

nuclearmasses.org

free online software system for research in nuclear masses

experimental, evaluated, theoretical mass datasets

visualize

analyze

compare

share

upload

store

merge

modify

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filip kondev
nuclear data program
argonne national lab

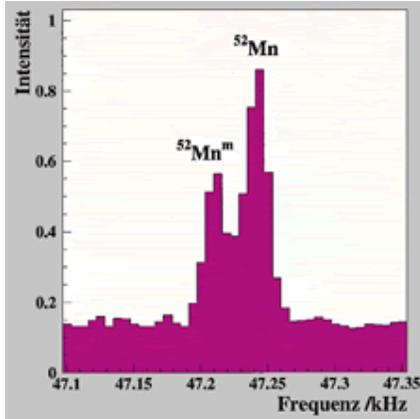
nuclearmasses.org

quick summary

- an online software system for nuclear mass research is freely available at nuclearmasses.org that makes it easy to
 - SHARE** your work with others
 - ACCESS** the work of others
 - VISUALIZE, ANALYZE**, and compare mass datasets
 - and otherwise **supplement** your research

system could provide software support for a new mass evaluation effort

nuclear masses: research activities

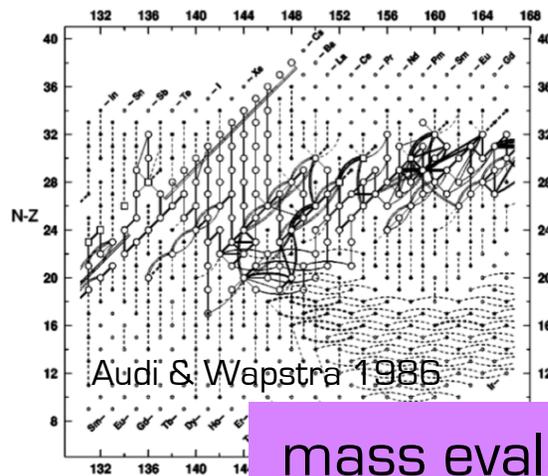


measurements

$$v_{ij} = t_0(1 + x_0 P_\sigma)\delta(\mathbf{r}_{ij}) + t_1(1 + x_1 P_\sigma)\frac{1}{2\hbar^2}\{p_{ij}^2\delta(\mathbf{r}_{ij}) + h.c.\} \\ + t_2(1 + x_2 P_\sigma)\frac{1}{\hbar^2}\mathbf{p}_{ij}\cdot\delta(\mathbf{r}_{ij})\mathbf{p}_{ij} + \frac{1}{6}t_3(1 + x_3 P_\sigma)\rho^\gamma\delta(\mathbf{r}_{ij}) \\ + \frac{i}{\hbar^2}W_0(\sigma_i + \sigma_j)\cdot\mathbf{p}_{ij} \times \delta(\mathbf{r}_{ij})\mathbf{p}_{ij}.$$

Skyrme force (Vautherin & Brink)

theoretical models



mass evaluations

http://amdc.in2p3.fr/masstabes/Ame2003/mass.mas03

bigbangonline.org nucastrodata.org ORNL Physics NASA ADS Google Google Image ORNL Home arXiv.org Yahoo! Apple

MASS LIST
for analysis

1N-Z MASS	N	Z	A	EL	O	MASS EXCESS (keV)	BINDING ENERGY/A (keV)	BETA-DECAY ENERGY (keV)	ATOMIC					
(micro-u)	0	1	1	0	1	n	8071.31710	0.00053	0.0	0.0	B-	782.347	0.001	1
008664.91574	-1	0	1	1	1	H	7288.97050	0.00011	0.0	0.0	B-	*		1
007825.03207	0	0	1	1	2	H	13135.72158	0.00035	1112.283	0.000	B-	*		2
014101.77785	0	1	2	1	3	H	14949.80600	0.00231	2827.266	0.001	B-	18.591	0.001	3

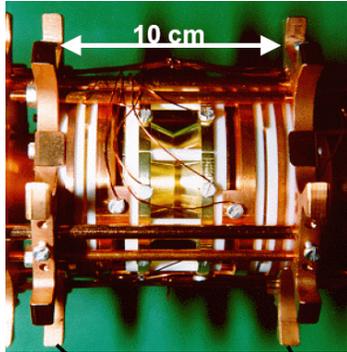
disseminations

researchers in each field have **needs** in

SHARING, COMPARING, ANALYZING, VISUALIZING

datasets of nuclear masses

nuclear mass research needs - measurements

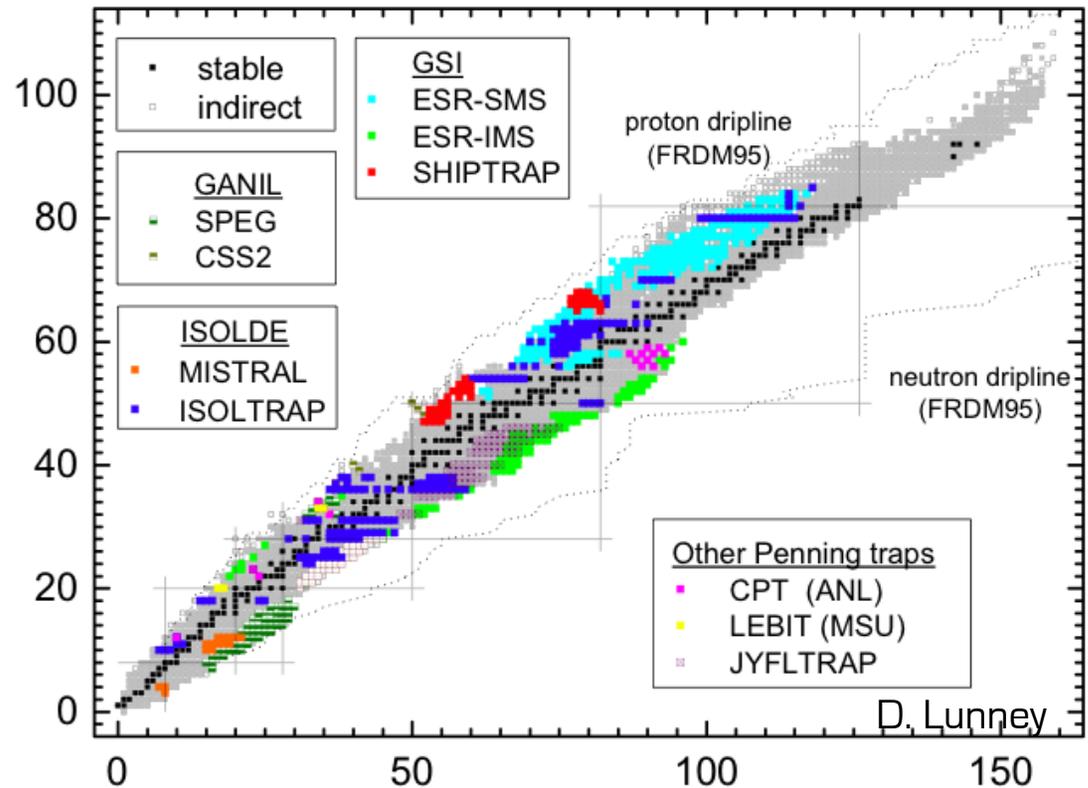


ISOLTRAP

experimentalists

how to quickly **SHARE** your new high-precision measurements with collaborators ?
with evaluators ?
with entire community ?

Z



how to quickly **COMPARE** your latest measurements with other experiments [search for systematic errors] ?
with evaluated masses ?
with theoretical models ?

N

how to ensure that your latest measurements are included in any **new mass evaluation** ? can you upload them yourself ?

nuclear mass research needs - modeling

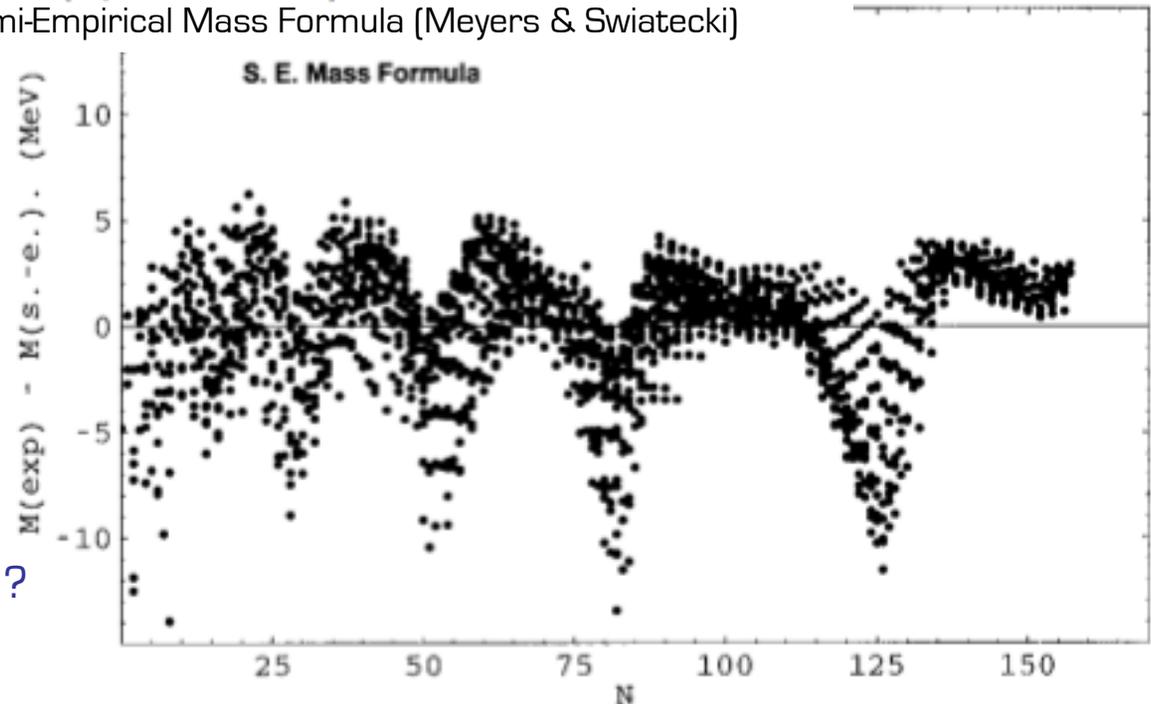
J. M. PEARSON

$$\frac{E_{\text{nuc}}}{A} = a_{\text{vol}} + a_{\text{sf}}A^{-1/3} + \frac{3e^2}{5r_0}Z^2A^{-4/3} + (a_{\text{sym}} + a_{\text{ss}}A^{-1/3})I^2,$$

Semi-Empirical Mass Formula (Meyers & Swiatecki)

theorists

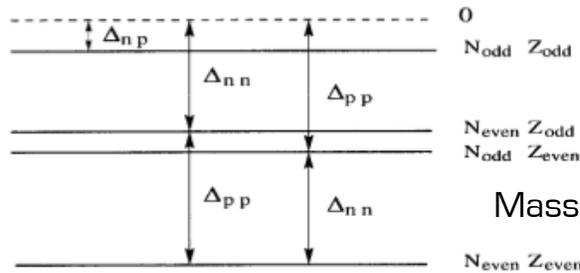
how to quickly **SHARE**
your latest model
with collaborators ?
with entire community ?



how can you *and your colleagues* quickly **COMPARE** your model
with other models ?
with evaluated masses ? **ANALYZE** the RMS deviations ...

how to quickly **VISUALIZE** your model ? and let *others* access & visualize it ...

nuclear mass research needs - evaluations



Mass Surface [Audi 2001]

Figure 5. The surface of masses is split into four sheets. This scheme represents the pairing energies responsible for this splitting. The zero energy surface is a purely hypothetical one for no pairing at all among the last nucleons.

evaluators

how to **STREAMLINE**

some common evaluation tasks ?

can you offload the dissemination /
visualization / information tasks
and focus on evaluations ?

how to **COLLECT** experimental, theoretical, & evaluated masses
in one location ?

how to quickly access, modify, manage, compare, analyze, and visualize
these datasets ? and let your *fellow evaluators* do the same ?

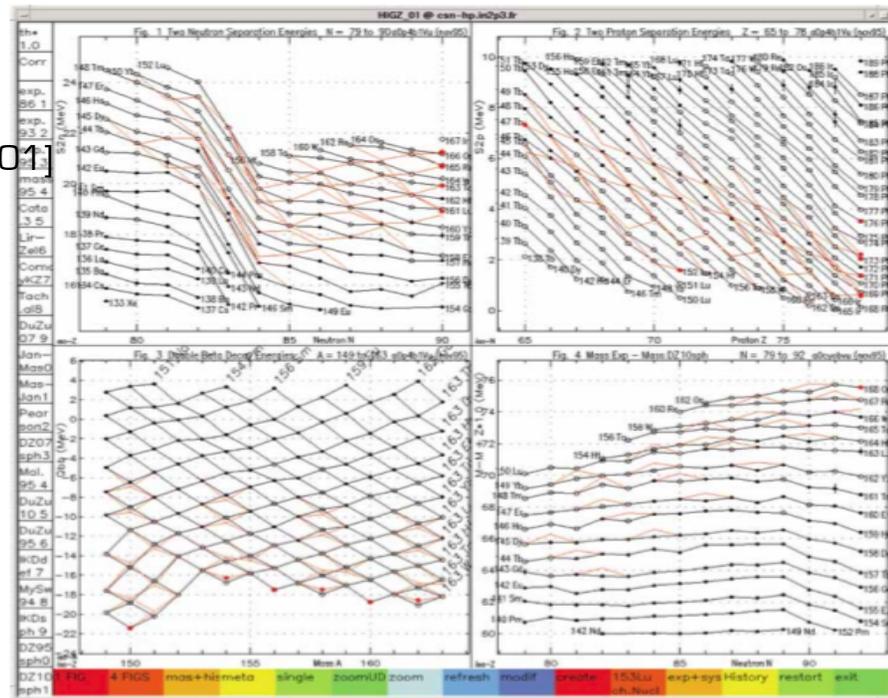


Figure 8. A screen image of DESINT, the interactive graphical display of four cuts in the surface of masses around ^{146}Gd . The four quadrants display respectively $S_{2n}(N)$, $S_{2p}(Z)$, $Q_{2\beta}(A)$ and $(M_{\text{exp}} - M_{\text{Duflot-Zuker}})(N)$ [36]. The lines in black connect nuclides with same Z , N , (Z and N) and Z , respectively. The boxes at left and bottom serve for various interactive commands. The $N = 82$ shell closure is clearly seen in quadrant 1 and in the lower left corner of quadrant 3. The lines in red illustrate the many consequences of an increase of the mass of ^{146}Gd by 500 keV.

nuclear mass research needs - disseminations

1N-Z MASS	N	Z	A	EL	O	MASS EXCESS (keV)	BINDING ENERGY/A (keV)	BETA-DECAY ENERGY (keV)	ATOMIC				
(micro-u)													
0 1 1	1	0	1	n		8071.31710	0.00053	0.0	0.0	B-	782.347	0.001	1
008664.91574				0.00056									
-1 0 1	1	1	H			7288.97050	0.00011	0.0	0.0	B-	*		1
007825.03207				0.00010									
0 0 1 1	1	2	H			13135.72158	0.00035	1112.283	0.000	B-	*		2
014101.77785				0.00036									
0 1 2 1	2	3	H			14949.80600	0.00231	2827.266	0.001	B-	18.591	0.001	3

- current dissemination of mass datasets:
 - some online as **text tables**
 - most are not online at all
- **primitive**: no plotting, no searching, no visualization
- **static**: change in dataset requires new web page; no interaction with users
- **haphazard**: no common format, comprehensive coverage, or regular updates
- **limited**: any analysis/visualization/comparisons must be done after downloading

nuclearmasses.org

all these issues are addressed by *freely available* software system at
nuclearmasses.org

creates an **ONLINE community** for **nuclear mass research**

SHARE *your work with colleagues & community*

upload your latest measurement, model, evaluation ...

ACCESS *the work of others*

browse, visualize, analyze, compare, search, and comment on datasets

CREATE *new datasets*

modify and combine existing sets

many new features being added at request of researchers ...

nuclearmasses.org

all these issues are addressed by *freely available* software system at **nuclearmasses.org**

the key: this can be a **SUPPLEMENT** to your research by

facilitating SHARING and ACCESS to datasets

COLLECTING measurements, models, & evaluations in one location

PROVIDING visualization & analysis tools [if you don't have your own]

facilitating some other important but repetitive tasks

(uploading, dissemination, file management, data modification, biblio...)

could provide software support for a new mass evaluation effort

nuclearmasses.org

all these issues are addressed by *freely available* software system at **nuclearmasses.org**

client - server application using open source approach
foundation: JAVA client, PHP cgi, MySQL database

requirements:

any computer with recent version of JAVA
internet connection

we have 10 man-years experience with client-server applications

- **nucastrodata.org** has users from 60 institutions in 20 countries
- two full time programmers maintain & develop on these systems
- funded by U.S. Nuclear Data Program / U.S. Dept. of Energy
- nuclear mass expertise from H. Koura [JAEA]

nuclearmasses.org – download tool

nuclearmasses.org

welcome

masses

gallery

resources

contributions

meetings

contact

W e l c o m e

nuclearmasses.org was founded to improve the dissemination of nuclear mass information to the nuclear science community.

We have written a suite of easy-to-use client-server applications that enable you to visualize and analyze models of nuclear masses, upload your own mass values, and store and share your results with colleagues.

This site can be an excellent way to inform the community of **your** latest mass models, measurements, and software tools. **Contact us** if you would like to contribute your work, and see our **contributions** page for some examples.

Click on **masses** to begin.

Click on **gallery** to see what is possible.

download the JAVA client application from nuclearmasses.org

nuclearmasses.org – download tool

The image shows a screenshot of the nuclearmasses.org website. The main heading is "nuclearmasses.org" in a large, black, monospace font. Below it is a navigation menu with items: "welcome", "masses", "gallery", "resources", "contributions", and "meetings". The "masses" item is highlighted with a blue bar and a red border. To the right of the menu is a blue box containing the text "nuclear masses" and a list of features: "visualize and analyze nuclear mass models", "compare mass models to evaluated masses", "upload your own mass values", and "store your work and share with colleagues". Below this list is a paragraph about Java requirements and a link to "system requirements for software". At the bottom of the blue box is a red-bordered button labeled "LAUNCH software". A red banner at the bottom of the screenshot contains the text "download the JAVA client application from nuclearmasses.org".

nuclearmasses.org

welcome

masses

gallery

resources

contributions

meetings

nuclear masses

Our free, platform-independent **client-server software suite** will enable you to

- visualize and analyze nuclear mass models
- compare mass models to evaluated masses
- upload your own mass values
- store your work and share with colleagues

You need to have a recent version of JAVA on your computer to run the client application. For more details, please refer to the **system requirements for software**

or write to coordinator@nuclearmasses.org

LAUNCH software

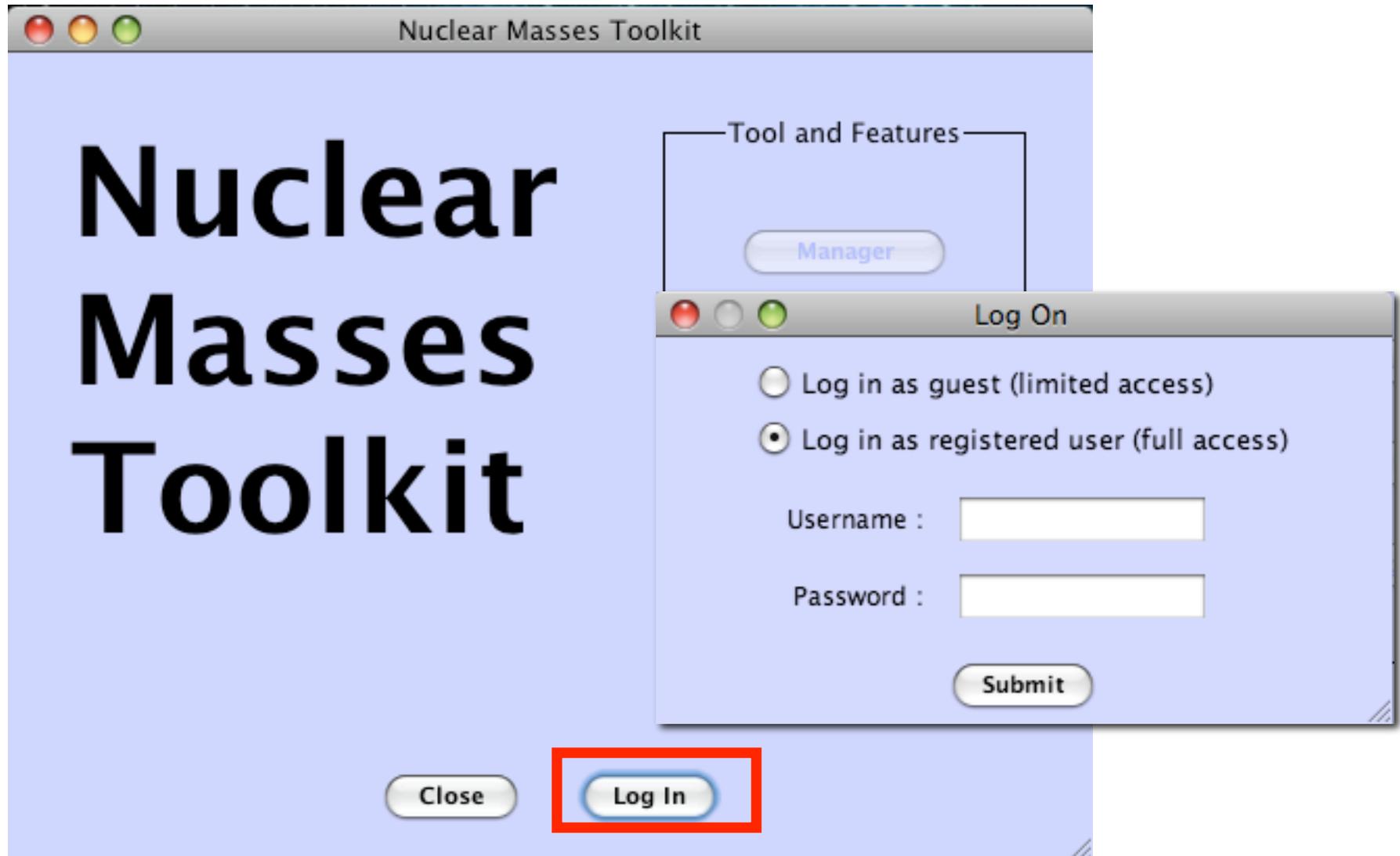
download the JAVA client application from nuclearmasses.org

nuclearmasses.org – log in



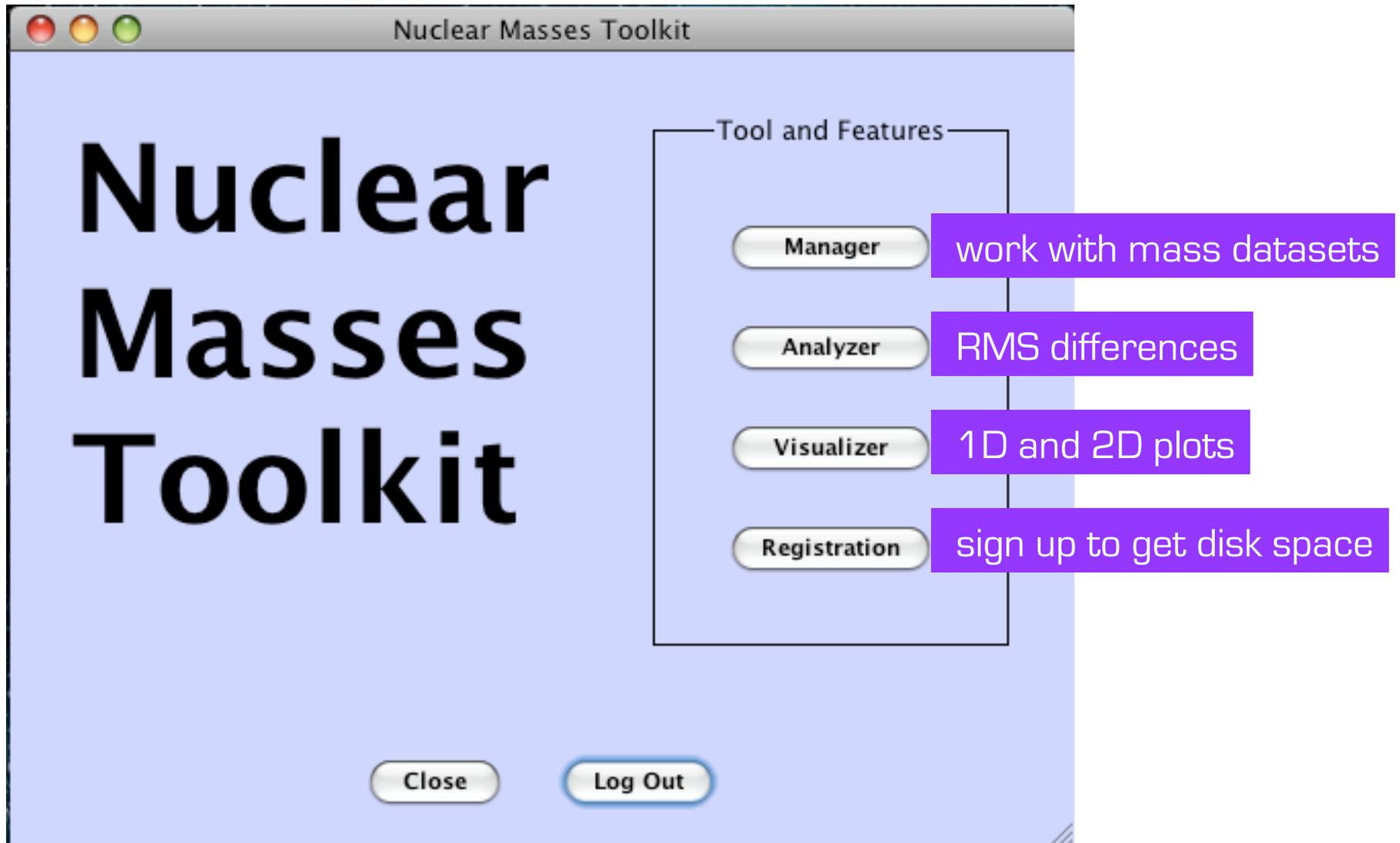
launch the application and log in ... you need an internet connection

nuclearmasses.org – log in



launch the application and log in - *registered users get disk space to save work*

nuclearmasses.org – four sets of tools



choose one of four sets of tools

nuclearmasses.org – dataset manager tools overview

The screenshot shows a web browser window titled "Mass Dataset Manager". On the left, the text "Mass Model Manager" is displayed. The main area contains a list of tools, each with a radio button:

- Upload New Mass Dataset
- Modify Existing Mass Dataset
- Merge Existing Mass Datasets
- Copy Mass Dataset to Shared Folder
- Mass Dataset Information
- Erase Mass Dataset

At the bottom of the list is a "Continue >" button. Purple callout boxes with lines pointing to the tools provide the following descriptions:

- enter your data into the system (points to "Upload New Mass Dataset")
- change some of your data (points to "Modify Existing Mass Dataset")
- combine two or more sets (points to "Merge Existing Mass Datasets")
- SHARE - give others access (points to "Copy Mass Dataset to Shared Folder")
- get information on a dataset (points to "Mass Dataset Information")
- delete one of your sets (points to "Erase Mass Dataset")

work with mass datasets

nuclearmasses.org – mass model analyzer overview

Mass Model Analyzer

Mass Dataset RMS Comparator

Mass Dataset RMS Calculator

Calculate the average RMS deviation of different mass datasets from a reference dataset as **FUNCTIONS** of Z, N, or A for a set of common nuclei.

Callouts:

- Compare RMS deviations of models
- helps you choose a model to use
- Calculate avg RMS values
- functions of Z, N, A

Summary:

- choose to analyze different mass datasets
- two approaches -
 - average the RMS deviation over a common set of nuclei
 - show the RMS deviations as a function of Z, N, or A

[Continue >](#)

nuclearmasses.org – mass model visualizer overview

Mass Dataset Visualizer | Mass Dataset Visualization Tools Step 3 of 3

Selected Reference Mass Dataset : AME2003
Selected Mass Datasets : HFB14

Click the *Open Mass Differences/RMS Plotter (1-D)* button to make 1-D plots of mass excess differences and the RMS values of mass excess differences.

Open Mass Differences/RMS Plotter (1-D)

Click the *Open S_{2n} Plotter (1-D)* button to make 1-D plots of S_{2n} .

Open S_{2n} Plotter (1-D)

Click the *Open Interactive Nuclide Chart (2-D)* button to view 2-D plots of n, 2n, p, 2p, and alpha separation energies and (alpha, n), (alpha, p), and (p, n) Q-values for theoretical and reference mass datasets, as well as the difference and absolute difference of these values.

Open Interactive Nuclide Chart (2-D)

r-Process path from **NUCLEAR PROPERTIES FOR ASTROPHYSICAL AND RADIOACTIVE-ION-BEAM APPLICATIONS** P. MOLLER, J. R. NIX, K. -L. KRATZ, Atomic Data Nuclear Data Tables 66 (1997) 131. using FRDM95 model.

[< Back](#) [Close Mass Dataset Visualizer](#) [Mass Dataset Visualizer Home](#)

1D plots, compare datasets

mass excesses, RMS

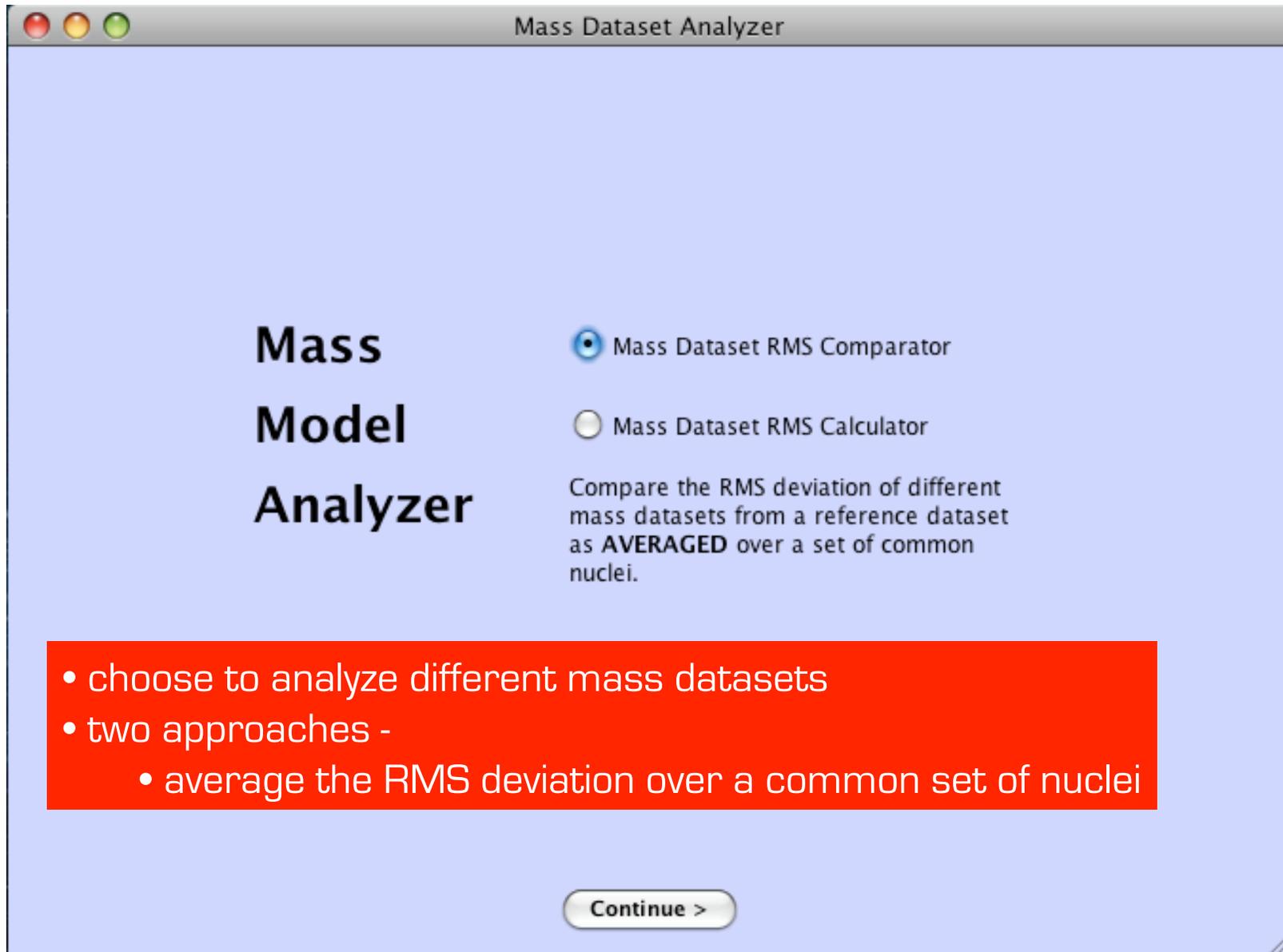
plot 2 neutron separation energies

2D plots, compare datasets

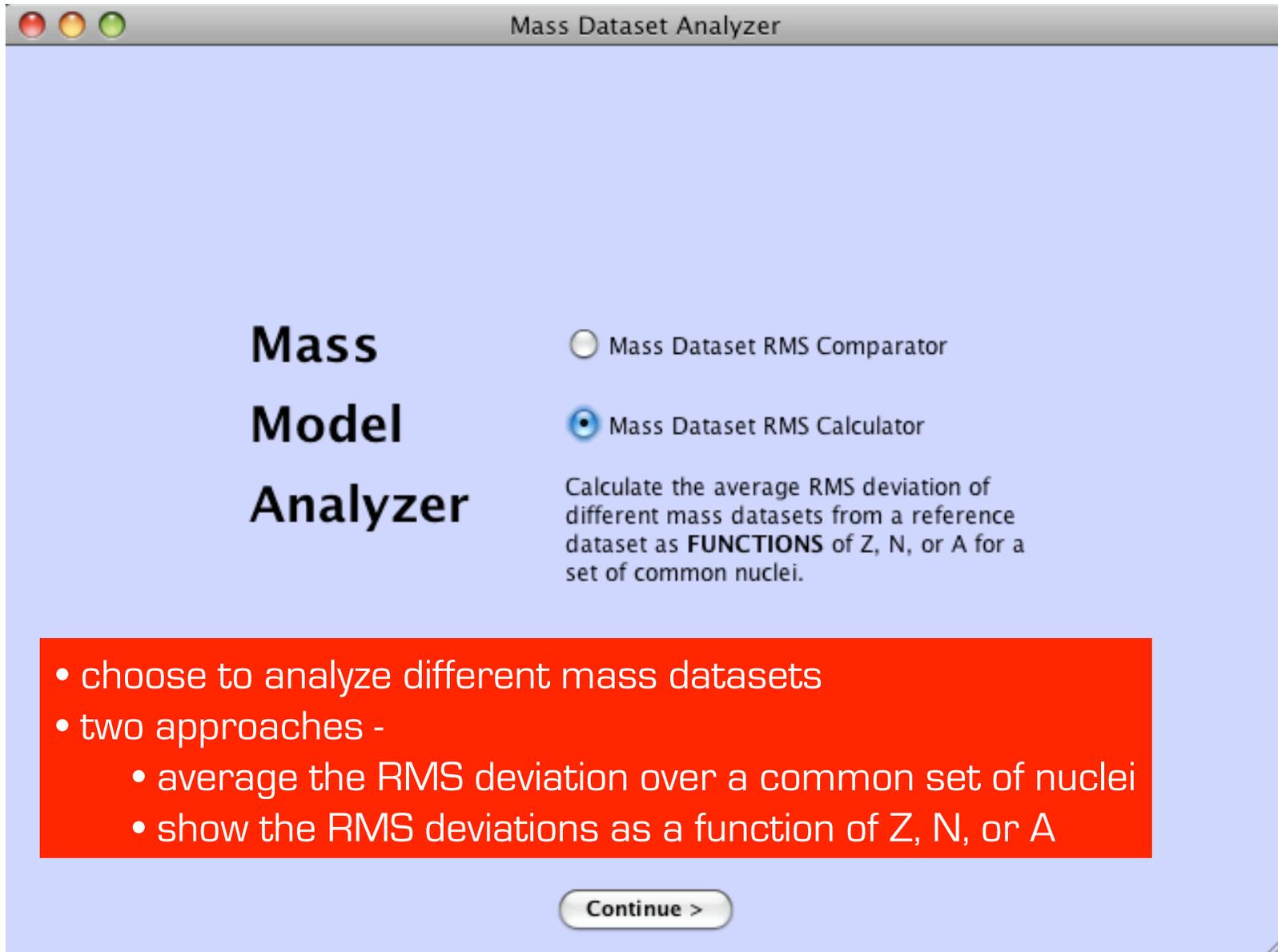
mass excesses, sep energies ...

choose datasets and a reference set to visualize in 1D or 2D plots

nuclearmasses.org: mass model analysis details

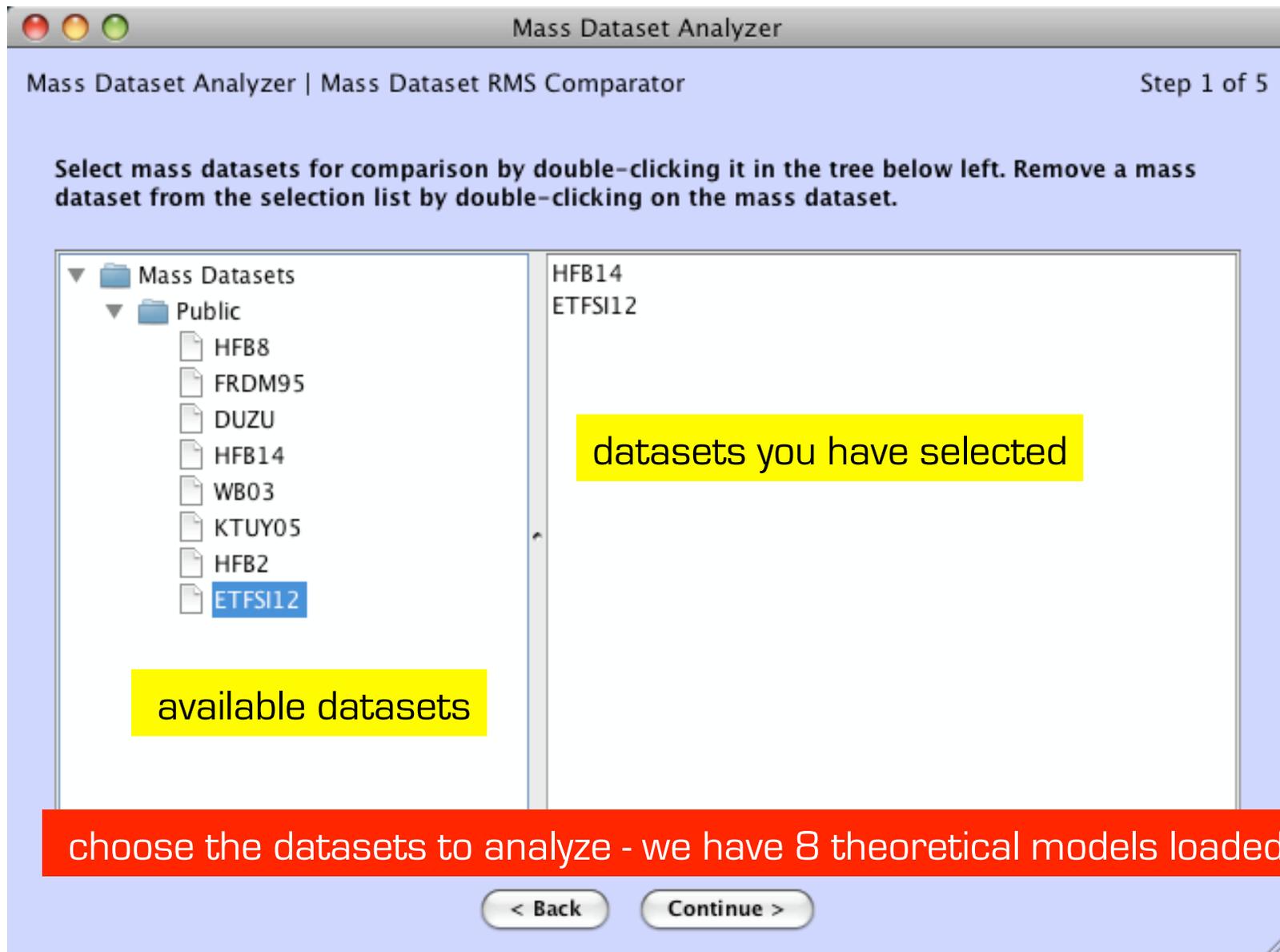


nuclearmasses.org: mass model analysis details

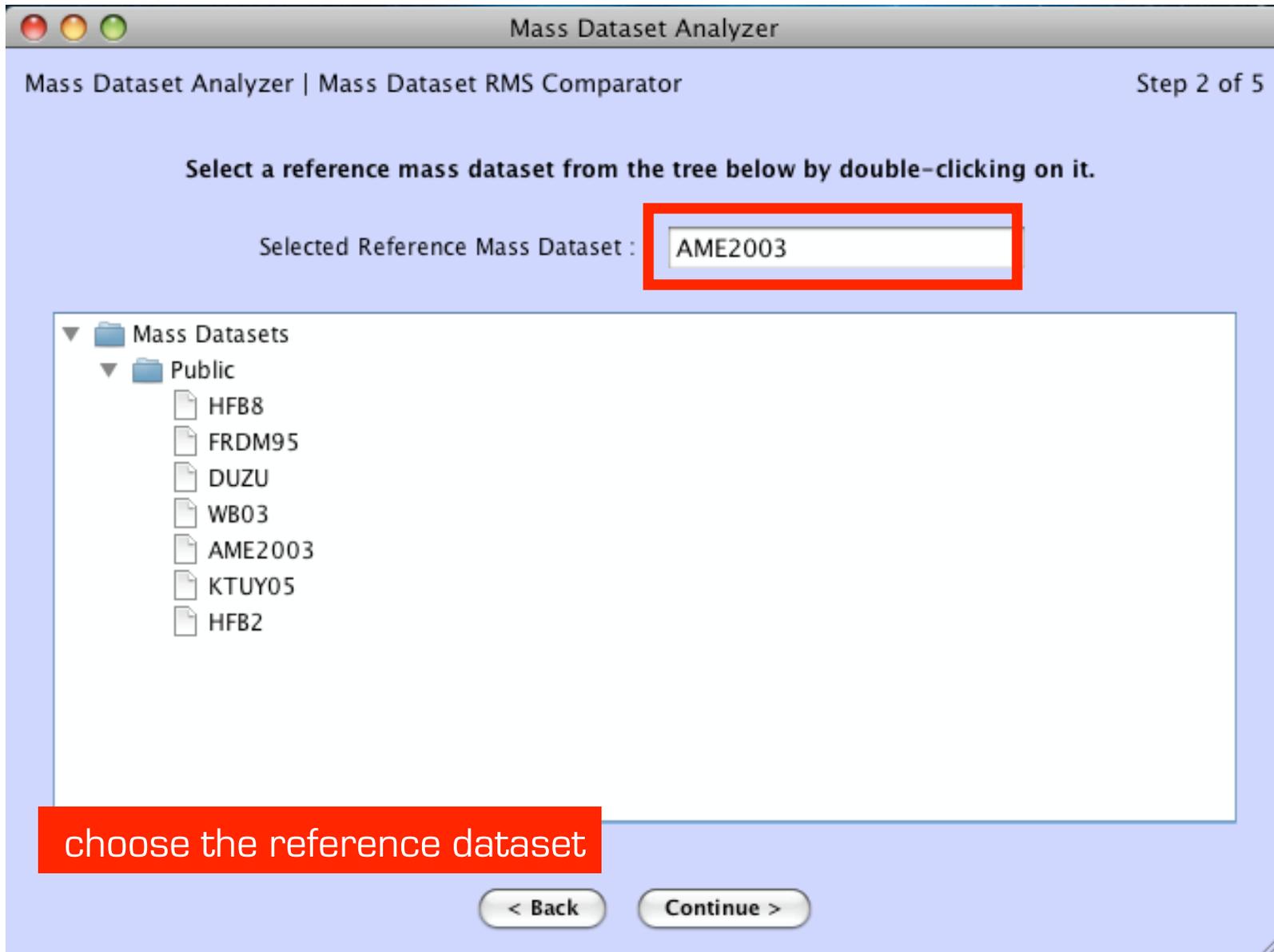


- choose to analyze different mass datasets
- two approaches -
 - average the RMS deviation over a common set of nuclei
 - show the RMS deviations as a function of Z, N, or A

nuclearmasses.org: selecting datasets to analyze



nuclearmasses.org: selecting datasets to analyze



choose the reference dataset

nuclearmasses.org: choose common set of nuclei

Mass Dataset Analyzer | Mass Dataset RMS Comparator Step 3 of 5

Please select and utilize a method for choosing a set of nuclei from the intersection of selected datasets.

All nuclei

Enter minimum and maximum mass values

Enter minimum and maximum Z and N values

Select set from nuclide chart

Minimum Z :

Maximum Z :

Minimum N :

Maximum N :

[Open Nuclide Chart](#)

choose a range of nuclei using one of four approaches

[< Back](#) [Continue >](#)

nuclearmasses.org: RMS averages over common nuclei

Mass Dataset Analyzer | Mass Dataset RMS Comparator Step 5 of 5

Mass Dataset RMS Averages

Reference Mass Dataset	AME2003
Number of Isotopes Used	109
Mass Dataset	RMS Average
ETFSI12	1.0538
HFB14	1.1195

Save as Text File Save as HTML File Copy Print

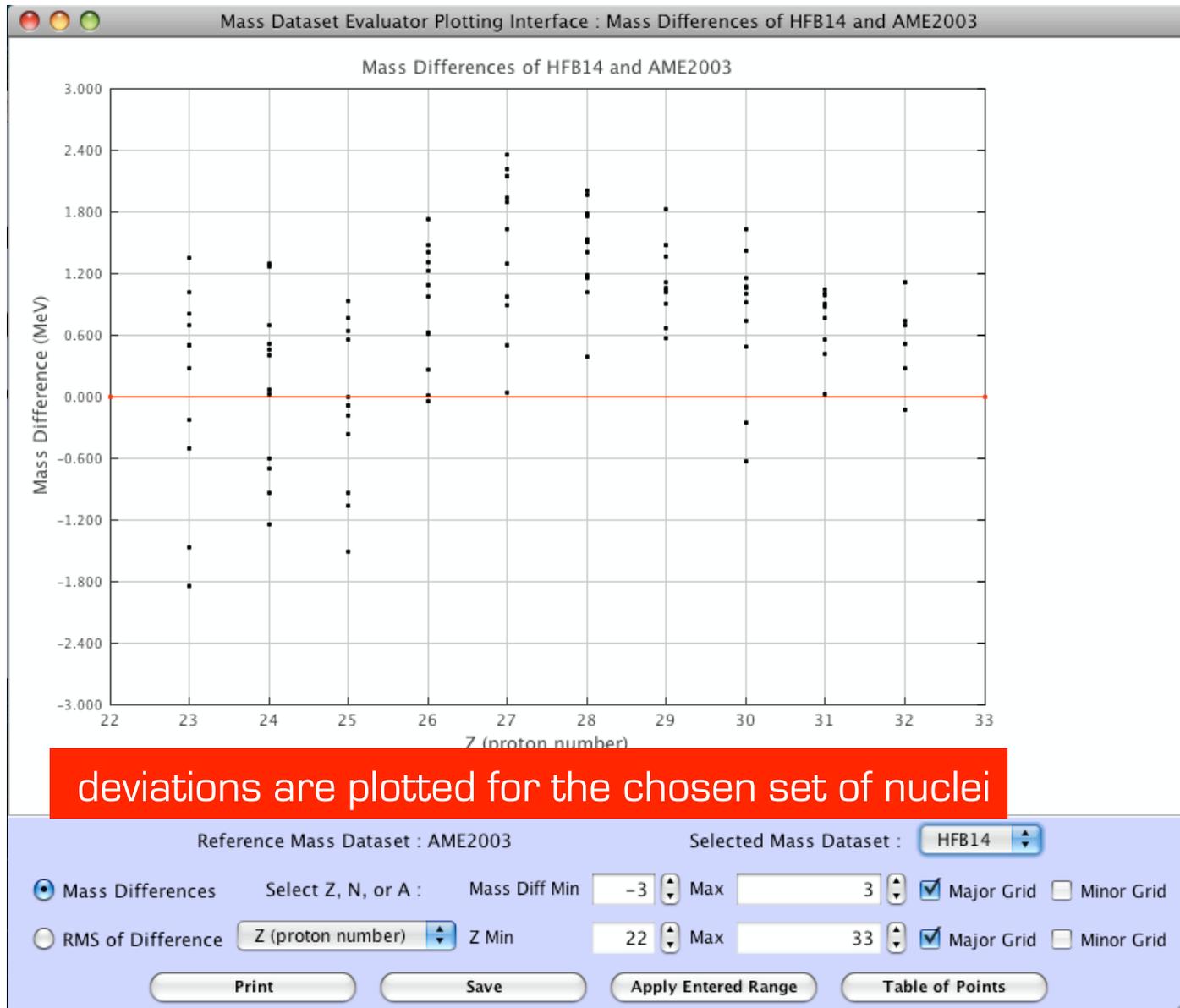
Explore Results in RMS Calculator

Open Mass Datasets in Visualizer

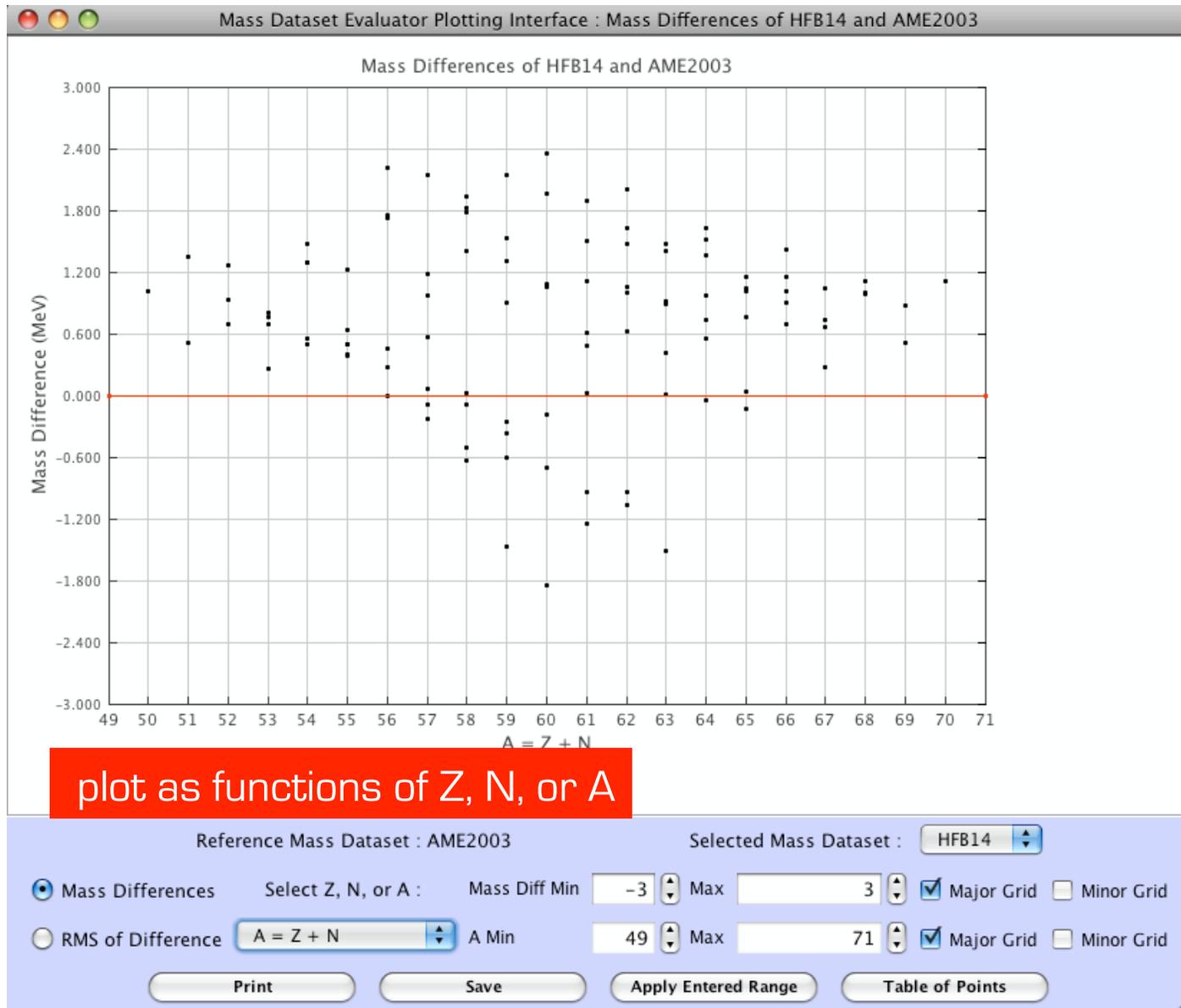
< Back Close Mass Dataset Analyzer Mass Dataset Analyzer Home

for more detail on the RMS averages, examine as function of Z, N, or A

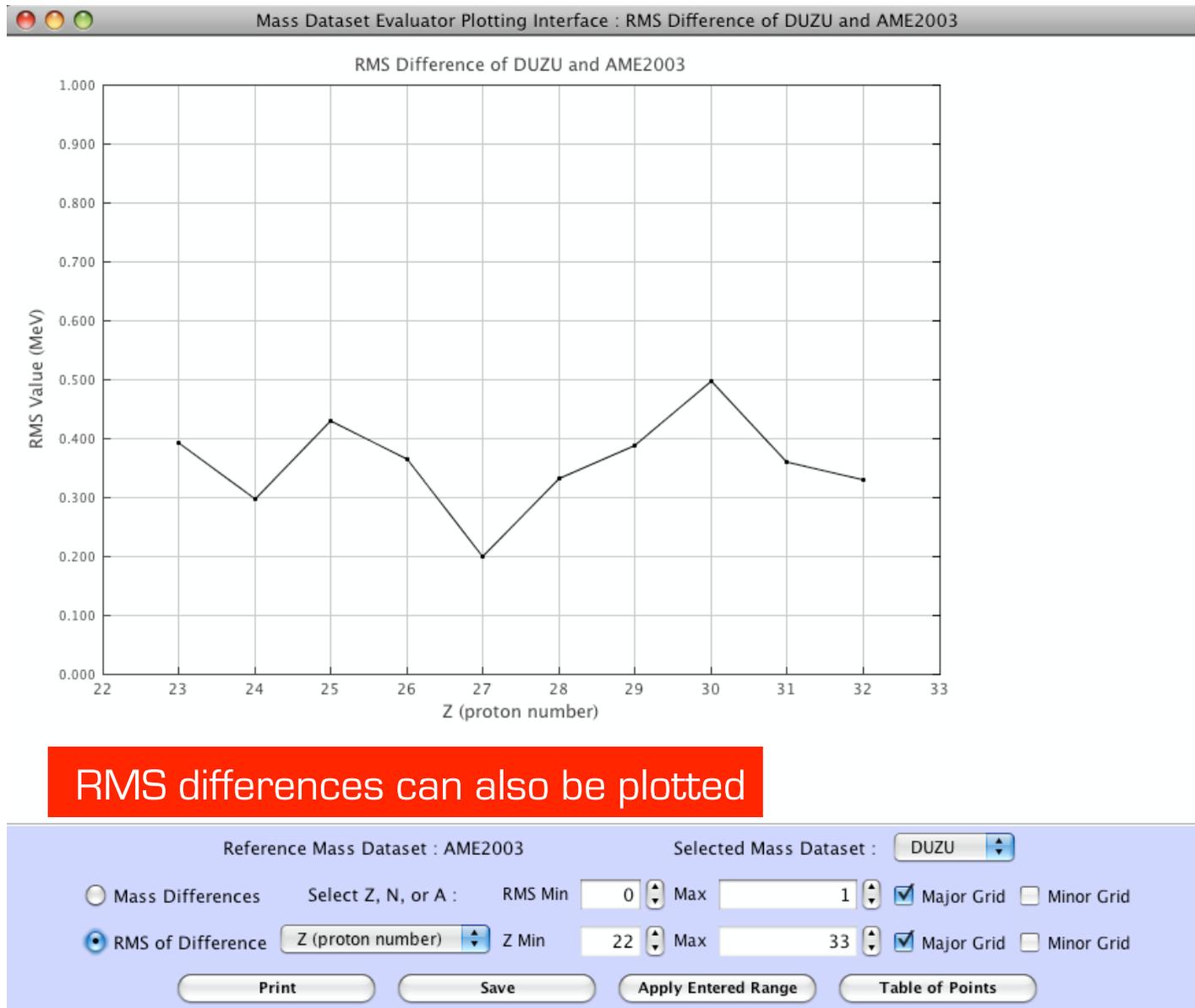
nuclearmasses.org: deviations as function of Z, N, A



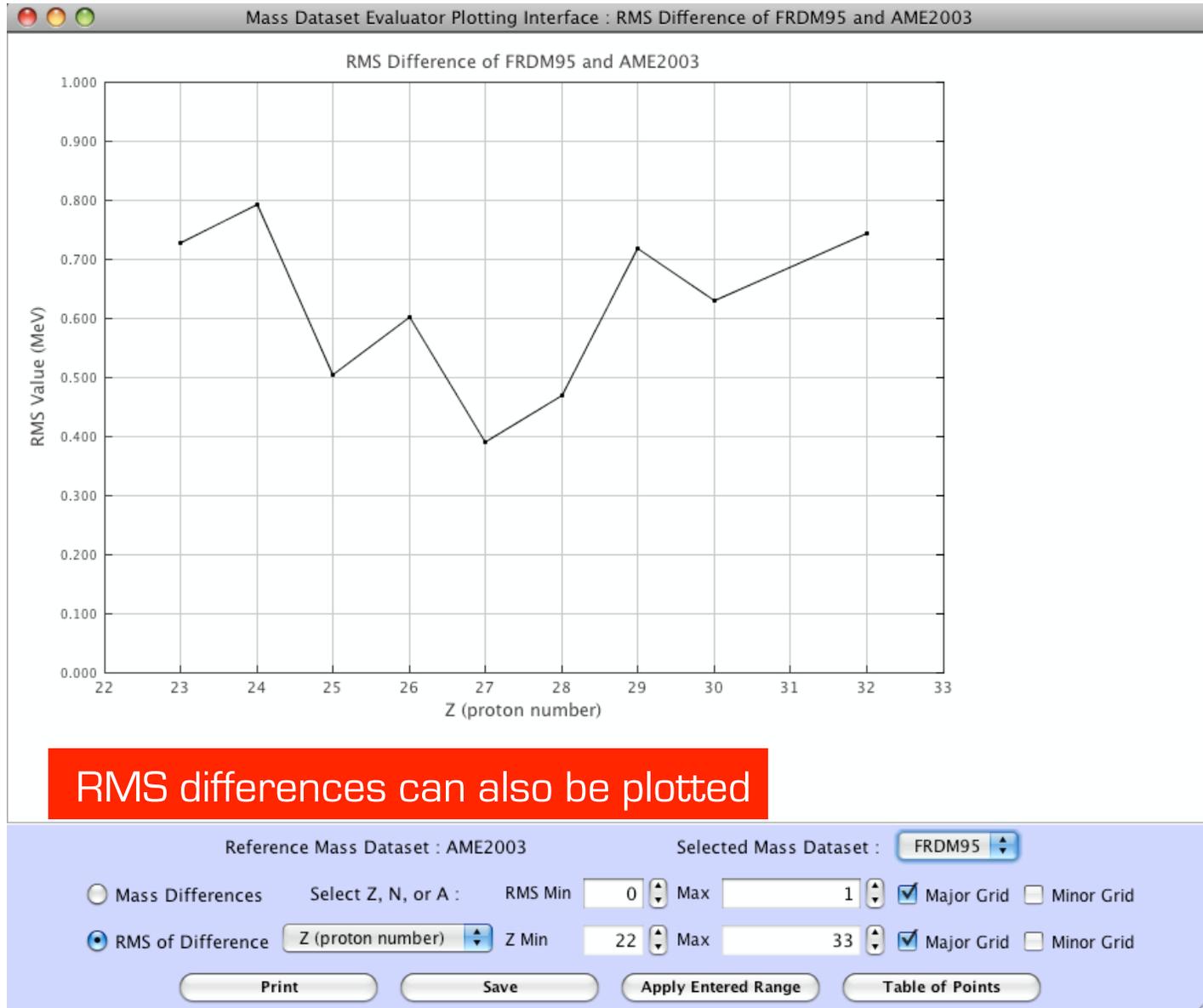
nuclearmasses.org: deviations as function of Z, N, A



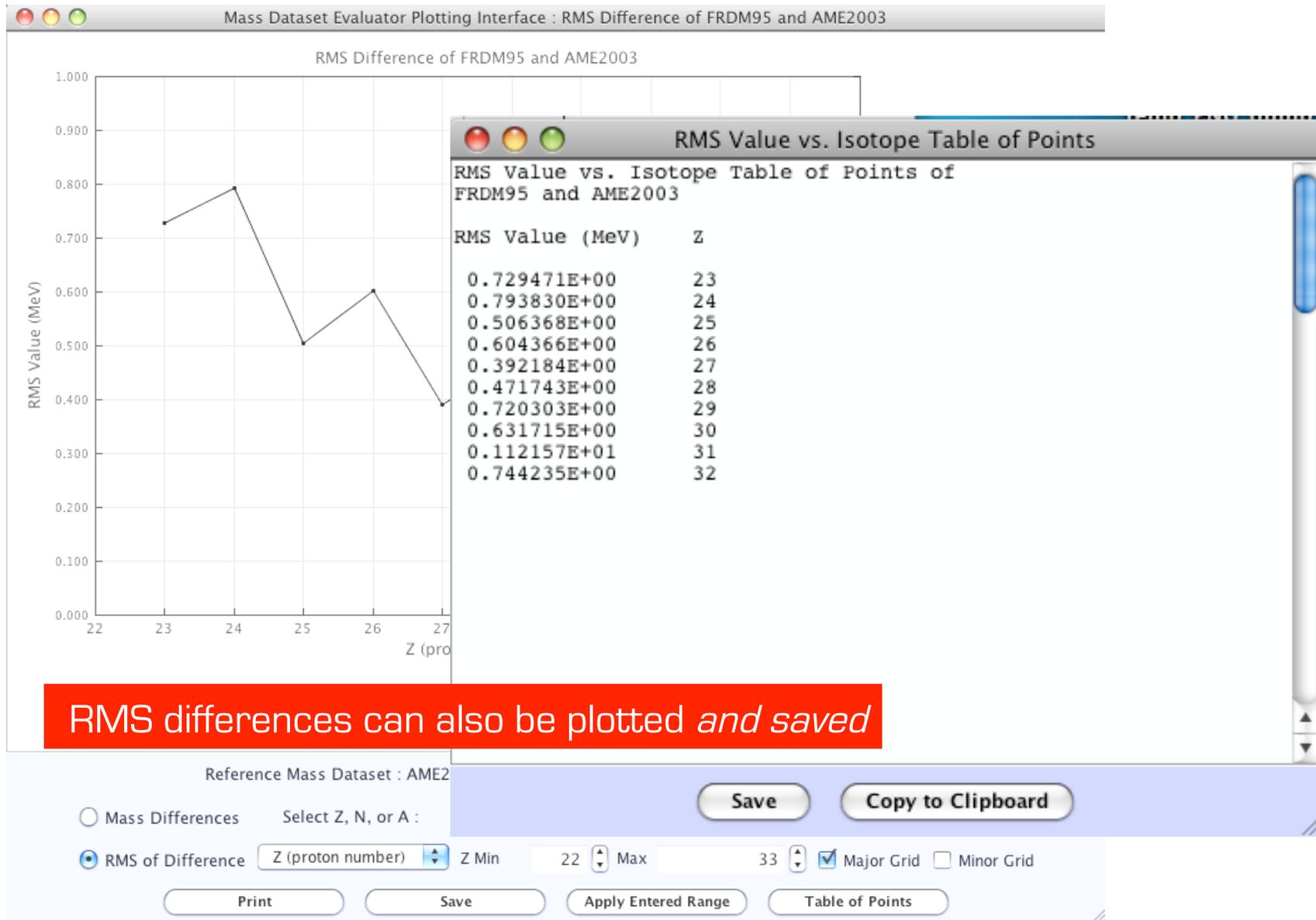
nuclearmasses.org: deviations as function of Z, N, A



nuclearmasses.org: deviations as function of Z, N, A

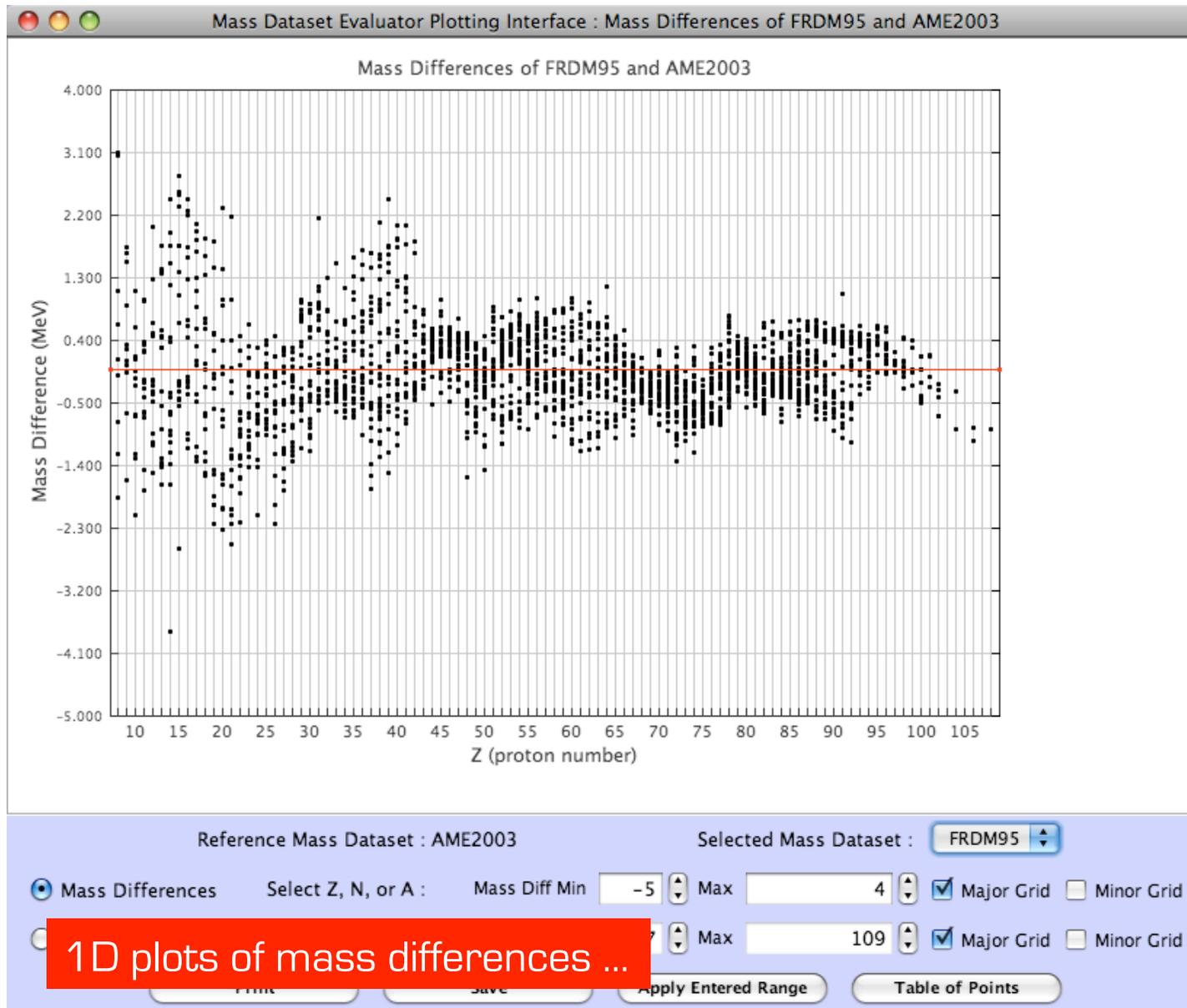


nuclearmasses.org: deviations as function of Z, N, A



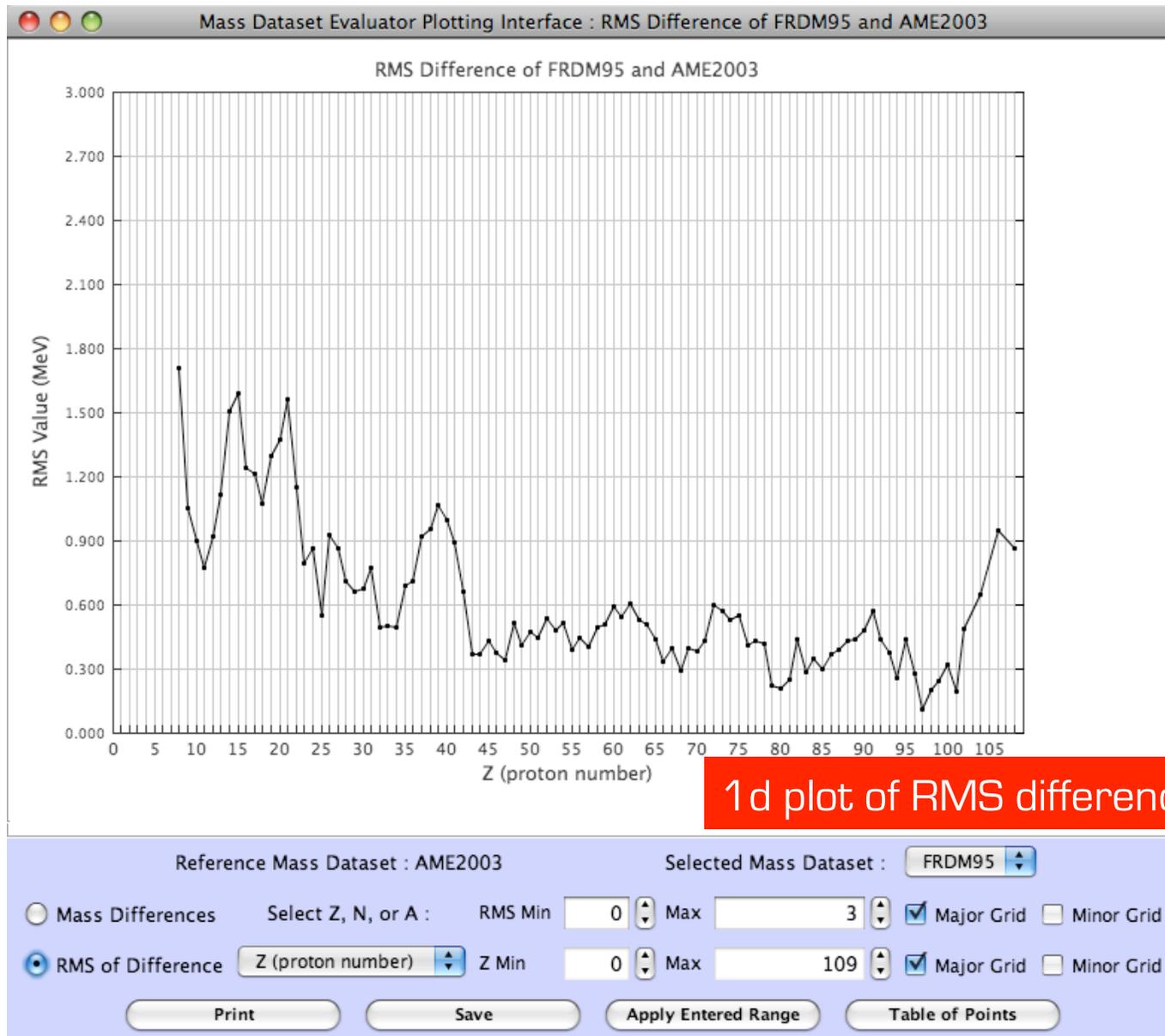
RMS differences can also be plotted *and saved*

nuclearmasses.org: visualization

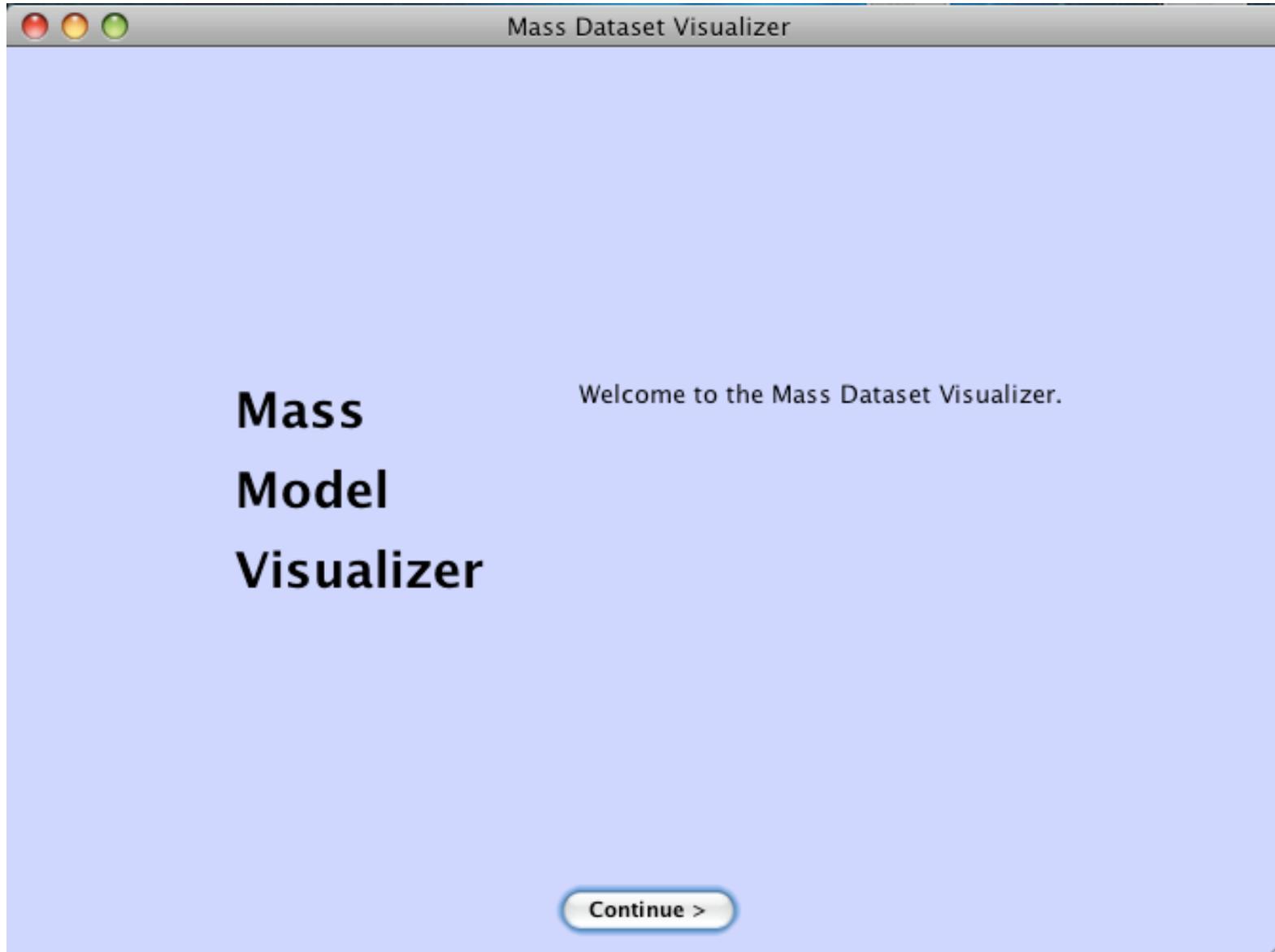


1D plots of mass differences ...

nuclearmasses.org: visualization



nuclearmasses.org: visualization



nuclearmasses.org: visualization

Mass Dataset Visualizer | Mass Dataset Visualization Tools Step 3 of 3

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[Open \$S_{2n}\$ Plotter \(1-D\)](#)

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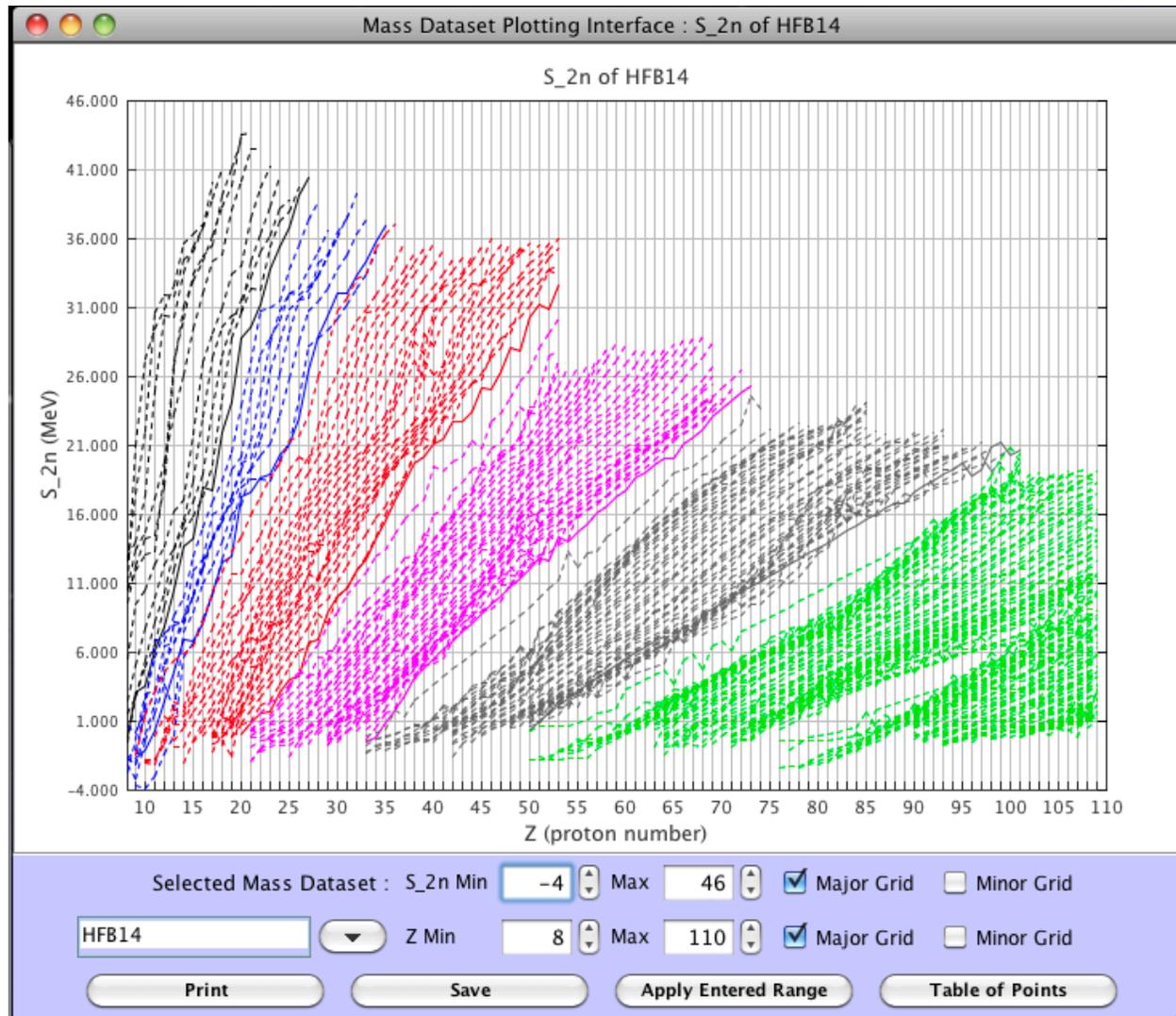
[Open Interactive Nuclide Chart \(2-D\)](#)

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choose datasets and a reference set to visualize in 1D or 2D plots

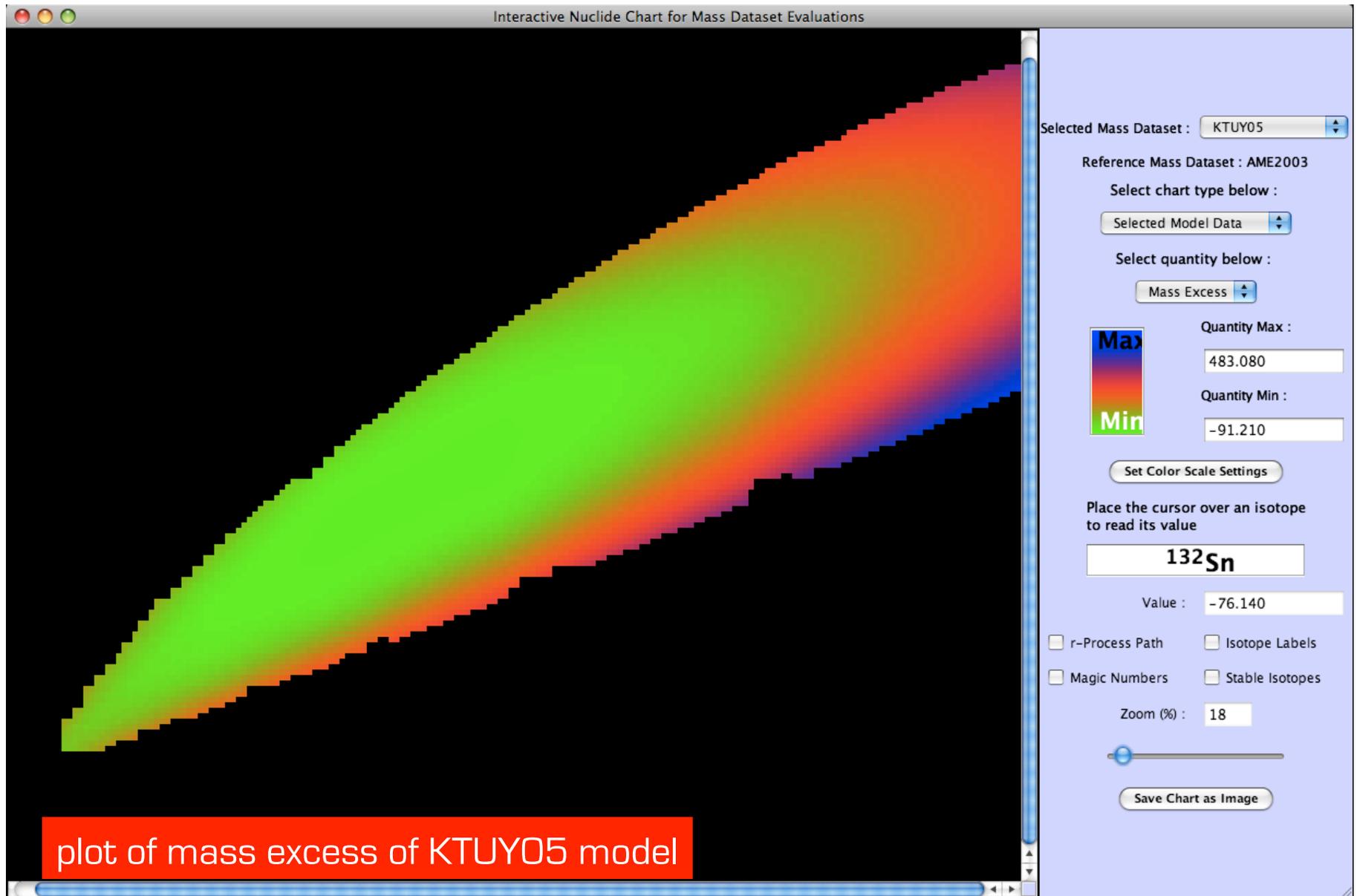
[< Back](#) [Close Mass Dataset Visualizer](#) [Mass Dataset Visualizer Home](#)

nuclearmasses.org: plotting $2n$ separation energies

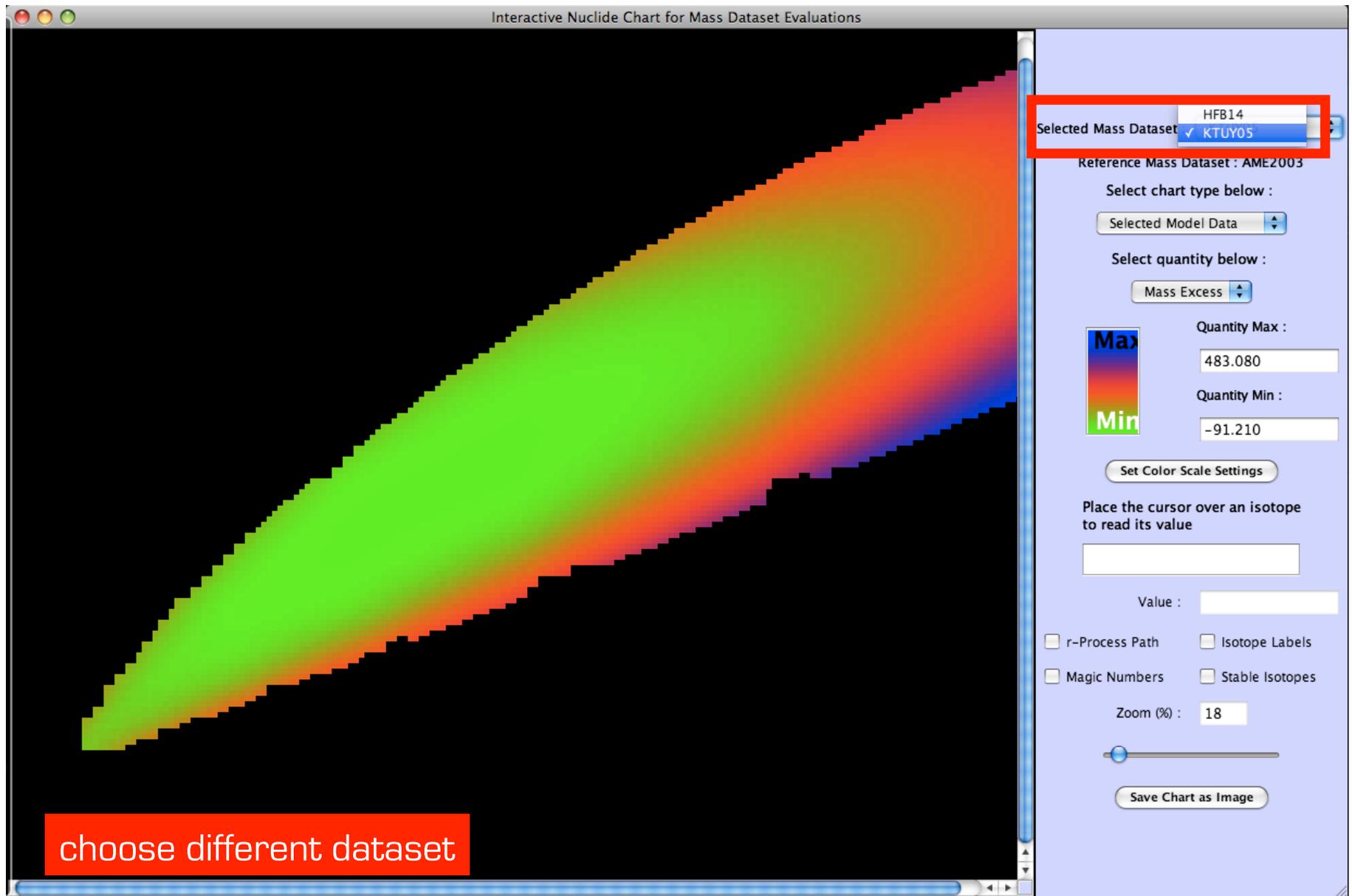


plot of S_{2n} for HFB14 model

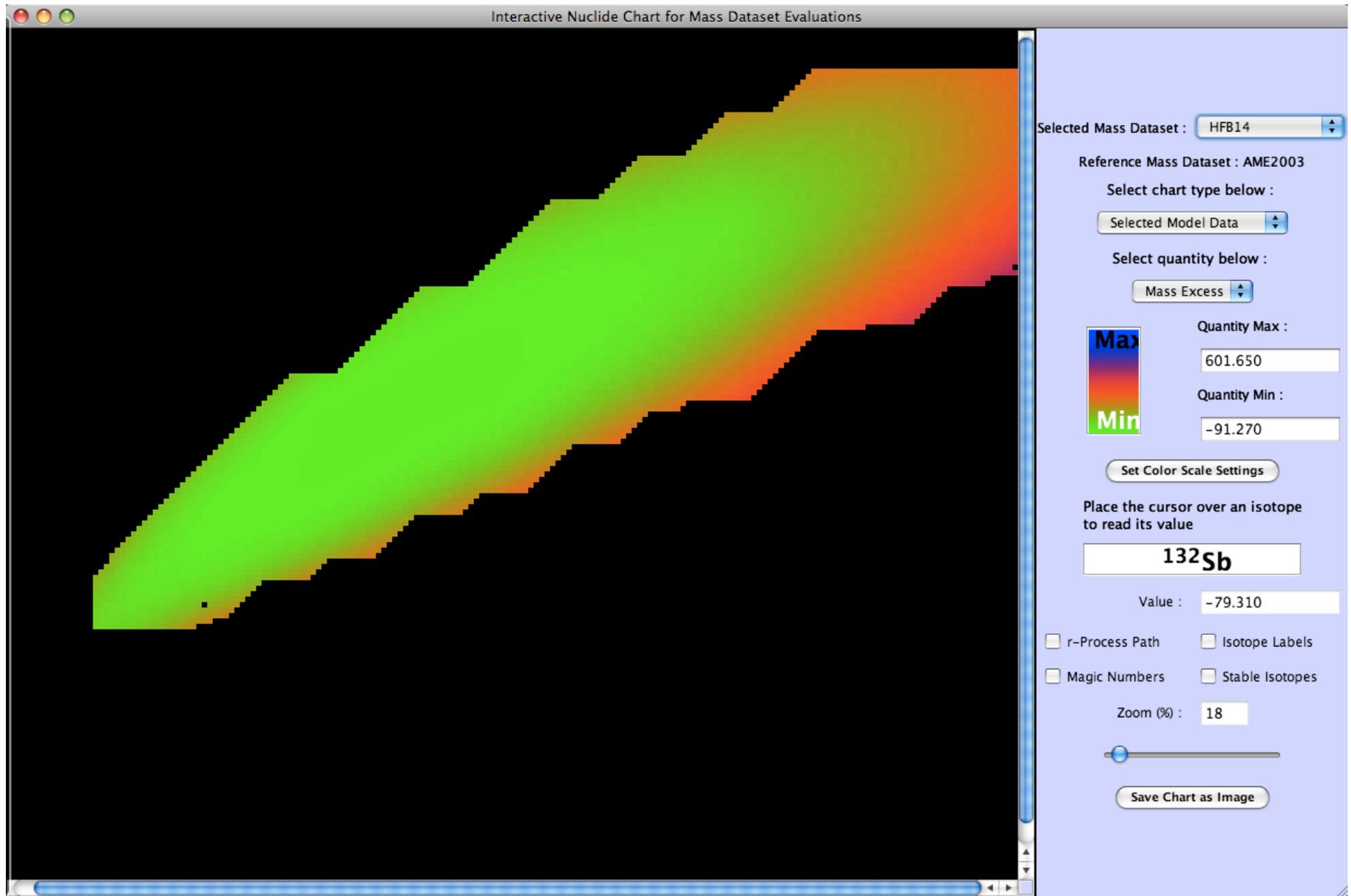
nuclearmasses.org: 2D model visualization



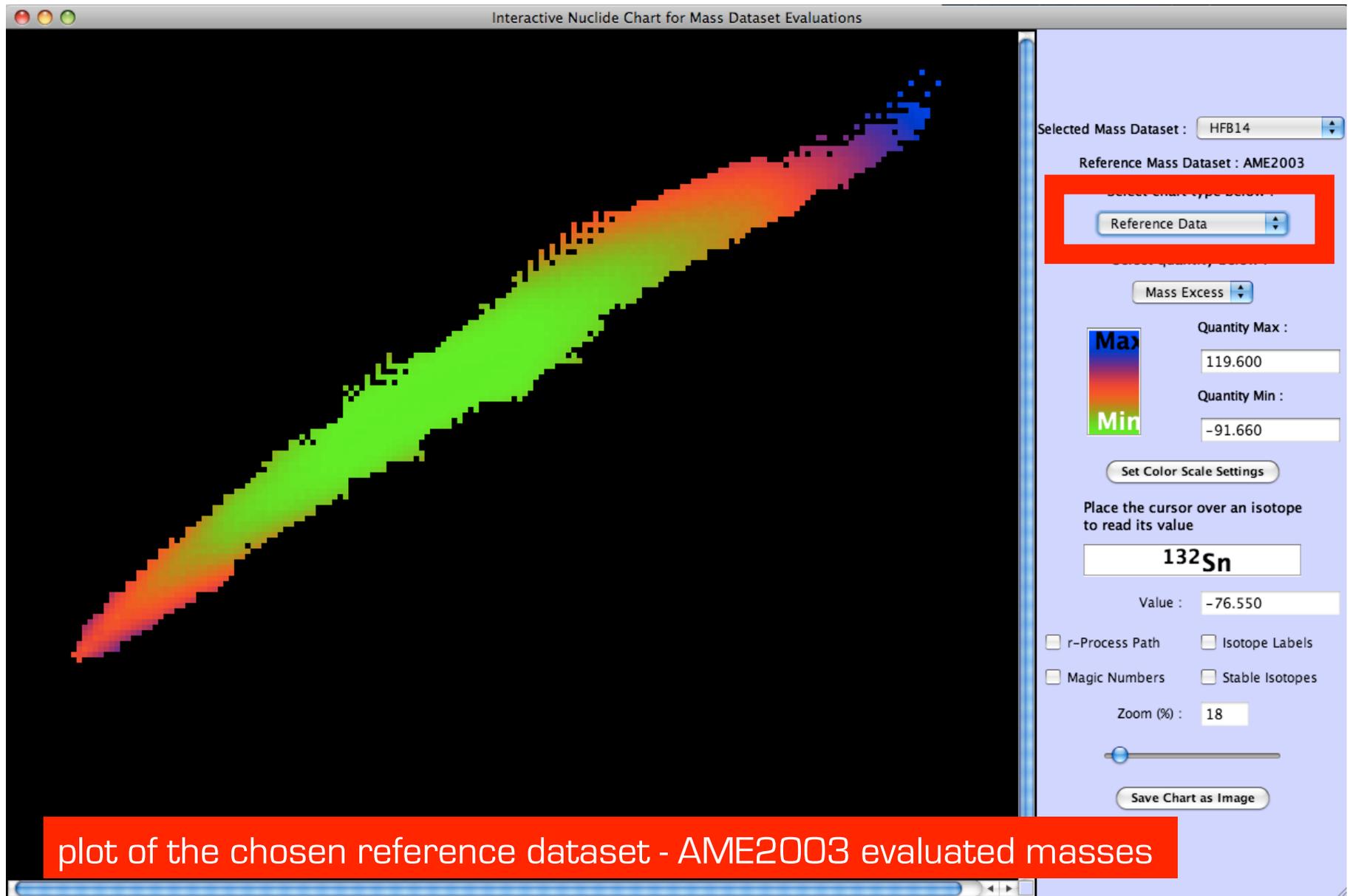
nuclearmasses.org: 2D model visualization



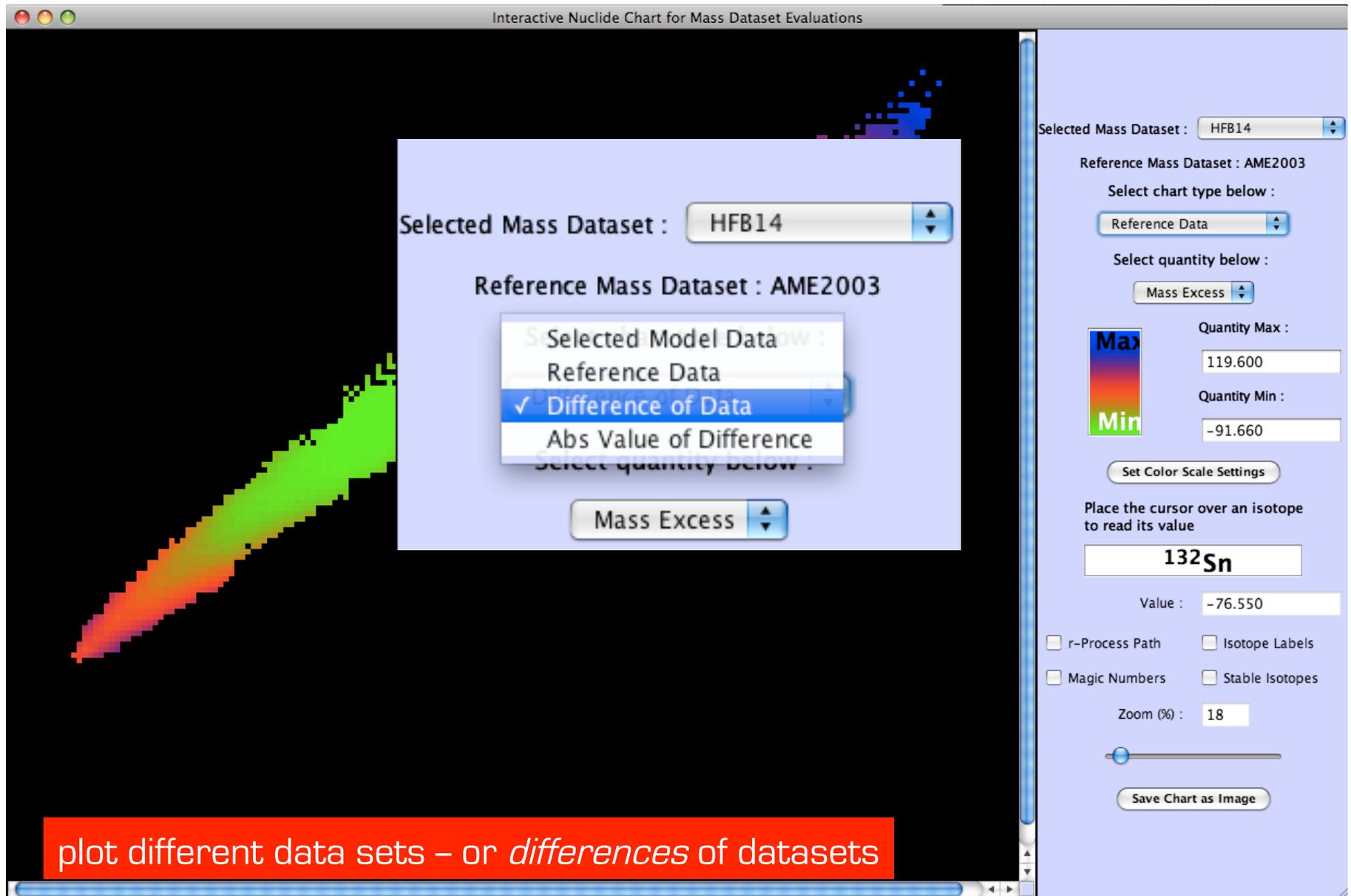
nuclearmasses.org: 2D model visualization



nuclearmasses.org: 2D model visualization

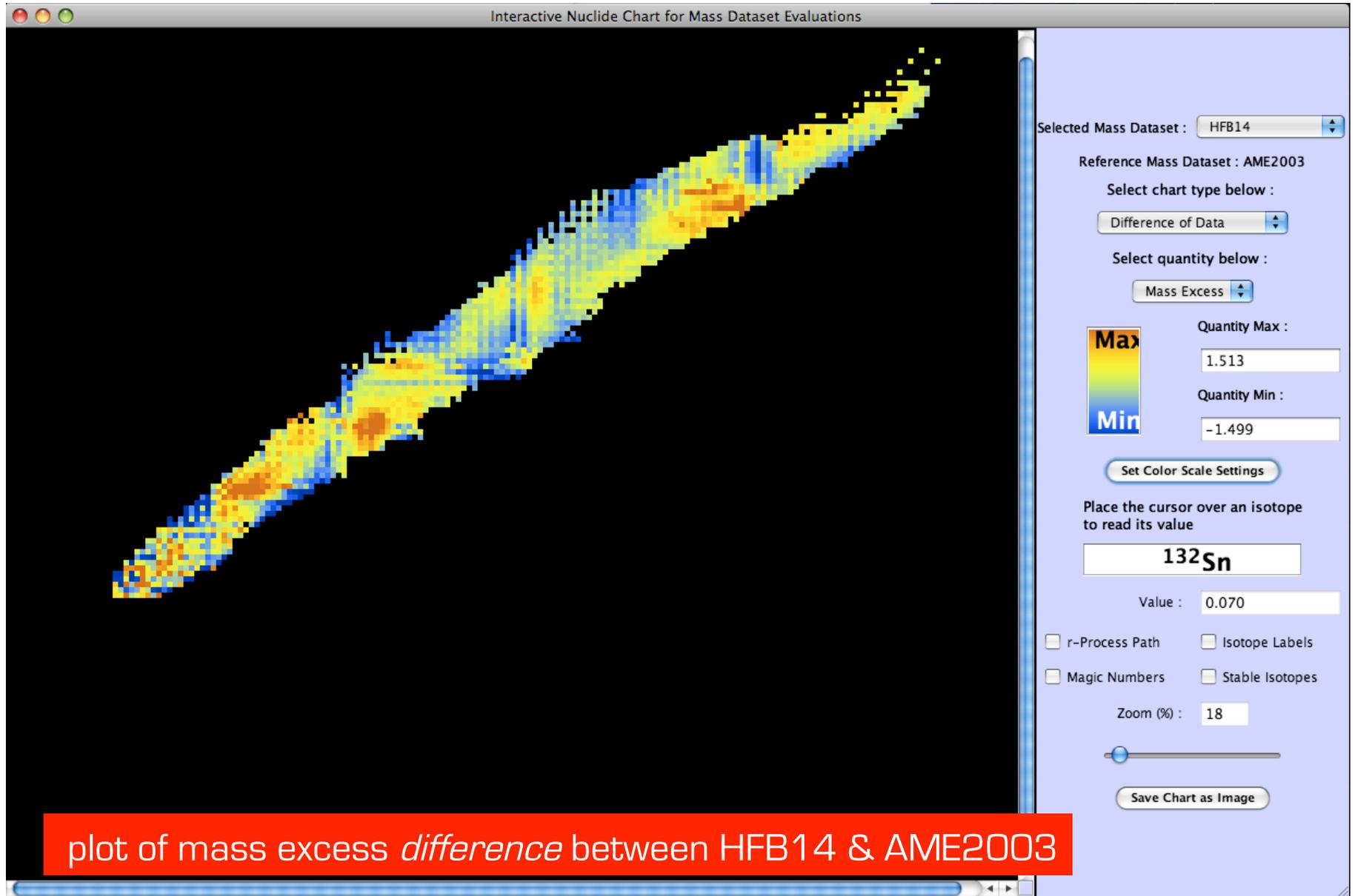


nuclearmasses.org: comparing models



plot different data sets – or *differences* of datasets

nuclearmasses.org: comparing models



plot of mass excess *difference* between HFB14 & AME2003

nuclearmasses.org: customized visualizations

Mass Dataset Nuclide Chart Color Scale Settings

Select type of color scale : Continuous

With this tool, you can set the floor and ceiling of the mass dataset nuclide chart color scale and select a new color scheme for the Mass Dataset Evaluator by using the sliders below.

Value max :

Value min :

Map values outside of range to max/min color

Show only values within this range

Choose a color scheme : Rainbow 2

Max
Min

Red		Green		Blue	
Position :	Amount :	Position :	Amount :	Position :	Amount :
0.44	0.25	0.02	0.32	1.0	0.37

Default Settings Apply Settings Enter Max/Min Range

Value :

r-Process Path Isotope Labels

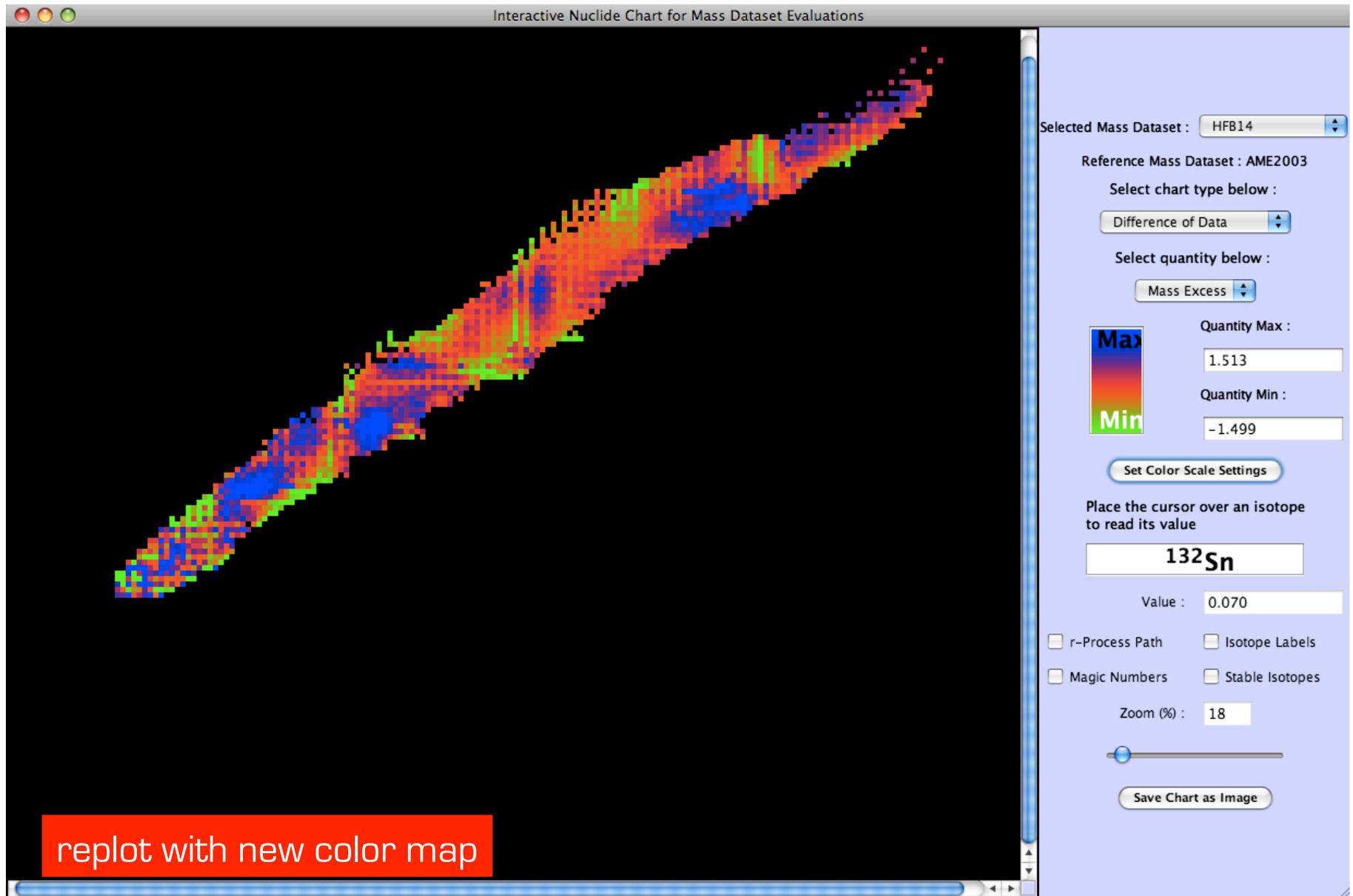
Magic Numbers Stable Isotopes

Zoom (%) :

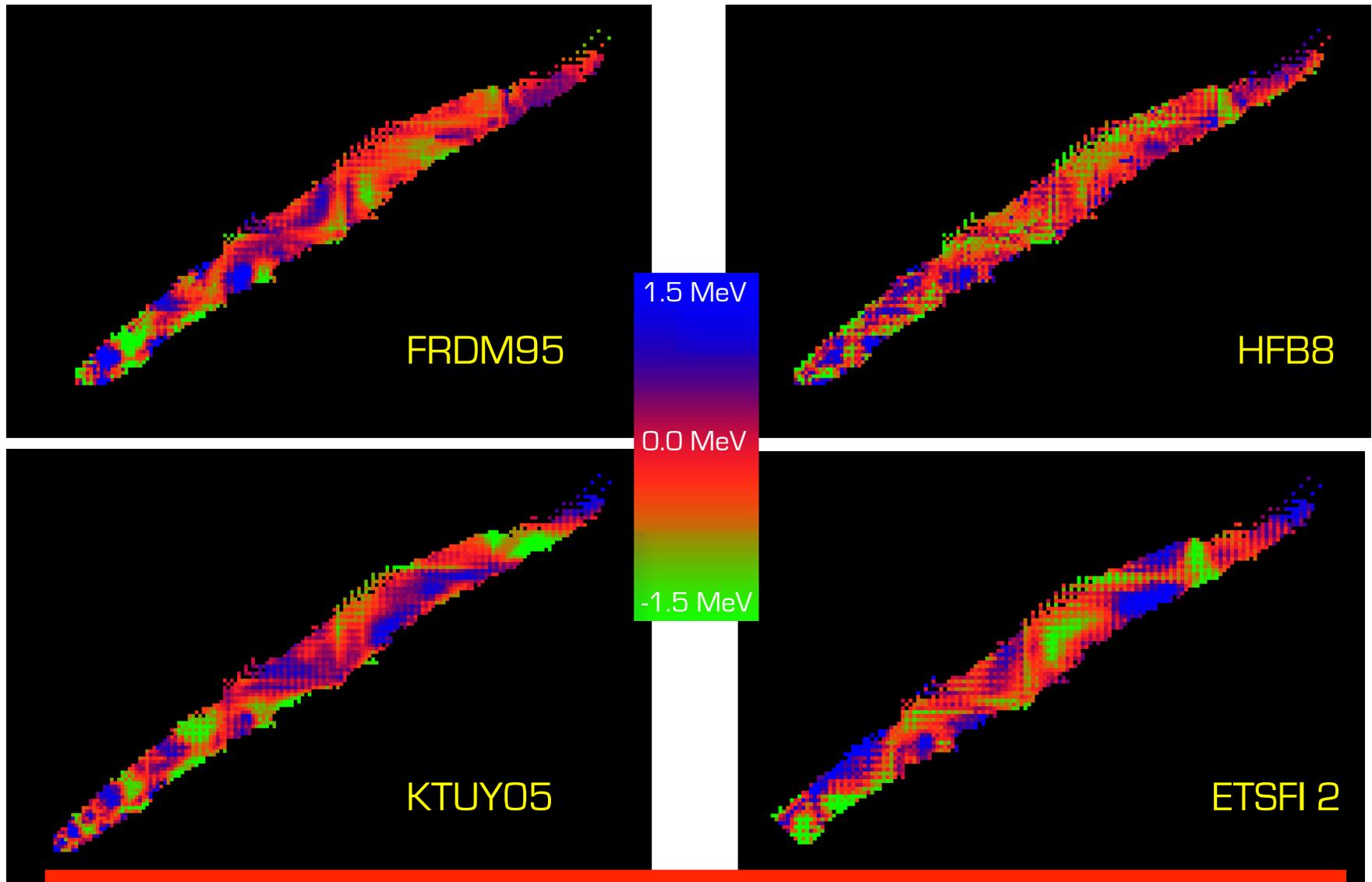
Save Chart as Image

completely customize the color map or choose from some preset schemes

nuclearmasses.org: customized visualizations

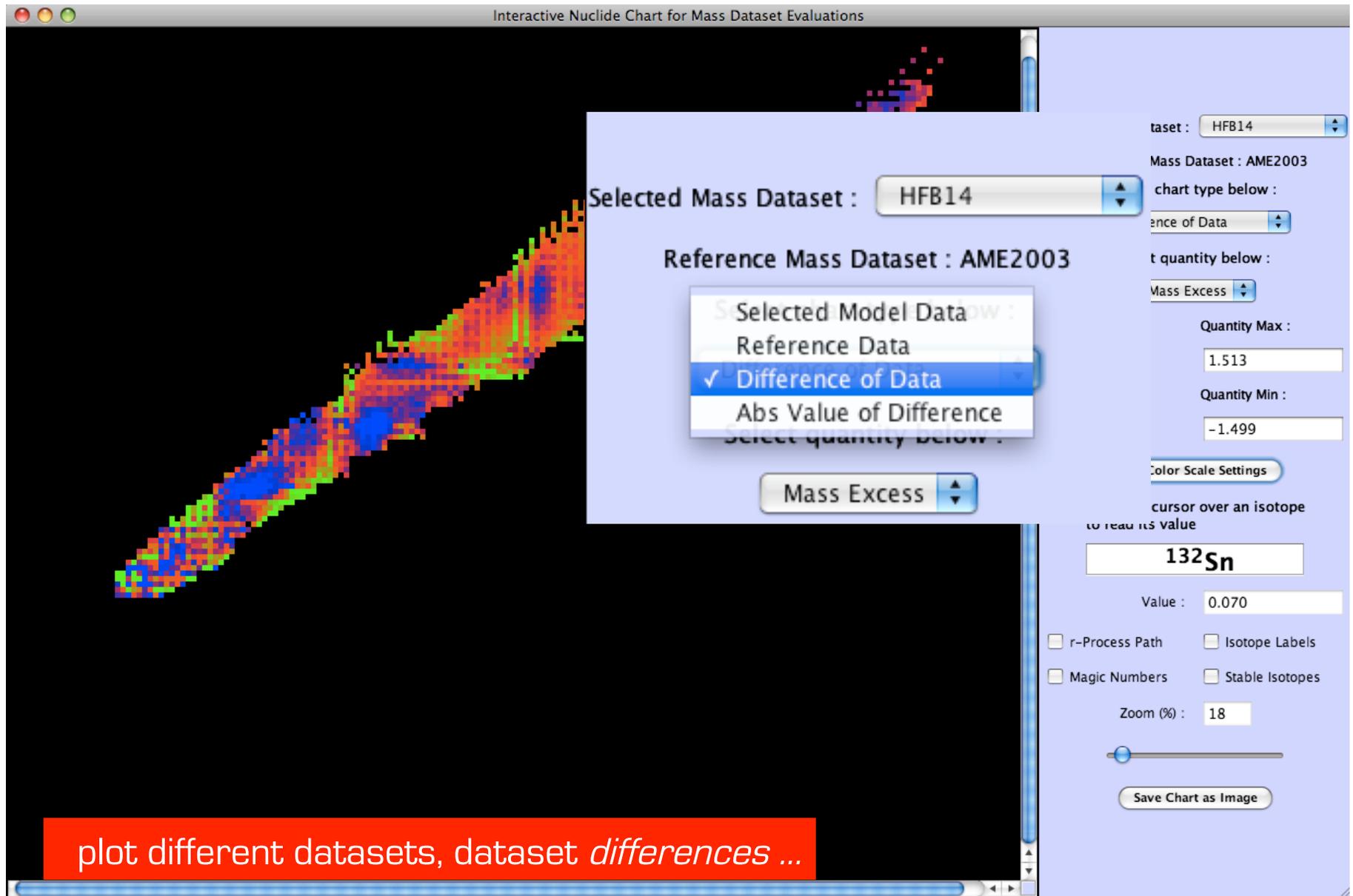


nuclearmasses.org: quick model comparisons



quickly compare mass differences between models & AME2003 masses

nuclearmasses.org: quick model comparisons



plot different datasets, dataset *differences* ...

nuclearmasses.org: quick model comparisons

Interactive Nuclide Chart for Mass Dataset Evaluations

Selected Mass Dataset : HFB14

Reference Mass Dataset : AME2003

Select chart type below :
Difference of Data

Select quantity below :
Mass Excess

- ✓ Mass Excess
- S_n
- S_{2n}
- S_p
- S_{2p}
- S_{alpha}
- Q(alpha, n)
- Q(alpha, p)

Quantity Max : 1.539

Quantity Min :

Selected Mass Dataset : HFB14

Reference Mass Dataset : AME2003

Selected Model Data :
Reference Data
✓ Difference of Data
Abs Value of Difference

Select quantity below :
Mass Excess

Quantity Max : 1.513

Quantity Min : -1.499

Color Scale Settings

cursor over an isotope to read its value

132Sn

Value : 0.070

r-Process Path Isotope Labels

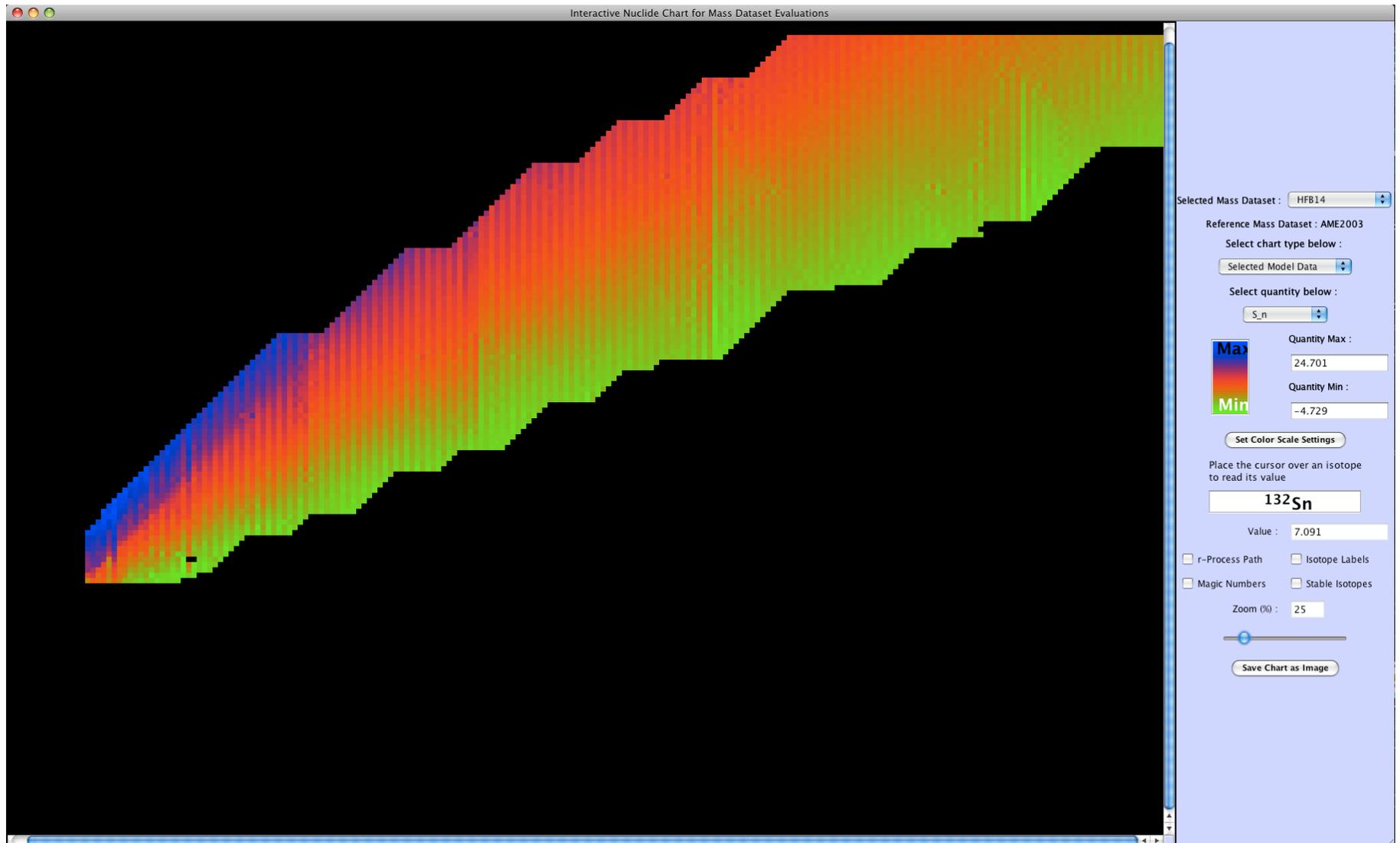
Magic Numbers Stable Isotopes

Zoom (%) : 18

Save Chart as Image

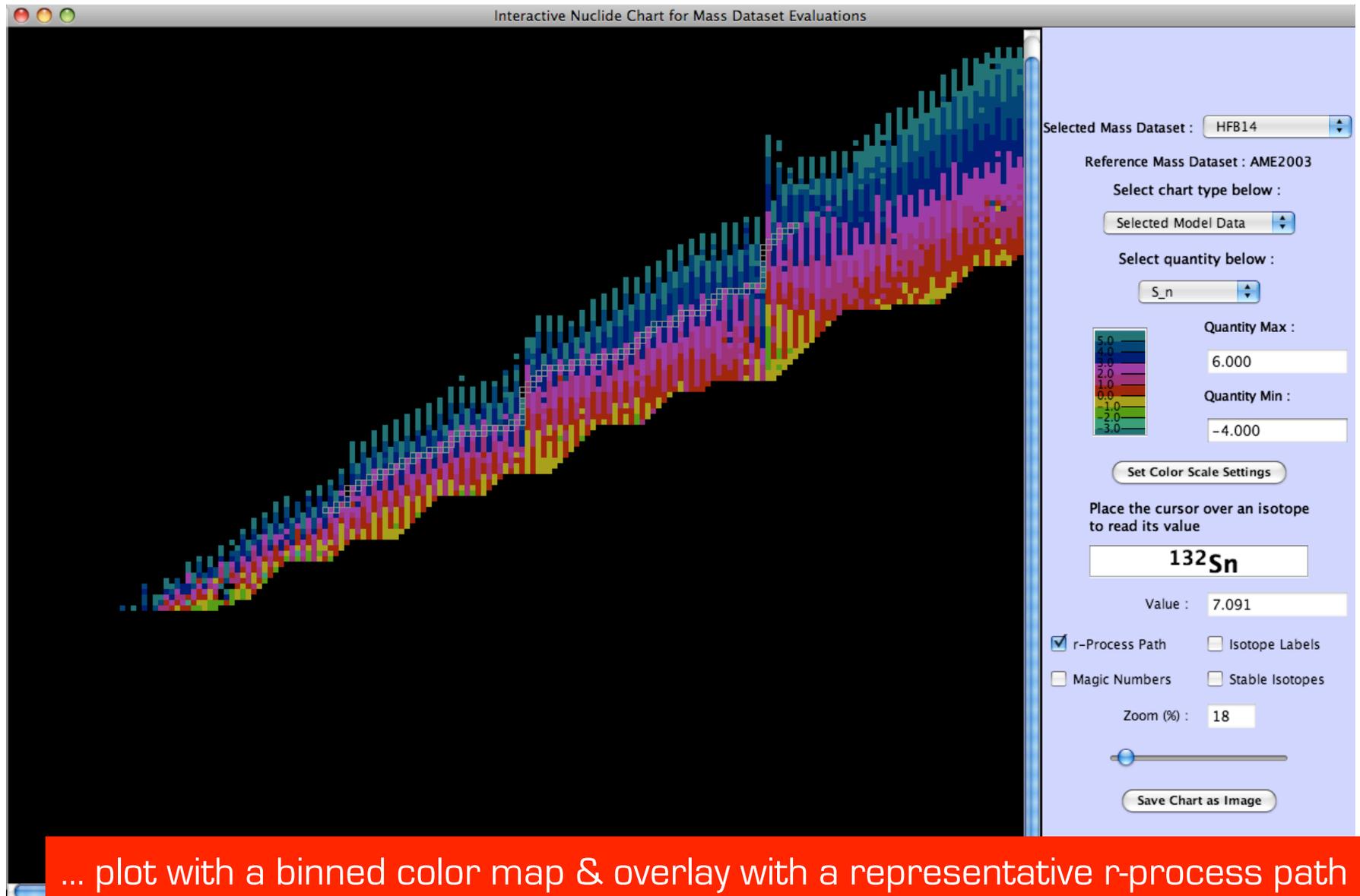
or plot different quantities...

nuclearmasses.org: visualize separation energies ...

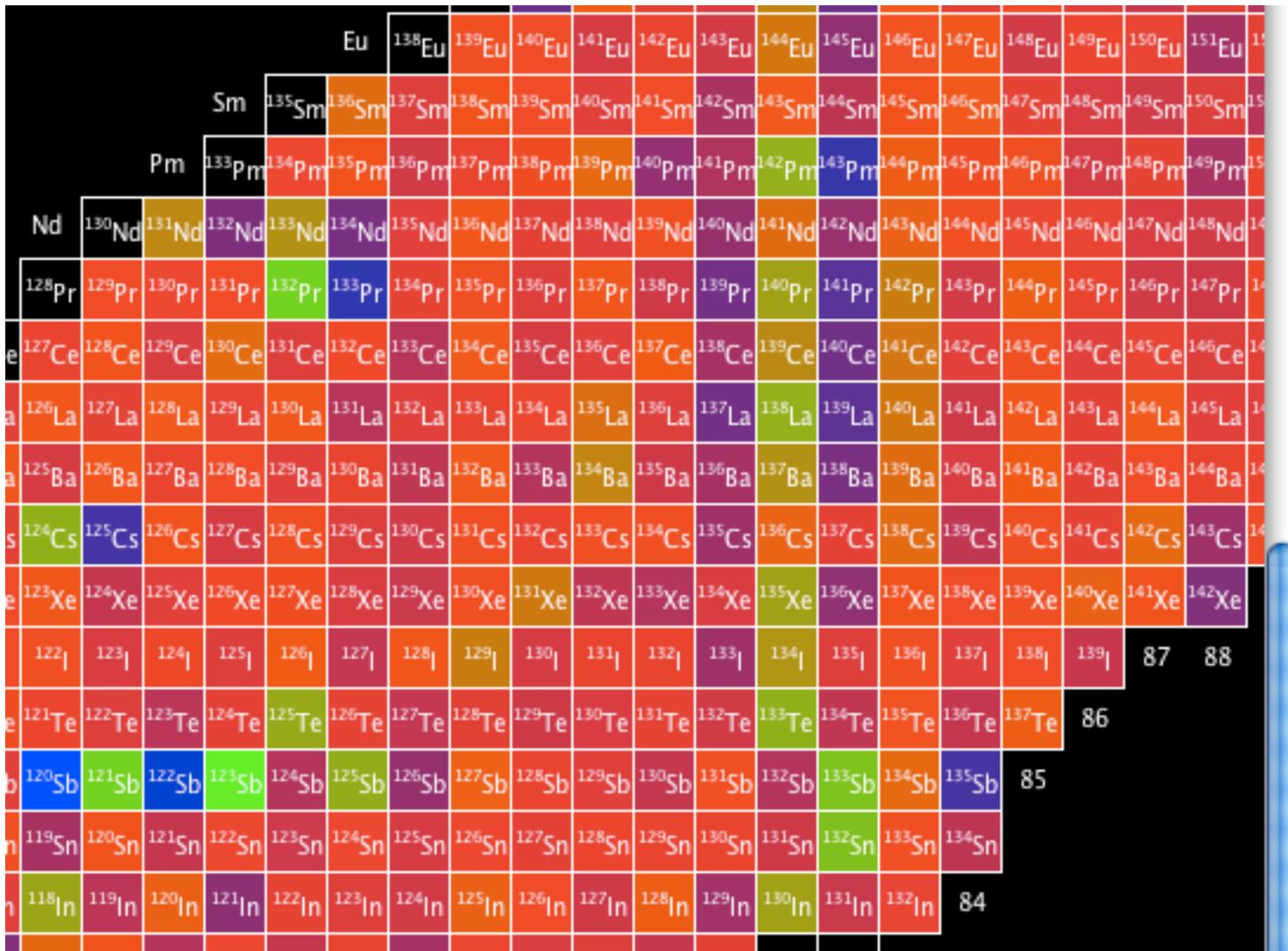


... such as neutron separation energy

nuclearmasses.org: visualize separation energies ...

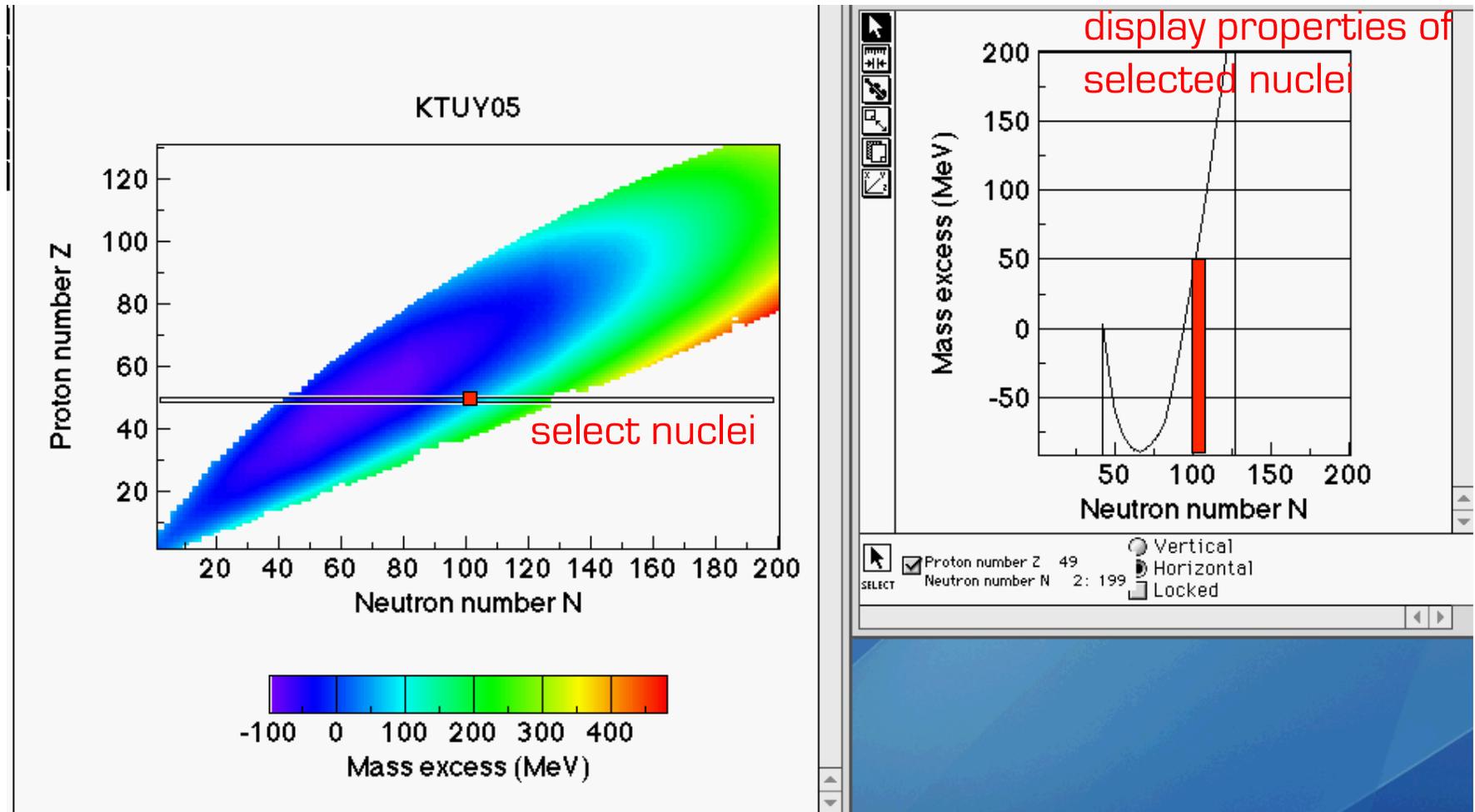


nuclearmasses.org: visualization



zoom in and show isotopes

future visualization features



- develop tools for mass model manipulations [with H. Koura, JAEA]

nuclearmasses.org: file management

The screenshot shows a web browser window titled "Mass Dataset Manager". On the left, the text "Mass Model Manager" is displayed. The main area contains a list of options, each with a radio button:

- Upload New Mass Dataset
- Modify Existing Mass Dataset
- Merge Existing Mass Datasets
- Copy Mass Dataset to Shared Folder
- Mass Dataset Information
- Erase Mass Dataset

At the bottom of the interface is a button labeled "Continue >".

Callouts (purple boxes) point to the following options:

- "enter your data into the system" points to "Upload New Mass Dataset".
- "change some of your data" points to "Modify Existing Mass Dataset".
- "combine two or more sets" points to "Merge Existing Mass Datasets".
- "SHARE - give others access" points to "Copy Mass Dataset to Shared Folder".
- "get information on a dataset" points to "Mass Dataset Information".
- "delete one of your sets" points to "Erase Mass Dataset".

work with mass datasets

nuclearmasses.org: file management



work with mass datasets - choose to upload a new set

nuclearmasses.org: file management

Mass Dataset Manager | Upload New Mass Dataset Step 1 of 4

Please enter the author for the new mass dataset in the field below and select either *Theoretical* or *Experimental* for the model's type.

Select Model Type : Experimental Theoretical

Enter author below :

enter author information

nuclearmasses.org: file management

Mass Dataset Manager

Mass Dataset Manager | Upload New Mass Dataset Step 2 of 4

Please enter the reference for the new mass dataset in the field below.



Enter reference below :

Journal:
Volume:
Page:
Authors:

enter bibliographical information

[< Back](#) [Continue >](#)

nuclearmasses.org: file management

Mass Dataset Manager | Upload New Mass Dataset Step 3 of 4

Please enter the description for the new mass dataset in the field below.

⏪ ⏩ | ✂ 📄 📂 | **B** U *I* | x_2 x^2 ABC | ∞ Σ

Enter description below :

enter a description

[< Back](#) [Continue >](#)

nuclearmasses.org: file management

Mass Dataset Manager | Upload New Mass Dataset Step 4 of 4

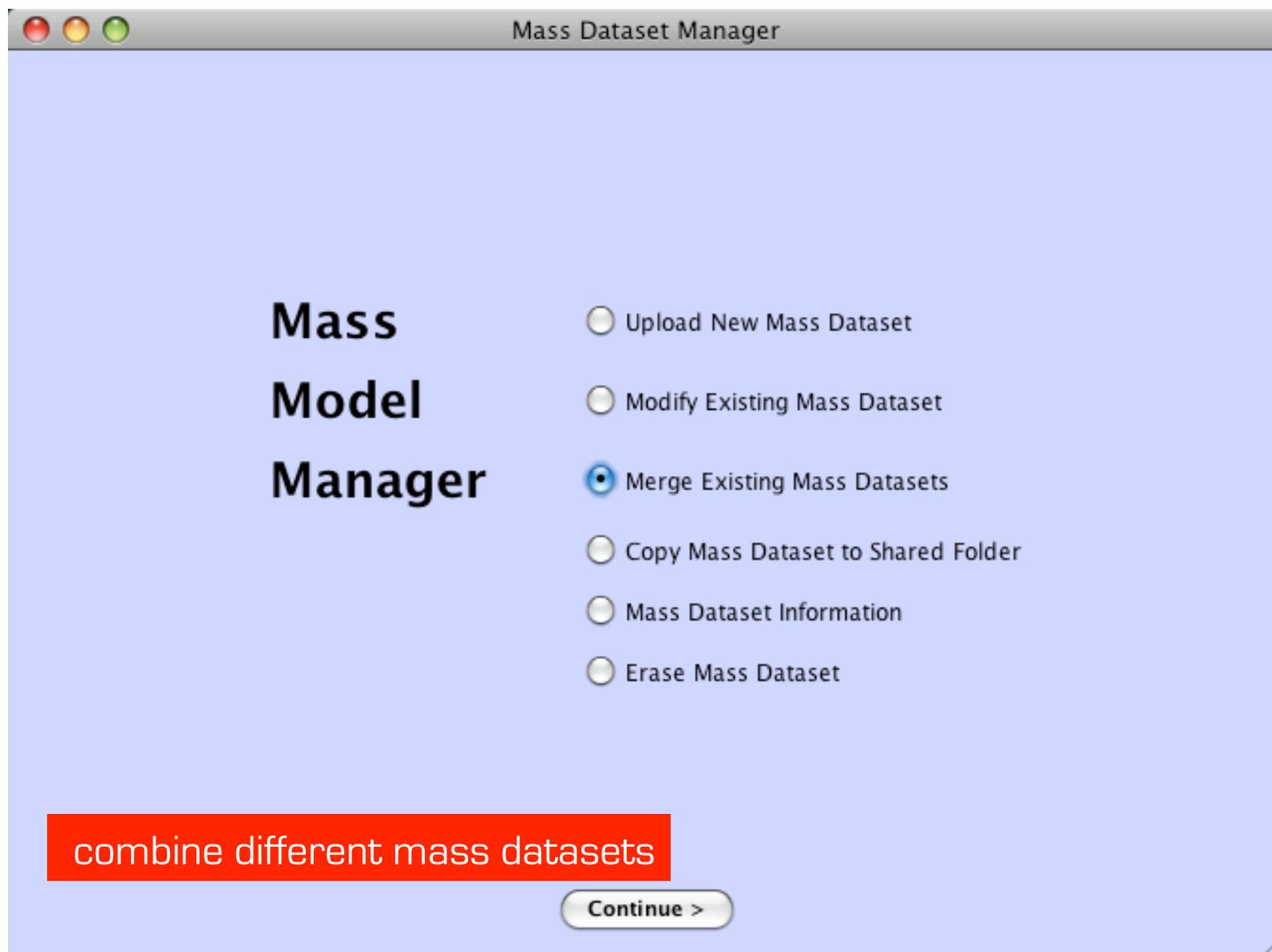
A new mass dataset may be entered by selecting and uploading a file or by pasting the mass data into the field below. To upload a mass dataset file, click *Upload Mass Dataset File* and select the file. To paste the mass data into the field, click *Paste Mass Dataset*. The mass dataset's format may be three columns of either *Z, N, Mass Excess (MeV)* or *Z, A, Mass Excess (MeV)*. When finished click *Save New Mass Dataset*.

Selected data entry method : Paste Mass Dataset Upload Mass Dataset File

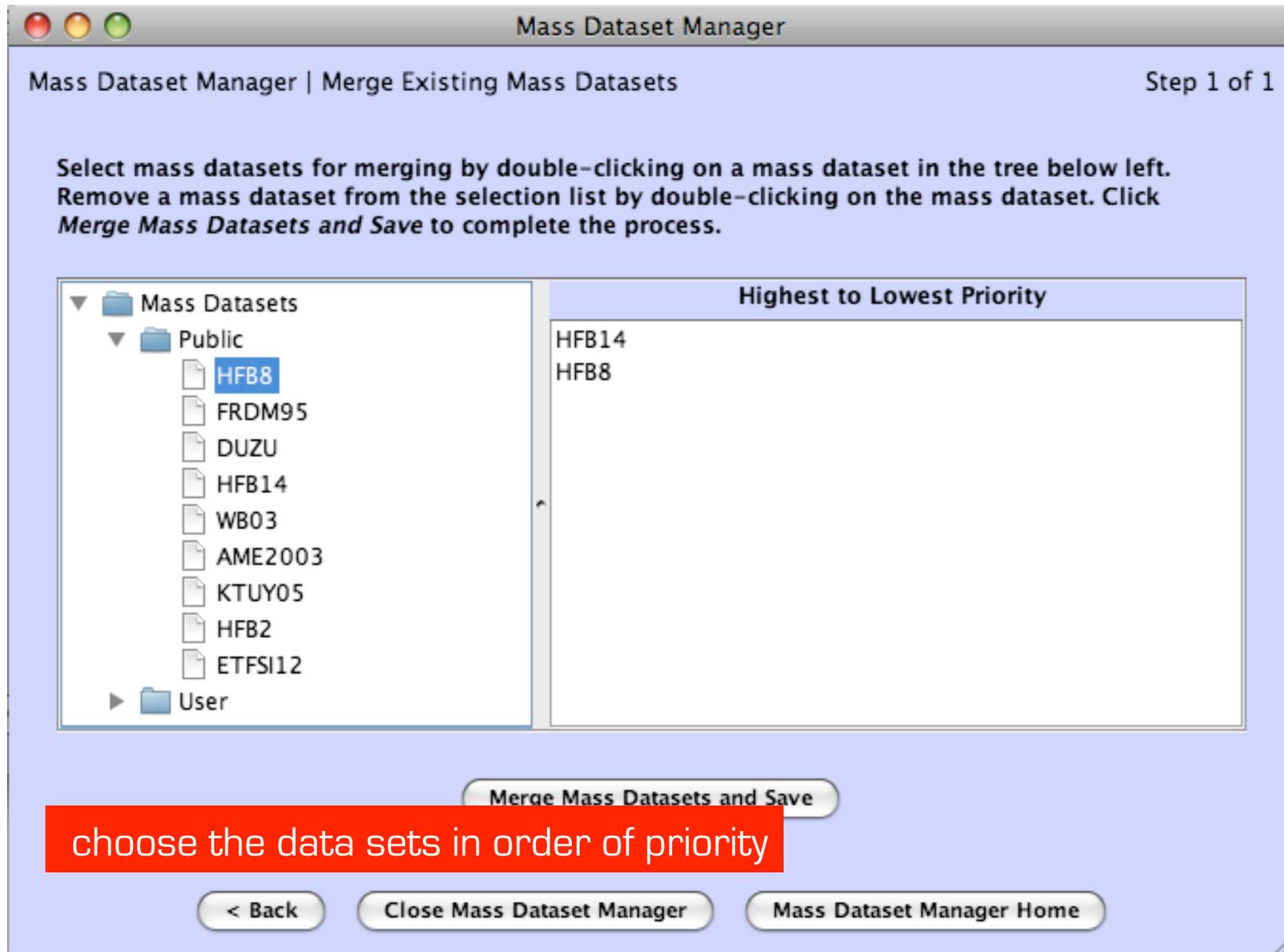
Selected format : Z, N, Mass Excess Z, A, Mass Excess

upload the data file or paste it into the text field - then save

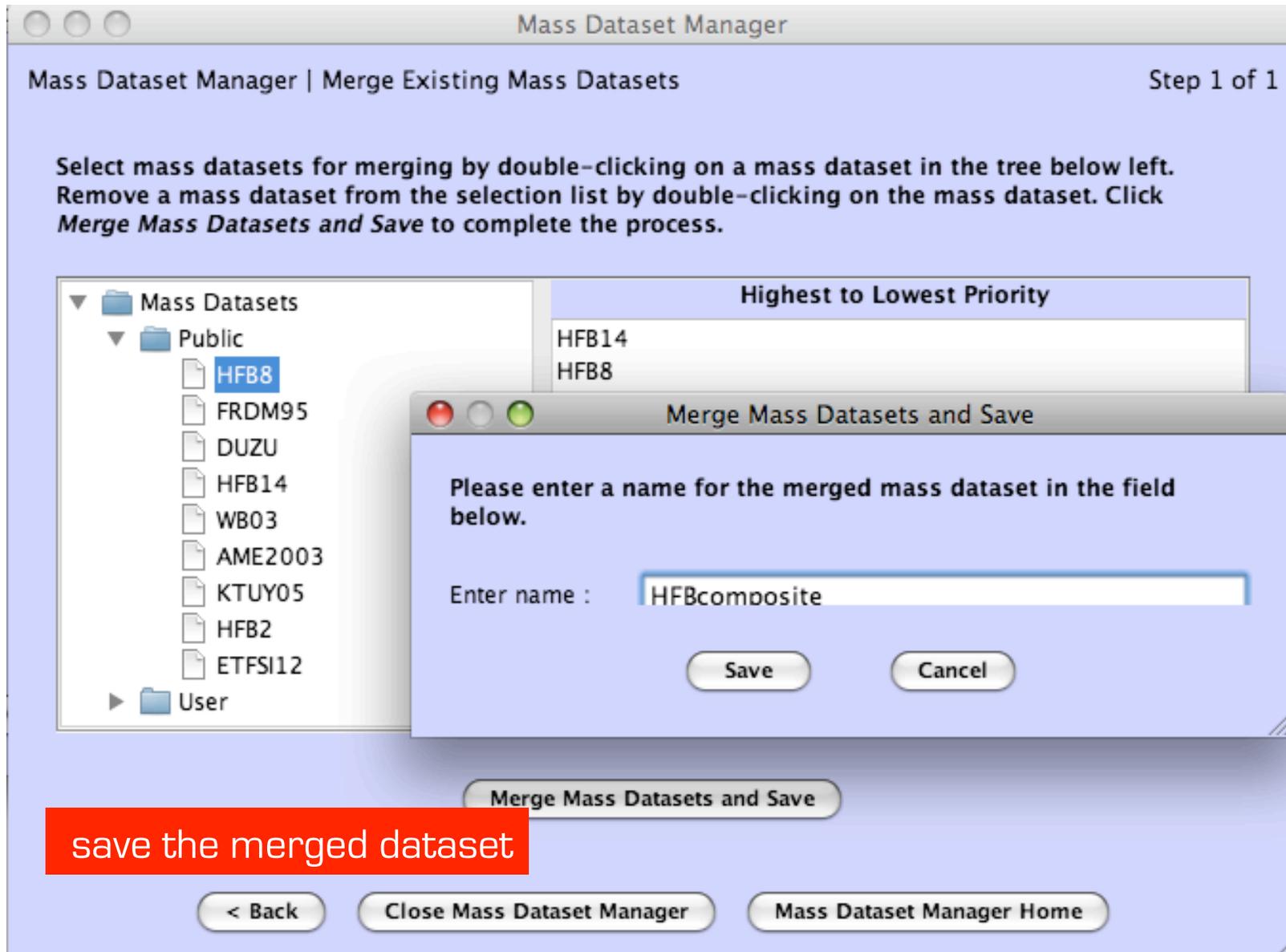
nuclearmasses.org: file management



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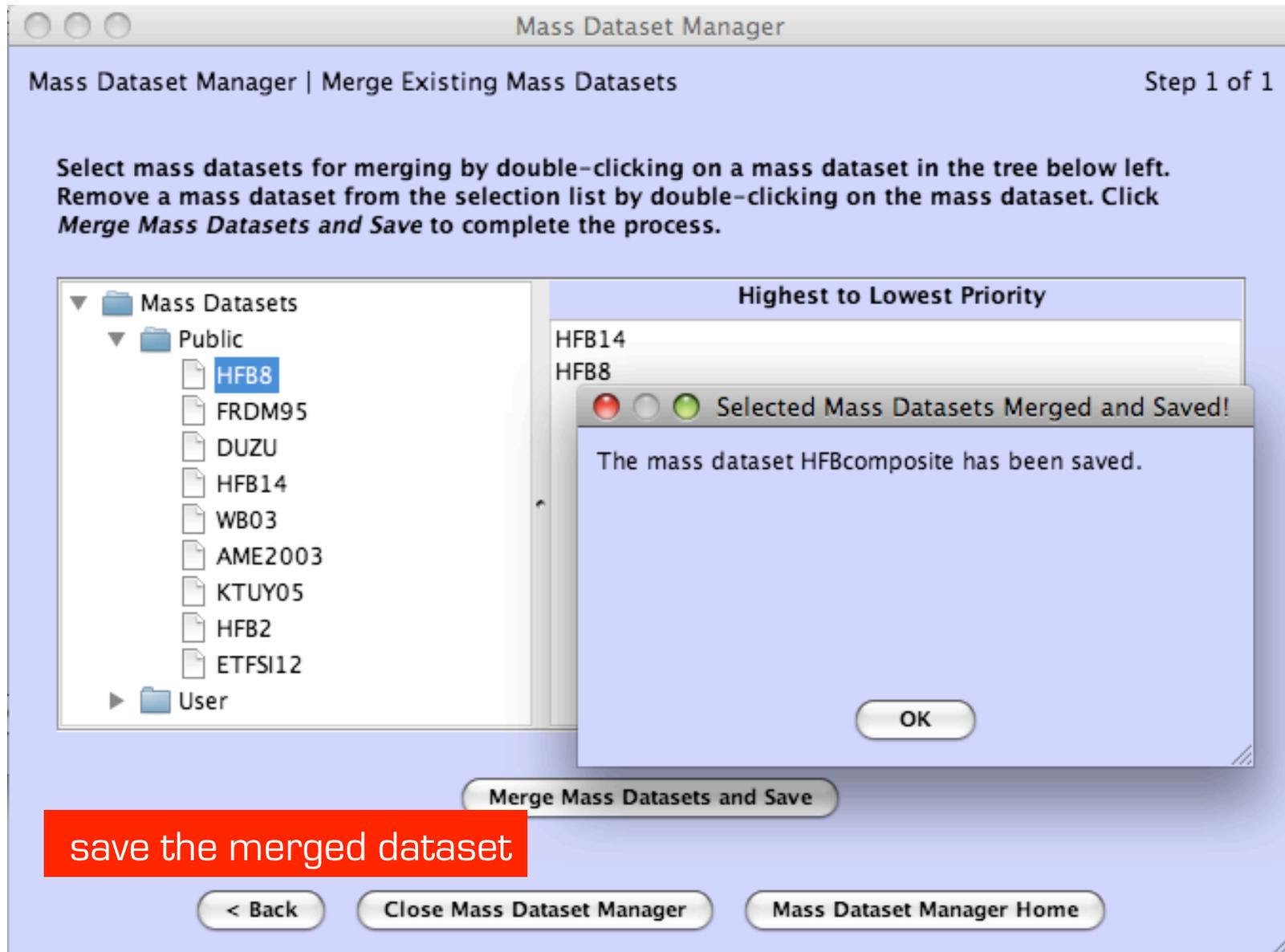


nuclearmasses.org: file management



save the merged dataset

nuclearmasses.org: file management



nuclearmasses.org: future features

- add another category for datasets - “collaborators” - for sharing data
- show information on masses of isomers
- output files that can be directly input into statistical models for σ calculations
- enable commenting on different mass models
- build in a robust feature to export mass datasets
- your ideas ...

nuclearmasses.org

summary

- an online software system for nuclear mass research is freely available at nuclearmasses.org
- this system can **SUPPLEMENT** your research:
 - make easy to **SHARE** your work with others
 - make it easy for you to **ACCESS** the work of others
 - provides visualization & analysis tools
 - makes some repetitive tasks easy
- invite you to register, try it out, and make suggestions on how we can improve it for you

system could provide software support for a new mass evaluation effort