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Title: Overview of Java-based Nuclear Information Software (JANIS)

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Overview of Java-based Nuclear Information Software (JANIS)

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MCNP Team Meeting
March 10, 2022

Managed by Triad National Security, LLC, for the U.S. Department of Energy's NNSA.

Outline

Introduction & Motivation
- Getting & Configuring JANIS

Data Queries
- Interaction Cross Sections
- Covariances via Correlation Matrix
- Fission Yields
- Radioactive Decay

Data Manipulations & Comparisons
- Weighting (Multi-group Collapse)
- Querying Multiple Libraries
- Evaluation vs. Experiment

Introduction & Motivation

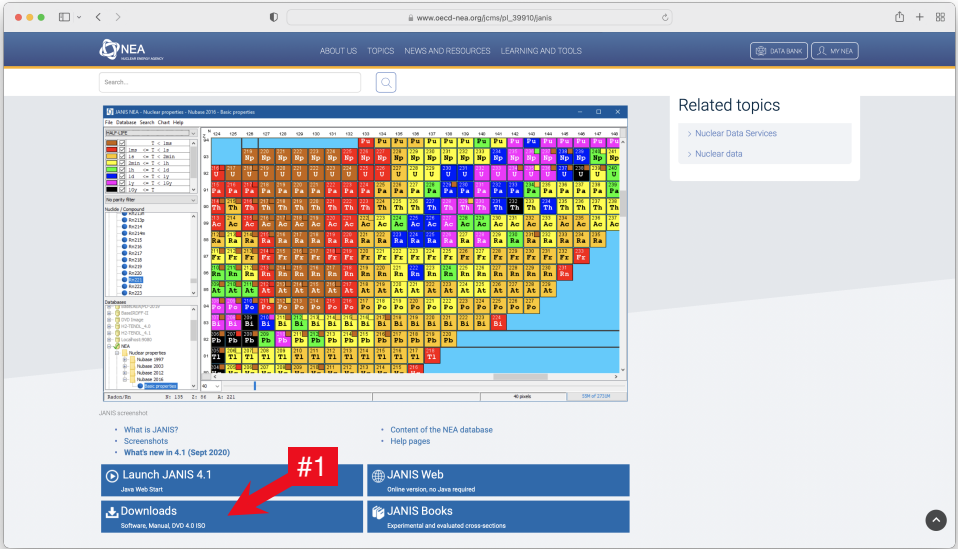
Objective: overview of JANIS software and select features

- JANIS: Java-based Nuclear Information Software [1]
- Available for offline (Java-based) and online (website-based) use
  - Focus of this talk is on the offline application
  - Both approaches are cross platform
- Visualize and manipulate a variety of nuclear data
  - Decay & fission-yield data
  - Interaction data: cross-sections, distributions, uncertainties
- Access a variety of libraries: EN(S)DF, JEFF, JENDL, TENDL, IRDF, etc.

- Why this talk?
  - JANIS is cited in several MCNP classes
  - Despite usefulness, awareness of JANIS is not pervasive
  - Alternative to BNL NNDC, KAERI NDC, IAEA EXFOR, etc.

JANIS 4.0 includes `log4j` version 1.2.17, which is not affected by the vulnerability identified in 2021.

Getting & Configuring JANIS

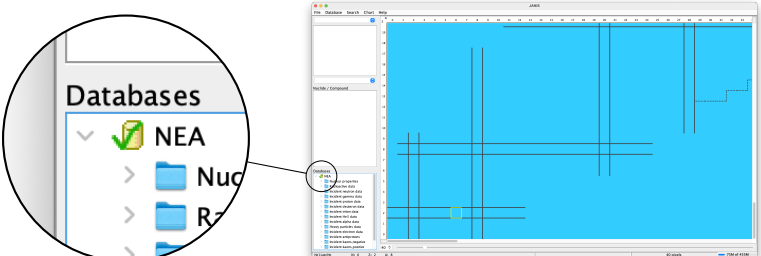


Available from: https://www.oecd-nea.org/jcms/pl_39910/janis.
Access downloads; choose "Software Only."
Note: a Google search for "janis" first gives Janis Joplin hits; suggest searching for "janis oecd".

Getting & Configuring JANIS, cont.

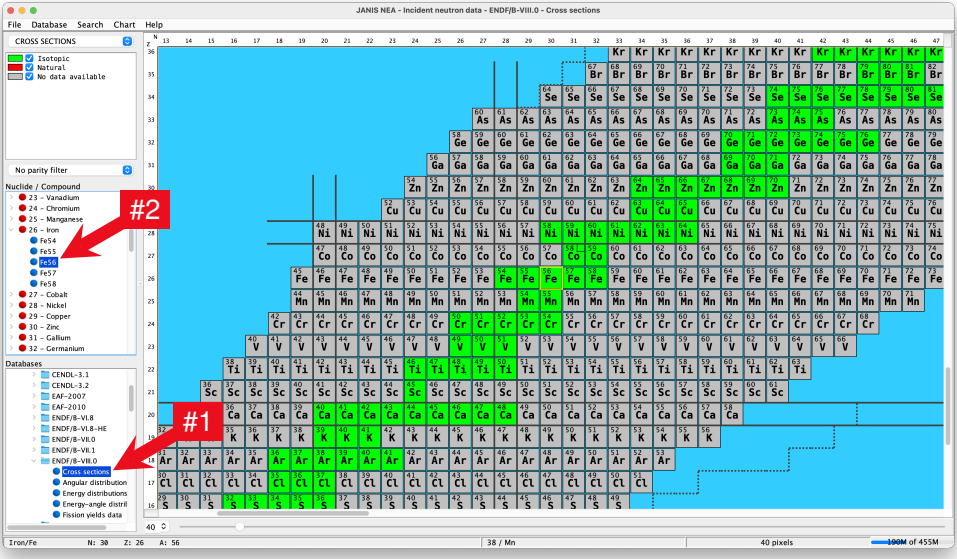
- Extract the ZIP file
- Bundle has caused problems recently with direct execution
  - Navigate to extraction directory and execute `janis.sh`
  - Effectively: `java -Xms100M -Xmx512M -jar software/Janis.jar`
- Untested, but is expected to be the same as macOS
- Navigate to extraction directory and execute `janis.bat`

- Once launched, may need to set proxy via File menu Preferences dialog
  - Use Network tab and Test Connectivity button

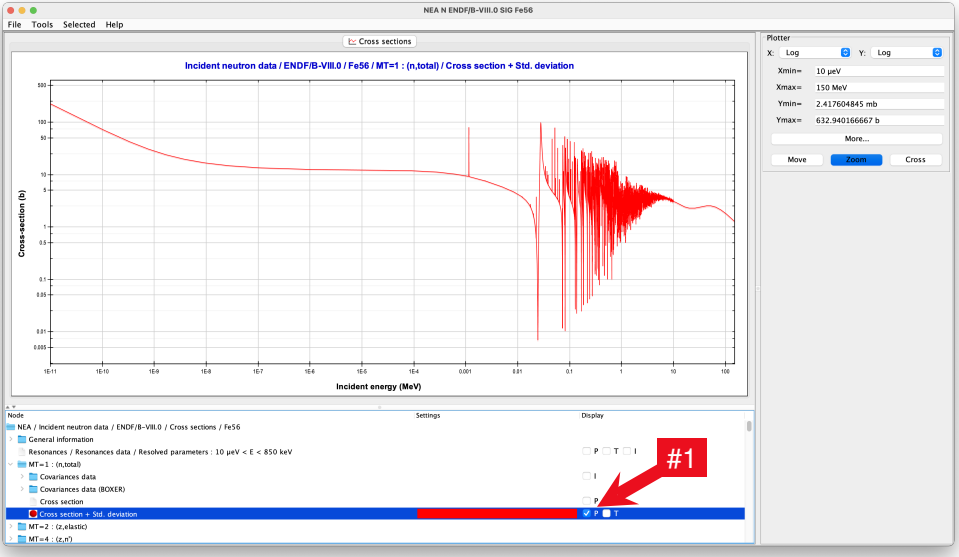


Look for the green checkmark—if present, one can proceed.

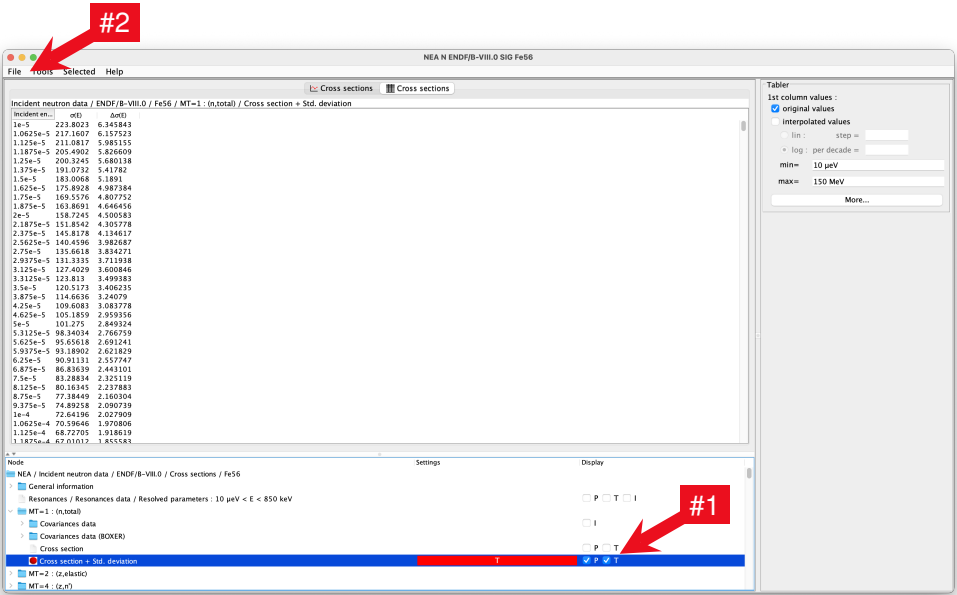
Interaction Cross Sections: Total Fe-56 + Unc.



Interaction Cross Sections: Total Fe-56 + Unc., cont.

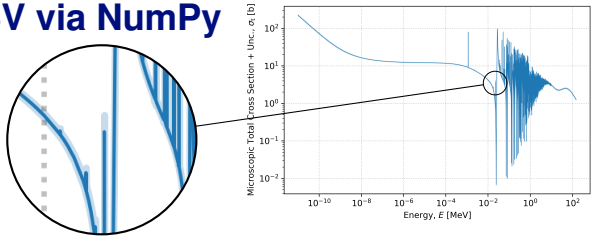


Interaction Cross Sections: Total Fe-56 + Unc., cont.



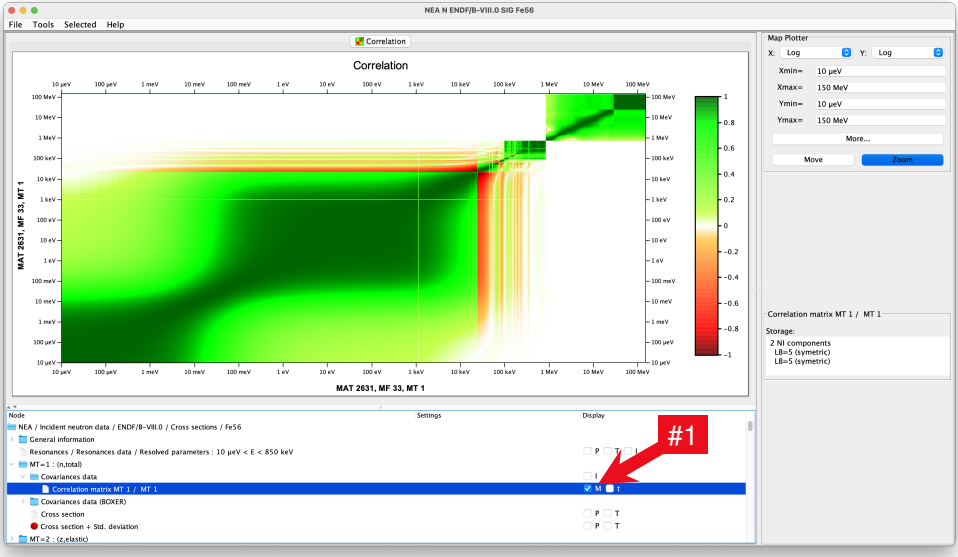
Use the File menu Export entry to save the tabular data as a CSV or XML file.

Plotting the Exported CSV via NumPy



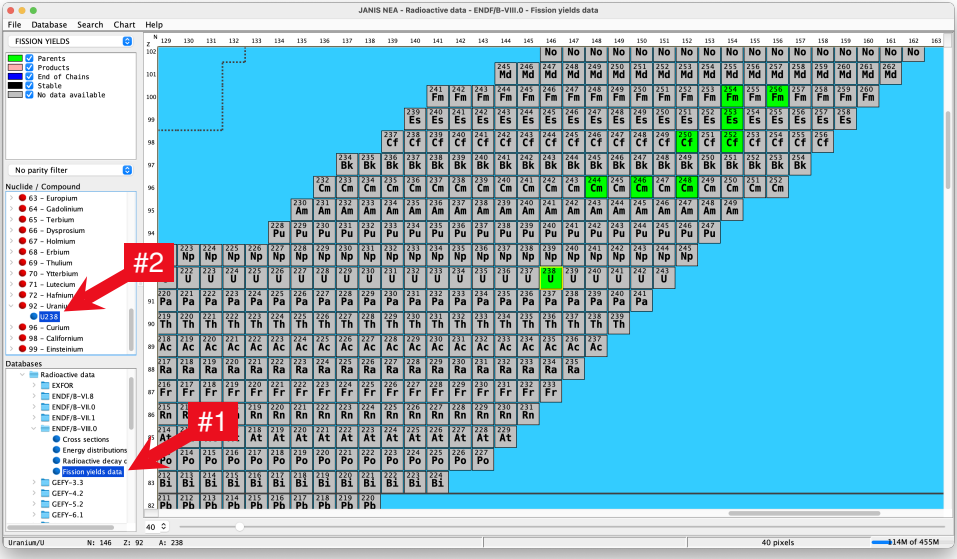

```
#!/usr/bin/env python

import matplotlib.pyplot as plt
import numpy as np

x, y, e = np.loadtxt("fe56_mt1_xs_stdev.csv", skiprows=3, delimiter=";", unpack=True)

fig, ax = plt.subplots(figsize=(6.5, 6.5 / 1.62))
x /= 1e6
p = plt.plot(x, y, lw=0.5)
plt.fill_between(x, y - e, y + e, alpha=0.25, color=p[-1].get_color())
plt.xscale("log")
plt.yscale("log")
plt.xlabel("Energy, $E$ [MeV]")
plt.ylabel(r"Microscopic Total Cross Section + Unc., $\sigma_{\mathrm{t}}$ [b]")
plt.grid(ls=":", color="#000000", alpha=0.25)
plt.savefig("fe56_mt1_xs_stdev.png", dpi=600, bbox_inches="tight")
```

Covariances via Correlation Matrix

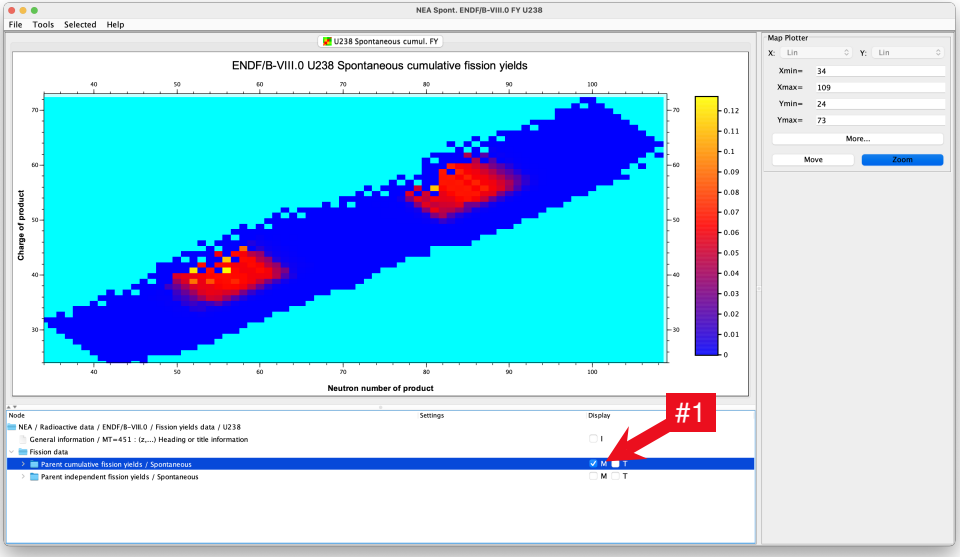


An application for these data is shown in [2].

Fission Yields

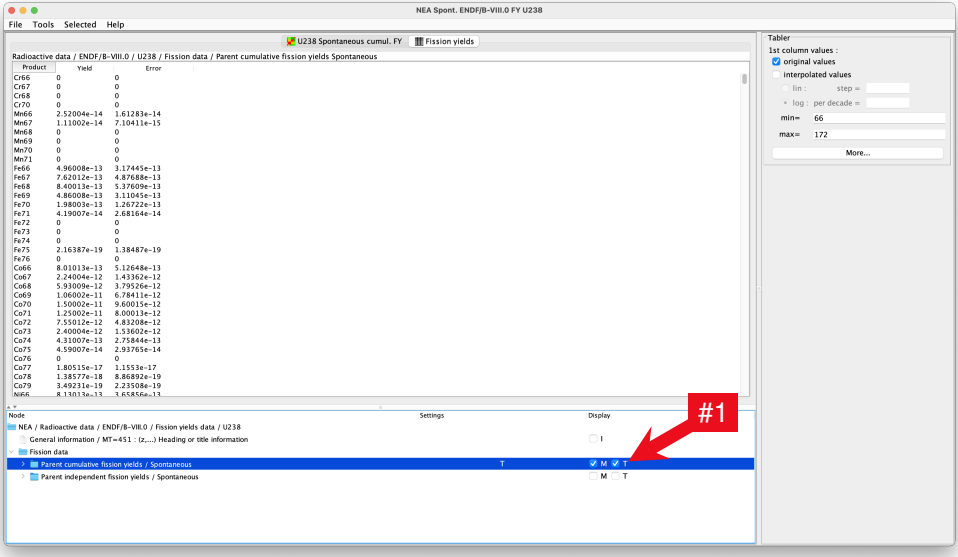


Fission Yields, cont.

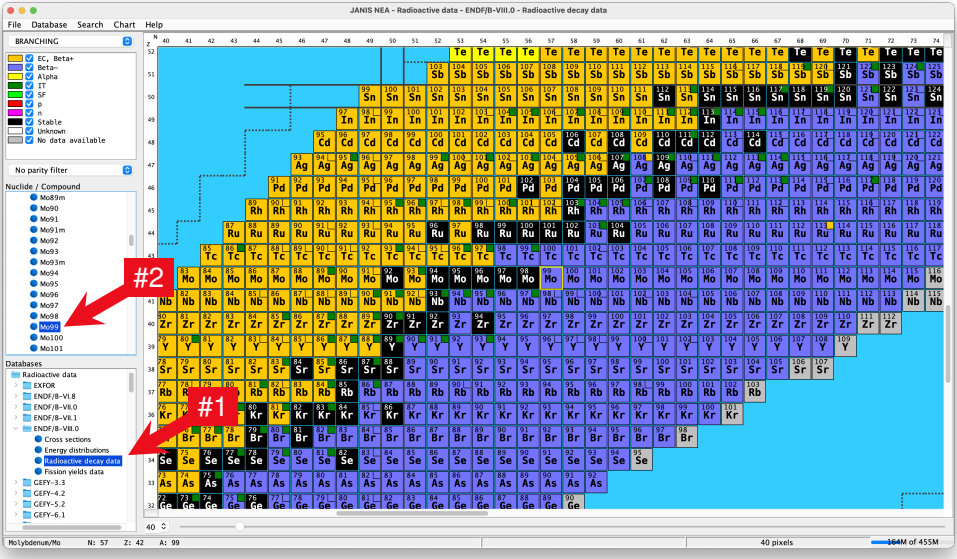


Cumulative fission yield: production directly from fission or by decay of other nuclides.

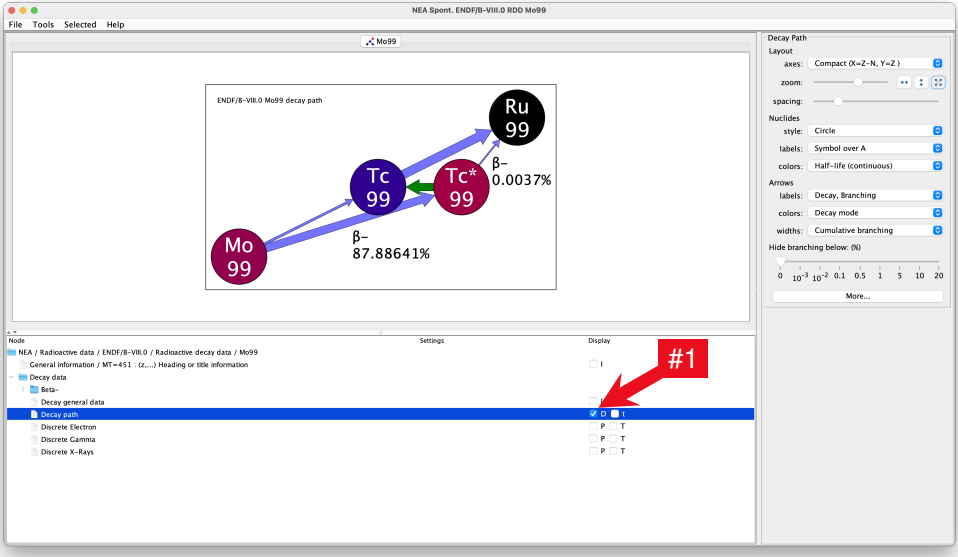
Fission Yields, cont.



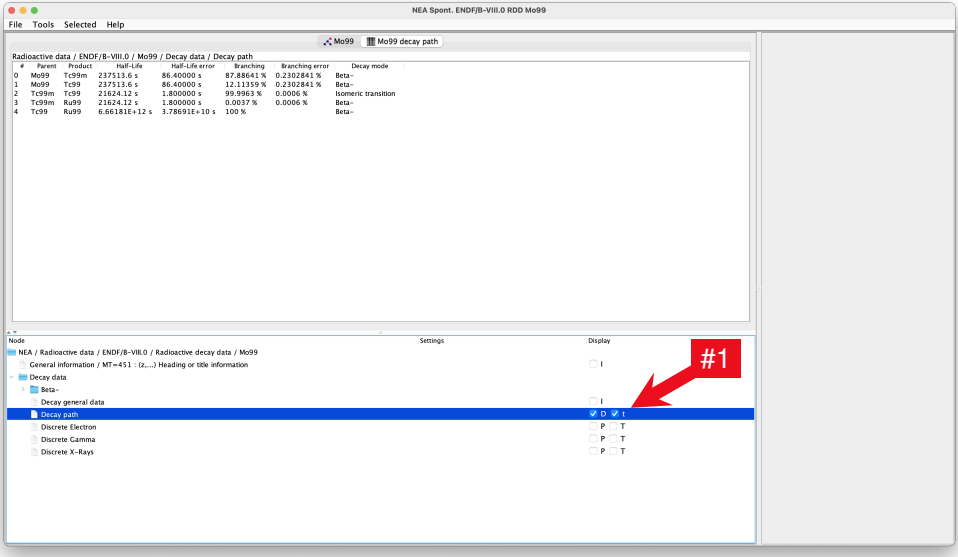
Radioactive Decay



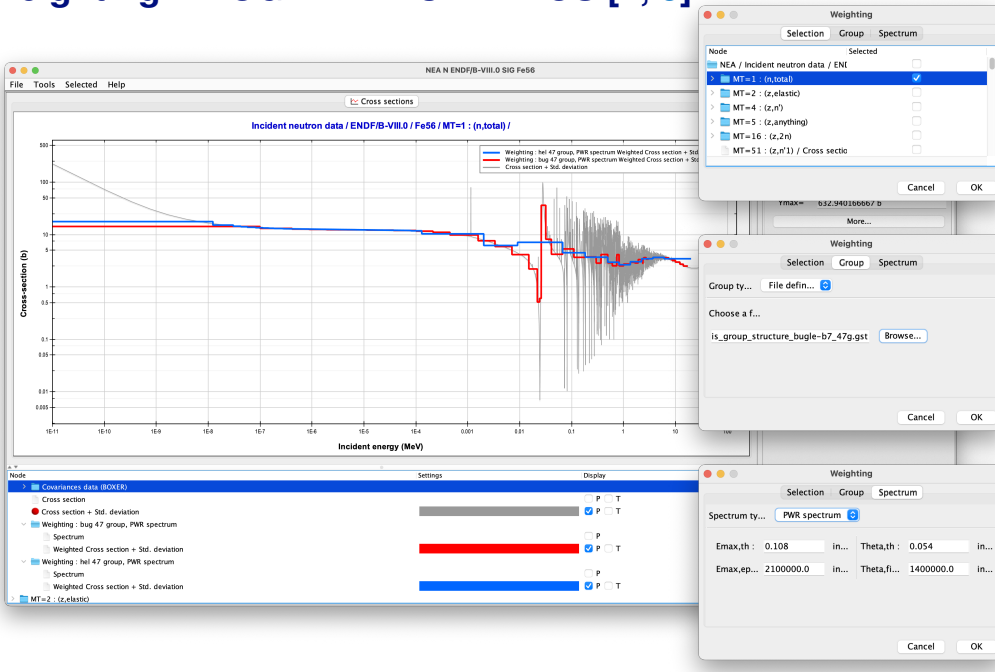
Radioactive Decay, cont.



Radioactive Decay, cont.

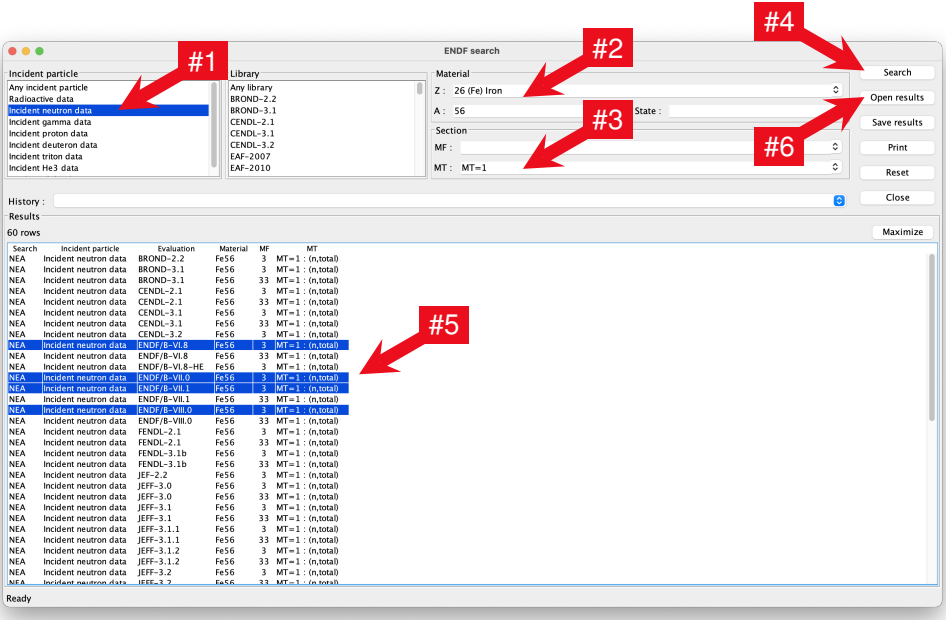


“Weighting”: BUGLE-B7 vs. HELIOS [4, 5]



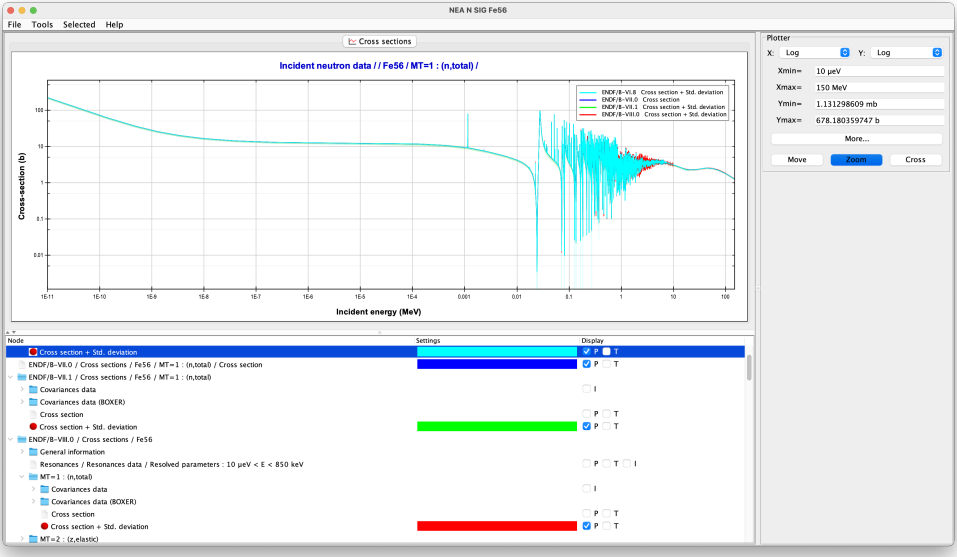
Available from the Tools menu Weighting entry.
Other group structure files are available from the JANIS download webpage.
Weighting spectrum details available in [3].

Querying Multiple Libraries



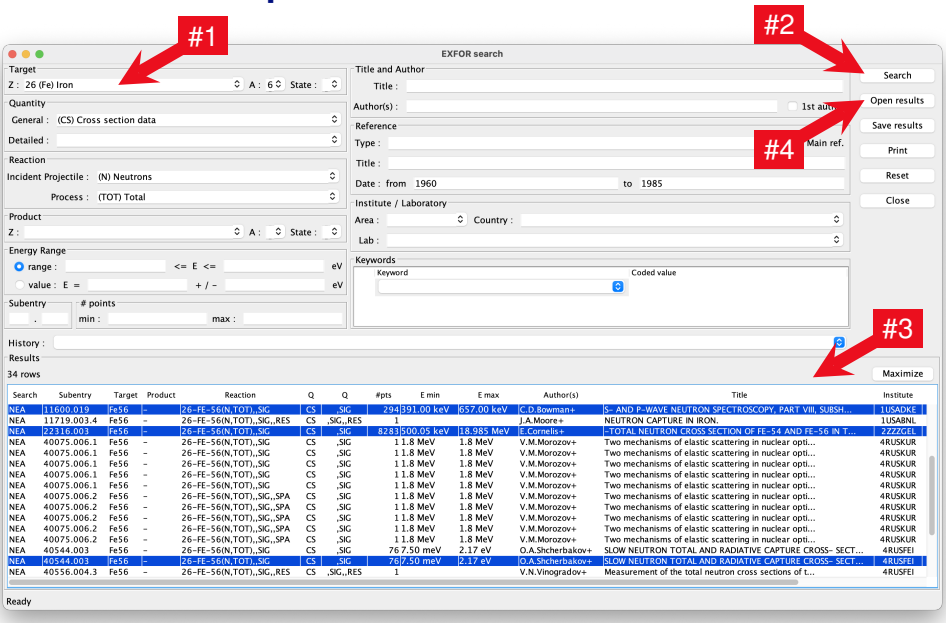
Available from the Tools menu Searches/ENDF entry.

Querying Multiple Libraries, cont.



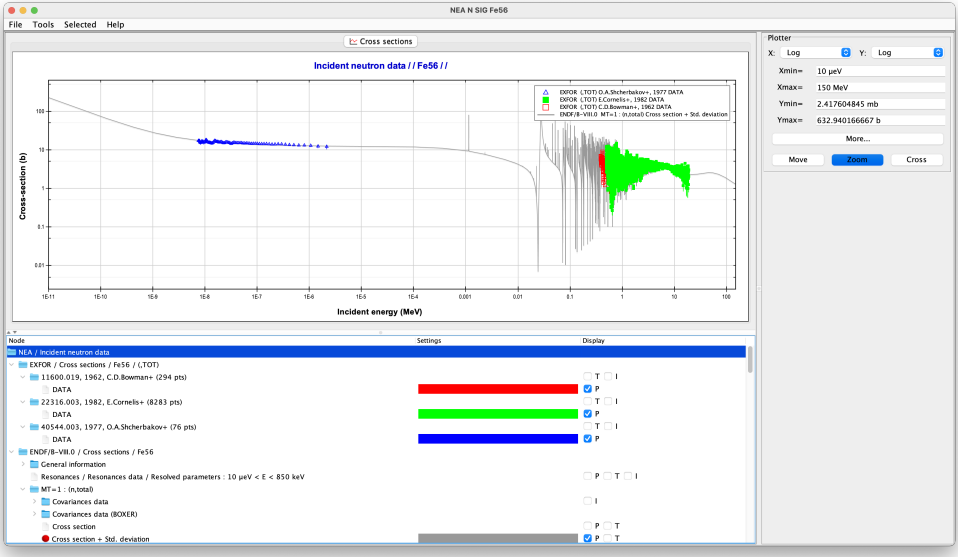
Select the newly available plots and style as desired.

Evaluation vs. Experiment



Available from the Tools menu Searches/EXFOR entry.

Evaluation vs. Experiment, cont.



Select the newly available plots and style as desired.

Questions?

Contact Information

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jkulesza@lanl.gov

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Backup Slides

References

[1] N. Soppera, M. Bossant, and E. Dupont, "JANIS 4: An Improved Version of the NEA Java-based Nuclear Data Information System," *Nuclear Data Sheets*, vol. 120, pp. 294–296, June 2014.

[2] M. E. Rising, "Evaluating Sensitivity-based Similarity Metrics Between Applicationsand Benchmarks," Tech. Rep. LA-UR-19-29241, Los Alamos National Laboratory, Los Alamos, NM, USA, Sept. 2019.

[3] N. Soppera, T. Ergun, M. Kellett, A. Nouri, Y. Rugama, H. Henriksson, and E. Dupont, "JANIS 4.0 User's Guide," Oct. 2013. Rev. 1.

[4] J. M. Risner, D. Wiarda, M. E. Dunn, T. M. Miller, D. E. Peplow, and B. W. Patton, "Production and Testing of the VITAMIN-B7 Fine-Group and BUGLE-B7 Broad-Group Coupled Neutron/Gamma Cross-Section Libraries Derived from ENDF/B-VII.0 Nuclear Data," Tech. Rep. NUREG/CR-7045 (ORNL/TM-2011/12), Oak Ridge National Laboratory, Oak Ridge, TN, USA, Jan. 2011.

References

[5] J. J. Casal, R. J. J. Stamm'ler, E. Villarino, and A. Ferri, "HELIOS: Geometric Capabilities of a New Fuel Assembly Program," in *Proceedings of the International Topical Meeting on Advances in Mathematics, Computations, and Reactor Physics*, (Pittsburgh, PA, USA), pp. 10.2–1–1 to 10.2–1–13, American Nuclear Society, 1991.

JANIS Group Structure File: BUGLE-B7 [4]

```
neutron group structure......bug 47 group
47 1.0000E-05  1.0000E-01
46 1.0000E-01  4.1399E-01
45 4.1399E-01  8.7643E-01
44 8.7643E-01  1.8554E+00
43 1.8554E+00  5.0435E+00
42 5.0435E+00  1.0677E+01
41 1.0677E+01  3.7267E+01
40 3.7267E+01  1.0130E+02
39 1.0130E+02  2.1445E+02
38 2.1445E+02  4.5400E+02
37 4.5400E+02  1.5846E+03
36 1.5846E+03  3.3546E+03
35 3.3546E+03  7.1017E+03
34 7.1017E+03  1.5034E+04
33 1.5034E+04  2.1875E+04
32 2.1875E+04  2.4176E+04
31 2.4176E+04  2.6058E+04
30 2.6058E+04  3.1828E+04
29 3.1828E+04  4.0868E+04
28 4.0868E+04  6.7379E+04
27 6.7379E+04  1.1109E+05
26 1.1109E+05  1.8316E+05
25 1.8316E+05  2.9721E+05
24 2.9721E+05  3.6883E+05
23 3.6883E+05  4.9787E+05
22 4.9787E+05  6.0810E+05
21 6.0810E+05  7.4274E+05
20 7.4274E+05  8.2085E+05
19 8.2085E+05  1.0026E+06
18 1.0026E+06  1.3534E+06
17 1.3534E+06  1.6530E+06
16 1.6530E+06  1.9205E+06
15 1.9205E+06  2.2313E+06
14 2.2313E+06  2.3457E+06
13 2.3457E+06  2.3652E+06
12 2.3652E+06  2.4660E+06
11 2.4660E+06  2.7253E+06
10 2.7253E+06  3.0119E+06
9  3.0119E+06  3.6788E+06
8  3.6788E+06  4.9658E+06
7  4.9658E+06  6.0653E+06
6  6.0653E+06  7.4082E+06
5  7.4082E+06  8.6071E+06
4  8.6071E+06  1.0000E+07
3  1.0000E+07  1.2214E+07
2  1.2214E+07  1.4191E+07
1  1.4191E+07  1.7332E+07
```

JANIS Group Structure File: HELIOS [5]

```
neutron group structure......hel 47 group
47 0.000000E+00 1.239596E-02
46 1.239596E-02 3.061288E-02
45 3.061288E-02 4.275520E-02
44 4.275520E-02 5.692194E-02
43 5.692194E-02 8.196816E-02
42 8.196816E-02 1.115699E-01
41 1.115699E-01 1.457206E-01
40 1.457206E-01 1.844302E-01
39 1.844302E-01 2.705213E-01
38 2.705213E-01 3.576701E-01
37 3.576701E-01 5.032318E-01
36 5.032318E-01 6.250621E-01
35 6.250621E-01 7.820830E-01
34 7.820830E-01 9.099967E-01
33 9.099967E-01 9.710043E-01
32 9.710043E-01 1.013699E+00
31 1.013699E+00 1.072203E+00
30 1.072203E+00 1.125397E+00
29 1.125397E+00 1.166404E+00
28 1.166404E+00 1.235105E+00
27 1.235105E+00 1.457402E+00
26 1.457402E+00 1.855391E+00
25 1.855391E+00 2.382393E+00
24 2.382393E+00 3.927903E+00
23 3.927903E+00 4.450897E+00
22 4.450897E+00 5.043477E+00
21 5.043477E+00 5.715008E+00
20 5.715008E+00 6.476017E+00
19 6.476017E+00 7.338215E+00
18 7.338215E+00 8.315287E+00
17 8.315287E+00 1.209903E+01
16 1.209903E+01 1.371000E+01
15 1.371000E+01 2.902291E+01
14 2.902291E+01 4.785117E+01
13 4.785117E+01 7.889325E+01
12 7.889325E+01 1.300704E+02
11 1.300704E+02 2.034700E+03
10 2.034700E+03 9.118801E+03
9  9.118801E+03 6.737900E+04
8  6.737900E+04 1.831601E+05
7  1.831601E+05 4.978702E+05
6  4.978702E+05 8.208500E+05
5  8.208500E+05 1.353400E+06
4  1.353400E+06 2.231299E+06
3  2.231299E+06 3.678800E+06
2  3.678800E+06 6.065300E+06
1  6.065300E+06 2.000000E+07
```