



# NNDC Report to the NRDC

David Brown  
National Nuclear Data Center

NRDC Meeting, IAEA, Vienna  
9 May, 2023



# NNDC Vision & Mission

The National Nuclear Data Center (NNDC) vision is to be the premier global resource for nuclear data and plan to:

- ❑ Implement AI/ML algorithms to reduce the time from data publication to integration in a recommended library to less than two years.
- ❑ Establish an open data repository for low-energy nuclear physics.
- ❑ Advance dissemination efforts with modern and efficient software tools.
- ❑ Sustain a robust nuclear physics research portfolio, including the development of an experimental program to accelerate isotope production science.



The NNDC is the lead and largest unit of the U.S. Nuclear Data Program (USNDP), whose mission is to provide current, accurate, authoritative data for workers in pure and applied areas of nuclear science and engineering. This is accomplished primarily through the compilation, evaluation, dissemination, and archiving of extensive nuclear datasets. USNDP also addresses gaps in the data, through targeted experimental studies and the use of theoretical models.

# US Nuclear Data Program Main Products

## Nuclear Science References (NSR)

Nuclear physics articles indexed according to content

## EXFOR

Compiled nuclear reaction data

## XUNDL

Compiled nuclear structure and decay data

## ENSDF

Recommended nuclear structure and decay data

## ENDF

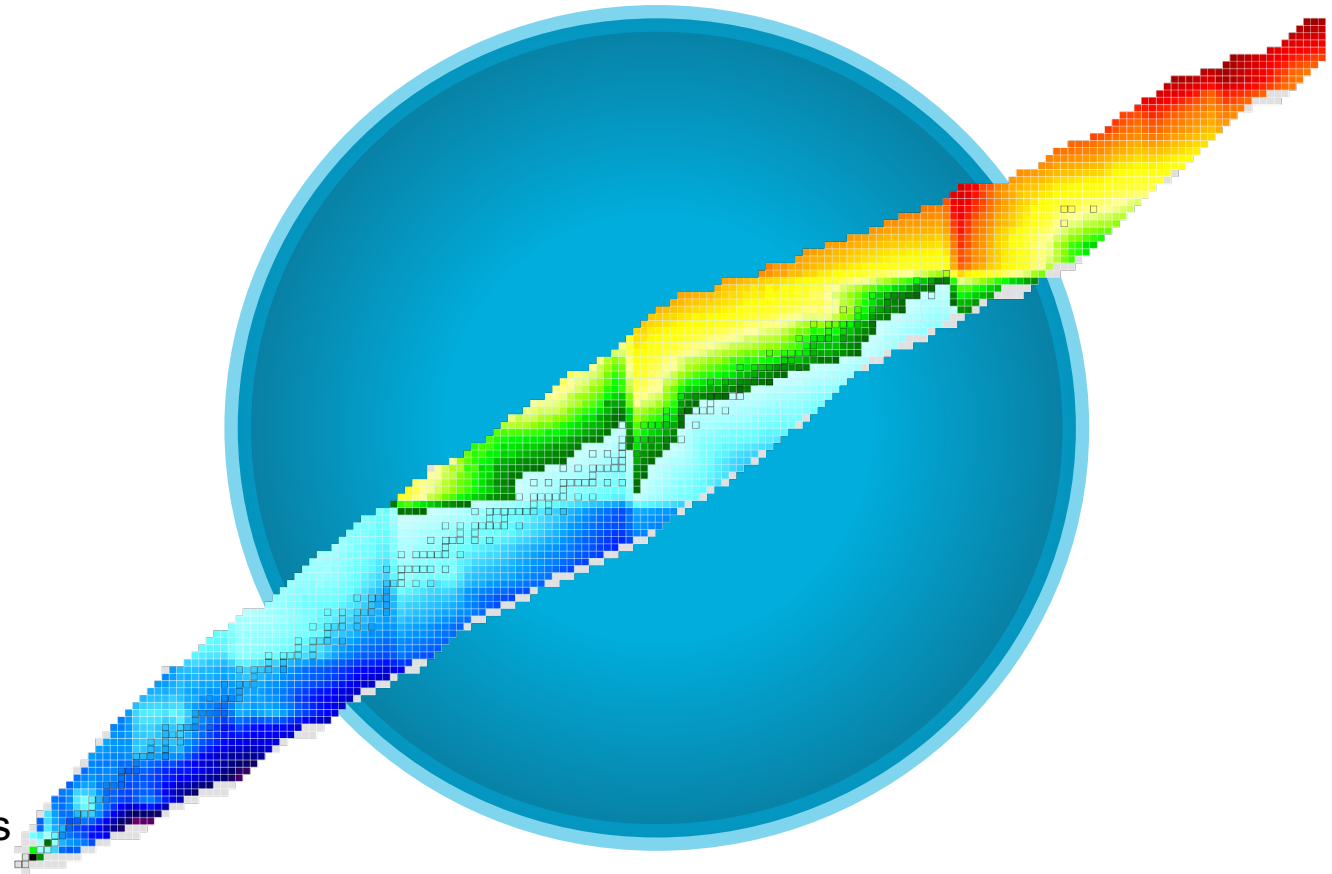
Recommended particle transport and decay data, with a strong emphasis on neutron-induced reaction data

## Nuclear Data Sheets

Journal devoted to the publication of nuclear data articles

## Web dissemination

[www.nndc.bnl.gov](http://www.nndc.bnl.gov), [nuastrodata.org](http://nuastrodata.org)

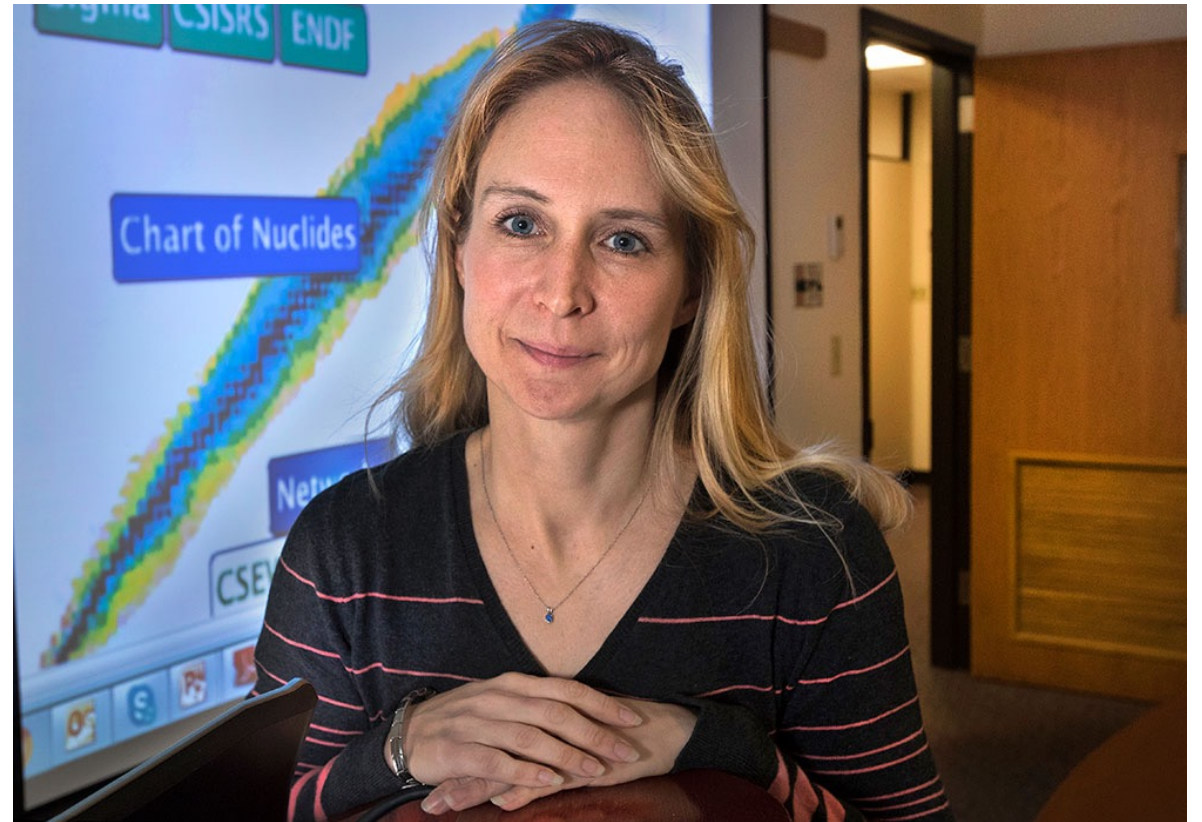


**Nuclear data science capability to support the development of new reactor concepts.**

# Personnel updates

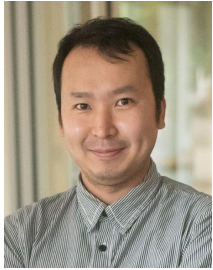
# Elizabeth (Libby) McCutchan

- APS Fellow 2022
- Citation: *“For innovative and distinguished contributions to understanding the evolution of collectivity in heavy nuclei, critical precision experiments to test ab initio methods in light nuclei, seminal analyses of antineutrino spectra, and the development of new database tools to understand nuclear data.”*



<https://www.bnl.gov/newsroom/news.php?a=120865>

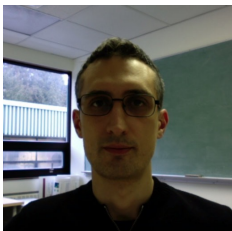
# Other personnel changes at the NNDC



**Shuya Ota** joined the NNDC May 1<sup>st</sup> as a scientific staff primarily working on ENSDF and XUNDL, plus developing the NNDC decay station.

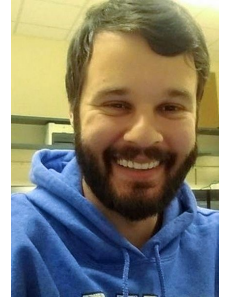


**Jin Wu** joined the NNDC on September 6<sup>th</sup> as a scientific staff working on ENSDF/XUNDL and gamma-ray spectroscopy.

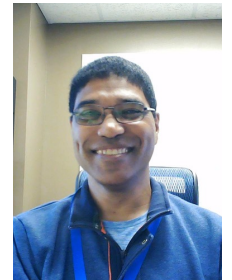


**Matteo Vorabbi** left the NNDC Sep. 16<sup>th</sup> to begin a position as Lecturer at the University of Surrey, UK.

**Emanuel Chimanski** joined the NNDC April 11, 2022 as a post doc working on the NA-22 Gamma Rays Induced by Neutrons project. Promoted to staff in April 2023.



**Sam Kim** joined the NNDC as a post-doc on March 7<sup>th</sup> to analyze data that helps determine antineutrino spectra, investigate  $^{69}\text{Ga}$ , and experiment on  $^{125}\text{Xe}$  trapped in silicate nanostructures.



**Adam Hayes** left the NNDC in January 2022 to work in the private sector



# 28 Students in FY22!



# NNDC Website



# Website Redesign

- **New front page + header/footer**
  - Deployed in time for ND2022
  - Reduced clutter to direct users to most-trafficked websites
  - Quick access to databases
  - Use of common stylesheets for consistent design
- **Roughly 80% of site fully converted to new style; all pages have new header/footer**



Credit: Donnie Mason

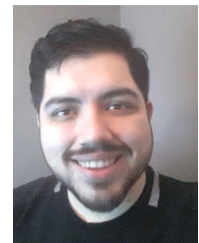
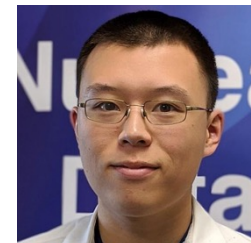
# The NNDC is Proactively Addressing Cybersecurity Issues

## EXFOR

- Unsecured database credentials on both NNDC and IAEA mirror sites
- Solution:
  - Consulted with ITD Cyber Security Operations Manager
  - Purged **exfor/** from NNDC web servers
  - Replaced compromised database account

## NSR

- Shared, unsecured passwords for article PDFs on both NNDC and IAEA mirror sites
- Solution:
  - Removed PDF access page from **nsr/**



Detected and resolved by:  
Benjamin Shu + Donnie Mason

# NNDC Website Modernization

## Principle of least privilege

- Selective permissions for controlling access
- No one account with access to whole database
- Credentials isolated to minimize potential breaches

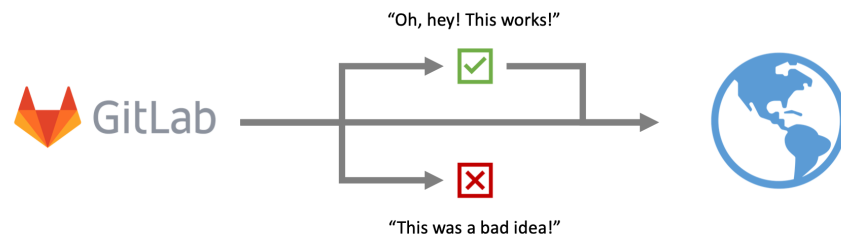
Assures a secure and reliable website consistent with modern webserver practices

## Webapp Containerization

- Use of Docker for containerized deployment
- Secure deployment with restricted credentials
- Robust, reproducible, version-controlled



podman



NNDC GitLab Server



Website project folder



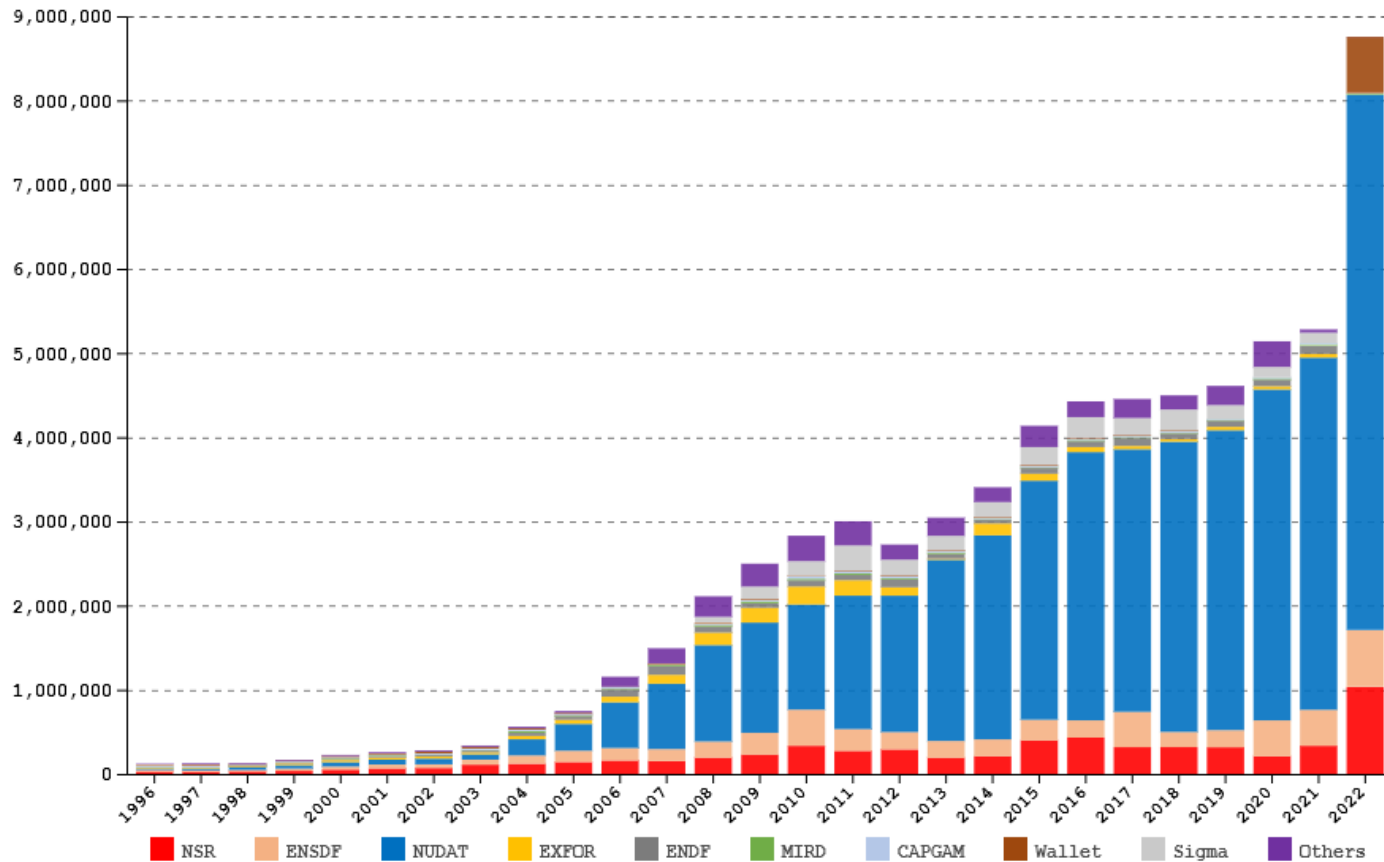
Gradle Build Tool



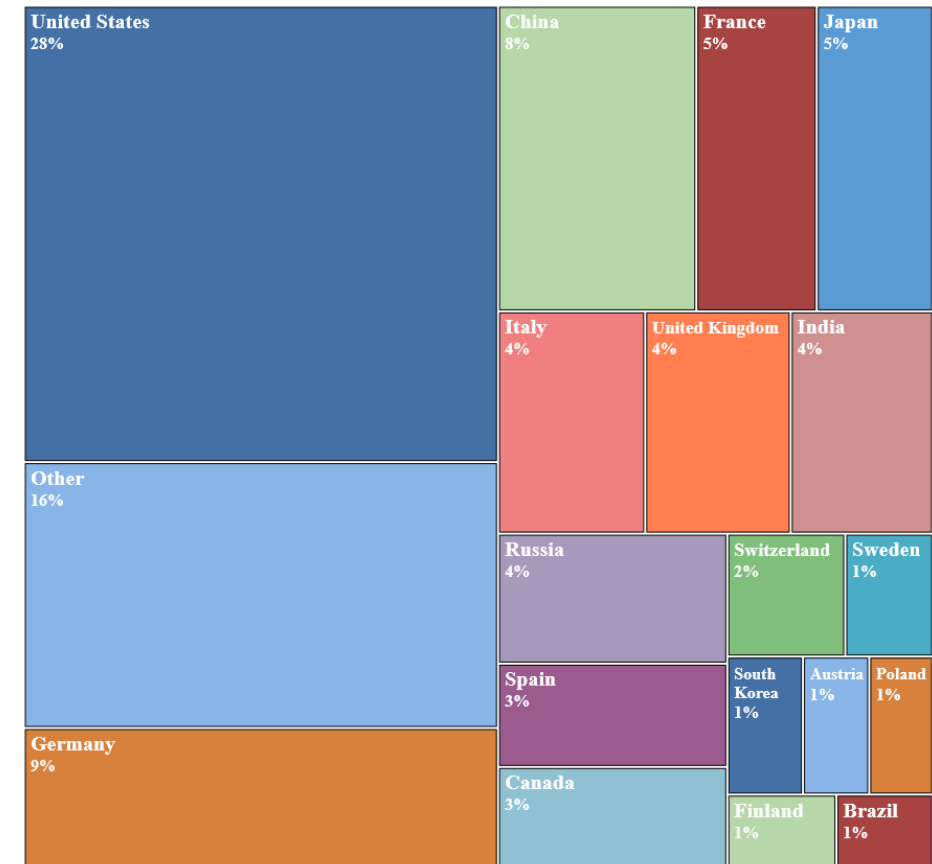
Web Archive (WAR)

# Modernization efforts paying off

NNDC Web Retrievals 1996-2022



NuDat Web Retrievals by Country (FY2022)



# ENSDF & ENDF updates

# XUNDL/ENSDF Metrics – for FY22

## XUNDL

Compiler	Papers	Datasets
Shaofei	9	16
Libby	162	293
Shuya	11	17
Jin	5	10

Total of 187 papers, 336 datasets

## ENSDF

Evaluator	Mass Chain	Nuclei
Chris	251	
Libby	47 (½)	30
Shuya	47(½)	

2 Mass Chains, 30 individual nuclei

## NDS publications

C. Morse, "*Nuclear Data Sheets for A=267, 271, 275, 279, 283, 287, 291, 295, 299*" NDS 182, 130 (2022)

C. Morse, "*Nuclear Data Sheets for A=269, 273, 277, 281, 285, 289, and 293*", NDS 182, 167 (2022)

S. Zhu, "*Nuclear Data Sheets for A=236*", Nucl.Data Sheets 182, 2 (2022)  
(reviewer comments received after Shaofei's passing)

# 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

**Preparing the next “minor” release:  
ENDF/B-VIII.1, due February 2024**



CSEWG collaboration meeting in November 2022: our first in-person meeting since the pandemic started!

# ENDF/B-VIII.1 release

## *Recommended particle transport and decay data*

The next release of the ENDF/B library is scheduled for February 2024!  
Although technically “minor”, it will have major impact.

- Why VIII.1 and not IX?
  - There are no planned updates of the standards library for this release
  - However, many, many important and impactful changes are on the way!!
- Full release will be in both legacy **ENDF-6** format and **GNDS-2.0**
- Will have an accompanying “**Big Paper**” in Nuclear Data Sheets
- Peer reviews of (most of) new evaluations complete
- Preliminary validation testing has begun
- ***Beta2 release planned for June/July,  
one more beta release planned before fall***





# Modernization efforts

# Digital Object Identifiers (DOIs)

As a **Public Reusable Research (PuRe) Data Repository** the NNDC strives to make data publicly available to advance scientific knowledge



3 major libraries already have library-wide DOIs:

- ENSDF
- XUNDL
- NSR

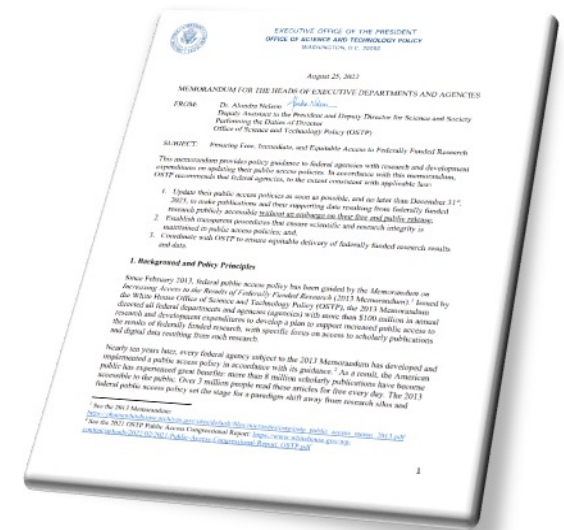
ENDF & the Atlas are next!

A screenshot of the National Nuclear Data Center (NNDC) website. The top navigation bar includes links for Databases, Structure & Decay, Reactions, Resources, and the Brookhaven National Laboratory logo. The main content area is titled "Evaluated Nuclear Structure Data File (ENSDF)" and contains a detailed description of the data. Below the text is a colorful graphic with the text "One Recommended Value" and "NSR Publications" and "References" and "Tools". A statistics bar shows: 19,591 Datasets, 3,408 Nuclides, 4,447 Decays, 10,813 Reactions, and 300 Mass Chains. Below this are sections for "Deposition Summary" and "Dataset Details".

Deposition Summary	Dataset Details
Depositor: Elizabeth Riocard-McCutchan	Total Datasets: 19591
Contact: mcutchan@bnl.gov	Nuclides: 3408
Deposition date: 2022/02/14	Decay Radiations: 4447
Last modified: 2022/04/05	Reactions: 10813
DOI: 10.18139/nndc.ensdf/1845010	Mass Chains: 300

Latest Dataset	Publication Details
File: ensdf_221004.zip	Journal: Nuclear Data Sheets
Date: 2022/10/04	Editor: E.A. McCutchan
Download	URL: www.nndc.bnl.gov/nds/



Compliance with OSTP policy guidelines from 25 August 2022 memo

# WalletCraft

*A new evaluation of properties of ground-state and long-lived isomers for all known nuclei*

Evaluation for g.s. and isomers ( $T_{1/2} > 100\text{ms}$ ) of:

- Spin/Parity
- Mass Excess – from AME2020
- Half-life, Width or Abundance
- Decay Mode(s)

Major changes *under the hood*:

- New JSON-based OODB
- We store experimental measurements (building block of the evaluation)

Advantages:

- Transparent documentation of evaluation history
- Format can be easily read in modern codes and data plotted/analyzed
- Allows for much shorter versioning (from 5-10 yr to ~1yr)

## Nuclear Wallet Cards

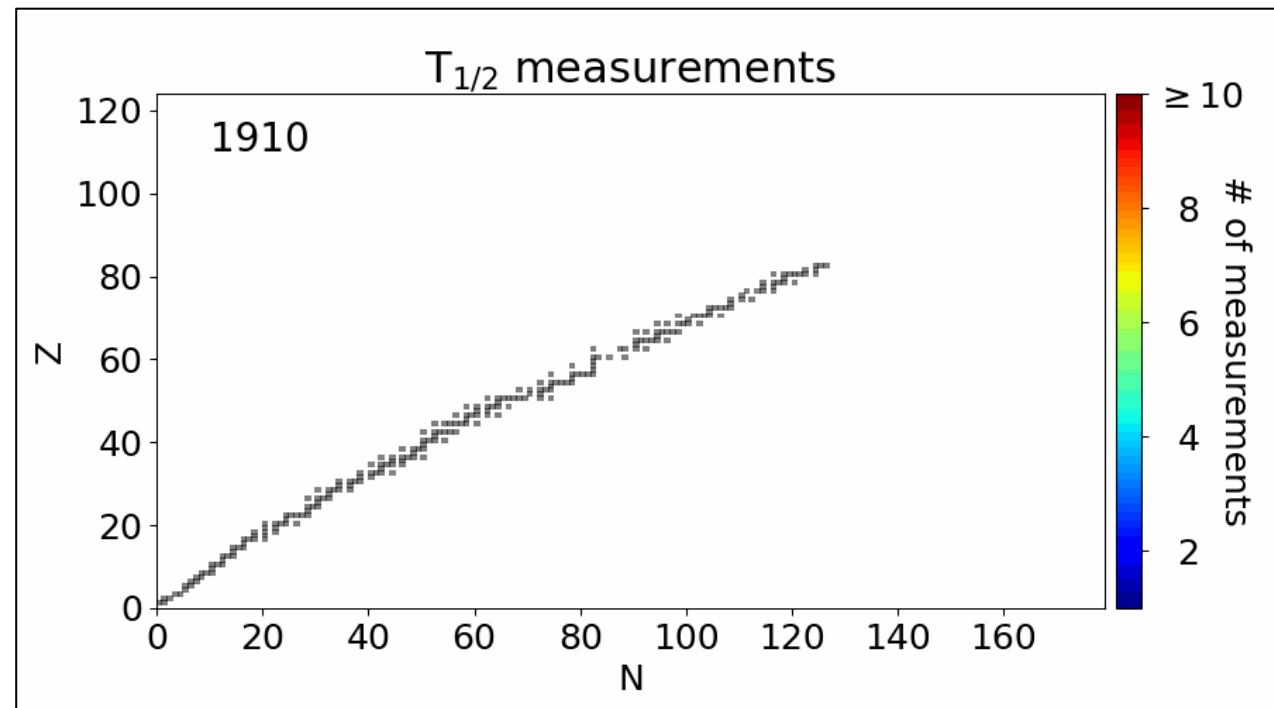
October 2022

National Nuclear Data Center  
[www.nndc.bnl.gov](http://www.nndc.bnl.gov)

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Brookhaven National Laboratory  
P.O. Box 5000  
Upton, New York 11973-5000  
U.S.A.

Z	A	Energy (keV)	Spin-Parity	Half-life (s)	Decay Mode	Reference
20	40	0	0 <sup>+</sup>	6.1126(10)	β <sup>-</sup>	AME2020
20	40	1.323(6)	2 <sup>+</sup>	1.323(6)	β <sup>-</sup>	AME2020
20	40	1.323(6)	2 <sup>+</sup>	1.323(6)	β <sup>-</sup>	AME2020



# A new object-oriented database for ENSDF

We've migrated from 80 column ASCII to JSON based

Developed a new Editor for ENSDF evaluators

And (for the first time!) designed an API for

```
137CS PN
137CS L 0.0 7/2+ 30.08 Y 9 A
137CSX L XREF=ACDEFGH
137CS2 L %B=-100$MOMM1=+2.8413 1 (1989Ra17)$MOME2=+0.051 1 (1989Ra17)
137CS cL T$Deduced by evaluators using the Limitation of Relative Statistical
137CS2cL Weights (LRSW) method for analyzing the following set of
137CS3cL discrepant ( $|h\{+2\}|/n=18.6$ ) experimental values: 10970 d {I20}
137CS4cL (2004Sc04); 11018 d {I10} (2002Un02); 10941 d {I7} (1992Go24);
137CS5cL 10968 d {I5} (1990Ma15); 11009 d {I11} (1980Ho17); 10906 d {I33}
137CS6cL (1978Gr08); 11034 d {I29} (1973Co39); 11021 d {I5} (1973Di01); 11023 d
137CS7cL {I37} (1972Em01); 10921 d {I17} (1970Wa19); 11191 d {I157} (1970Ha32);
137CS8cL 11286 d {I256}, 10921 d {I183} (1965Fl01); 11220 d {I47} (1965Le25);
```

```
{
  "spinParityValues": [
    {
      "spin": 2,
      "isTentativeSpin": true,
      "isTentativeParity": true,
      "parity": "+",
      "parityNumber": 1
    },
    {
      "spin": 3,
      "isTentativeSpin": true,
      "isTentativeParity": true,
      "parity": "-",
      "parityNumber": -1
    }
  ],
  "comments": [
    "Assignments are based on..."
  ]
}
```

The screenshot shows the 'Levels and Gammas' editor interface. It features a table with columns for Energy, J $\pi$ , HalfLife, Decay Mode, and Gammas. Below the table are various control elements including a search bar, filters for Symmetric, Limit, and Existence, and a '+ Gamma' button to add new entries.

Energy	J $\pi$	HalfLife	Decay Mode	Gammas
0	0+	11.5 s 0.2		0
199.326	2+	0.71 ns 0.02		1
530.19	4+	34 ps 5		1
758.94	1-	< 24 ps		2
838.37	3-	< 10 ps		2

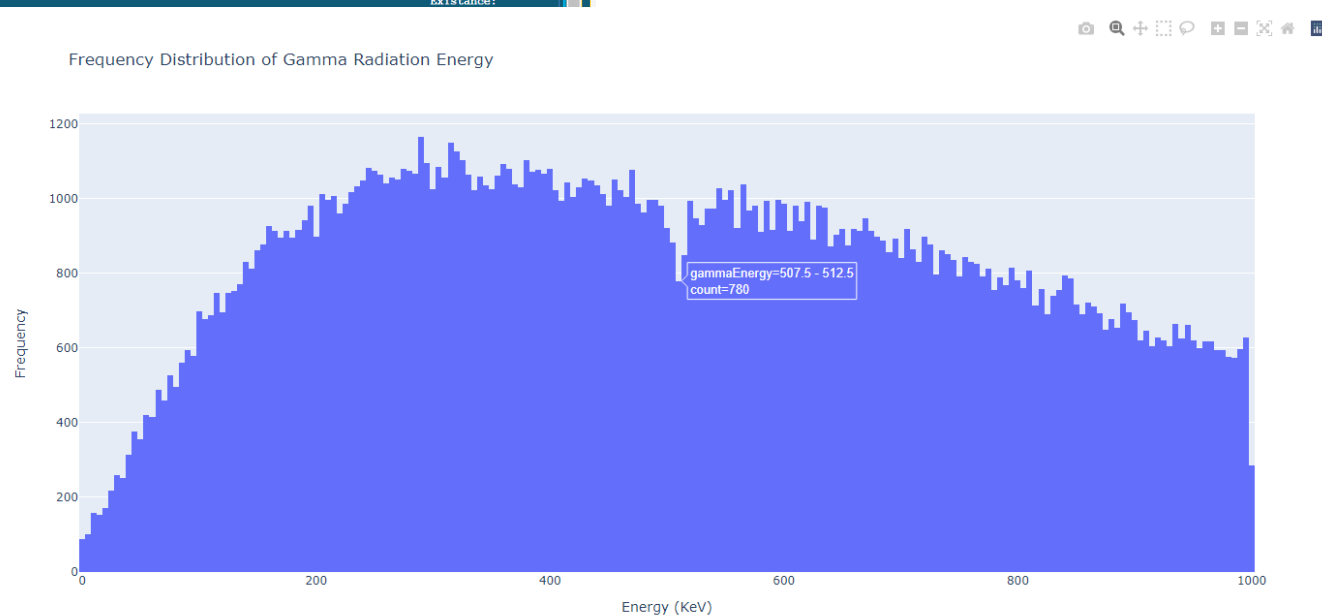
```
# Initialize API
api = ensdfAPI(ipAddress="127.0.0.1", port=5001)

# Get all gammas 0-1000 keV
values_dict=api.filterByGammas(0,1000)
dataframe = plot.createViewDataFrame(values_dict)

# Label plot
plot.configuration.setAxisTitle("x", "Energy (KeV)")
plot.configuration.setAxisTitle("y", "Frequency")
plot.configuration.setTitle("Frequency Distribution of Gamma Radiation Energy")

# Plot as a histogram
figure=plot.createHistogram(dataframe, "gammaEnergy")

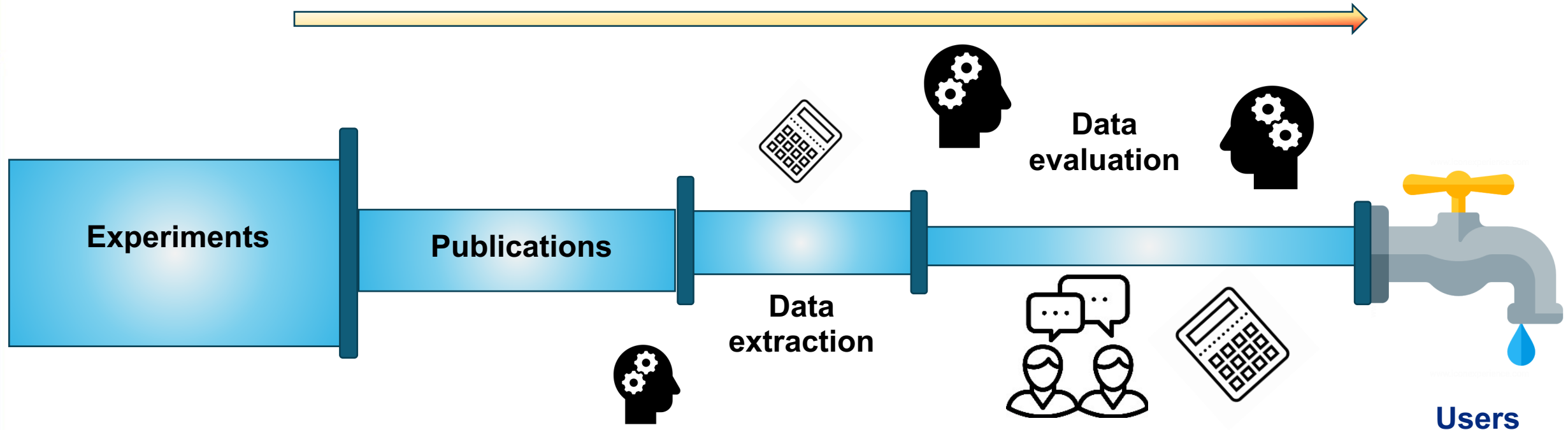
plot.showFigure(figure)
```



# What we're working on now

# Nuclear Data Pipeline, now

Current timeline of about **5 – 10 years**

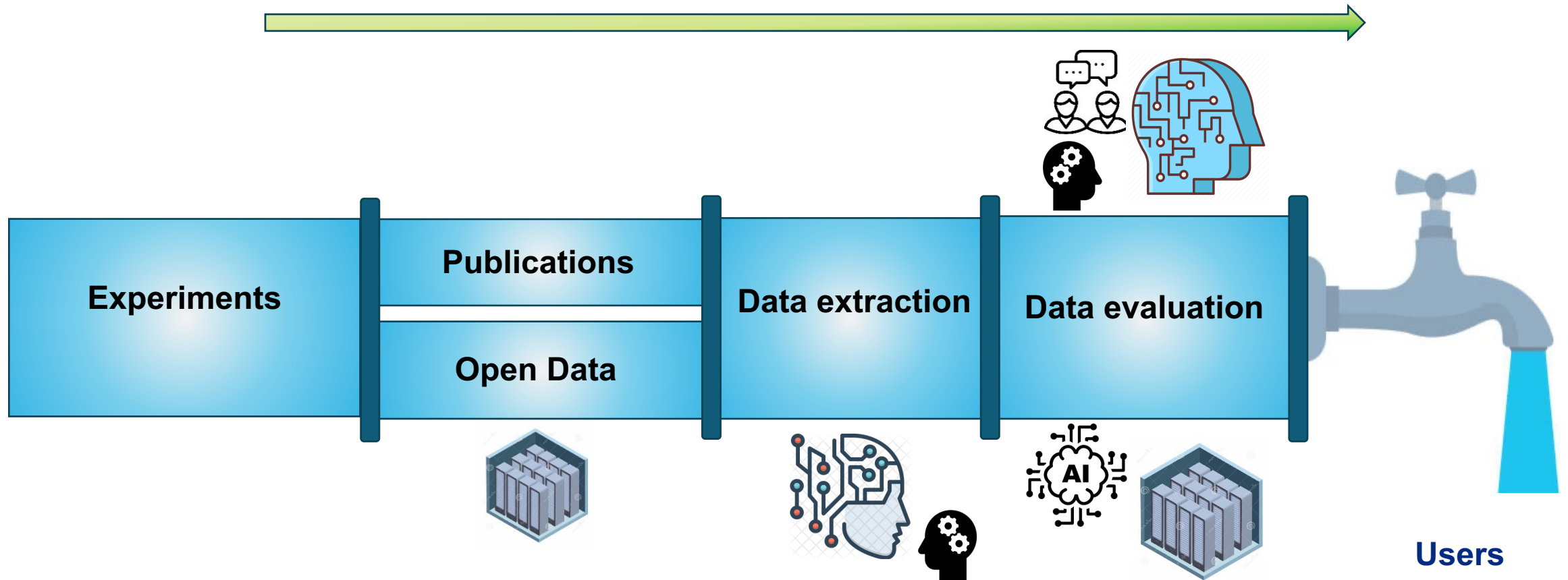


Our product's impact is limited by:

- Outdated formats
- Outdated evaluation procedures
- Often publications only contain a portion of all data measured

# Nuclear Data Pipeline, 2028

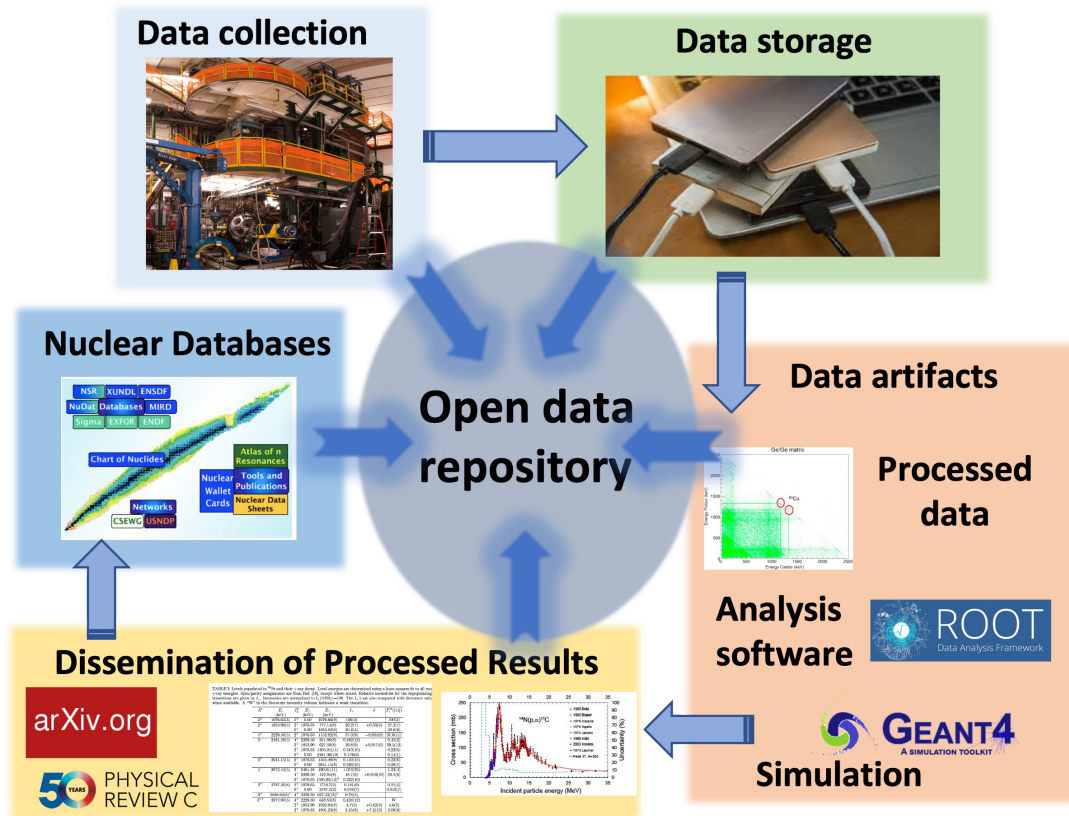
Proposed timeline of about 1 – 2 years



This new paradigm will address bottlenecks, ensure that results of expensive experiments are properly stored, and address stakeholders' feedback in a timely manner.

# Open Nuclear Data

Low Energy Nuclear Physics has strategic value and should be archived (Harriet Kung (DOE SC) at WANDA2021)



Purpose is to ingest, document, and preserve data at each stage of an experiment

## Benefits :

- help fully realize discovery potential
- maximize return on investment
- extract more physics with advanced analysis codes
- explore additional reaction channels
- enable accurate renormalizations as “standards” change
- re-examination and validation of results
- source of critical training data for ML approaches
- useful for student training

**In the US, the USNDP is the community to do this !!**

- Leverage RHIC/HP Data Computing Facility expertise
- Promote community buy in through our connections with major facilities (FRIB, ATLAS, LANCE)
- **Integrate USNDP in Data Management Plans**

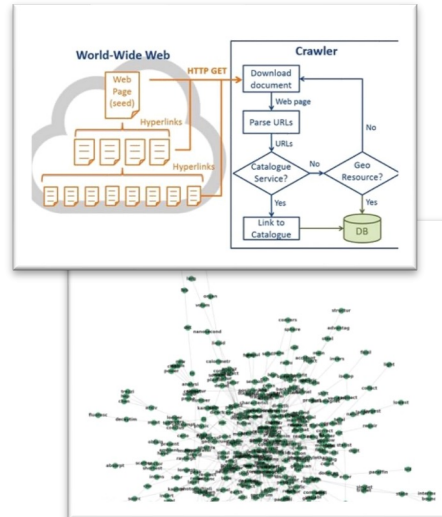


# Current & Planned Modernization Efforts

## Progress on more efficient extraction of data from publications

### NucScholar for NSR

- Automated literature collection
- Automatic keyword extraction
- Natural language queries



### Tabular Extraction for XUNDL/EXFOR

- Modified CascadeTabNet for table detection
- Im2markup for cell recognition
- To be presented at CODA 2023

TABLE 1. Summary of  $\gamma$  lines assigned to the decay of  $^{232}\text{Th}$ . Intensities are given per 100 decays.

Energy (keV)	Intensity (%)	Assignment
203.9	0.0000	203.9
212.0	0.0000	212.0
220.4	0.0000	220.4
228.2	0.0000	228.2
234.5	0.0000	234.5
244.0	0.0000	244.0
253.8	0.0000	253.8
261.5	0.0000	261.5
270.3	0.0000	270.3
279.2	0.0000	279.2
288.3	0.0000	288.3
297.5	0.0000	297.5
306.8	0.0000	306.8
316.2	0.0000	316.2
325.7	0.0000	325.7
335.3	0.0000	335.3
345.0	0.0000	345.0
354.8	0.0000	354.8
364.7	0.0000	364.7
374.7	0.0000	374.7
384.8	0.0000	384.8
395.0	0.0000	395.0
405.3	0.0000	405.3
415.7	0.0000	415.7
426.2	0.0000	426.2
436.8	0.0000	436.8
447.5	0.0000	447.5
458.3	0.0000	458.3
469.2	0.0000	469.2
480.2	0.0000	480.2
491.3	0.0000	491.3
502.5	0.0000	502.5
513.8	0.0000	513.8
525.2	0.0000	525.2
536.7	0.0000	536.7
548.3	0.0000	548.3
560.0	0.0000	560.0
571.8	0.0000	571.8
583.7	0.0000	583.7
595.7	0.0000	595.7
607.8	0.0000	607.8
620.0	0.0000	620.0
632.3	0.0000	632.3
644.7	0.0000	644.7
657.2	0.0000	657.2
670.0	0.0000	670.0
682.9	0.0000	682.9
696.0	0.0000	696.0
709.2	0.0000	709.2
722.5	0.0000	722.5
736.0	0.0000	736.0
750.0	0.0000	750.0
764.2	0.0000	764.2
778.5	0.0000	778.5
793.0	0.0000	793.0
807.5	0.0000	807.5
822.2	0.0000	822.2
837.0	0.0000	837.0
852.0	0.0000	852.0
867.0	0.0000	867.0
882.0	0.0000	882.0
897.0	0.0000	897.0
912.0	0.0000	912.0
927.0	0.0000	927.0
942.0	0.0000	942.0
957.0	0.0000	957.0
972.0	0.0000	972.0
987.0	0.0000	987.0
1002.0	0.0000	1002.0
1017.0	0.0000	1017.0
1032.0	0.0000	1032.0
1047.0	0.0000	1047.0
1062.0	0.0000	1062.0
1077.0	0.0000	1077.0
1092.0	0.0000	1092.0
1107.0	0.0000	1107.0
1122.0	0.0000	1122.0
1137.0	0.0000	1137.0
1152.0	0.0000	1152.0
1167.0	0.0000	1167.0
1182.0	0.0000	1182.0
1197.0	0.0000	1197.0
1212.0	0.0000	1212.0
1227.0	0.0000	1227.0
1242.0	0.0000	1242.0
1257.0	0.0000	1257.0
1272.0	0.0000	1272.0
1287.0	0.0000	1287.0
1302.0	0.0000	1302.0
1317.0	0.0000	1317.0
1332.0	0.0000	1332.0
1347.0	0.0000	1347.0
1362.0	0.0000	1362.0
1377.0	0.0000	1377.0
1392.0	0.0000	1392.0
1407.0	0.0000	1407.0
1422.0	0.0000	1422.0
1437.0	0.0000	1437.0
1452.0	0.0000	1452.0
1467.0	0.0000	1467.0
1482.0	0.0000	1482.0
1497.0	0.0000	1497.0
1512.0	0.0000	1512.0
1527.0	0.0000	1527.0
1542.0	0.0000	1542.0
1557.0	0.0000	1557.0
1572.0	0.0000	1572.0
1587.0	0.0000	1587.0
1602.0	0.0000	1602.0
1617.0	0.0000	1617.0
1632.0	0.0000	1632.0
1647.0	0.0000	1647.0
1662.0	0.0000	1662.0
1677.0	0.0000	1677.0
1692.0	0.0000	1692.0
1707.0	0.0000	1707.0
1722.0	0.0000	1722.0
1737.0	0.0000	1737.0
1752.0	0.0000	1752.0
1767.0	0.0000	1767.0
1782.0	0.0000	1782.0
1797.0	0.0000	1797.0
1812.0	0.0000	1812.0
1827.0	0.0000	1827.0
1842.0	0.0000	1842.0
1857.0	0.0000	1857.0
1872.0	0.0000	1872.0
1887.0	0.0000	1887.0
1902.0	0.0000	1902.0
1917.0	0.0000	1917.0
1932.0	0.0000	1932.0
1947.0	0.0000	1947.0
1962.0	0.0000	1962.0
1977.0	0.0000	1977.0
1992.0	0.0000	1992.0
2007.0	0.0000	2007.0
2022.0	0.0000	2022.0
2037.0	0.0000	2037.0
2052.0	0.0000	2052.0
2067.0	0.0000	2067.0
2082.0	0.0000	2082.0
2097.0	0.0000	2097.0
2112.0	0.0000	2112.0
2127.0	0.0000	2127.0
2142.0	0.0000	2142.0
2157.0	0.0000	2157.0
2172.0	0.0000	2172.0
2187.0	0.0000	2187.0
2202.0	0.0000	2202.0
2217.0	0.0000	2217.0
2232.0	0.0000	2232.0
2247.0	0.0000	2247.0
2262.0	0.0000	2262.0
2277.0	0.0000	2277.0
2292.0	0.0000	2292.0
2307.0	0.0000	2307.0
2322.0	0.0000	2322.0
2337.0	0.0000	2337.0
2352.0	0.0000	2352.0
2367.0	0.0000	2367.0
2382.0	0.0000	2382.0
2397.0	0.0000	2397.0
2412.0	0.0000	2412.0
2427.0	0.0000	2427.0
2442.0	0.0000	2442.0
2457.0	0.0000	2457.0
2472.0	0.0000	2472.0
2487.0	0.0000	2487.0
2502.0	0.0000	2502.0
2517.0	0.0000	2517.0
2532.0	0.0000	2532.0
2547.0	0.0000	2547.0
2562.0	0.0000	2562.0
2577.0	0.0000	2577.0
2592.0	0.0000	2592.0
2607.0	0.0000	2607.0
2622.0	0.0000	2622.0
2637.0	0.0000	2637.0
2652.0	0.0000	2652.0
2667.0	0.0000	2667.0
2682.0	0.0000	2682.0
2697.0	0.0000	2697.0
2712.0	0.0000	2712.0
2727.0	0.0000	2727.0
2742.0	0.0000	2742.0
2757.0	0.0000	2757.0
2772.0	0.0000	2772.0
2787.0	0.0000	2787.0
2802.0	0.0000	2802.0
2817.0	0.0000	2817.0
2832.0	0.0000	2832.0
2847.0	0.0000	2847.0
2862.0	0.0000	2862.0
2877.0	0.0000	2877.0
2892.0	0.0000	2892.0
2907.0	0.0000	2907.0
2922.0	0.0000	2922.0
2937.0	0.0000	2937.0
2952.0	0.0000	2952.0
2967.0	0.0000	2967.0
2982.0	0.0000	2982.0
2997.0	0.0000	2997.0
3012.0	0.0000	3012.0
3027.0	0.0000	3027.0
3042.0	0.0000	3042.0
3057.0	0.0000	3057.0
3072.0	0.0000	3072.0
3087.0	0.0000	3087.0
3102.0	0.0000	3102.0
3117.0	0.0000	3117.0
3132.0	0.0000	3132.0
3147.0	0.0000	3147.0
3162.0	0.0000	3162.0
3177.0	0.0000	3177.0
3192.0	0.0000	3192.0
3207.0	0.0000	3207.0
3222.0	0.0000	3222.0
3237.0	0.0000	3237.0
3252.0	0.0000	3252.0
3267.0	0.0000	3267.0
3282.0	0.0000	3282.0
3297.0	0.0000	3297.0
3312.0	0.0000	3312.0
3327.0	0.0000	3327.0
3342.0	0.0000	3342.0
3357.0	0.0000	3357.0
3372.0	0.0000	3372.0
3387.0	0.0000	3387.0
3402.0	0.0000	3402.0
3417.0	0.0000	3417.0
3432.0	0.0000	3432.0
3447.0	0.0000	3447.0
3462.0	0.0000	3462.0
3477.0	0.0000	3477.0
3492.0	0.0000	3492.0
3507.0	0.0000	3507.0
3522.0	0.0000	3522.0
3537.0	0.0000	3537.0
3552.0	0.0000	3552.0
3567.0	0.0000	3567.0
3582.0	0.0000	3582.0
3597.0	0.0000	3597.0
3612.0	0.0000	3612.0
3627.0	0.0000	3627.0
3642.0	0.0000	3642.0
3657.0	0.0000	3657.0
3672.0	0.0000	3672.0
3687.0	0.0000	3687.0
3702.0	0.0000	3702.0
3717.0	0.0000	3717.0
3732.0	0.0000	3732.0
3747.0	0.0000	3747.0
3762.0	0.0000	3762.0
3777.0	0.0000	3777.0
3792.0	0.0000	3792.0
3807.0	0.0000	3807.0
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3837.0	0.0000	3837.0
3852.0	0.0000	3852.0
3867.0	0.0000	3867.0
3882.0	0.0000	3882.0
3897.0	0.0000	3897.0
3912.0	0.0000	3912.0
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3957.0	0.0000	3957.0
3972.0	0.0000	3972.0
3987.0	0.0000	3987.0
4002.0	0.0000	4002.0
4017.0	0.0000	4017.0
4032.0	0.0000	4032.0
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4062.0	0.0000	4062.0
4077.0	0.0000	4077.0
4092.0	0.0000	4092.0
4107.0	0.0000	4107.0
4122.0	0.0000	4122.0
4137.0	0.0000	4137.0
4152.0	0.0000	4152.0
4167.0	0.0000	4167.0
4182.0	0.0000	4182.0
4197.0	0.0000	4197.0
4212.0	0.0000	4212.0
4227.0	0.0000	4227.0
4242.0	0.0000	4242.0
4257.0	0.0000	4257.0
4272.0	0.0000	4272.0
4287.0	0.0000	4287.0
4302.0	0.0000	4302.0
4317.0	0.0000	4317.0
4332.0	0.0000	4332.0
4347.0	0.0000	4347.0
4362.0	0.0000	4362.0
4377.0	0.0000	4377.0
4392.0	0.0000	4392.0
4407.0	0.0000	4407.0
4422.0	0.0000	4422.0
4437.0	0.0000	4437.0
4452.0	0.0000	4452.0
4467.0	0.0000	4467.0
4482.0	0.0000	4482.0
4497.0	0.0000	4497.0
4512.0	0.0000	4512.0
4527.0	0.0000	4527.0
4542.0	0.0000	4542.0
4557.0	0.0000	4557.0
4572.0	0.0000	4572.0
4587.0	0.0000	4587.0
4602.0	0.0000	4602.0
4617.0	0.0000	4617.0
4632.0	0.0000	4632.0
4647.0	0.0000	4647.0
4662.0	0.0000	4662.0
4677.0	0.0000	4677.0
4692.0	0.0000	4692.0
4707.0	0.0000	4707.0
4722.0	0.0000	4722.0
4737.0	0.0000	4737.0
4752.0	0.0000	4752.0
4767.0	0.0000	4767.0
4782.0	0.0000	4782.0
4797.0	0.0000	479