Nuclear Data at BNL: Toward ENDF/B-IX.0

G.P.A. Nobre

Third International Workshop on
Perspectives on Nuclear Data for the Next Decade
March 9-13, 2026 - Paris, France

@BrookhavenLab

BNL-3313372

Outline

- Contextualizing ND at BNL: NNDC

- ENDF/B-VIII.1

- ENDF Library activities towards ENDF/B-IX.0

  - Expectations

  - Developments

  - Status and plans

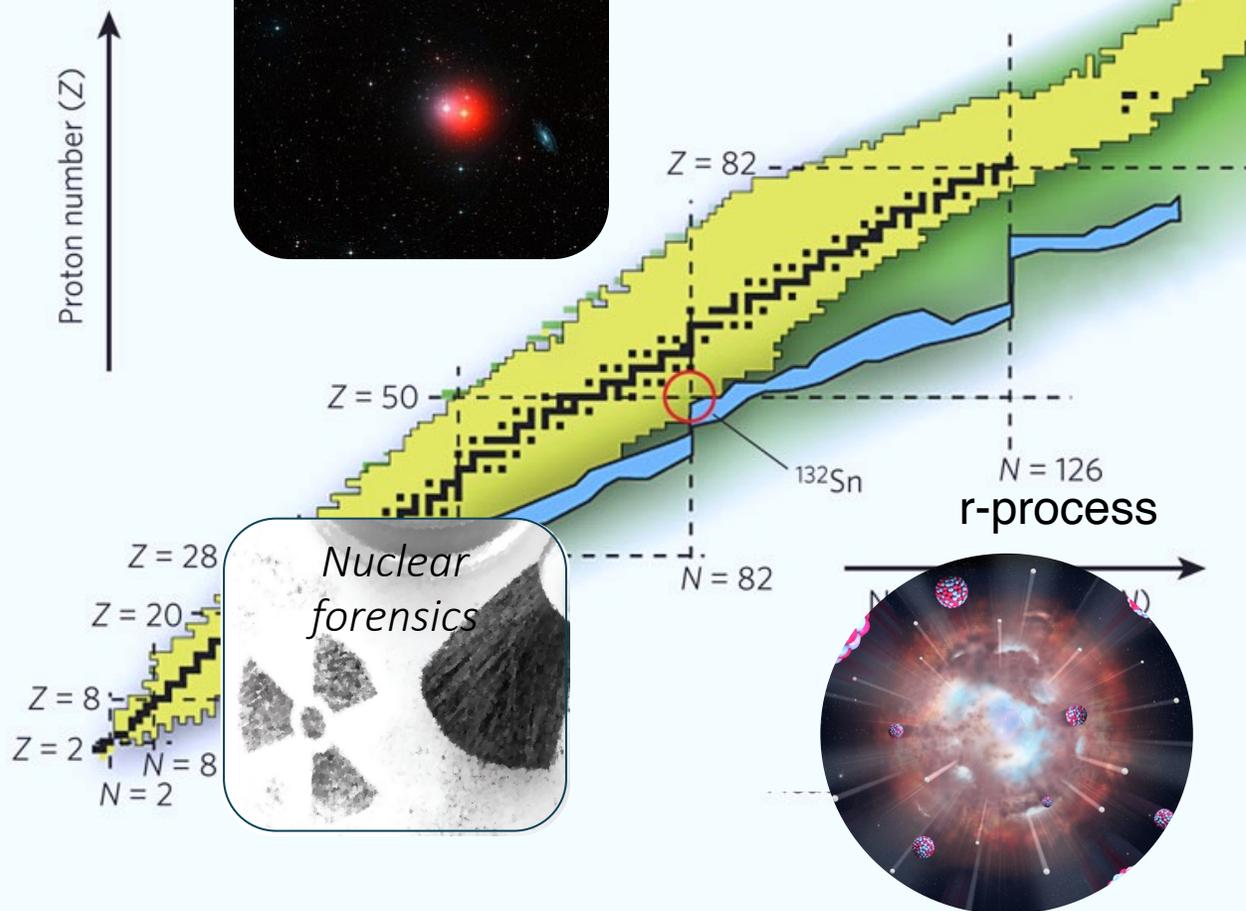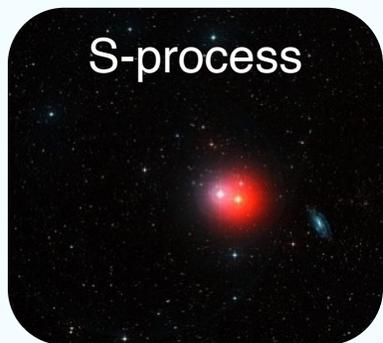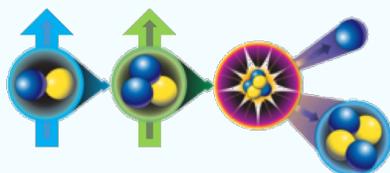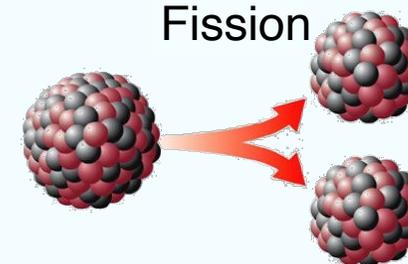# Nuclear Data is the interface between nuclear physics and science, and technical nuclear applications on which they depend

What is the NNDC?

Mission

The National Nuclear Data Center (NNDC) **collects**, **evaluates**, and **disseminates nuclear physics data** for basic nuclear research and applied nuclear technologies. The NNDC is a worldwide resource for nuclear data. The information available to the users of NNDC services is the product of the combined efforts of the NNDC and cooperating data centers and other interested groups, both in the United States and worldwide.

some people are missing in the picture!

https://www.nndc.bnl.gov/about/
https://www.nndc.bnl.gov/history/

https://www.nndc.bnl.gov/

Outdated!
We've moved to 490D

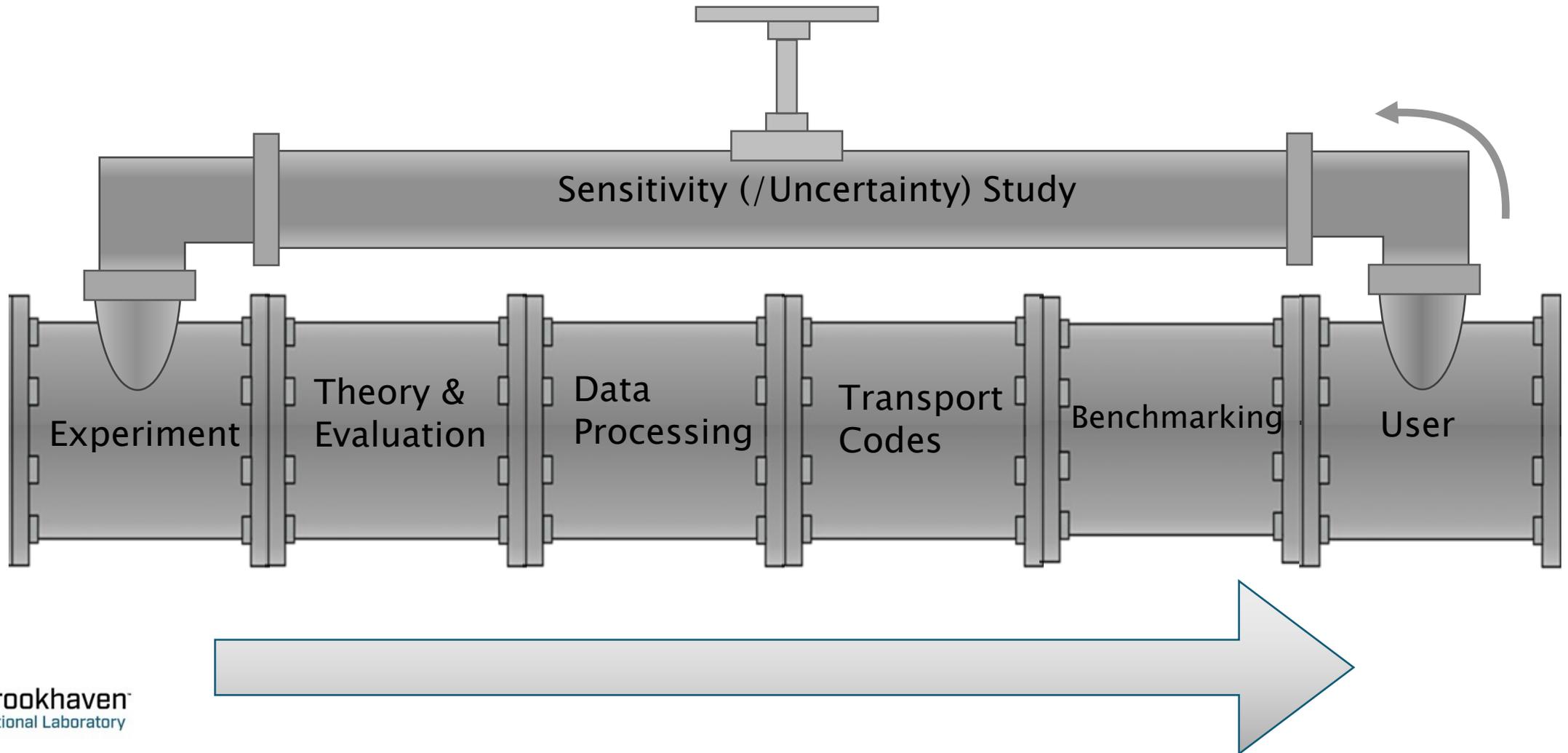# The Cross Section Evaluation Working Group produces ENDF/B library

- **Formed 1966 & Chaired by BNL**

- **Currently ~200 members of the collaboration from 25 institutions**
  - US programs, industry and international partners
  - If you see something in the library, at some point a sponsor somewhere wanted it

- **All steps of nuclear data pipeline coordinated through CSEWG**

- **Depending on what needs done, getting required data in library can be major effort**

2025 CSEWG meeting, BNL, Jan. 2026

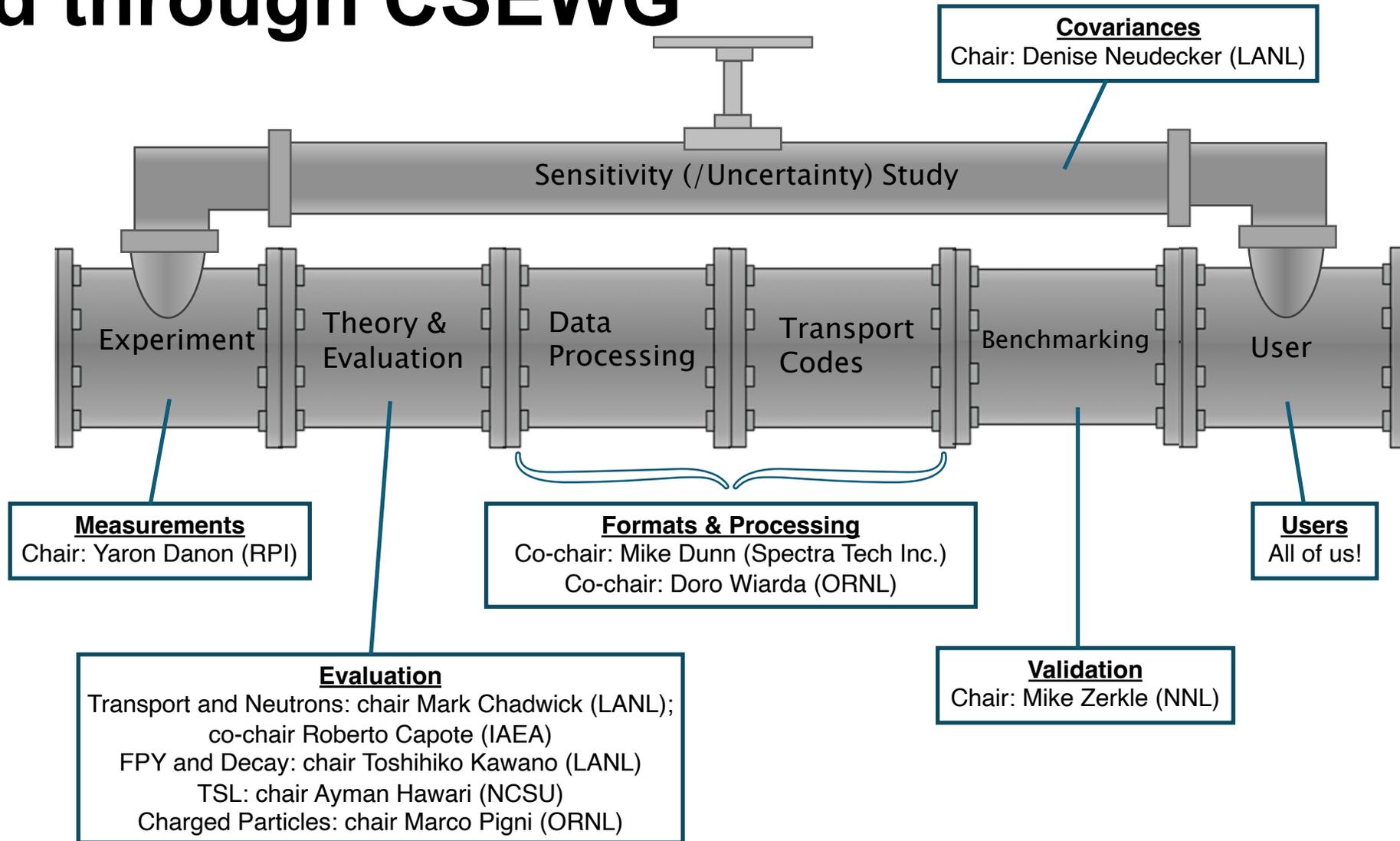**We are always open to new users and collaborators**

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The Nuclear Data Pipeline

Sensitivity (/Uncertainty) Study

Experiment

Theory & Evaluation

Data Processing

Transport Codes

Benchmarking

User

All steps of nuclear data pipeline are coordinated through CSEWG

Chair:
   David Brown (BNL)
   dbrown@bnl.gov

Library Manager:
   Gustavo Nobre (BNL)
   gnobre@bnl.gov

Covariances
Chair: Denise Neudecker (LANL)

Sensitivity (/Uncertainty) Study

Experiment | Theory & Evaluation | Data Processing | Transport Codes | Benchmarking | User

Measurements
Chair: Yaron Danon (RPI)

Formats & Processing
Co-chair: Mike Dunn (Spectra Tech Inc.)
Co-chair: Doro Wiarda (ORNL)

Users
All of us!

Evaluation
Transport and Neutrons: chair Mark Chadwick (LANL);
co-chair Roberto Capote (IAEA)
FPY and Decay: chair Toshihiko Kawano (LANL)
TSL: chair Ayman Hawari (NCSU)
Charged Particles: chair Marco Pigni (ORNL)

Validation
Chair: Mike Zerkle (NNL)

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ENDF Timeline

1962 — Meeting in DC led to conception of CSEWG & ENDF

1972 — ENDF/B-III

1975 — ENDF/B-IV

1977 — AEC becomes DOE

1990-2001 — ENDF/B-VI's

2006 — ENDF/B-VII.0

2018 — ENDF/B-VIII.0

2024 — ENDF/B-VIII.1

1960   1970   1980   1990   2000   2010   2020   2030   2040

1965 — ENDF format published

1966 — CSEWG formed

1968 — ENDF/B-I

1970 — ENDF/B-II

1979 — ENDF/B-V (classified)

1985 — ENDF/B-V.2*

2011 — ENDF/B-VII.1

2020 — GNDS-1.9 published

2023 — GNDS-2.0 published

2030? — ENDF/B-IX.0 (planned)

Timeline courtesy of Dave Brown

Strong connection with user needs!

- Shortly after the ENDF/B-VIII.0 release, it was reported that a loss reactivity was found at high burnup, which discouraged its adoption by the nuclear reactor community
- This depletion issue was taken seriously in validation efforts during VIII.1 development

Journal of *Nuclear Engineering*

Article

Neutronic Characteristics of ENDF/B-VIII.0 Compared to ENDF/B-VII.1 for Light-Water Reactor Analysis

Kang-Seog Kim * and William A. Wieselquist

Investigation on the Reactivity Underestimation of ENDF/B-VIII.0 Compared to ENDF/B-VII.1 for Thermal Reactor Analysis
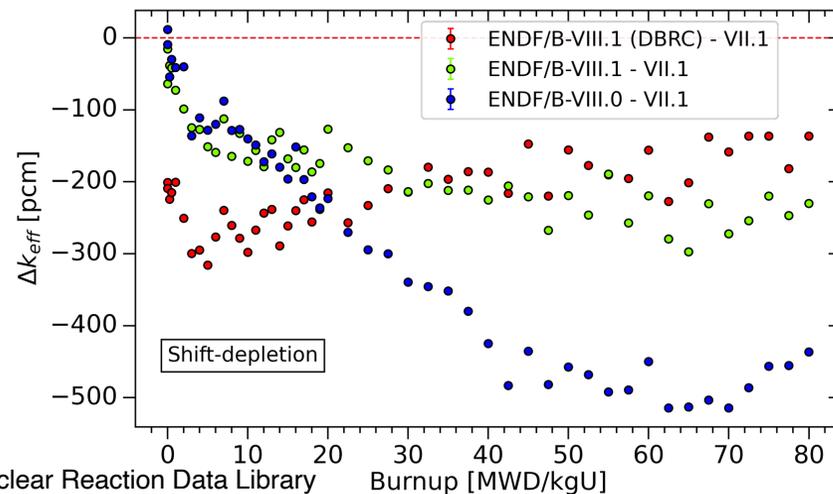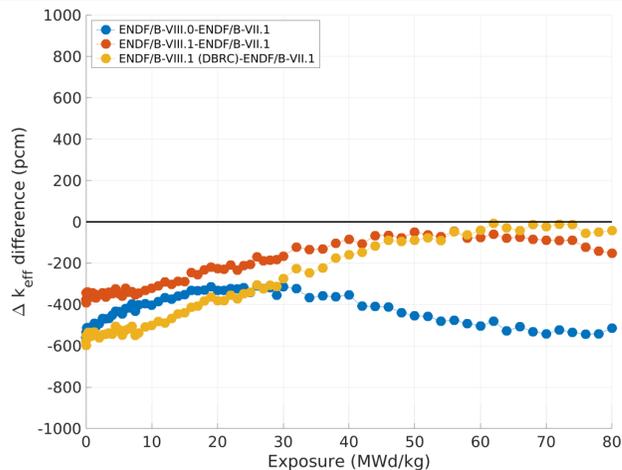
2020 CSEWG Meeting
December 2, 2020

SCALE XSProc Team

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

Discussion & Conclusion

- **ENDF/B-VII.1 vs. ENDF/B-VIII.0**
  - Most influencing nuclides
    - U-238, Pu-239, O-16 and U-235
    - U-238: +300 pcm at 0 burnup & getting decreased at high burnup
    - O-16: -150 pcm at all burnup steps
    - U-235: -150 pcm at all burnup steps
    - Pu-239: -200 pcm at high burnups
  - Error cancellation
    - U-238 (positive) vs. U-235 + O-16 (negative)
  - Decay data & F.P. yield data
    - No impact
  - Thermal reactor analysis
    - Generally accepted that even ENDF/B-VII.1 underestimates keff at high burnup
    - No epithermal upscattering
      - Considering epithermal upscattering would make it more negative
    - ENDF/B-VIII.0 may not be used for thermal reactor (PWR & BWR) analysis
  - ENDF/B release
    - May need to perform a sensitivity study for depletion effect

Strong connection with user needs!

- Shortly after the ENDF/B-VIII.0 release, it was reported that a loss reactivity was found at high burnup, which discouraged its adoption by the nuclear reactor community

- This depletion issue was taken seriously in validation efforts during VIII.1 development

- As shown by multiple independent sets of calculations, the depletion performance was dramatically improved in ENDF/B-VIII.1
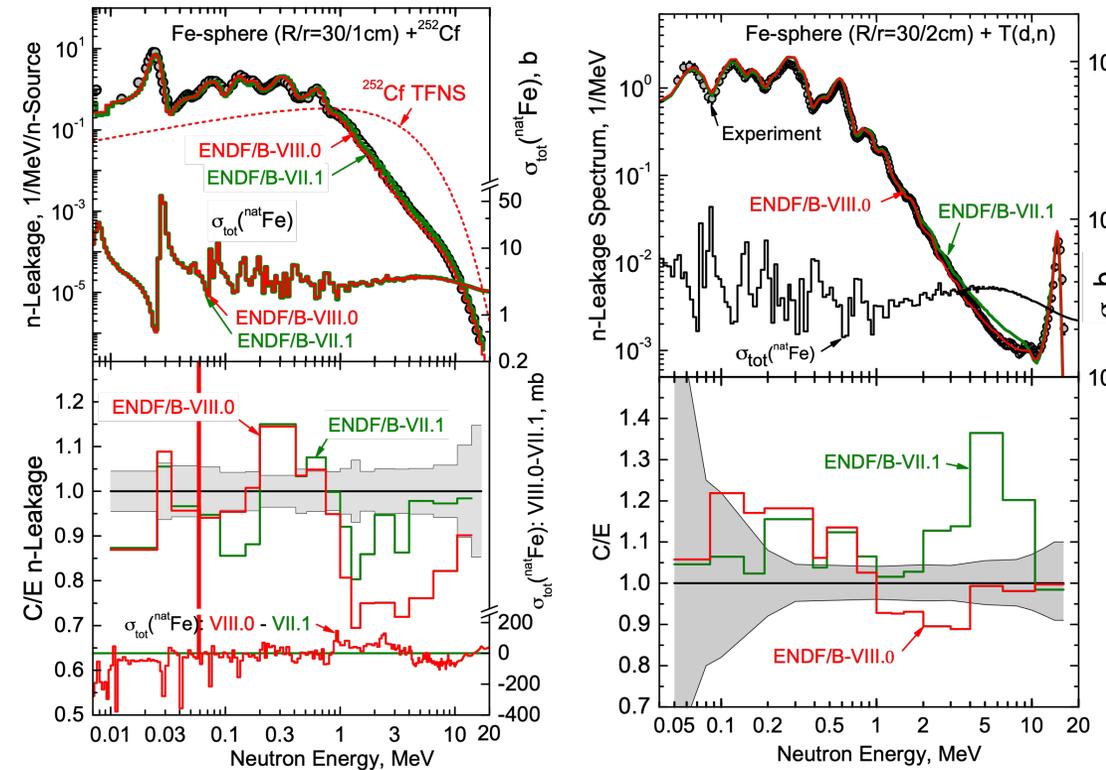

G. P. A. NOBRE et al., "ENDF/B-VIII.1: Updated Nuclear Reaction Data Library for Science and Applications," Nucl. Data Sheets (2024) (submitted for publication).

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Strong connection with user needs!

- Just before the ENDF/B-VIII.0 release, it was found that there was a 30% underestimation of neutron leakage in iron spheres.

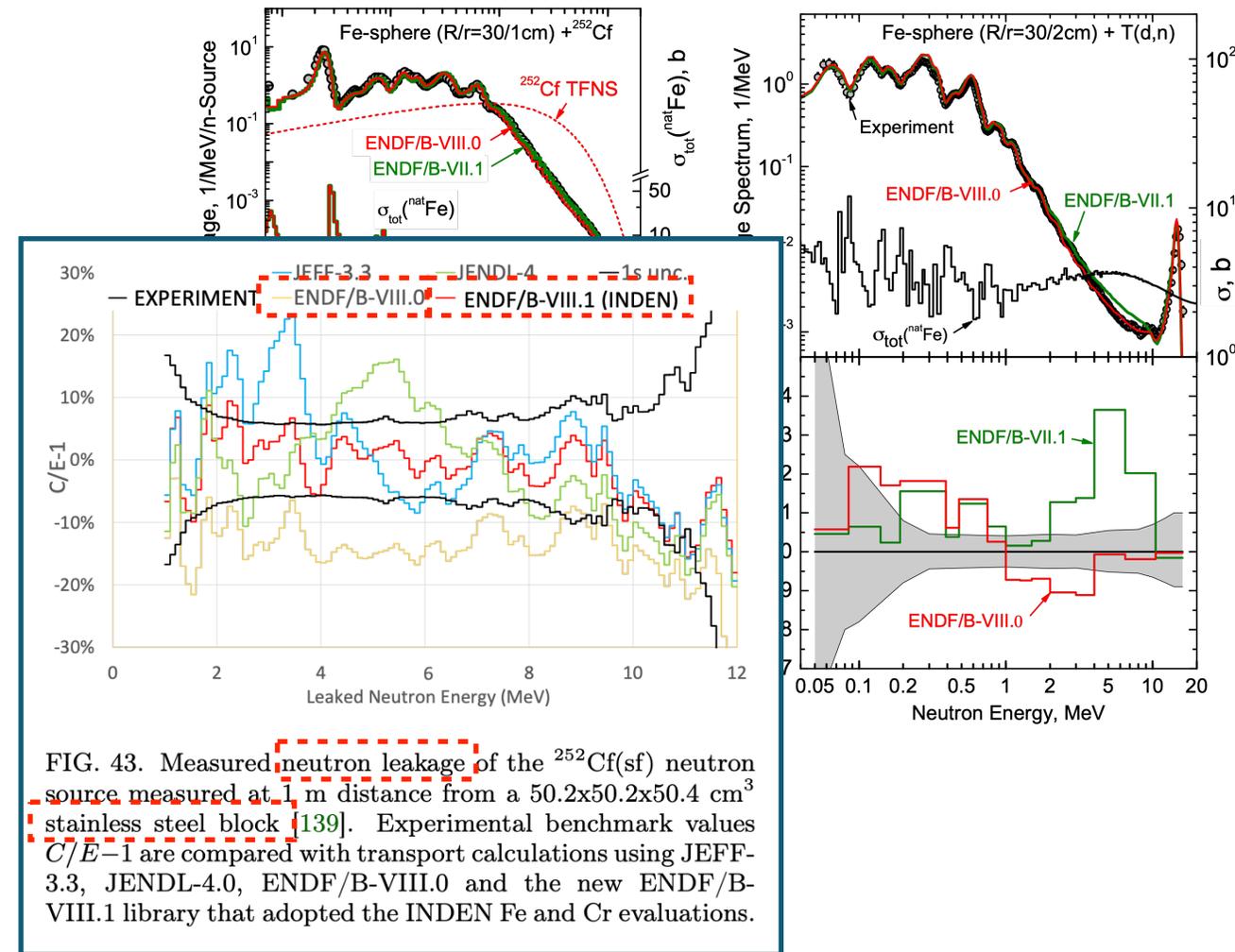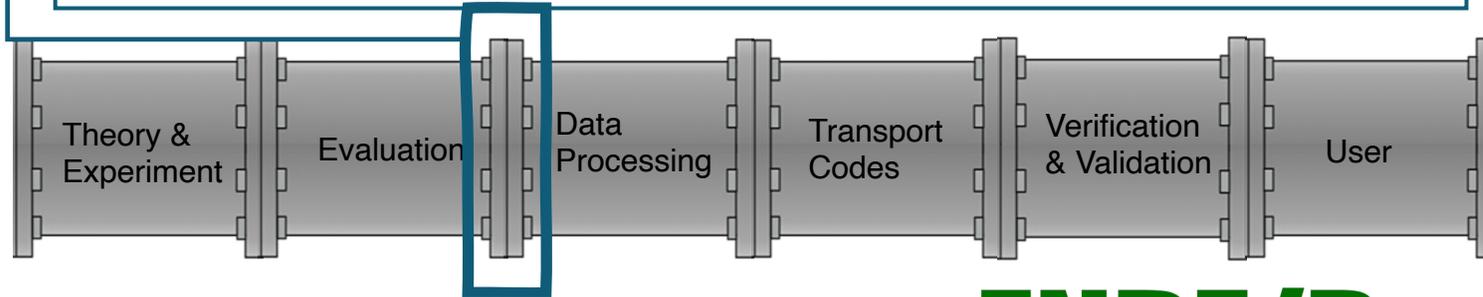- This prevented VIII.0 Fe to be used in reactor shielding simulations

Strong connection with user needs!

- Just before the ENDF/B-VIII.0 release, it was found that there was a 30% underestimation of neutron leakage in iron spheres.

- This prevented VIII.0 Fe to be used in reactor shielding simulations

- This was fixed in ENDF/B-VIII.1

- Feedback from reactor community that this finally allowed them to move to a more recent release

- Bonus: Leakage validation was considered more carefully in the evaluation of other structural materials: Cr, Cu, Pb, etc…

FIG. 43. Measured neutron leakage of the ^{252}Cf(sf) neutron source measured at 1 m distance from a 50.2x50.2x50.4 cm^3 stainless steel block [139]. Experimental benchmark values $C/E-1$ are compared with transport calculations using JEFF-3.3, JENDL-4.0, ENDF/B-VIII.0 and the new ENDF/B-VIII.1 library that adopted the INDEN Fe and Cr evaluations.

G. P. A. NOBRE et al., "ENDF/B-VIII.1: Updated Nuclear Reaction Data Library for Science and Applications," Nucl. Data Sheets (2024) (submitted for publication).

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ENDF/B releases are a key interface in the improvement of the nuclear data that reaches the users' community!

Theory & Experiment | Evaluation | Data Processing | Transport Codes | Verification & Validation | User

ENDF/B VIII.1
was released Aug 30, 2024!

The previous release (VIII.0) was great, but…
- Underpredicted depletion at high burnup
- Had deficiencies in leakage benchmarks
- Many other contributions since then
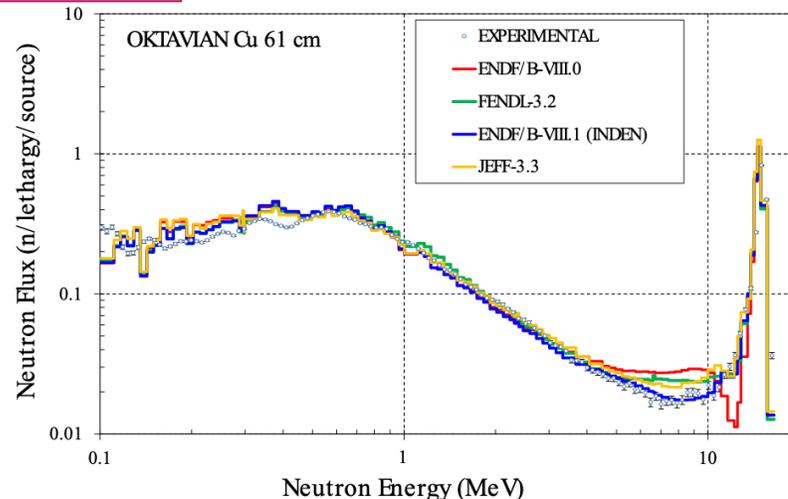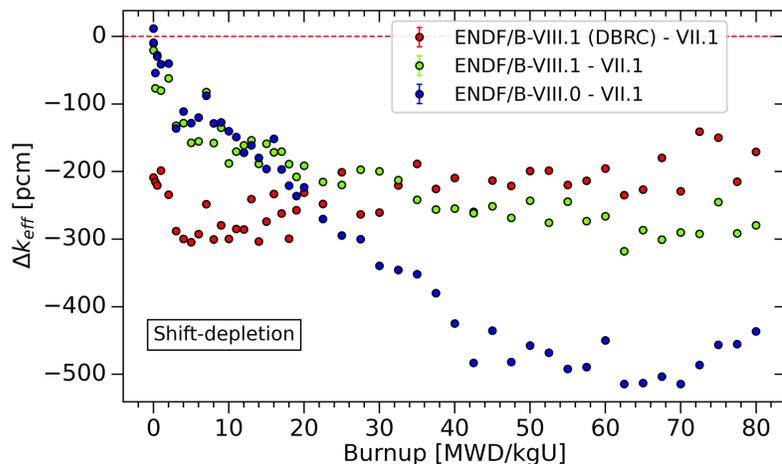
Mosteller's Suite - 123

□ Case HMF4.1: Δkeff EXP=30 pcm

- ENDF/B-VII.1
- ENDF/B-VIII.0b4
- JEFF-3.3
- ENDF/B-VIII.1b2
- ENDF/B-VIII.1b3
- ENDF/B-VIII.1b4

$$\chi^2 = \frac{1}{N} \cdot \sum_{i=1}^{N} \frac{(k_{C,i} - k_{E,i})^2}{\Delta k_{C,i}^2 + \Delta k_{E,i}^2}$$

(SUM Chi-squared)/N

PU | HEU | IEU | LEU | U233 | MIX

PMF8-1 | PST9-1,3 | HMF4-1 | HMI6-4 | UMF4-2 | UCT1-3

Num. ICSBEP Benchmarks

Left chart:
- ENDF/B-VIII.1 (DBRC) - VII.1
- ENDF/B-VIII.1 - VII.1
- ENDF/B-VIII.0 - VII.1

Shift-depletion

Δk_{eff} [pcm] vs Burnup [MWD/kgU]

Middle chart:
OKTAVIAN Cu 61 cm
- EXPERIMENTAL
- ENDF/B-VIII0
- FENDL-3.2
- ENDF/B-VIII.1 (INDEN)
- JEFF-3.3

Neutron Flux (n/lethargy/ source) vs Neutron Energy (MeV)

VIII.1 dramatically improves depletion performance,…

…performs much better in leakage and shielding experiments due to updates in Cu, Fe, Cr, Pb,…

…all while further improving the performance in criticality benchmarks, with updates to ^{239}Pu, ^{235,238}U, et al.!!

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Further improvement in criticality performance

- Performance of the library assessed thoroughly and consistently throughout the development against complete suite of benchmarks

- Final set further improves agreement with integral data!!

- Not perfect, still room for improvements
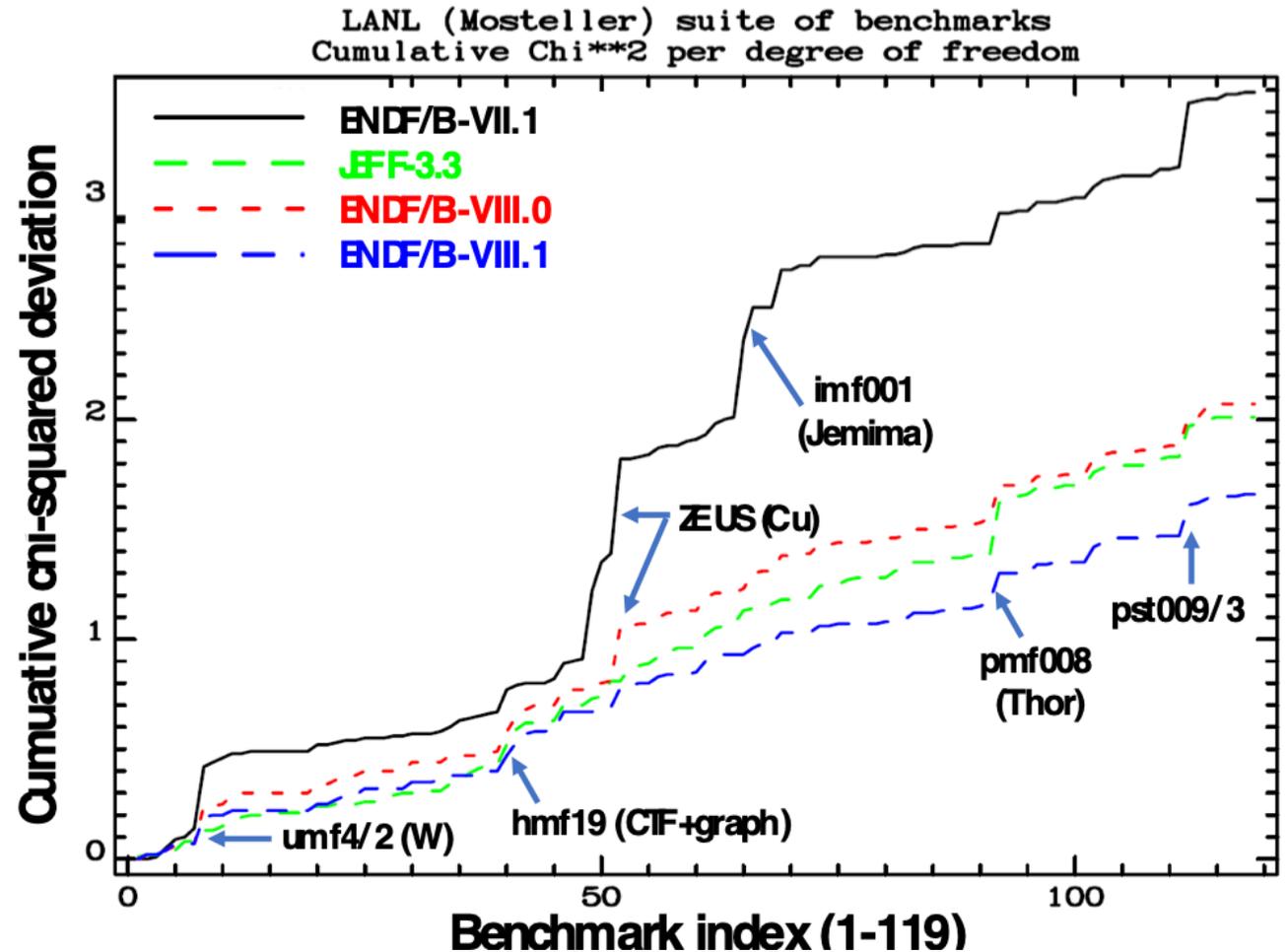
LANL (Mosteller) suite of benchmarks
Cumulative Chi**2 per degree of freedom

ENDF/B-VII.1
JEFF-3.3
ENDF/B-VIII.0
ENDF/B-VIII.1

imf001 (Jemima)
ZEUS (Cu)
pst009/3
pmf008 (Thor)
hmf19 (CTF+graph)
umf4/2 (W)

Cumulative chi-squared deviation

Benchmark index (1-119)

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gnobre@bnl.gov

Bottom line:

If you find an issue with the ENDF/B library, *PLEASE report* to us!

DOIs for ENDF/B-VIII.1 data

"ENDF/B-VIII.1 release." https://doi.org/10.11578/endf/2571019 (2024).

"ENDF/B-VIII.1 release – alphas sublibrary." https://doi.org/10.11578/endf/2571012 (2024).

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"ENDF/B-VIII.1 release – electrons sublibrary." https://doi.org/10.11578/endf/2571016 (2024).

"ENDF/B-VIII.1 release – photonuclear sublibrary." https://doi.org/10.11578/endf/2571020 (2024).

"ENDF/B-VIII.1 release – helions sublibrary." https://doi.org/10.11578/endf/2571021 (2024).

"ENDF/B-VIII.1 release – neutrons sublibrary." https://doi.org/10.11578/endf/2571022 (2024).

"ENDF/B-VIII.1 release – neutron-induced fission product yields sublibrary." https://doi.org/10.11578/endf/2571023 (2024).

"ENDF/B-VIII.1 release – photo-atomic sublibrary." https://doi.org/10.11578/endf/2571024 (2024).

"ENDF/B-VIII.1 release – protons sublibrary." https://doi.org/10.11578/endf/2571025 (2024).

"ENDF/B-VIII.1 release – spontaneous fission product yields sublibrary." https://doi.org/10.11578/endf/2571026 (2024).

"ENDF/B-VIII.1 release – standards sublibrary." https://doi.org/10.11578/endf/2571027 (2024).

"ENDF/B-VIII.1 release – thermal scattering law sublibrary." https://doi.org/10.11578/endf/2571028 (2024).

"ENDF/B-VIII.1 release – tritons sublibrary." https://doi.org/10.11578/endf/2584305 (2024).

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"Big Paper" Timeline

- **October 23, 2024:** Text finalized, only tables and plots needed to be updated from last beta version to final VIII.1

- **December 23, 2024:** Final manuscript submitted to Nuclear Data Sheets

- **August 11, 2025:** Referee reports received

- **October 21, 2025:** Revised manuscript resubmitted

- **November 5, 2025:** Posted in arXiv

https://doi.org/10.48550/arXiv.2511.03564

Hopefully, it will get published early 2026!

arXiv:2511.03564v1 [physics.app-ph] 5 Nov 2025

Preparing original submission

Waiting for response from referees

Addressing comments from 1st round of referee reports

Waiting for response from referees

23-Oct-24 | 23-Nov-24 | 23-Dec-24 | 23-Jan-25 | 23-Feb-25 | 23-Mar-25 | 23-Apr-25 | 23-May-25 | 23-Jun-25 | 23-Jul-25 | 23-Aug-25 | 23-Sep-25 | 23-Oct-25 | 23-Nov-25 | 23-Dec-25 | 23-Jan-26 | 23-Feb-26

Beyond ENDF/B-VIII.1, towards ENDF/B-IX.0

Importance of review process

Allied with consistent validation, review system allows for a predictable, progressively-convergent path towards a **final ENDF release**!

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Allied with consistent validation, review system allows for a predictable, progressively-convergent path towards a **final ENDF release**!

- We learned many lessons from the VIII.1 review process:
  - Identified <u>several issues</u>:
    - Current **review form** is not very useful
    - Wiki page and **report tarballs** are not very helpful either
    - Issues with integration with **processing codes**
  - On the positive side:
    - GitLab's **merge request GUI environment** for review was great for discussions, documentation, tracking of updates, etc., all integrated with commits and issue trackers

Importance of review process
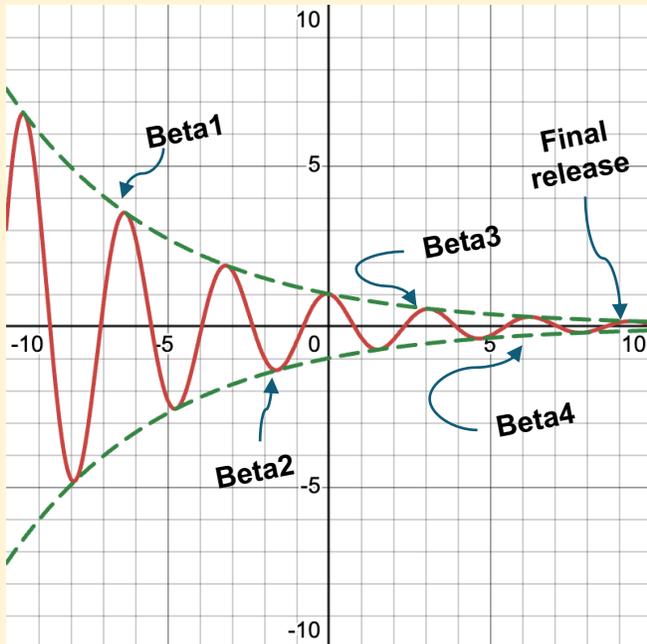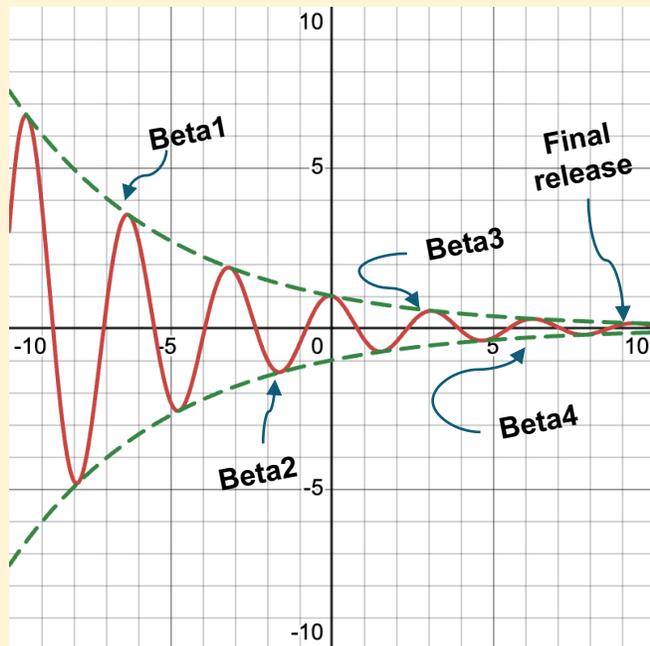
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For the ENDF/B-IX.0 cycle, we are planning a **complete re-work** of the review process through a working group, aiming to make it more user-friendly
- In the meantime, we will keep working as we have been doing…

Expectations for the next library release

It's hard to know what exactly will be in the release, but we can guess…

Known programmatic drivers

- Fusion
- HALEU & next gen. reactors
- Non-proliferation needs
- Data science
- New Standards
- Activation library

Anticipated foci

- **Standards**
- **Actinides:** ^{239}Pu, $^{233,235,238}U$, etc.
- Reactions on unstable fission products
- Materials for next gen. reactors (Cl, Zr (WPEC SG-53),…)
- Data science, ML & AI
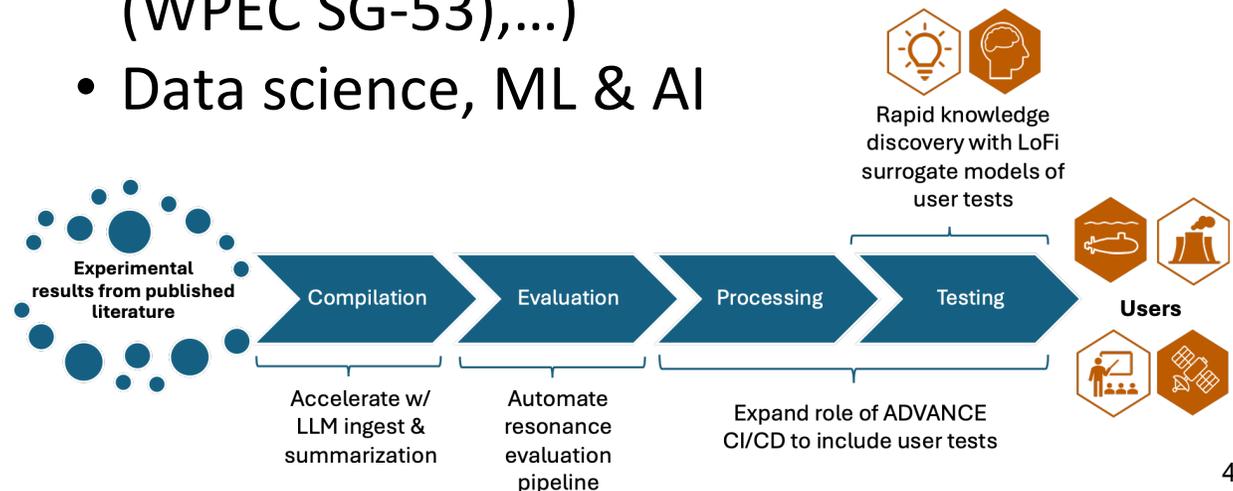
Rapid knowledge discovery with LoFi surrogate models of user tests

Experimental results from published literature → Compilation → Evaluation → Processing → Testing → Users

Accelerate w/ LLM ingest & summarization

Automate resonance evaluation pipeline

Expand role of ADVANCE CI/CD to include user tests

Evaluations already submitted

Neutrons:

- ^{35}Cl (LANL/Terrapower/ORNL)
- ^{238}U (PFNS from Chi-Nu data)

TSL:

- Polyethylene extended temperatures (NCSU/TAMU)
- W, V, Pb, Ni, Mo, Cu (ORNL)

Photonuclear:

- ^{9}Be (NNL)

Expected/planned submissions

Neutrons:

- ^{239}Pu (INDEN; updated inelastic, elastic, total)
- ^{95}Mo, Gd (ORNL)
- Zr (RPI/ORNL/BNL…)
- Gamma spectra fixes
- …

Deuterons:

- D+T (LANL/LLNL)

Standards:

- ^{252}Cf sf
- Etc…

TSL

- Reactor graphite discussion

FPY

Decay

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Photonuclear:
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Initial tests* in Fast MSR (^{Nat}Cl, Pu, MgO reflected) indicate that new Cl file has impact of the order of **~1500pcm**; equivalent to "savings" of about **75kg of ^{239}Pu!**

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TSL
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FPY

Decay

Brookhaven National Laboratory

Thanks to David Bernard (CEA) for the calculations and estimates!

Neutron Data Standards

- Standards are cross sections for specific reactions, in specific energy ranges, that are so well-know that they are often used as reference in other measurements

- New experimental data has prompted the need of reevaluation of the Standards

- For details see A. Carlson's talks in 2025 CSEWG: https://indico.bnl.gov/event/29405/

- IAEA project: https://nds.iaea.org/standards/

TABLE XLV. Neutron Data Standards.

Neutron cross section standards

Reaction	Standards incident neutron energy range
H(n,n)	1 keV to 20 MeV
^{3}He(n,p)	0.0253 eV to 50 keV
^{6}Li(n,t)	0.0253 eV to 1.0 MeV
^{10}B(n,α)	0.0253 eV to 1 MeV
^{10}B(n,$\alpha_1\gamma$)	0.0253 eV to 1 MeV
C(n,n)	10 eV to 1.8 MeV[a]
Au(n,γ)	0.0253 eV, 0.2 to 2.5 MeV, 30 keV MACS
^{235}U(n,f)	8–11eV (integral)
	0.15 to 200 MeV
^{238}U(n,f)	2 MeV to 200 MeV

High energy reference fission cross sections

Reaction	Reference incident neutron energy range
^{Nat}Pb(n,f)	$\approx$ 34 MeV up to 1 GeV
^{209}Bi(n,f)	$\approx$ 34 MeV up to 1 GeV
^{235}U(n,f)	200 MeV to 1 GeV
^{238}U(n,f)	200 MeV to 1 GeV
^{239}Pu(n,f)	200 MeV to 1 GeV

Prompt γ-ray production reference cross sections

Reaction	Reference incident neutron energy range
^{10}B(n,$\alpha_1\gamma$)	0.0253 eV to 1 MeV
^{7}Li(n,n'γ)	0.9 MeV to 8 MeV
^{48}Ti(n,n'γ)	2.8 MeV to 16 MeV

Thermal neutron constants at E=0.0253 eV (2200 m/s)

Prompt fission neutron spectra (PFNS)

Reaction	Reference outgoing neutron energy range
^{235}U(n$_{th}$,f)	0.00001 eV to 30 MeV
^{252}Cf(sf)	0.00001 eV to 30 MeV

[a] The angular distributions at these incident energies are declared standard

Neutron Data Standards

- Standards are cross sections for specific reactions, in specific energy ranges, that are so well-know that they are often used as reference in other measurements

- New experimental data has prompted the need of reevaluation of the Standards

- For details see A. Carlson's talks in 2025 CSEWG: https://indico.bnl.gov/event/29405/

- IAEA project: https://nds.iaea.org/standards/

There will be updates to standards, so…

ENDF/B-VIII.2   ENDF/B-IX.0

TABLE XLV. Neutron Data Standards.

Neutron cross section standards

Reaction	Standards incident neutron energy range
$H(n,n)$	1 keV to 20 MeV
$^3He(n,p)$	0.0253 eV to 50 keV
$^6Li(n,t)$	0.0253 eV to 1.0 MeV
$^{10}B(n,\alpha)$	0.0253 eV to 1 MeV
$^{10}B(n,\alpha_1\gamma)$	0.0253 eV to 1 MeV
$C(n,n)$	10 eV to 1.8 MeV[a]
$Au(n,\gamma)$	0.0253 eV, 0.2 to 2.5 MeV, 30 keV MACS
$^{235}U(n,f)$	8–11eV (integral)
	0.15 to 200 MeV
$^{238}U(n,f)$	2 MeV to 200 MeV

High energy reference fission cross sections

Reaction	Reference incident neutron energy range
$^{Nat}Pb(n,f)$	$\approx$ 34 MeV up to 1 GeV
$^{209}Bi(n,f)$	$\approx$ 34 MeV up to 1 GeV
$^{235}U(n,f)$	200 MeV to 1 GeV
$^{238}U(n,f)$	200 MeV to 1 GeV
$^{239}Pu(n,f)$	200 MeV to 1 GeV

Prompt γ-ray production reference cross sections

Reaction	Reference incident neutron energy range
$^{10}B(n,\alpha_1\gamma)$	0.0253 eV to 1 MeV
$^7Li(n,n'\gamma)$	0.9 MeV to 8 MeV
$^{48}Ti(n,n'\gamma)$	2.8 MeV to 16 MeV

Thermal neutron constants at E=0.0253 eV (2200 m/s)

Prompt fission neutron spectra (PFNS)

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https://doi.org/10.48550/arXiv.2511.03564

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There are many efforts in the community regarding measuring, modeling, evaluating unstable nuclei: Activation library?

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Realistic Reaction Evaluations for Fission Products Off Stability

- Funded project to develop reaction evaluations for fission products off stability
- Leveraging machine-learning and microscopic models
- Expected to impact depletion, waste management, etc.
- Looking for ways to validate this effort

For details, see:

- ND2025 poster
- BNL-229070-2025-INRE report
- 2026 WANDA talk

1st Reactor Graphite (ReGra) Workshop
Bringing together experts in the nuclear data community

Hosted by Brookhaven National Laboratory
July 8–9, 2025

Reactor Graphite Workshop

Jul 8 – 9, 2025
Berkner Hall (Bldg. 488)
US/Eastern timezone

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✉ gnobre@bnl.gov
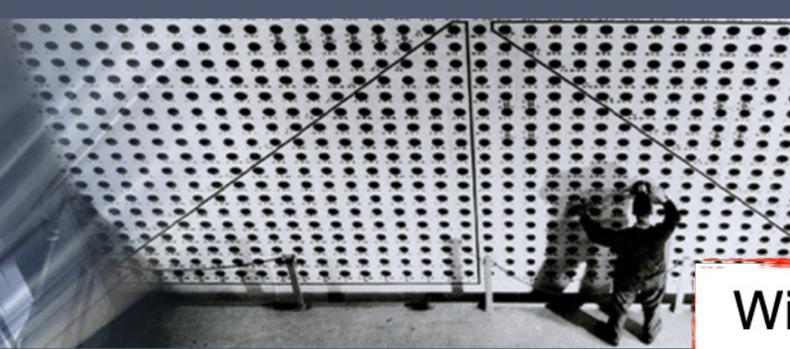
Within the community, there were **different perspectives** on what should the thermal-neutron scattering law libraries associated with reactor graphite.

- This motivated the organization of an in-person, highly-focused workshop.

- Participants from BNL, RPI, ORNL, NCSU, TAMU, Kairos Power, BWXT Advanced Technologies, Foster & Associates, JAEA, INL, LLNL, U. Michigan, LANL, NNL, Studsvik Scandpower

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Meeting minutes published

- Published meeting minutes as a BNL lab report:
  - https://doi.org/10.2172/2998877
  - Report is NOT a scientific paper
  - Report is a description of **what happened** at the meeting:
    - What was presented
    - What was discussed: Comments, objections, replies, agreements and disagreements; past, present, future on the topic
    - Key takeaways: discussed, edited in real time, and agreed upon by ALL participants in the last session, before meeting ended
  - Feedback was **positive**:
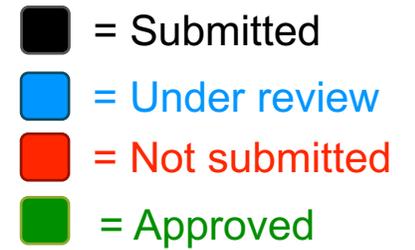   - There will likely be a follow-up edition (2027?)

Report # BNL-229060-2025-INRE

Summary of the 1st Reactor Graphite Workshop,

8-9 July, 2025

Gustavo P.A. Nobre[1], David A. Brown[1], Benjamin Wang[2], Iyad Al-Qasir[3], John Bess[4], Chris Chapman[3], Arantxa Cuadra[1], Yaron Danon[2], Simerjeet Gill[1], Travis Greene[3], Ayman Hawari[5, 6], Richard Hernandez[7], Chase Lawing[8], Gabriel Lentchner[8], Cihang Lu[1], Shinsuke Nakayama[9], Matthew Nash[8], Javier Ortensi[10], Catherine Percher[11], Dominic Piedmont[1], Kemal Ramić[3], Volkan Seker[12], Gregory Siemers[2, 13], Jason Thompson[14], Nicholas Thompson[13], Charles Wemple[15], Michael Zerkle[14]

[1]Brookhaven National Laboratory, [2]Rensselear Polytechnic Institute, [3]Oak Ridge National Laboratory, [4]JFoster & Associates, LLC, [5]North Carilina State University, [6]Texas A&M University, [7]Kairos Power, [8]BWXT Advanced Technologies, LLC, [9]Japan Atomic Energy Agency, [10]Idaho National Laboratory, [11]Lawrence Livermore National Laboratory, [12]University of Michigan, [13]Los Alamos National Laboratory, [14]Naval Nuclear Laboratory, [15]Studsvik Scandpower, Inc.

managed by Brookhaven Science Associates on behalf of the U.S. Department of Energy

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Current status of the library

Neutrons sublibrary

■ = Submitted
■ = Under review
■ = Not submitted
■ = Approved

n-004_Be_009.endf: GRIN capture gammas update

n-006_C_012.endf: GRIN updates to inelastic and capture gammas

n-007_N_014.endf: GRIN inelastic gamma updates

n-007_N_015.endf: GRIN inelastic gamma updates

n-008_O_016.endf: Fixes to elastic covariance issues introduced in Dec. 2022

n-008_O_017.endf: GRIN inelastic gamma updates

n-011_Na_022.endf: GRIN inelastic gamma updates

n-011_Na_023.endf: GRIN inelastic gamma updates

n-012_Mg_024.endf: GRIN updates to inelastic and capture gammas

n-012_Mg_025.endf: GRIN updates to inelastic and capture gammas

n-013_Al_027.endf: GRIN inclusion of branching ratios (needs to address a double-counting issue)

n-014_Si_028.endf: GRIN inclusion of branching ratios

n-014_Si_029.endf: GRIN inclusion of branching ratios (needs to fix an unintended change)

n-014_Si_030.endf: GRIN inclusion of branching ratios (needs to fix an unintended change)

n-014_Si_031.endf: GRIN inclusion of branching ratios

n-014_Si_032.endf: GRIN inclusion of branching ratios (There's a small change in MF/MT=6/800, was that intentional?)

n-016_S_032.endf: GRIN capture gammas update and interpolation flag fix in MT102 – Additional flag fix needs to be reviewed

n-017_Cl_035.endf:
- LANL/Terrapower
- ORNL

n-017_Cl_037.endf:
- LANL/Terrapower
- ORNL

n-025_Mn_055.endf: GRIN inclusion of branching ratios

n-026_Fe_054.endf: Patch to fix negative elastic cross sections

n-057_La_139.endf: ORNL/LANL evaluation

n-073_Ta_181.endf: Fix of URR covariances

n-092_U_234.endf: ORNL update to the two resonances & parameter transformation from MLBW to Reich-Moore

n-092_U_238.endf: LANL new PFNS eval. including Chi-Nu data

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TSL sublibrary

tsl-Cu.endf - NJOY+NCrystal

tsl-HinCH2.endf - NCSU extension of VIII.0 evaluation (updated temperature grid and masses/free atom cross sections)

tsl-Mo.endf - NJOY+NCrystal

tsl-Ni.endf - NJOY+NCrystal

tsl-Pb.endf - NJOY+NCrystal

tsl-V-metal.endf - NJOY+NCrystal

tsl-W-metal.endf - NJOY+NCrystal

Photonuclear sublibrary

g-004_Be_009.endf: Updated NNL evaluation

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Additionally…

- There are many fixes from the 2025 Hackathon (ORNL) sitting on separate branches.
    - I'm slowly going through them, and they should be gradually incorporated into `phase1`/`phase2` branches.
- In process of identifying reviewers to speed up the acceptance of the already-submitted files
- Planning Beta1 release for the Spring, hopefully in sync with the Standards

ENDF/B
IX.0-β1

vs.

ENDF/B
VIII.2-β1

will depend whether standards will be updated in time

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Automation of ENDF data retrieval

- ENDF data is now retrievable through a REST API
  - Allows automation through scripts using unique URLs
  - Usage examples provided using Jupyter Notebook
  - Integrated with plotting capability
  - So far implemented for ENDF/B-VIII.1, VIII.0, VII.1 – whole files or individual cross sections

- Website is live; "README" report: **BNL-229520-2026-INRE**

https://www.nndc.bnl.gov/endf-api

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BNL-229520-2026-INRE

A REST API for Nuclear Reaction Data Libraries

March 6, 2026

managed by Brookhaven Science Associates
on behalf of the U.S. Department of Energy   BNL-5417682   U.S. DEPARTMENT OF ENERGY

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A REST API for Nuclear Reaction Data Libraries

March 6, 2026

ENDF API

Welcome

This is the ENDF REST API entry point. Use the links below to explore the API documentation or run...

Interactive Docs (Swagger UI)
Browse endpoints, inspect schemas, and try out API calls directly from your browser.

Open Swagger UI

Reference Docs (ReDoc)
Read-only documentation view generated from the OpenAPI specification.

Open ReDoc

Tutorial
Jupyter no...
to use this...
Google Co...

View Tu...

Root path: /endf-api

In the future, we plan to extend to other libraries and other observables (ang. dist., spectra, uncertainties/covariances, etc.), provided there is additional support

Conclusion

ENDF/B-VIII.1 released on *August 30, 2024* :

- Many, many important updates
- Substantial <u>improvement</u> in performance
  - Reactor depletion
  - Criticality systems
  - Leakage/shielding
- Accompanying "Big Paper"
  - Revised version submitted in October, 2025, should be published this year
  - Preprint available: https://doi.org/10.48550/arXiv.2511.03564
- DOIs and landing page for data are available now

Beginning of next ENDF cycle, ENDF/B-IX.0:
- Bug fixes: Hackathon in early August at ORNL
- We expect: Standards, ^{239}Pu, ^{233,234,238}U, chlorine, TSL graphite (1st ReGra workshop), etc.
- Improving infrastructure and evaluation & UQ methods
- Working on next Beta release: aiming for late Spring, hopefully in-sync with Standards

Acknowledgements