ENDF/VIII.1 Release Developments and Timeline

G.P.A. Nobre[1]

[1]National Nuclear Data Center, Brookhaven National Laboratory

2023 mini-CSEWG Meeting - Evaluation session
LLNL Open Campus, April 25-27, 2023

Topics

- Release Timeline
- 2023 Hackathon
- ENDF/B-VIII.1-Beta1
- ENDF/B-VIII.1-Beta1.1
- What to expect for ENDF/B-VIII.1-Beta2
- Reviewers wanted

Release timeline

ENDF/B VIII.1

Feb 2023
- Covariances ready for validation

25-27 Apr 2023
- Mini-CSEWG - LLNL
- 28 April: Classified day

Apr 15 2023
- 1st iteration of text for paper due

Jun 2023
- Release of Beta2
- First complete draft of Big Paper

Sep 2023
- FPY files w/ covariances tested

Apr-May 2024
- Paper is published

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- Hackaton at LANL (TBC)

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Mar 1st 2023
- Release first beta version for general testing, containing updates for neutrons (^{239}Pu, INDEN, et al.), alphas, FPY

Until Apr 2023
- Collect feedback from the community on the beta version
- Address issues found
- Wrap up “lesser impactful” files

Nov 13-17 2023 CSEWG
- Final validation results
- Beta4/release candidate
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2023 Hackathon

2023 Hackathon: Confirmed!

- Organized by LANL
- Dates: **August 7-9, 2023**
- Location: **LANL Study Center**
- Works best as in-person event but there will be a remote connection setup available
- Foreign nationals must sign up at least 60 days ahead of time, so we should start processing sign ups soon
- For questions: **Nathan Gibson (ngibson@lanl.gov)**

- Goals:
  - Find and resolve bugs across all libraries
  - Ensure files are in best shape for the release

ENDF/B-VIII.1-Beta1

Released March 1, 2023

Brookhaven National Laboratory

Main updates for VIII.1 - neutron sub library

ENDF/B VIII.1-β1

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- ^{235}U
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- Fission products (RQW+BNL): ^{78}Se, ^{84}Kr, ^{85}Rb, ^{97}Mo, ^{99}Tc, ^{102}Pd, ^{109}Ag, ^{113,115}In, ^{115,119}Sn, ^{127}I, ^{122,124}Te, ^{133,134}Cs, ^{130,134,137}Ba, ^{138}La, ^{143}Pr, ^{147}Pm, ^{148,150}Nd, ^{153}Sm, ^{155}Eu, ^{160}Gd, ^{159}Tb, ^{166,168,170}Er, ^{175,176}Lu, ^{168,176}Yb, ^{174,176,177,178,179,180}Hf
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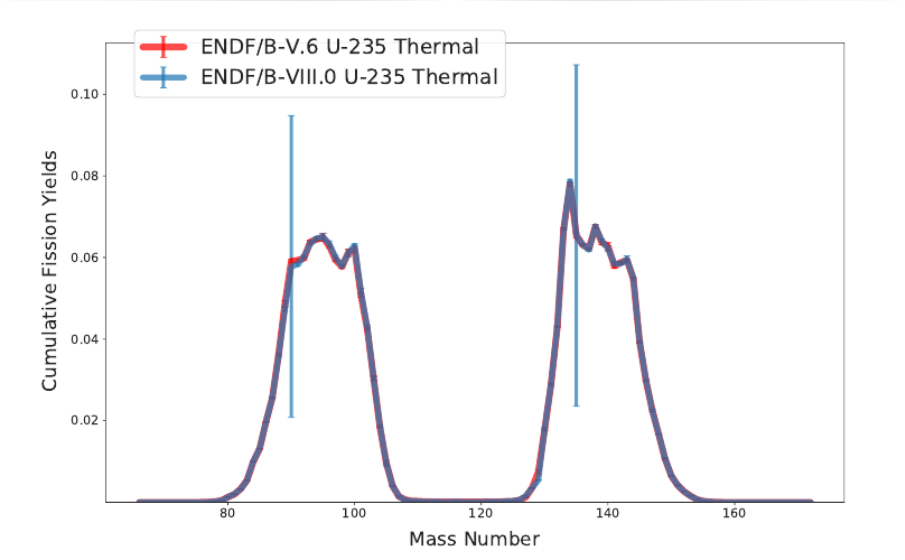
Spontaneus and Induced Fission Yields sub libraries

ENDF/B VIII.1-β1

A. Mattera & A. Sonzogni noticed some cumulative yields had **huge** unphysical uncertainty (coming from wrong error propagation) and recalculated them and updated the values: **BNL-220804-2021-INRE**



Spontaneous Fission Yields

- sfy-092_U_238.endf
- sfy-096_Cm_244.endf
- sfy-096_Cm_246.endf
- sfy-096_Cm_248.endf
- sfy-098_Cf_250.endf
- sfy-098_Cf_252.endf
- sfy-099_Es_253.endf
- sfy-100_Fm_254.endf
- sfy-100_Fm_256.endf

n-induced Fission Yields

- nfy-090_Th_227.endf
- nfy-090_Th_229.endf
- nfy-090_Th_232.endf
- nfy-091_Pa_231.endf
- nfy-092_U_232.endf
- nfy-092_U_233.endf
- nfy-092_U_234.endf
- nfy-092_U_235.endf
- nfy-092_U_236.endf
- nfy-092_U_237.endf
- nfy-092_U_238.endf
- nfy-093_Np_237.endf
- nfy-093_Np_238.endf
- nfy-094_Pu_238.endf
- nfy-094_Pu_239.endf
- nfy-094_Pu_240.endf
- nfy-094_Pu_241.endf
- nfy-094_Pu_242.endf
- nfy-095_Am_241.endf
- nfy-095_Am_242m1.endf
- nfy-095_Am_243.endf
- nfy-096_Cm_242.endf
- nfy-096_Cm_243.endf
- nfy-096_Cm_244.endf
- nfy-096_Cm_245.endf
- nfy-096_Cm_246.endf
- nfy-096_Cm_248.endf
- nfy-098_Cf_249.endf
- nfy-098_Cf_251.endf
- nfy-099_Es_254.endf
- nfy-100_Fm_255.endf

Alphas sub library

Alpha sub library

- ^{9}Be, ^{17}O, ^{18}O
- Files existed before but many reactions are being described for the first time
- ^{4}He - minor fixes

ENDF/B VIII.1-β1

ENDF/B-VIII.1-Beta1.1

Released April 18, 2023

Updates from Beta1:

- TSL
  - Updates and new files from **NCSU**, **NNL**, **ORNL**
- Fixes in neutrons sub library (which should **not** impact criticality):
  - **^{9}Be**: Fixed low-energy interpolation flag
  - **^{54}Cr**: Beta1 was crashing NJOY due to bug. Reassembled MF=32 with proper flag.
  - **^{235}U**: Restored MF=35 MT=18 covariances that had been accidentally lost when updating INDEN versions of the file
  - **^{239}Pu**: Restored MF=34/MT=2 after it had been accidentally omitted from Beta1

Main updates for VIII.1 - TSL sublibrary

- NCSU Phase1 branch:
  - tsl-AlinAl2O3.endf
  - **tsl-Be-metal+Sd.endf**
  - tsl-Be-metal.endf
  - tsl-BeinBeO.endf
  - **tsl-BeinFLiBe.endf**
  - **tsl-CainCaH2.endf**
  - tsl-CinSiC.endf
  - **tsl-CinUC-10P.endf**
  - **tsl-CinUC-5P.endf**
  - **tsl-CinUC-HEU.endf**
  - **tsl-CinUC.endf**
  - **tsl-FinFLiBe.endf**
  - **tsl-FinHF.endf**
  - **tsl-H1inCaH2.endf**
  - **tsl-H2inCaH2.endf**
  - tsl-HinC5O2H8.endf
  - tsl-HinCH2.endf (VIII.0)
  - **tsl-HinHF.endf**
  - tsl-HinParaffinicOil.endf
  - **tsl-LiinFLiBe.endf**
  - tsl-NinUN.endf
  - **tsl-NinUN-10P.endf**
  - **tsl-NinUN-5P.endf**
  - **tsl-NinUN-HEU.endf**
  - tsl-OinAl2O3.endf
  - tsl-OinBeO.endf
  - **tsl-OinSiO2-alpha.endf**
  - **tsl-OinUO2-10P.endf**
  - **tsl-OinUO2-5P.endf**
  - **tsl-OinUO2-HEU.endf**
  - tsl-OinUO2.endf
  - tsl-SiinSiC.endf
  - **tsl-SiinSiO2-alpha.endf**
  - **tsl-U-metal-10P.endf**
  - **tsl-U-metal-5P.endf**
  - **tsl-U-metal-HEU.endf**
  - **tsl-U-metal.endf**
  - **tsl-UinUC-10P.endf**
  - **tsl-UinUC-5P.endf**
  - **tsl-UinUC-HEU.endf**
  - **tsl-UinUC.endf**
  - **tsl-UinUN-10P.endf**
  - **tsl-UinUN-5P.endf**
  - **tsl-UinUN-HEU.endf**
  - tsl-UinUN.endf
  - **tsl-UinUO2-10P.endf**
  - **tsl-UinUO2-5P.endf**
  - **tsl-UinUO2-HEU.endf**
  - tsl-UinUO2.endf
  - **tsl-graphiteSd.endf**
  - **tsl-reactor-graphite-20P.endf**
- ARCAB phase1 branch:
  - tsl-HinH2O.endf (Damian)

Only real conflict!

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BOLD = new evaluation
RED = Conflict! (or so we thought)

= Reviewed by ORNL
= Reviewed by NNL
= Reviewed by NCSU

Main updates for VIII.1 - TSL sublibrary

- ORNL_TSL_EVALUATIONS branch:
  - **tsl-CinC5O2H8.endf**
  - **tsl-CinC8H8.endf**
  - **tsl-CinCF2.endf**
  - **tsl-CinCH2.endf**
  - **tsl-FinCF2.endf**
  - tsl-HinC5O2H8.endf (Review merge request already created)
  - **tsl-HinC8H8.endf**
- tsl-HinCH2.endf (conflict with VIII.0)
- **tsl-OinC5O2H8.endf**

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- NNL phase1 branch:
  - **tsl-BeinBe2C.endf**
  - **tsl-CinBe2C.endf**
  - **tsl-7Liin7LiH-mixed.endf**
  - **tsl-Hin7LiH-mixed.endf**
  - **tsl-7Liin7LiD-mixed.endf**
  - **tsl-Din7LiD-mixed.endf**
  - **tsl-HinZrH2.endf**
  - **tsl-HinZrHx.endf**
  - **tsl-ZrinZrH2.endf**
  - **tsl-ZrinZrHx.endf**
  - tsl-HinUH3.endf (BAPL)

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Not really a conflict! Very minor fixes to VIII.0 header.

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Towards ENDF/B-VIII.1-Beta2

To be released in June

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- **Neutron:**
  - Exit distributions overhaul (see Ian Thompson & Hye-Young Lee's talk)
    - LLNL's changes are live in phase1 branch and LANL ones should be so soon
  - Fixes or improvements based on Beta1 feedback:
    - ^{238}U:
      - motivated by Skip Kahler report
      - updated RRR (JENDL: VIII.0 up to 100eV, increased capture 100eV-20keV), nubar, PFNS (see Roberto Capote's talk)
      - Seems to work well with ^{234,236}U LANL evaluation
    - ^{6}Li: restored (n,t) cross-section below 1 MeV back to standards
    - ^{28,29,30}Si: Files posted to INDEN and thus NNDC were "*missing the direct capture component, which destroys completely the performance in criticality benchmarks (e.g. "hmm005").*" Correct files were already uploaded to phase1 branch.
    - ^{9}Be: "*revert mf3 mt24 (n,2n) to ENDF/B-VIII.0 mf3 mt16; mt1 unchanged, mt2 changed to satisfy mt1 sum rule*"
    - ^{235}U: Fix due to "*confusing cross-material covariances inherited from standards sub-library*"
    - Others?
  - All files that were not reviewed in time for Beta1

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- Fixes/improvements: ^{2}H, ^{23}Na, ^{37}Cl, ^{58}Co, ^{58,60}Ni, ^{107}Ag, ^{106,108,110,111,112,114,116}Cd (LANL scatt. rad. fix), ^{170}Tm, ^{243}Pu, ^{10}B
- Other small fixes: ^{1}H, ^{7}Li, ^{12,13}C, ^{17}O, ^{20,21,22}Ne, ^{26m1}Al, ^{31,32}Si, ^{35}S, ^{36}Cl, ^{37,38,39,41}Ar, ^{41,45,47}Ca, ^{49}V, ^{54}Mn, ^{55}Fe, ^{58m1}Co, ^{63}Ni, ^{64}Cu, ^{69}Zn, ^{70}Ga, ^{71,75}Ge, ^{74}As, ^{75,81}Se,

Zr, ^{93}Mo, ^{98}Tc, ^{97,105}Ru, ^{104}Rh, ^{15,116,117,118m1}Ag, ^{107,109}Cd, ^{114}In, ^{21m1,131,131m1}Te, ^{127}Xe, ^{131,139}Ba, ^{137,137m1}Ce, ^{150}Pm, ^{145,146}Sm, ^{159}Gd, ^{158,161}Tb, ^{155,156,157,158,160,161,162,163,164}Dy, ^{163,165,167,169}Er, ^{168,169,171}Tm, ^{169,175}Yb, ^{175}Hf, ^{181,182,183,185,186}W, ^{186m1,187}Re, ^{185,191}Os, ^{192,194m1}Ir, ^{190,193,194,196,198}Pt, ^{197,197m1,203}Hg, ^{203,204}Tl, ^{204,205,206}Pb, ^{210m1}Bi, ^{208,209,210}Po, ^{223,226}Ra, ^{225,226,227}Ac, ^{227,228,229,230,231,232,233,234}Th, ^{229,230,231,232,233}Pa, ^{230,231,232,237,239,240,241}U, ^{234,235,236,236m1,237,238,239}Np, ^{236,237,238,240,241,242,244,245,246}Pu, ^{240,241,242,242m1,243,244,244m1}Am, ^{240,241,242,243,244,245,246,247,248,249,250}Cm, ^{245,246,247,248,249,250}Bk, ^{246,247,248,249,250,251,252,253,254}Cf, ^{251,252,253,254,254m1,255}Es

- Legacy changes: ^{10}B (ENDF/B-VIII.0 errata), ^{156,158,160,161,162,163,164}Dy (ORNL), ^{192}Pt (tweaked first resonance), ^{240}Pu (LANL unitarity fix)

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Expected updates from Beta1/1.1 into Beta2:

- **TSL**:
  - New MAT number assignments aiming to solve overload
  - Light water: New file from ESS is available with interpolations from VIII.0 for different temperatures. There were questions about behavior around phase transition. Discussions are ongoing.
  - Polystyrene (C_8H_8): Exchanges between evaluators and reviewers are ongoing
- Handling conflicts:
  - HinC5O2H8: Review panel à la ^{239}Pu for neutrons?
- Other materials: ZrC, …?
- Materials from other libraries (JEFF):
  - tsl-HinMesitylene-PhaseII.endf
  - tsl-HinToluene.endf
  - tsl-Mg.endf
  - tsl-Si.endf
  - tsl-HinIcelh.endf (conflict with VIII.0 in phase1 branch)

Expected updates from Beta1/1.1 into Beta2:

- **Photonuclear**:
  - IAEA CRP back in 2019 updated many files
  - Currently, in phase1 branch:
    - **200** files taken directly from the IAEA CRP
    - **16** files taken from IAEA CRP, but with small format fixes
    - **3** originally taken from IAEA CRP, with small format fixes, but then superseded by Kawano's files
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  - *Initial plan* was to simply adopt these files. **However**, they may in principle overwrite important developments from earlier LANL evaluations
  - CRP paper has plots comparing the 2019 evaluations with the previous IAEA photonuclear files from 1999, but not with ENDF/B.
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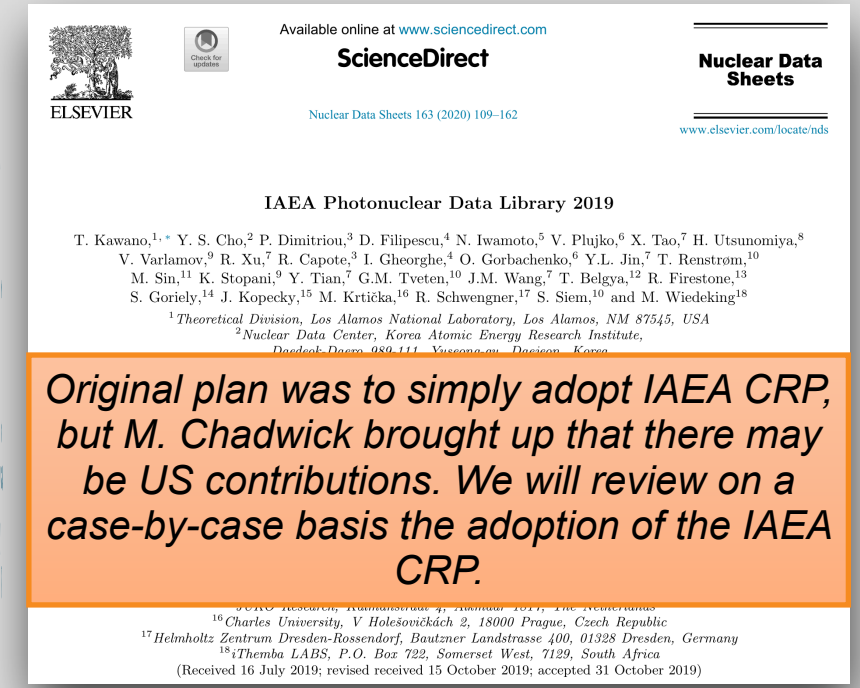
Photo-nuclear

Taken from IAEA CRP

Nuclear Data Sheets 163 (2020) 109-162



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IAEA Photonuclear Data Library 2019

T. Kawano,[1,*] Y. S. Cho,[2] P. Dimitriou,[3] D. Filipescu,[4] N. Iwamoto,[5] V. Plujko,[6] X. Tao,[7] H. Utsunomiya,[8] V. Varlamov,[9] R. Xu,[7] R. Capote,[3] I. Gheorghe,[4] O. Gorbachenko,[6] Y.L. Jin,[7] T. Renstrøm,[10] M. Sin,[11] K. Stopani,[9] Y. Tian,[7] G.M. Tveten,[10] J.M. Wang,[7] T. Belgya,[12] R. Firestone,[13] S. Goriely,[14] J. Kopecky,[15] M. Krtička,[16] R. Schwengner,[17] S. Siem,[10] and M. Wiedeking[18]

[1] *Theoretical Division, Los Alamos National Laboratory, Los Alamos, NM 87545, USA*
[2] *Nuclear Data Center, Korea Atomic Energy Research Institute, Daedeok-Daero 989-111, Yuseong-gu, Daejeon, Korea*

Original plan was to simply adopt IAEA CRP, but M. Chadwick brought up that there may be US contributions. We will review on a case-by-case basis the adoption of the IAEA CRP.

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[17] *Helmholtz Zentrum Dresden-Rossendorf, Bautzner Landstrasse 400, 01328 Dresden, Germany*
[18] *iThemba LABS, P.O. Box 722, Somerset West, 7129, South Africa*

(Received 16 July 2019; revised received 15 October 2019; accepted 31 October 2019)

We report our coordinated efforts to address these data needs and present the results of the new up-to-date evaluations included in the new updated IAEA Photonuclear Data Library consisting of 219 nuclides. The new library includes 188 new evaluations produced by the CRP evaluators, and one evaluation taken from the JENDL/PD-2016 library, while 20 evaluations were retained from the previous 1999 IAEA Photonuclear Data Library. In most of the cases, the photon energy goes up to 200 MeV. A total of 55 nuclides are new in this library reflecting the progress in measurements but also the developing data needs. In this paper we discuss the new assessment method and make recommendations to the user community in cases where the experimental data are discrepant

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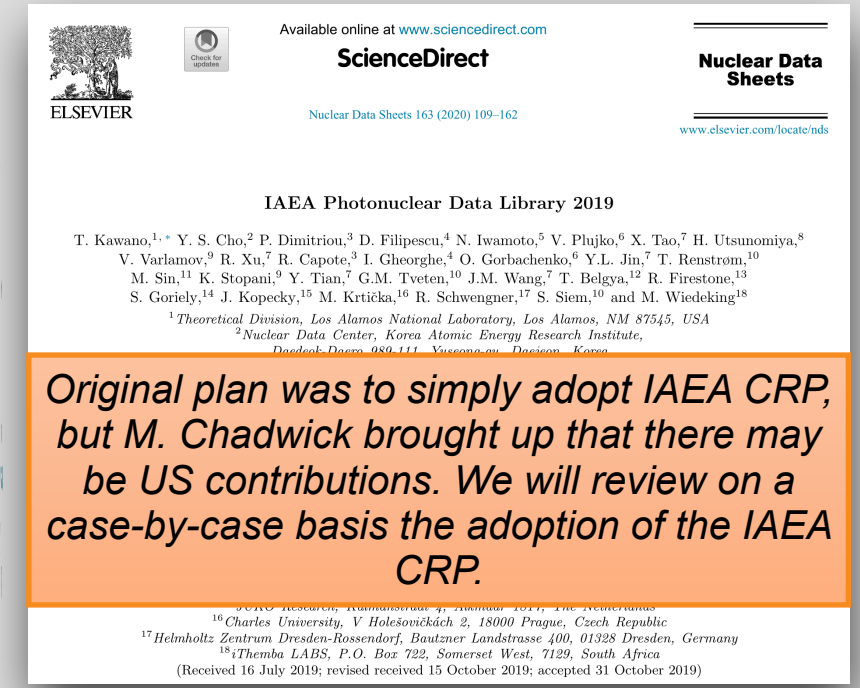
See M. Chadwick's talk

Photo-nuclear

Taken from IAEA CRP

Nuclear Data Sheets 163 (2020) 109-162



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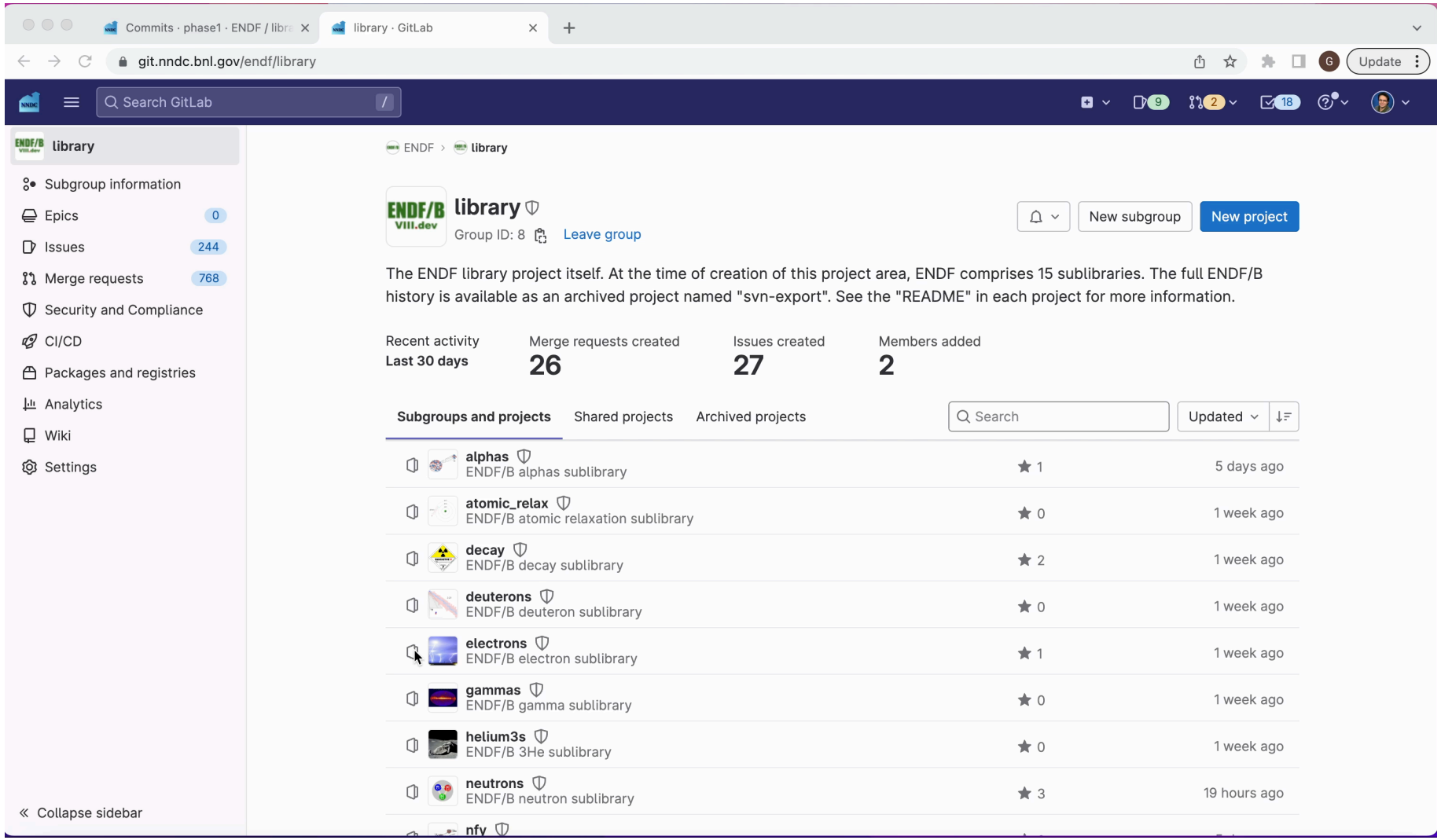
  - **When in doubt, reach out!**

- Well, but how do I know if my files were changed??
- Fear not, for GitLab shall come to rescue!



Finding the commit history of a file

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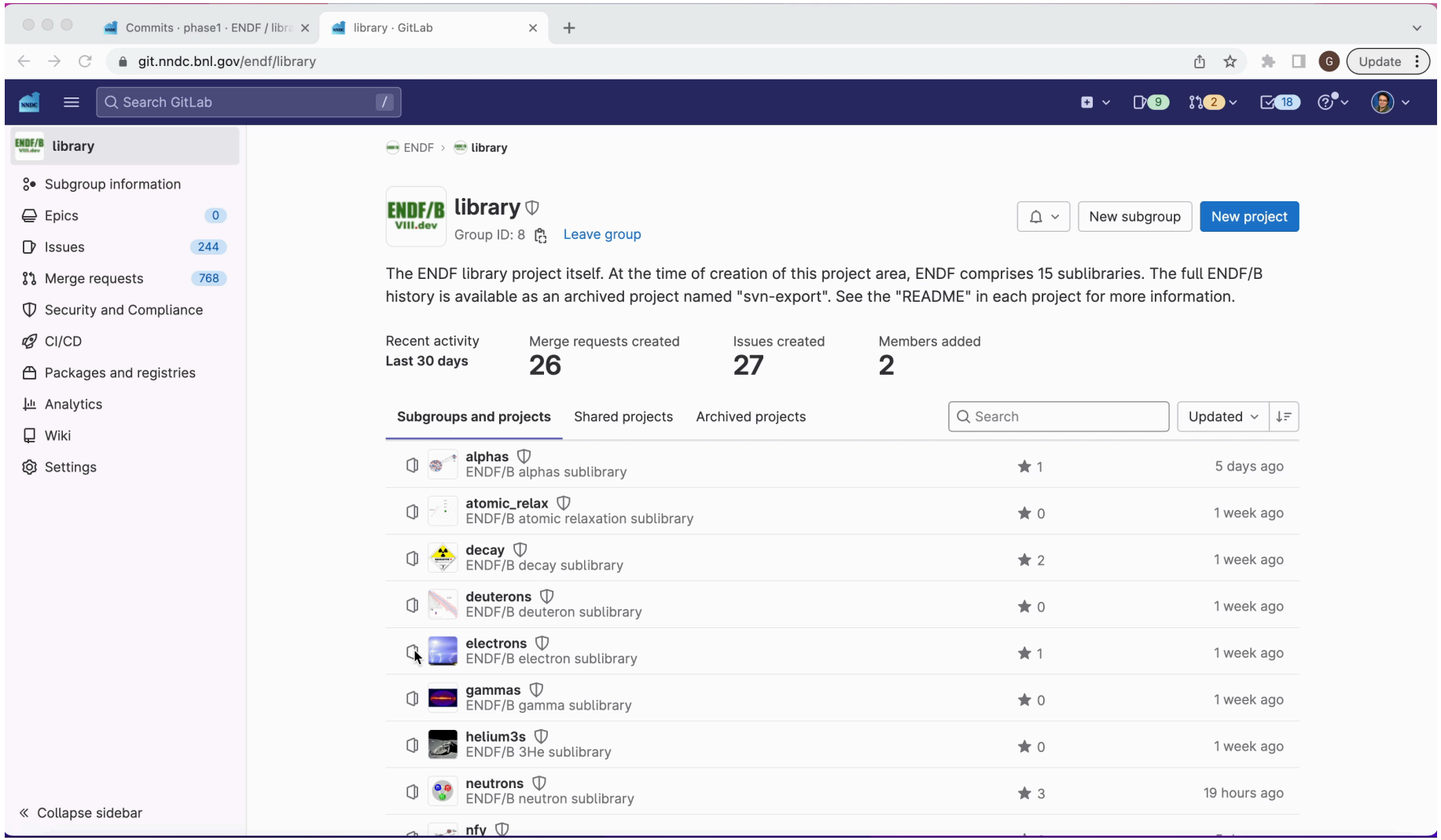

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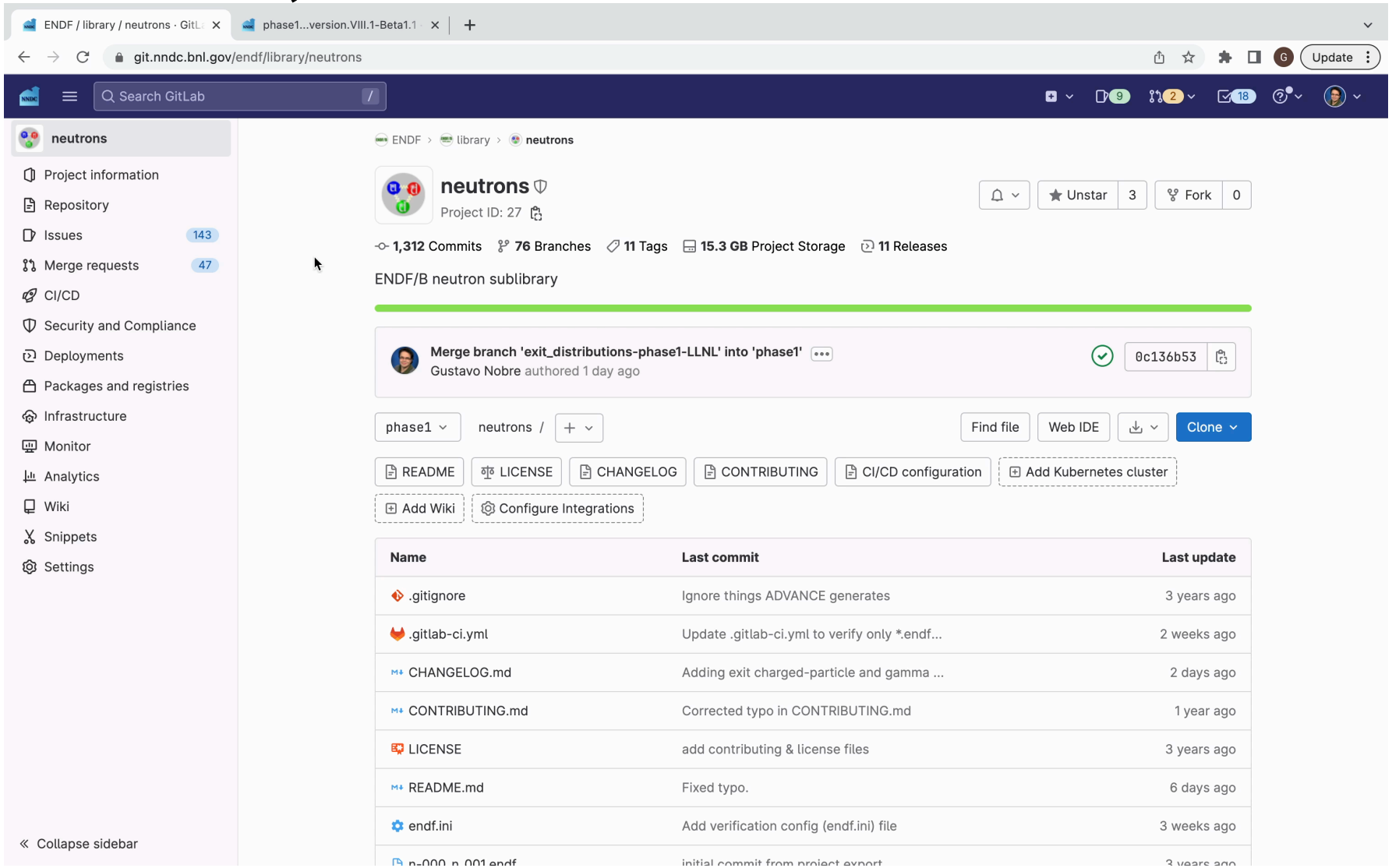

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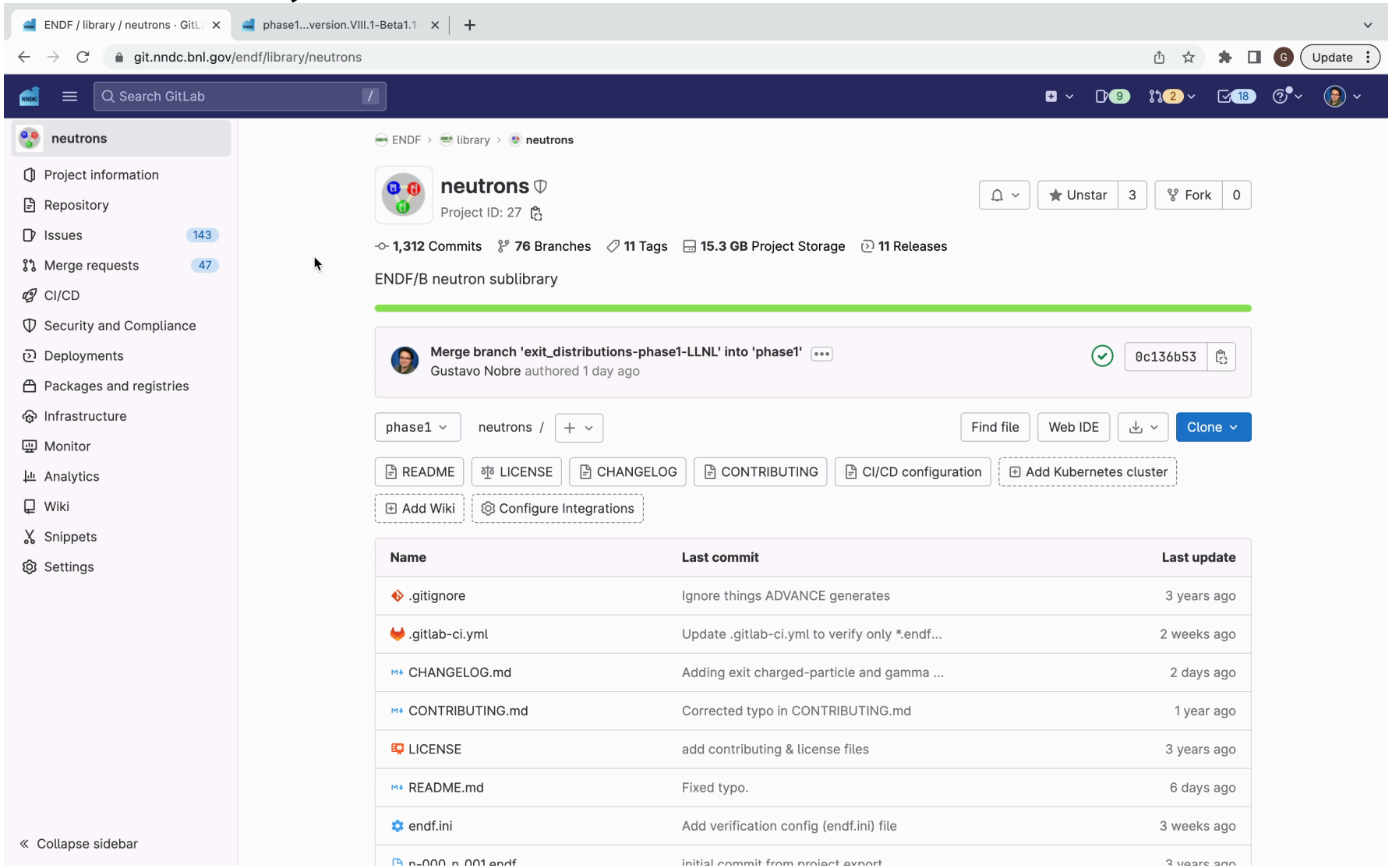

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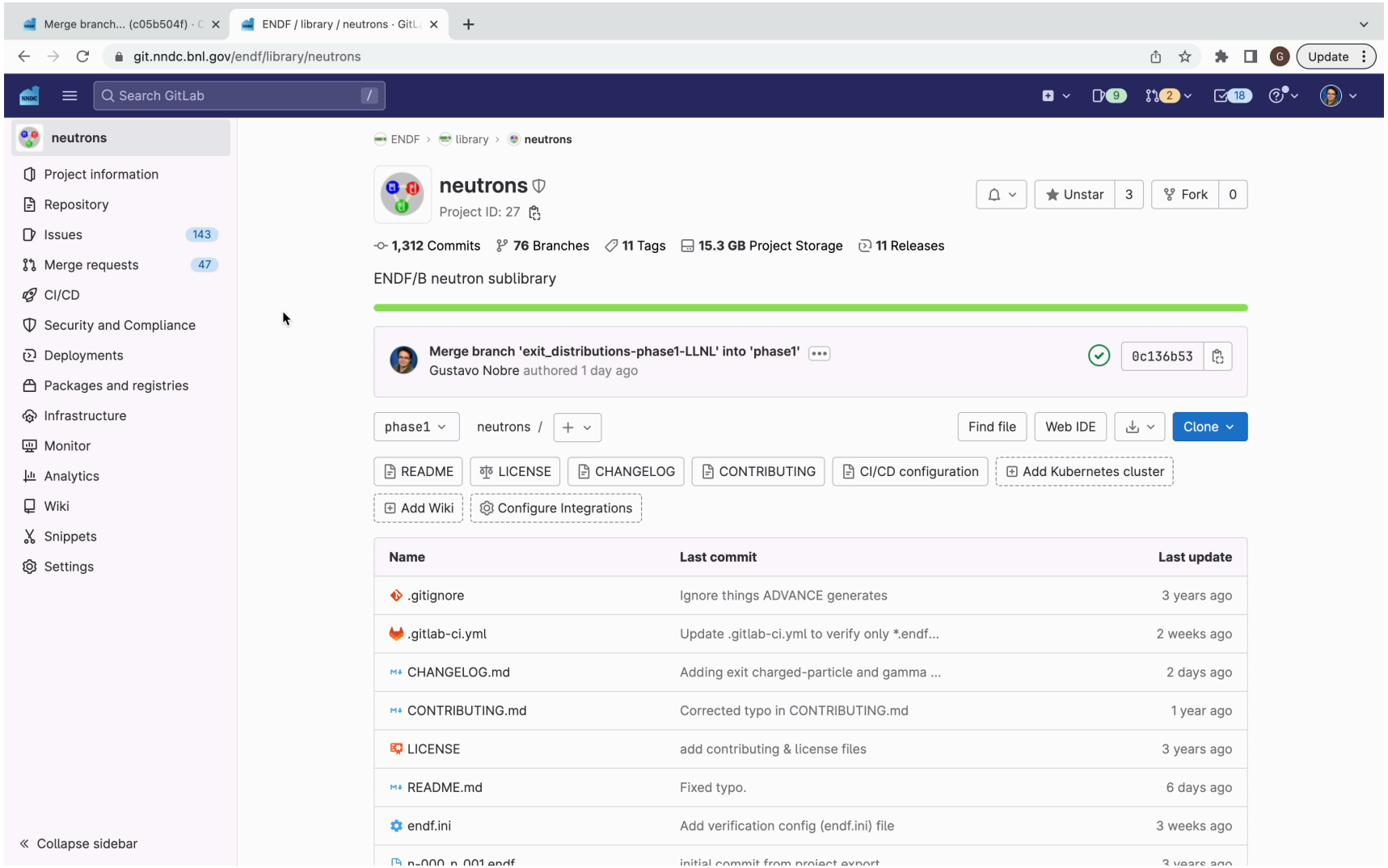

Finding commits since a tagged release

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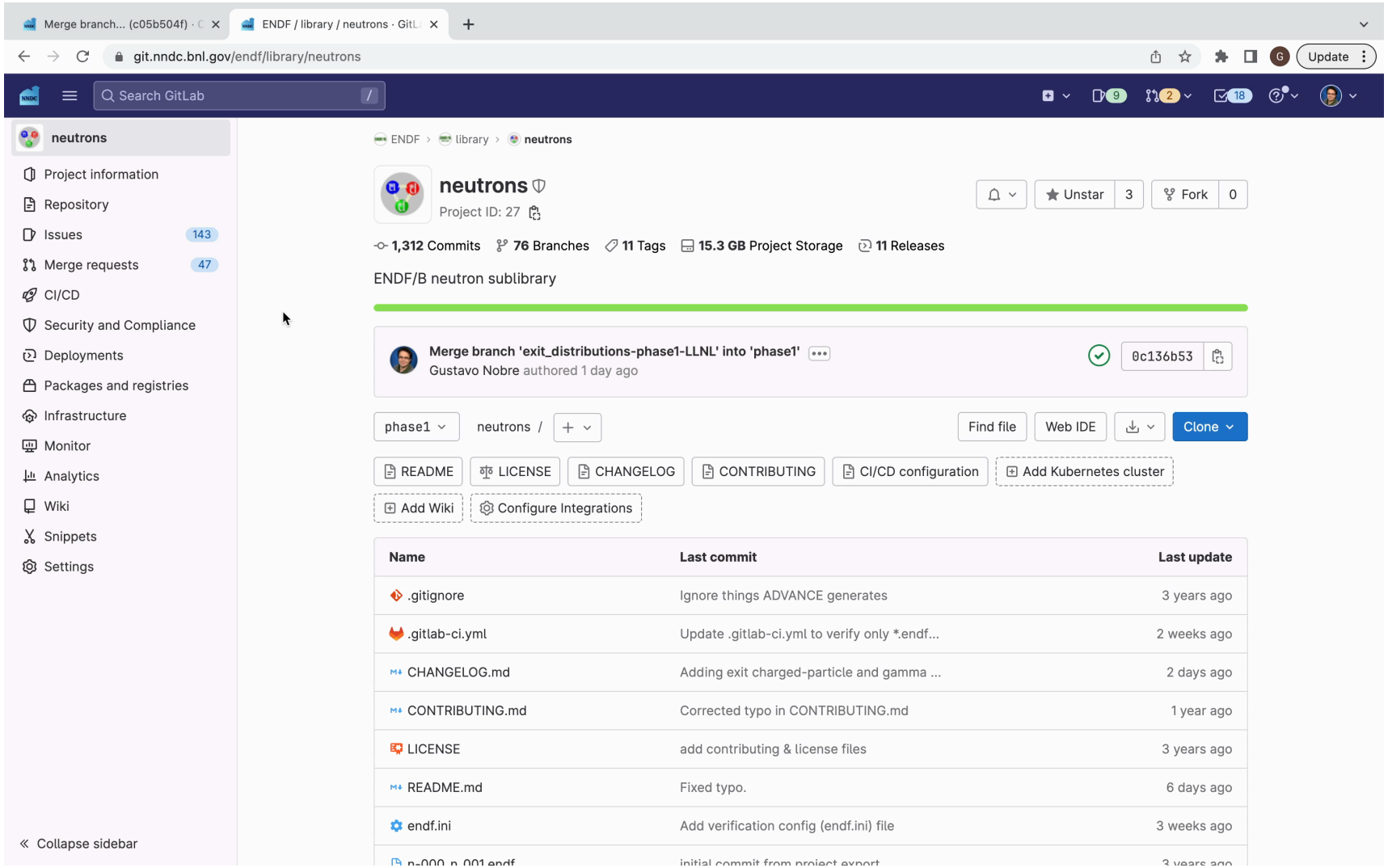


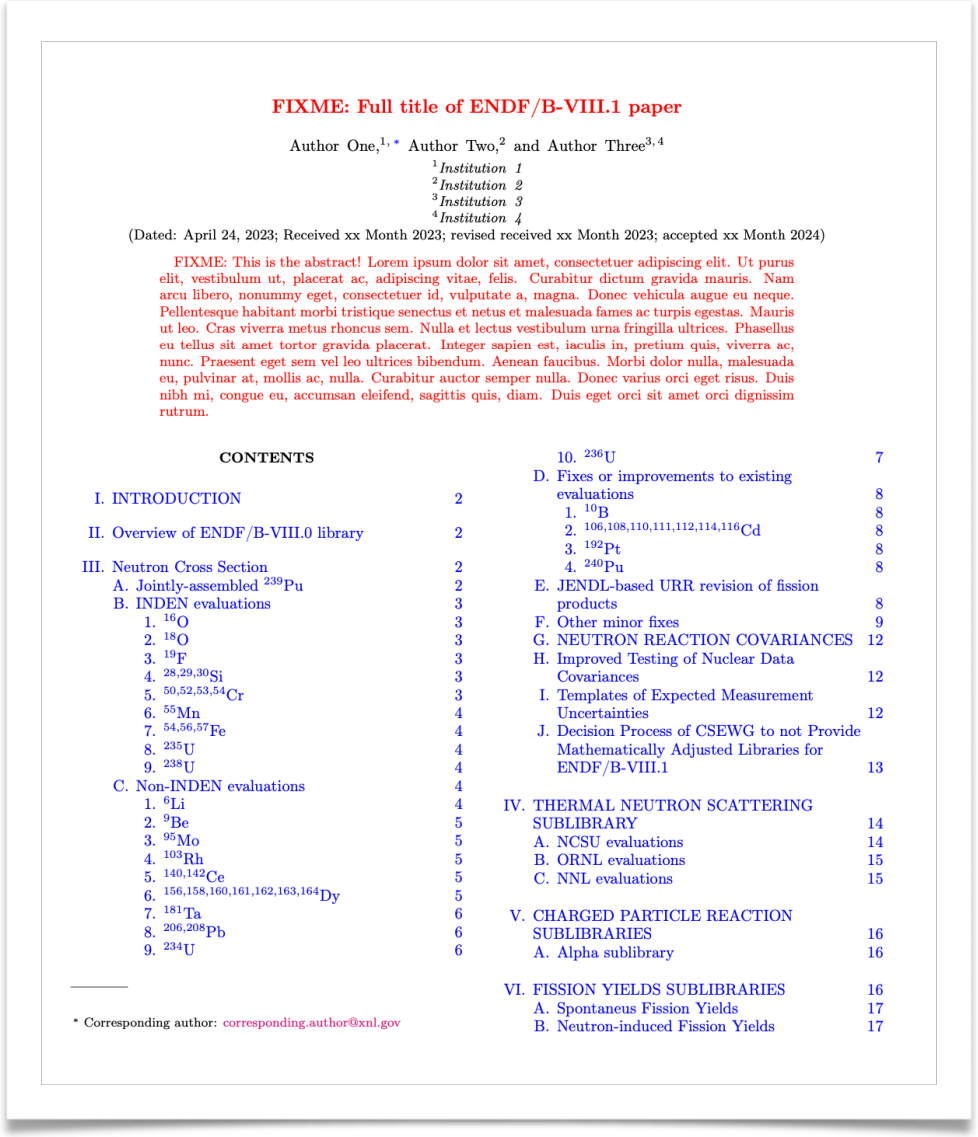
Finding commits since a tagged release

ENDF/B-VIII.1 “Big Paper”

The writing has begun!

"Well-begun is half done!"
- M. Poppins

- Created a GitLab project
  - Contributions should be made or merged to "development" branch
  - Or sent directly to me
- Set up a preliminary general structure for the paper, based on Beta1.
- People have begun to send their contributions (thank you!!), others promised to send their piece soon. So it's (slowly, but surely) moving along!
- We will have to have some tricky discussions:
  - Authorship
  - Deadlines
  - As it has been done in the past releases, the CSEWG Executive Committee should discuss and decide in a fair and equitable way



FIXME: Full title of ENDF/B-VIII.1 paper

Author One,[1,*] Author Two,[2] and Author Three[3,4]

[1] *Institution 1*
[2] *Institution 2*
[3] *Institution 3*
[4] *Institution 4*

(Dated: April 24, 2023; Received xx Month 2023; revised received xx Month 2023; accepted xx Month 2024)

FIXME: This is the abstract! Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

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* Corresponding author: corresponding.author@xnl.gov

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Pardon my recruiting…

- New round of reviews is coming up
- We need volunteer reviewers!
- The number of reviewers has been the main bottleneck
- To finalize all open reviews and have Beta2 released in time, we have to move fast

… to be a volunteer reviewer!