

Bayesian Mass Explorer

2024 BAND/Data Workshop



Kyle Godbey
Facility for Rare Isotope Beams

Play along at <https://bmex.dev>

<https://docs.google.com/presentation/d/1QYklz-Hzf44-v9DNRQaUWt4nN7UNK86LObqjQ2odeu4/edit?usp=sharing>

BMEX Project Goal #1



Build an accessible science gateway
for nuclear properties and quantified
theoretical model predictions

BMEX Project Goal #2



Provide an intuitive interface for researchers to perform simple calculations in the cloud

BMEX at v1.0.0



We've built and shipped a useful piece of research software with a broad target audience

BMEX at v1.0.0

1

2

3

+

Dimension:

1D Chains

1D Chain:

Isotonic Chain

Select Quantity:

Single-Proton Energy Splitting

$$\Delta\epsilon_p(N,Z) = S_p(N,Z) - S_p(N,Z+2)$$

N=60 | AME2020

N=60 | UNEDF1

N=60 | SV

N=60 | HFB24

N=60 | FRDM12

+

Neutrons:

60

Select Dataset:

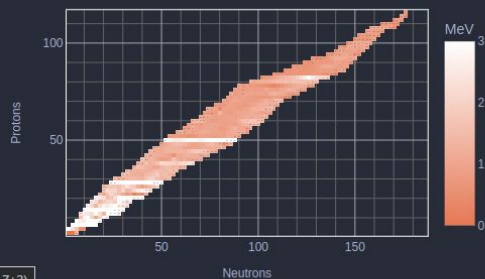
FRDM12

Wigner Adjustment:

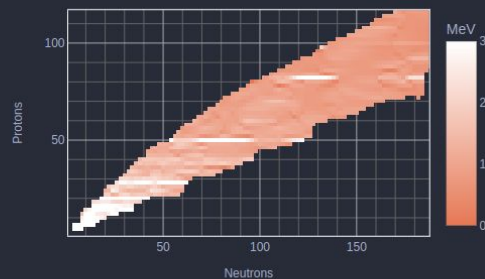
None

DELETE SERIES

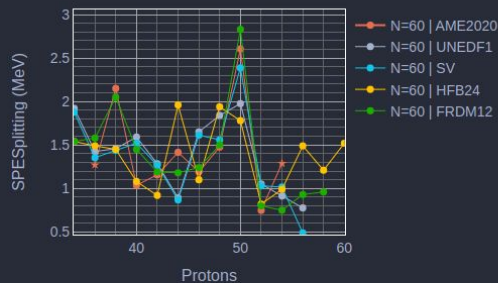
Single Proton Energy Splitting | AME2020



Single Proton Energy Splitting | UNEDF1



Isotonic Chain



Share View



EXPORT PUB. PDFS

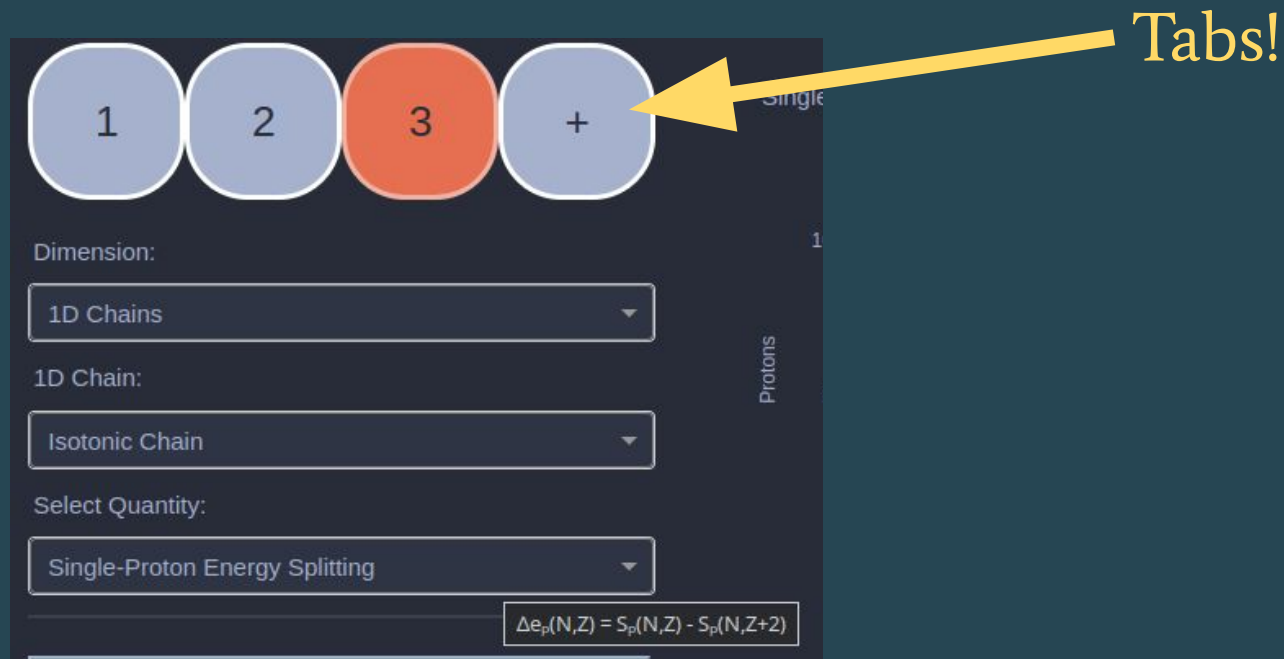
LINK VIEWS

☒ 1 ☒ 2 ☒ 3☒ Even-Even Nuclei

RESCALE COLORBAR

RESET PAGE

BMEX at v1.0.0



The image shows a software interface for BMEX v1.0.0. At the top, there are four rounded square tabs labeled '1', '2', '3', and '+'. Tab '3' is highlighted in orange, while the others are light blue. A yellow arrow points from the text 'Tabs!' to the '+' tab. Below the tabs, there are three dropdown menus: 'Dimension:' set to '1D Chains', '1D Chain:' set to 'Isotonic Chain', and 'Select Quantity:' set to 'Single-Proton Energy Splitting'. To the right of these menus, the word 'Protons' is written vertically. At the bottom right, a box contains the equation $\Delta e_p(N,Z) = S_p(N,Z) - S_p(N,Z+2)$.

Tabs!

Dimension:

1D Chains

1D Chain:

Isotonic Chain

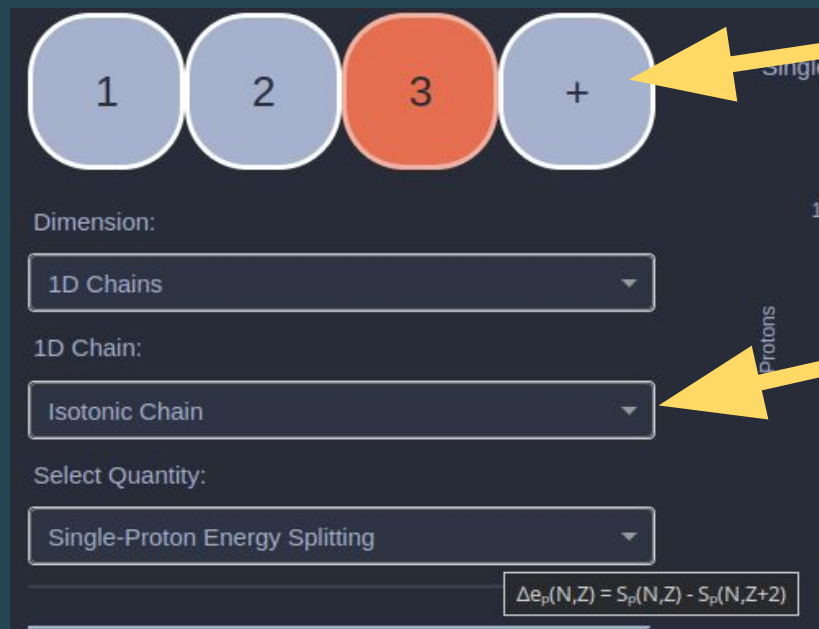
Select Quantity:

Single-Proton Energy Splitting

Protons

$\Delta e_p(N,Z) = S_p(N,Z) - S_p(N,Z+2)$

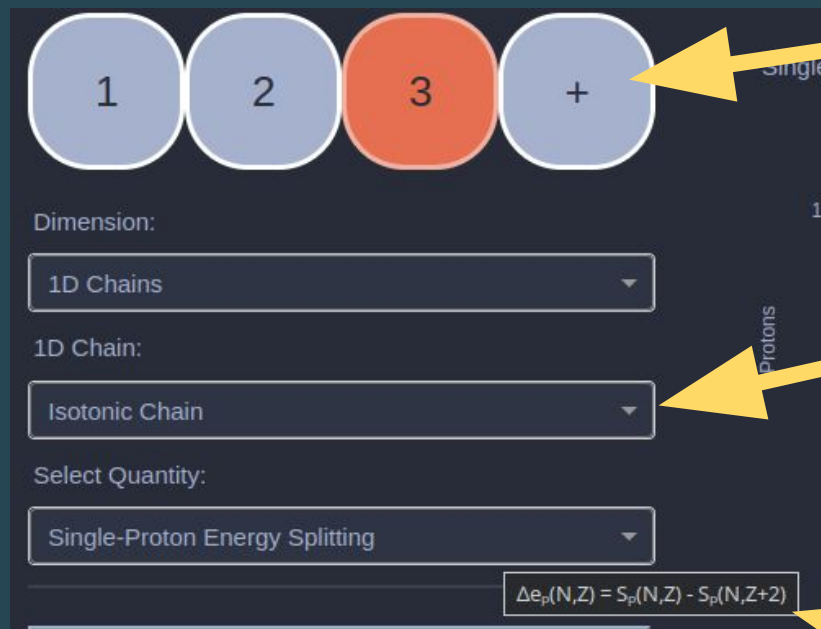
BMEX at v1.0.0



Tabs!

Each plot object is self-contained and is defined independently

BMEX at v1.0.0



Tabs!

Each plot object is self-contained and is defined independently

Hovering tooltips added throughout to provide context and guidance

BMEX at v1.0.0

Multi-series
plots added

| |
|----------------|
| N=60 AME2020 |
| N=60 UNEDF1 |
| N=60 SV |
| N=60 HFB24 |
| N=60 FRDM12 |
| + |

Neutrons:

60

Select Dataset:

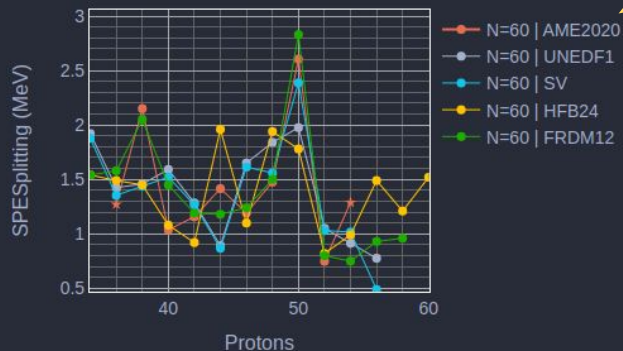
FRDM12

Wigner Adjustment:

None

DELETE SERIES

Isotonic Chain



BMEX at v1.0.0

Multi-series
plots

| |
|----------------|
| N=60 AME2020 |
| N=60 UNEDF1 |
| N=60 SV |
| N=60 HFB24 |
| N=60 FRDM12 |
| + |

Neutrons:

60

Select Dataset:

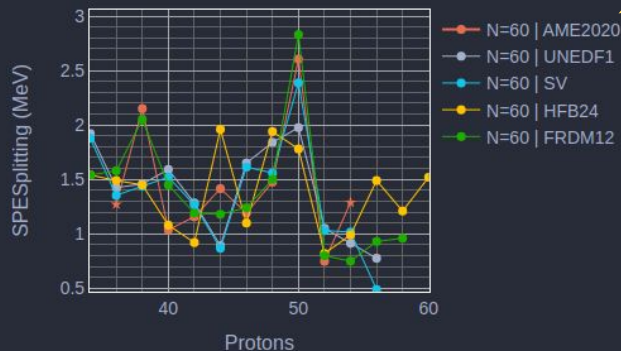
FRDM12

Wigner Adjustment:

None

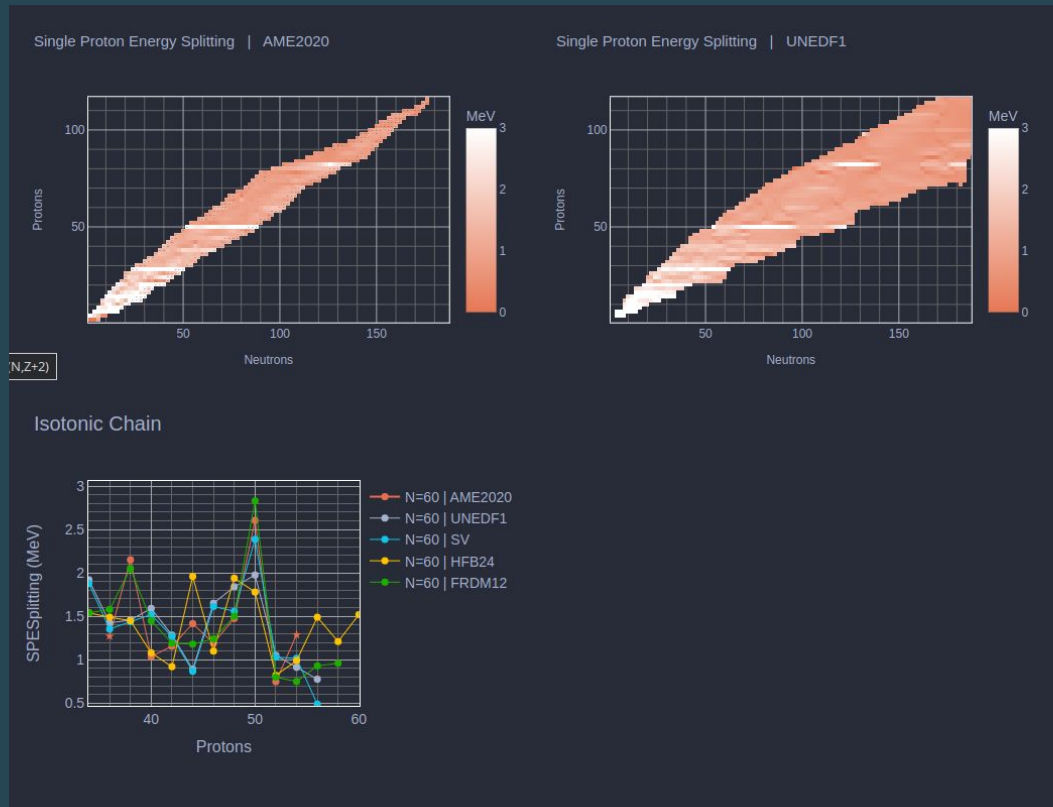
DELETE SERIES

Isotonic Chain



Series and plot
management

BMEX at v1.0.0



Responsive grid view added to better adapt to user devices' screen sizes

BMEX at v1.0.0

Database-backed sharing
functionality implemented
to save user state



Share View



EXPORT PUB. PDFS

LINK VIEWS

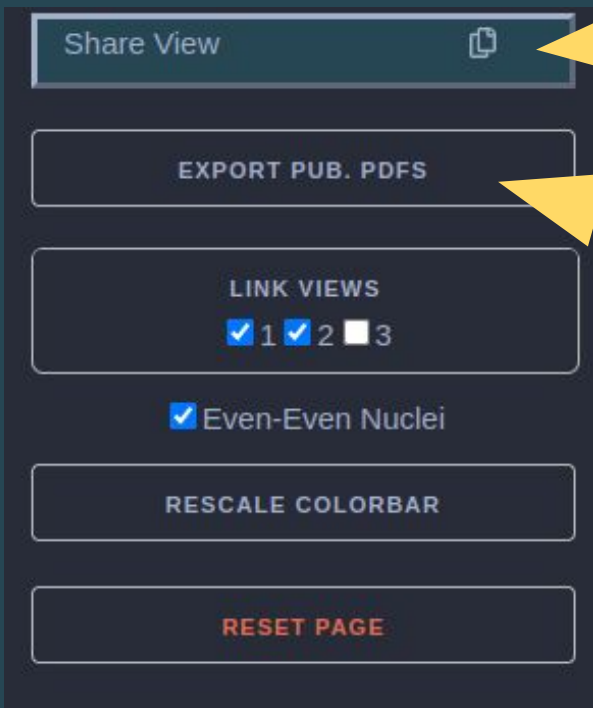
☒ 1 ☒ 2 ☐ 3

☒ Even-Even Nuclei

RESCALE COLORBAR

RESET PAGE

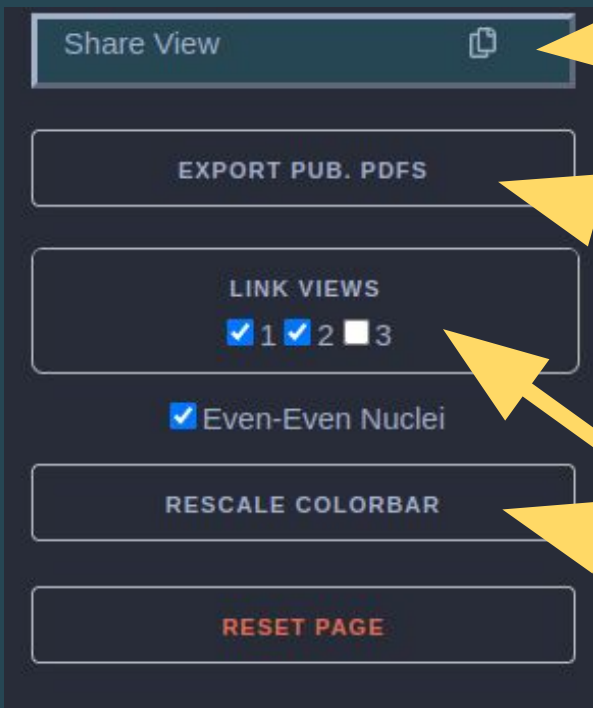
BMEX at v1.0.0



Database-backed sharing
functionality implemented
to save user state

PDF output for current
plots in view

BMEX at v1.0.0



Database-backed sharing functionality implemented to save user state

PDF output for current plots in view

Set of global plotting toggles for managing plot views and scales

BMEX at v1.0.0

Share View



EXPORT PUB. PDFS

LINK VIEWS

☒ 1 ☒ 2 ☐ 3

☒ Even-Even Nuclei

RESCALE COLORBAR

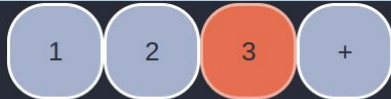
RESET PAGE

Database-backed sharing functionality implemented to save user state

PDF output for current plots in view

Set of global plotting toggles for managing plot views and scales

Easy to clear the canvas and get a fresh page to work from



Dimension:

1D Chains

1D Chain:

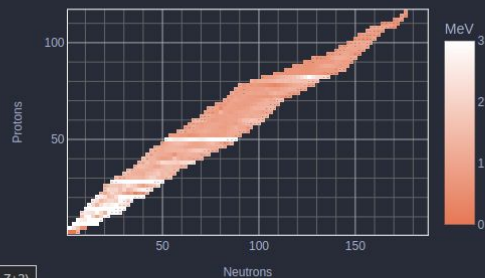
Isotonic Chain

Select Quantity:

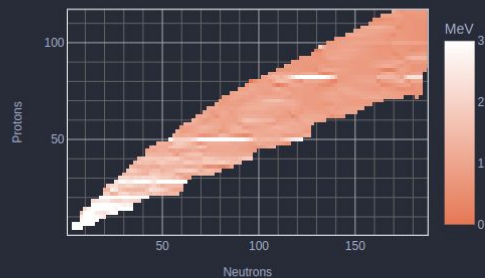
Single-Proton Energy Splitting

$$\Delta e_p(N,Z) = S_p(N,Z) - S_p(N,Z+2)$$

Single Proton Energy Splitting | AME2020



Single Proton Energy Splitting | UNEDF1



Share View



EXPORT PUB, PDFS

LINK VIEWS

☒ 1 ☒ 2 ☐ 3

☒ Even-Even Nuclei

RESCALE COLORBAR

RESET PAGE

Isotonic Chain



<https://bmex.dev>

1

2

3

+

Dimension:

1D Chains

1D Chain:

Isotonic Chain

Select Quantity:

Single-Proton Energy Splitting

$$\Delta e_p(N,Z) = S_p(N,Z) - S_p(N,Z+2)$$

N=60 | AME2020

N=60 | UNEDF1

N=60 | SV

N=60 | HFB24

N=60 | FRDM12

+

Neutrons:

60

Select Dataset:

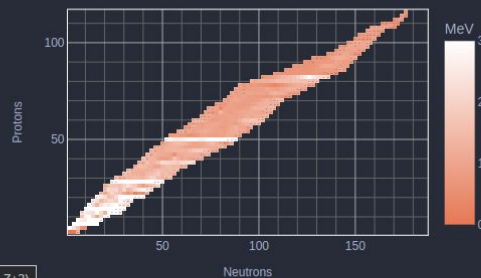
FRDM12

Wigner Adjustment:

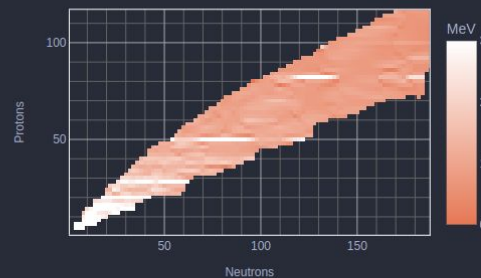
None

DELETE SERIES

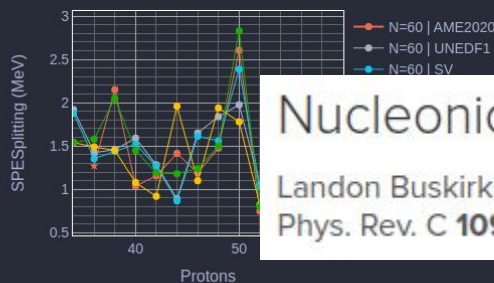
Single Proton Energy Splitting | AME2020



Single Proton Energy Splitting | UNEDF1



Isotonic Chain



Nucleonic shells and nuclear masses

Landon Buskirk, Kyle Godbey, Witold Nazarewicz, and Wojciech Satulà
Phys. Rev. C **109**, 044311 – Published 5 April 2024

Share View

EXPORT PUB. PDFS

LINK VIEWS

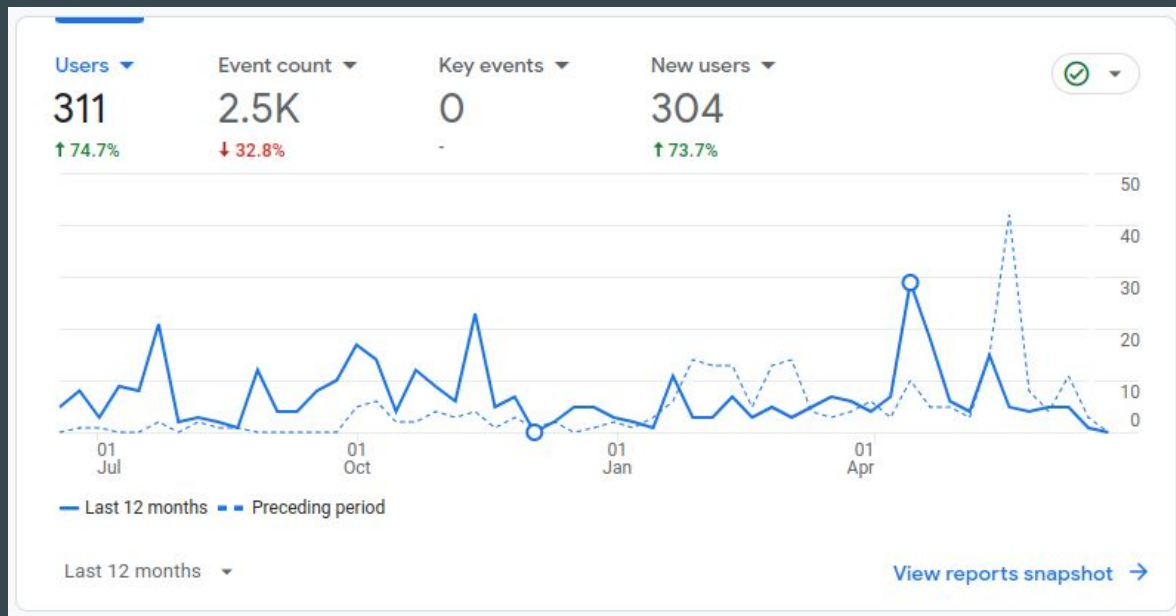
☒ 1 ☒ 2 ☐ 3

☒ Even-Even Nuclei

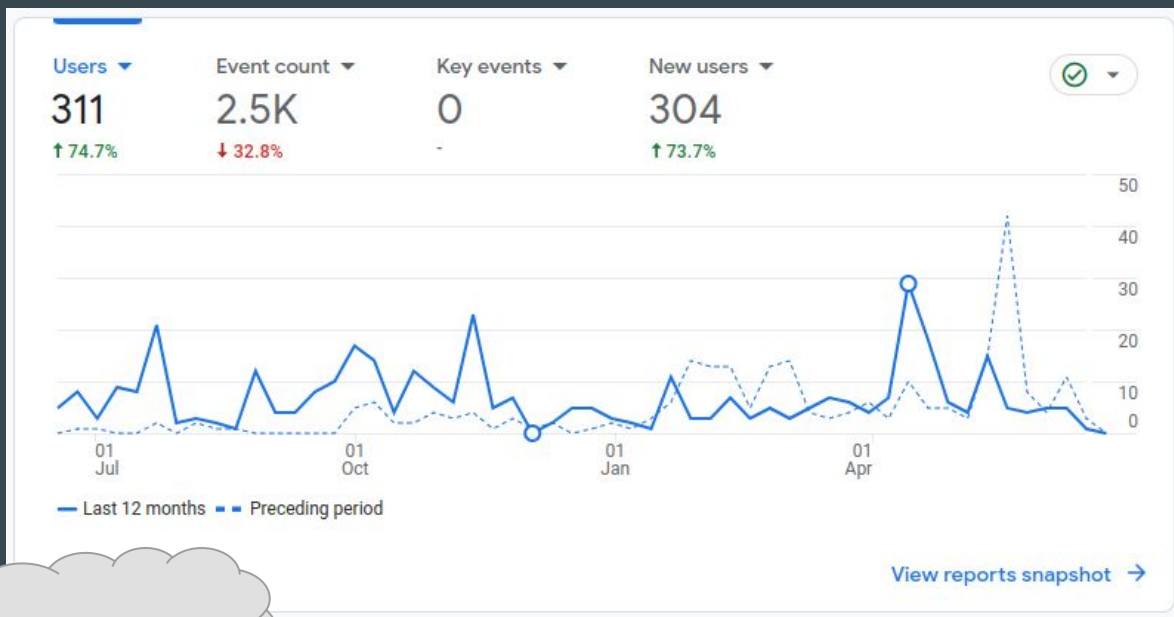
RESCALE COLORBAR

RESET PAGE

<https://bmex.dev>



<https://bmex.dev>



Concern

How do we make this sustainable and enable future growth?

<https://bmex.dev>

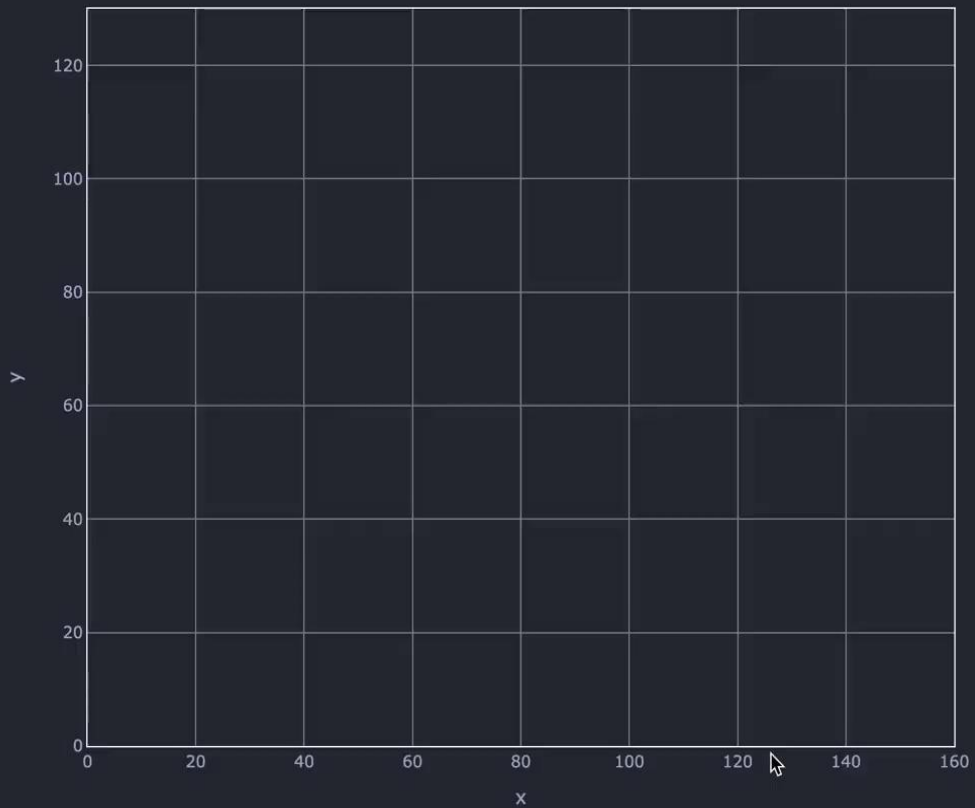
Vision for the Future

- 1) Explore new user interaction paradigms and streamline delivery of useful data for downstream applications
- 2) Develop similar gateways for new types of data (including multimodal sources)

FIT

CLEAR

| | x | y | δy |
|---|---|---|------------|
| x | | | |



The Level Density Project

Search Criteria:

Enter Proton Number

Enter Mass Number

Filter by method:

☐ Evaporation ☐ Oslo ☐ Ericson

☐ Inverse Oslo ☐ Beta Oslo

Select or type a reaction

| | Isotope | Z | A | E _{min} | E _{max} | Method | Reaction | Reference |
|--------------------------|---------|----|----|------------------|------------------|---------|----------|---|
| <input type="checkbox"/> | 25Mg | 12 | 25 | 14 | 20 | Ericson | p,t; d,d | Carlson and Barschall, Phys. Rev. 158, 1967 |
| <input type="checkbox"/> | 28Al | 13 | 28 | 13 | 16 | Ericson | p,t; d,d | Carlson and Barschall, Phys. Rev. 158, 1967 |
| <input type="checkbox"/> | 28Al | 13 | 28 | 12 | 18 | Ericson | n,g | DOI:10.1103/PhysRevC.47.1033. |
| <input type="checkbox"/> | 29Si | 14 | 29 | 15 | 20 | Ericson | p,t; d,d | Carlson and Barschall, Phys. Rev. 158, 1967 |
| <input type="checkbox"/> | 29Si | 14 | 29 | 12.5 | 21 | Ericson | n,g | DOI:10.1103/PhysRevC.47.1033. |
| <input type="checkbox"/> | 32P | 15 | 32 | 9.5 | 17 | Ericson | n,g | Phys. Rev. C 62, 064312 (2000) |
| <input type="checkbox"/> | 33S | 16 | 33 | 15 | 19 | Ericson | p,t; d,d | Carlson and Barschall, Phys. Rev. 158, 1967 |
| <input type="checkbox"/> | 33S | 16 | 33 | 9 | 17.5 | Ericson | n,g | Phys. Rev. C 62, 064312 (2000) |
| <input type="checkbox"/> | 40K | 19 | 40 | 8.75 | 12 | Ericson | n,g | Phys. Rev. C 62, 064312 (2000) |
| <input type="checkbox"/> | 40K | 19 | 40 | 8.75 | 12 | Ericson | n,g | Phys. Rev. C 62, 064312 (2000) |

<< < 1 / 16 > >>



The underlying platform built for BMEX is flexible
and is currently being used in other projects
<https://nld.ascsn.net>

Main Takeaway

Data stewardship and preservation is a vital component of scientific discovery and any eventual application of that discovery

Theory data should be held to a similar standard and, at the very least, be made easily available