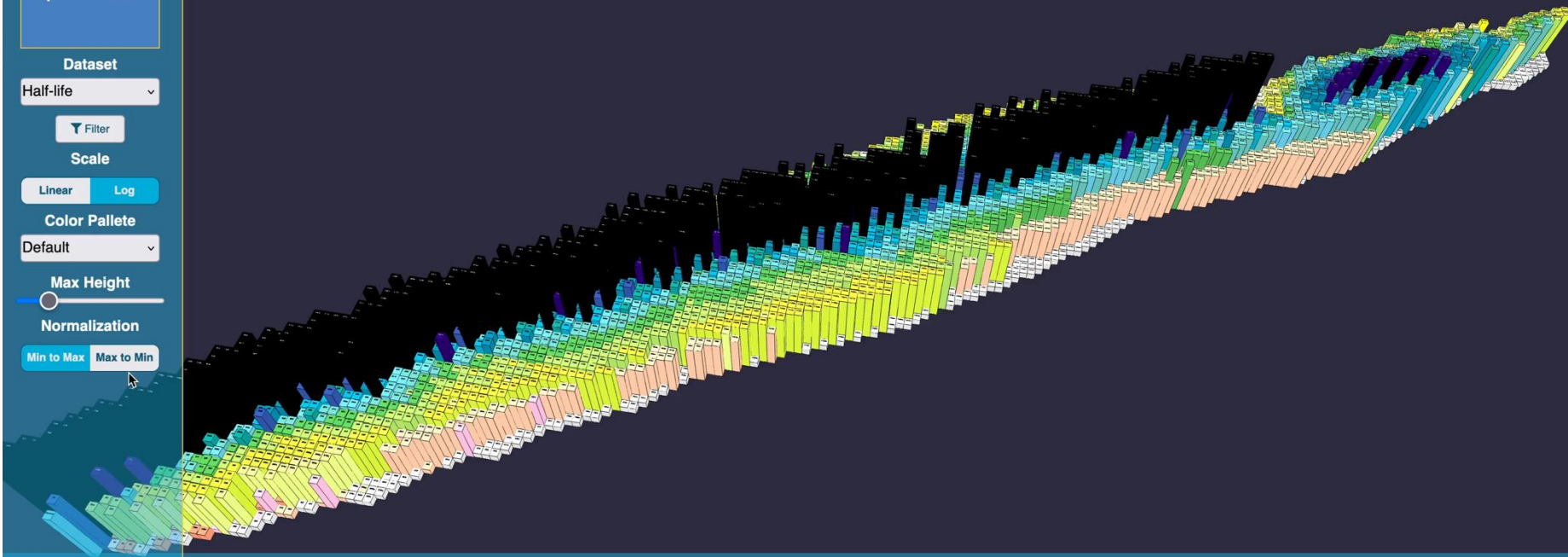
Color Palette

Default

Max Height

Normalization

Min to Max Max to Min



Ground and isomeric state information for $^{148}_{59}\text{Pr}$

E(level) (MeV)	J^π	Mass Excess (keV)	$T_{1/2}$	Decay Modes
0.0	1-	-72535 15	2.29 min 2	$\beta^- = 100.00\%$

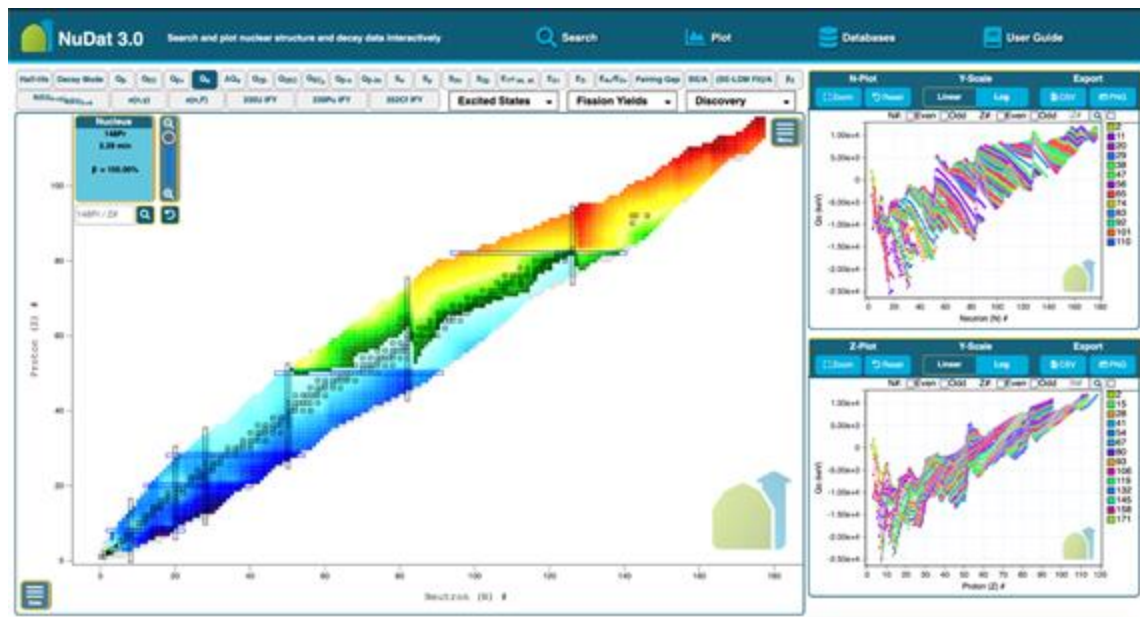
Contact Us

NuDat 3 is available here:
www.nndc.bnl.gov/nudat3/

Improvements based on
community feedback

We encourage you to send us
your feedback and suggestions

Thank you!



Donnie Mason - dmason@bnl.gov