

National Nuclear
Data Center



ENDF Library Update

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@BrookhavenLab

2024 CSEWG Meeting

BNL - November 5-7, 2024

Outline

- Status of ENDF/B-VIII.1
- ENDF website
- ENDF/B-VIII.1 Big Paper
- ENDF/B-IX.0-Beta1

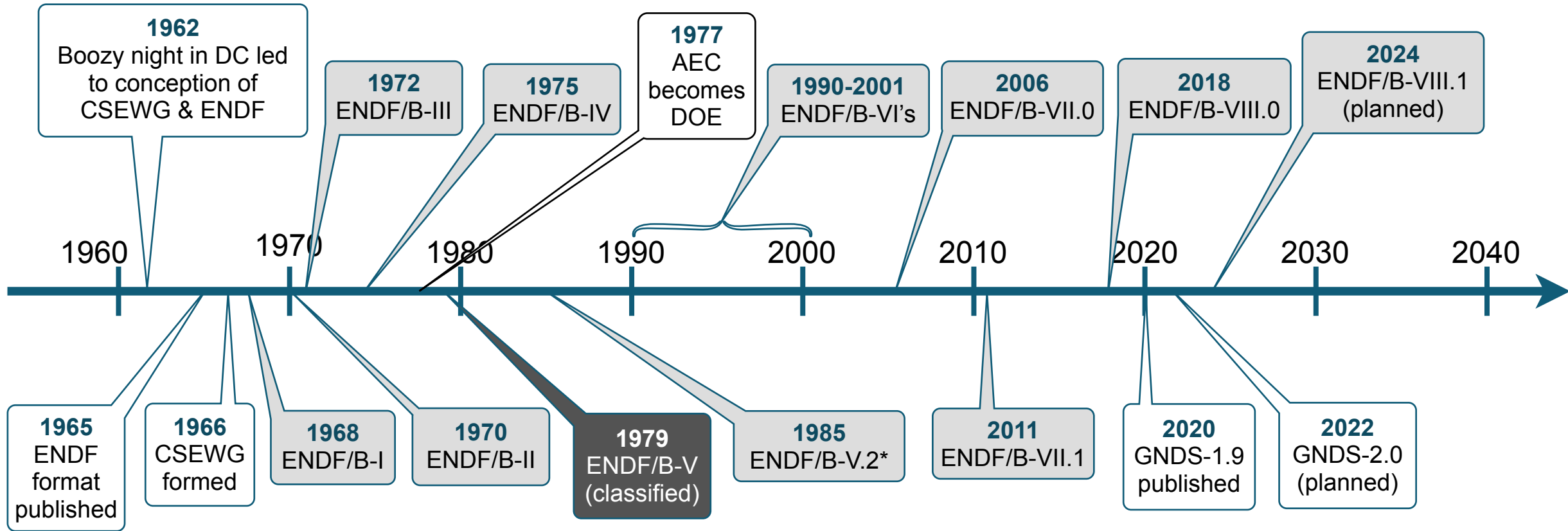
ENDF/B-VIII.1 release status



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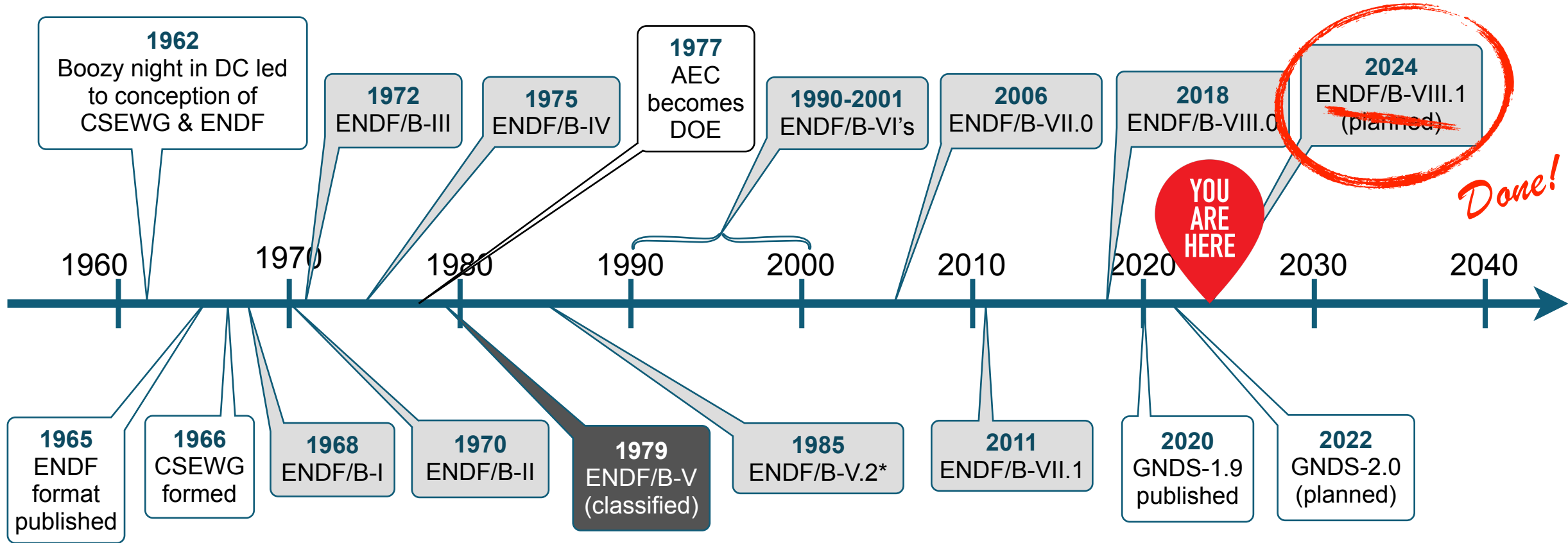
ENDF/B-VIII.1 was released on August 30th, 2024!

ENDF Timeline



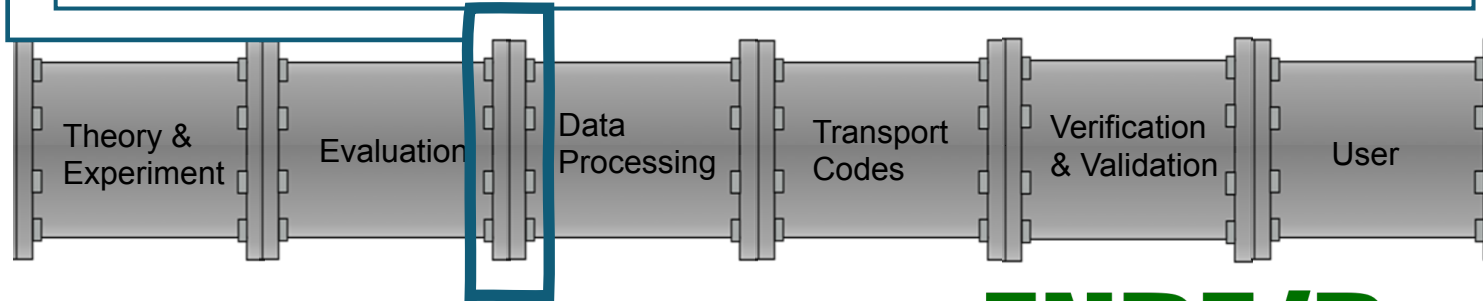
* everybody's favorite release

ENDF Timeline



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



The previous release (VIII.0) was great, but...

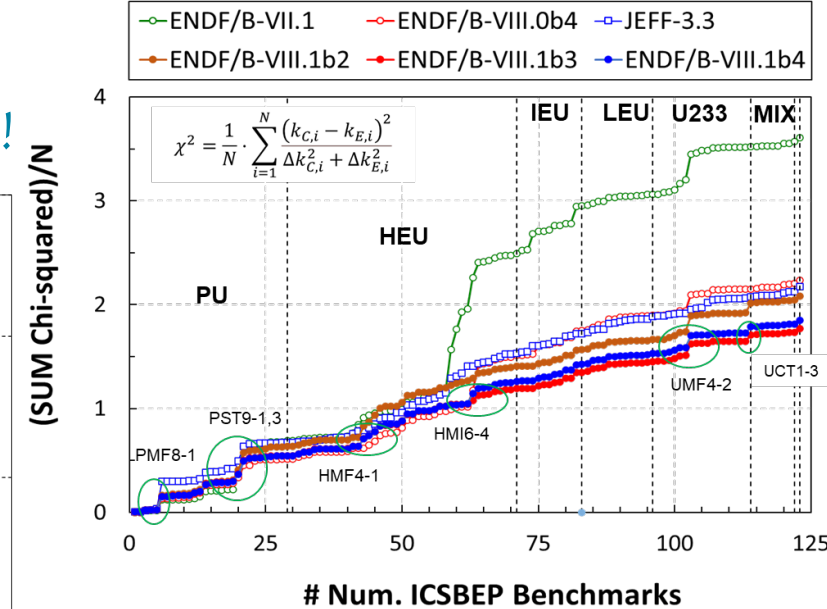
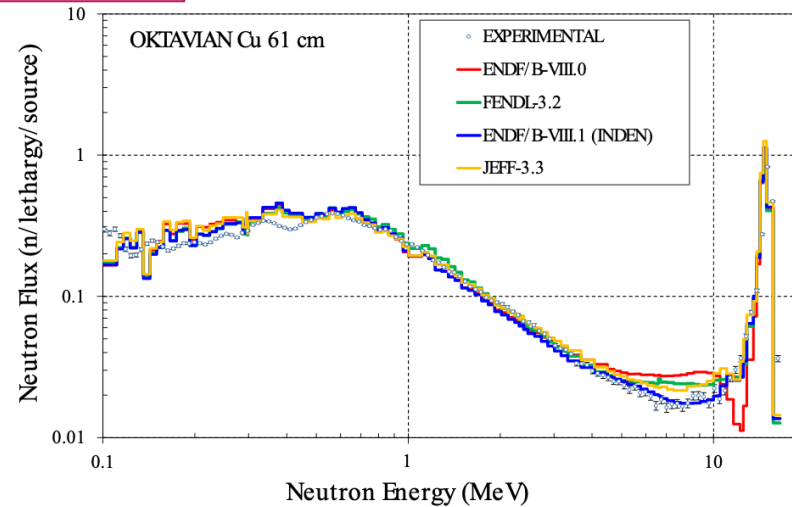
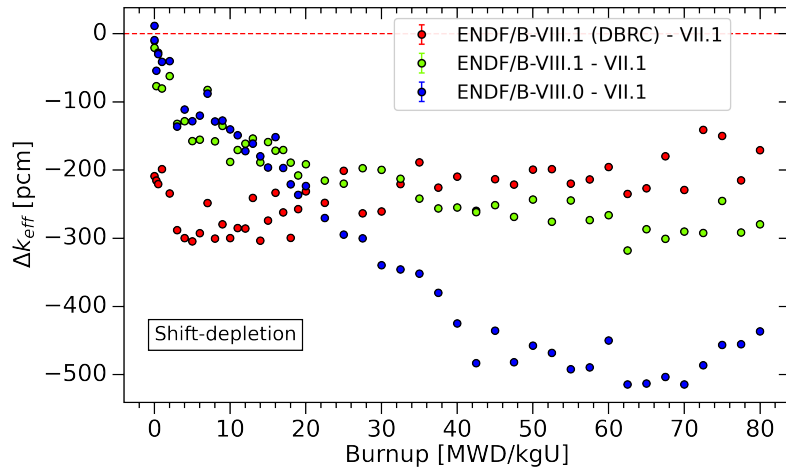
- Underpredicted depletion at high burnup
- Had deficiencies in leakage benchmarks
- Many other contributions since then

ENDF/B VIII.1

was released Aug 30, 2024!

Mosteller's Suite - 123

□ Case HMF4.1: $\Delta k_{eff} EXP = 30$ pcm



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 , $^{235,238}\text{U}$, et al.!!

Feedback on VIII.1

ENDF/B
VIII.1

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VIII.1

- More people have reached out requesting the release (ENDF-6 and GNDS)

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 - Generally positive, nothing unexpected
 - Noticed the need to direct users to the right versions of processing codes

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 - A “procedure mishap” led to an inadvertent replacement of URR covariances by ones extended from fast region
 - This happened on VIII.1-Beta4 and went unnoticed until after VIII.1 final release

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New ENDF website - Donnie Mason

The screenshot displays the National Nuclear Data Center website interface. At the top, the browser address bar shows 'nndc.bnl.gov'. The navigation bar includes the 'National Nuclear Data Center' logo and links for 'Databases', 'Structure & Decay', 'Reactions', and 'Resources'. The Brookhaven National Laboratory logo is on the right. Below the navigation bar, a grid of buttons provides access to various data services: NSR, XUNDL, ENSDF, NuDat, Databases, MIRD, Sigma, EXFOR, and ENDF. The ENDF button is highlighted in dark blue. The main content area features a 'Chart of Nuclides' visualization, a 'Chart of Nuclides' label, and a 'Networks' section with buttons for CSEWG, USNDP, and NDWG. On the right side, there is a vertical stack of buttons for 'Atlas of Neutron Resonances', 'Tool and Publications', 'Nuclear Data Sheets', and 'Nuclear Wallet Cards'. The Brookhaven National Laboratory logo is also present in the bottom left corner.

New ENDF website - Donnie Mason

The screenshot displays the National Nuclear Data Center website. The top navigation bar includes links for Databases, Structure & Decay, Reactions, Resources, and the Brookhaven National Laboratory logo. A left sidebar menu lists various sections such as 'The ENDF Project', 'About ENDF', 'ENDF Formats', and 'ENDF/B Releases'. The main content area is titled 'Evaluated Nuclear Data File (ENDF)' and features a prominent green header. Below the header, there are two call-to-action buttons: 'Try the updated ENDF landing page' with an information icon, and 'ENDF Library' with a right-pointing arrow. A second set of buttons highlights the 'ENDF/B VIII.1' release, dated August 30, 2024, with a 'Download Here' button. A yellow banner on the left side of the main content area reads 'Nuclear Data Sheets ENDF/B-VIII.0 Reference Paper'. The text below the banner describes the ENDF/B-VIII.0 release, noting its incorporation of new Neutron Data Standards and improved thermal neutron scattering data. It also lists notable advances in evaluated data for light nuclei, structural materials, actinides, fission energy release, prompt fission neutron and gamma-ray spectra, thermal neutron scattering data, and charged-particle reactions. At the bottom of the main content area, there is a search interface with tabs for 'Basic Retrieval', 'Extended Retrieval', 'Advanced Retrieval', 'Help', and 'Ogma Retrieval'. The 'Basic Retrieval' tab is active, showing input fields for 'Target', 'Reaction', and 'Quantity'. The 'Library' section on the right lists several data libraries with checkboxes for selection, including ENDF/B-VIII.0 (USA, 2018), ENDF/B-VII.1 (USA, 2011), JEFF-3.3 (Europe, 2017), JENDL-5 (Japan, 2021), CENDL-3.2 (China, 2020), and ROSFOND (Russia, 2010). 'Submit' and 'Reset' buttons are located at the bottom of the search interface. The footer of the page includes sponsorship information from the Office of Nuclear Physics, Office of Science, and the U.S. Department of Energy, along with links for Acknowledgments, About Us, Comments/Questions, and Disclaimer.

New ENDF website - Donnie Mason

Evaluated Nuclear Data File (ENDF)

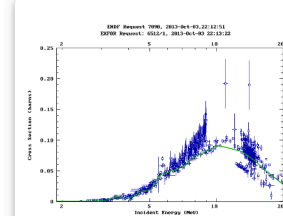
ENDF/B-VIII.1
ENDF/B-VIII.0
ENDF/B-VII.1

ENDF/B VIII.1

Library Releases

DOWNLOAD FULL RELEASES

The ENDF/B-VIII.1 release is the newest evaluated nuclear data library produced, distributed, and recommended by CSEWG for use in nuclear science and technology applications.



Sigma

PLOT ENDF DATA

Retrieving and plotting reaction evaluation data from multiple libraries (e.g., ENDF).



Cross Section Evaluation Working Group

CSEWG

A cooperative effort of the national laboratories, industry, and universities in the United States and Canada, responsible for the production of ENDF/B.

ENDF/B

ENDF Formats

VIEW FORMAT MANUALS

View and download format manuals for ENDF-6 from the current release ENDF-102 (2023) to ENDF/A BNL-8381 (1965). GND specifications are also provided.



CSEWG Document ENDF-102
Report BNL-22491-2023-ENRE
GND Version: 0000114

ENDF-6 Formats Manual
Data Formats and Procedures for the Evaluated Nuclear Data File
ENDF/B-VI, ENDF/B-VII and ENDF/B-VIII

Written by the Members of the Cross-Section Evaluation Working Group

Edited by
D. A. Brown

September 28, 2023

Reports

FORMAL LABORATORY REPORTS

The NNDC is responsible for assigning ENDF reference numbers for all formal laboratory reports associated with the ENDF system.



History

ENDF HISTORY & NAMING

Discover the history and naming of the Evaluated Nuclear Data File (ENDF).

New ENDF website - Donnie Mason

The screenshot displays the ENDF website interface. At the top, there is a navigation bar with the National Nuclear Data Center logo and several menu items: Databases, Structure & Decay, Reactions, Resources, and the Brookhaven National Laboratory logo. Below the navigation bar, a version selector is set to 'B-VIII.1'. A horizontal menu lists various data categories: Full Library, Neutrons, Neutron Standards, Thermal Scattering, Photonuclear, Deuterons, Tritons, Helium-3, Alpha, NFY, and SFY. The 'Full Library' category is selected, leading to the 'ENDF B-VIII.1 Full Library' page. The page features a large green graphic with the text 'ENDF/B VIII.1'. Below this, the text reads 'ENDF B-VIII.1 Full Library (907.934 Mb)'. There is a link for 'Format Manual'. A 'Download Checksum' section shows 'MD5' as the selected format and the checksum '9696a44db1aeb833502a3f128e1e957e'. A 'Download' button is located at the bottom right of this section. At the bottom of the page, there is a 'Citation' section with a dropdown menu set to 'TBD' and a 'Copy' button. Below the citation section, the text 'Awaiting Publication...' is visible.

New ENDF website - Donnie Mason

Library Downloads

[Download Selected](#)

File	Size
<input type="checkbox"/> Electron Reaction Sublibrary	7.544 Mb
<input type="checkbox"/> Photonuclear Sublibrary	141.016 Mb
<input type="checkbox"/> Helium-3 Reaction Sublibrary	203 KB
<input type="checkbox"/> Neutron Reaction Sublibrary	343.487 Mb
<input type="checkbox"/> Neutron Induced Fission Product Yields Sublibrary	1.502 Mb
<input type="checkbox"/> Photoatomic Reaction Sublibrary	33.635 Mb
<input type="checkbox"/> Proton Reaction Sublibrary	12.473 Mb
<input type="checkbox"/> Spontaneous Fission Product Yields Reaction Sublibrary	277 KB
<input type="checkbox"/> Neutron Standards Sublibrary	19.52 Mb
<input type="checkbox"/> Thermal Neutron Scattering Sublibrary	480.459 Mb
<input type="checkbox"/> Triton Reaction Sublibrary	186 KB

Collaboration Summary

Data Manager National Nuclear Data Center (NNDC)

Data Curator Gustavo Nobre

Contact Person Gustavo Nobre

Project Leader David Brown

Hosting Institution Brookhaven National Laboratory (BNL)

Producer Cross Section Evaluation Working Group (CSEWG)

Deposition Summary

Depositor Gustavo Nobre

Contact gnobre@bnl.gov

Deposition Date 10/21/2024

Last Modified 10/21/2024

DOI TBD

Resources



Format Manual



Summary



GNDS

ENDF/B VIII.1

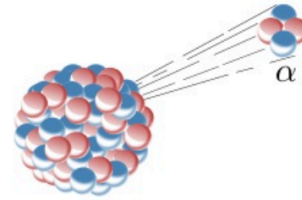
ENDF B-VIII.1 Full Library (907.934 Mb)

[Format Manual](#)

Download Checksum:

9696a44db1aeb833502a3f128e1e957e

 Download



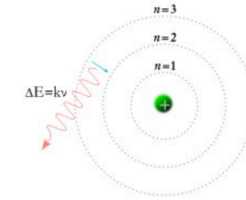
Alpha Reaction Sublibrary (181 KB)

[Release Notes](#) · [Changelog](#) · [Material List](#)

Download Checksum:

6fcf286ea16af58ce4c7dd565eb5c66a

 Download



Atomic Relaxation Reaction Sublibrary (1.397 Mb)

[Release Notes](#) · [Changelog](#) · [Material List](#)

Download Checksum:

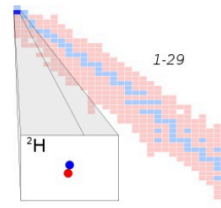
70e9ca0c481236499b7a3e0a490f4ef2

 Download



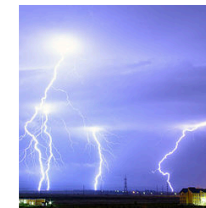
Decay Reaction Sublibrary (10.358 KB)

[Release Notes](#) · [Changelog](#) · [Material List](#)



Deuteron Reaction Sublibrary (208 KB)

[Release Notes](#) · [Changelog](#) · [Material List](#)



Electron Reaction Sublibrary (7.544 Mb)

[Release Notes](#) · [Changelog](#) · [Material List](#)

ENDF/B-VIII.1 Big Paper

Big Paper - ~~GREAT~~ Good news!

ENDF/B-VIII.1: Updated Nuclear Reaction Data Library for Science and Applications

G.P.A. Nobre,^{1,*} R. Capote,² M.T. Pigni,³ A. Trkov,⁴ C.M. Mattoon,⁵ D. Neudecker,⁶ D.A. Brown,¹ M.B. Chadwick,⁶ A.C. Kähler,⁶ N.A. Kleedtke,⁶ M. Zerkle,⁷ A.I. Hawari,⁸ C.W. Chapman,³ N.C. Fleming,⁸ J.L. Wormald,⁷ K. Ramić,³ Y. Danon,⁹ N.A. Gibson,⁶ P. Brain,⁹ M.W. Paris,⁶ G.M. Hale,⁶ I.J. Thompson,⁵ D.P. Barry,¹⁰ I. Stetcu,⁶ W. Haack,⁶ A.E. Lovell,⁶ M.R. Mumpower,⁶ G. Potel,⁵ K. Kravvaris,⁵ G. Noguere,¹¹ J.D. McDonnell,³ A.D. Carlson,¹² M. Dunn,¹³ T. Kawano,⁶ D. Wiarda,³ I. Al-Qasir,^{14,3} G. Arbanas,³ R. Arcilla,¹ B. Beck,⁵ D. Bernard,¹¹ R. Beyer,¹⁵ J.M. Brown,³ O. Cabellos,¹⁶ R.J. Casperson,⁵ Y. Cheng,³ E.V. Chimanski,¹ R. Coles,¹ M. Cornock,¹⁷ J. Cotchen,⁷ J.P.W. Crozier,⁵ D.E. Cullen,^{2,†} A. Daskalakis,¹⁰ M.-A. Descalle,⁵ D.D. DiJulio,¹⁸ P. Dimitriou,² A.C. Dreyfuss,⁵ I. Durán,^{19,20} R. Ferrer,²¹ T. Gaines,¹⁷ V. Gillette,¹⁴ G. Gert,³ K.H. Guber,³ J.D. Haverkamp,¹⁰ M.W. Herman,⁶ J. Holmes,⁷ M. Hursin,²² N. Jisrawi,¹⁴ A.R. Junghans,¹⁵ K.J. Kelly,⁶ H.I. Kim,²³ K.S. Kim,³ A.J. Koning,² M. Košťál,²⁴ B.K. Laramée,⁸ A. Lauer-Coles,¹ L. Leal,^{3,25} H.Y. Lee,⁶ A.M. Lewis,¹⁰ J. Malec,⁴ J.I. Márquez Damián,¹⁸ W.J. Marshall,³ A. Mattera,¹ G. Muhrer,¹⁸ A. Ney,¹⁰ W.E. Ormand,⁵ D.K. Parsons,⁶ C.M. Percher,⁵ B. Pritychenko,¹ V.G. Pronyayev,²⁰ A. Qteish,²⁶ S. Quaglioni,⁵ M. Rapp,¹⁰ J.J. Ressler,⁵ M. Rising,⁶ D. Rochman,²⁷ P.K. Romano,²⁸ D. Roubtsov,²⁹ G. Schnabel,² M. Schulc,²⁴ G.J. Siemers,⁹ A.A. Sonzogni,¹ P. Talou,⁶ J. Thompson,¹⁰ T.H. Trumbull,¹⁰ S.C. van der Marck,³⁰ M. Vorabbi,^{1,31} C. Wemple,²¹ K.A. Wendt,⁵ M. White,⁵ and R.Q. Wright^{3,†}

¹Brookhaven National Laboratory, Upton, NY 11973-5000, USA

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³Oak Ridge National Laboratory, Oak Ridge, TN 37831-6171, USA

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⁶Los Alamos National Laboratory, Los Alamos, NM 87545, USA

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⁸North Carolina State University, Department of Nuclear Engineering, Raleigh, North Carolina 27695

⁹Rensselaer Polytechnic Institute, Troy, NY 12180, USA

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³¹University of Surrey, Guildford, Surrey, GU2 7XH, UK

Big Paper - ~~GREAT~~ Good news!

- Paper was reviewed by national labs for export control / public utterance: **Green light!**

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Big Paper - ~~GREAT~~ Good news!

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ENDF/B-VIII.1: Updated Nuclear Reaction Data Library for Science and Applications

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 - In the past,
 - Big Papers on ENDF/B releases were part of a special edition and had a “special edition editor” who would allow us some *privileges*.
 - Select referees and submit manuscript to review while details like final numbers on tables and plots were being finalized
 - Seemed like a good arrangement, since Big Paper draws so many citations

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- We can't do that anymore, reasonable concerns:
 - Journal concerned about precedence setting for non-Big-Paper submissions
 - Appearance of “nepotism” by giving special treatment to a manuscript authored by many NNDC'ers

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 - Journal concerned about precedence setting for non-Big-Paper submissions
 - Appearance of "nepotism" by giving special treatment to a manuscript authored by many NNDC'ers
- What can we do?
 - LANL is finishing the complete validation table (main paper and supplemental materials)
 - I am going over the paper, especially validation section, to see if there are plots/table done with VIII.1-BetaX instead of final VIII.1 version
 - Will contact authors to update this. If you already know you need to do an update like that, do so, don't wait for my email!

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ENDF/B-IX.0-Beta1

2025 Hackathon...?

- There are many remaining bugs in the library
- With the push for the final release, Hackathon was low-priority
- This is a good time to do it:
 - After VIII.1 and before IX-Beta1
- Who's organizing it?
 - There have been indications of volunteers
 - Is the volunteer still volunteering?
 - We need to confirm organizer, ASAP
- When? February? April?



Evaluations already submitted

Neutrons:

- ^{35}Cl (LANL/Terrapower)
- ^{181}Ta (URR covariance fix)
- ^{238}U (LANL PFNS)
- GRIN (^9Be , ^{12}C , $^{14,15}\text{N}$, ^{17}O , $^{22,23}\text{Na}$, $^{24,25,26}\text{Mg}$, ^{27}Al , $^{28,29,30,31,32}\text{Si}$, ^{32}S , ^{55}Mn , $^{63,65}\text{Cu}$)

TSL:

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

Photonuclear:

- ^9Be (NNL)

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Photonuclear:

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Expected/planned submissions (That I know of...)

Neutrons:

- ^{95}Mo , Gd (ORNL)
- Zr (RPI/ORNL/BNL...)

Deuterons:

- D+T (LANL/LLNL)

Standards:

- ^{252}Cf sf

Alphas:

- (a,n) from JENDL (M. Pigni)

FPY

Decay

Timeline of ENDF/B-IX.0-Beta1

- Feedback from Validation community:
 - Predictable timeline
 - Ample time for testing
- My considerations, up for debate:
 - I could push for a quick turnaround, but...
 - Better wait for Hackathon
 - Now that we won't need to fast-track ^{181}Ta , we can bring all submissions from **saved_for_after_VIII.1** branch and start doing all reviews.
 - If [ENDF/B-IX-Beta1](#) is released in the [first semester of 2025](#), that should give comfortable time for tests to be presented at 2025 CSEWG in November

ENDF/B
IX.0-β1

There's a celebratory surprise awaiting at the morning break!



Acknowledgements

This work was supported by the Nuclear Criticality Safety Program, funded and managed by the National Nuclear Security Administration for the U.S. Department of Energy. Additionally, work at Brookhaven National Laboratory was sponsored by the Office of Nuclear Physics, Office of Science of the U.S. Department of Energy under Contract No. DE-SC0012704 with Brookhaven Science Associates, LLC. This project was supported in part by the Brookhaven National Laboratory (BNL), National Nuclear Data Center under the BNL Supplemental Undergraduate Research Program (SURP) and by the U.S. Department of Energy, Office of Science, Office of Workforce Development for Teachers and Scientists (WDTS) under the Science Undergraduate Laboratory Internships Program (SULI).

