



USNDP/NNDC Report

David Brown
National Nuclear Data Center



USNDP Annual Meeting 2024
Duke U., Durham NC, Sep 2024

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.



Personnel changes at the NNDC



Sanjane Waniganeththi joined the NNDC on April 1st as a post-doc to work on the Accelerated Decay Data Evaluation project

Sam Kim has left the NNDC for a post-doctoral position at LANL in the isotopes production group.



Gulhan Gurdal brought under NNDC contract for XUNDL compilations following a recommendation from NDAC



Libby Ricard became member of BNL RAP1 team in addition to her duties as deputy NNDC head and ENSDF library manager.

**The NNDC currently has
9 staff scientists,
1 post-doc,
4 professional staff and
3 contractors**

FY24 Staffing Summary

For FY 24, the NNDC supported

- 3 IT professionals (**Arcilla**, **Mason**, & **Shu**),
- 3 administrative staff (**Dunn**, **Krejci**, & **Frejka**)
- 11 permanent scientists (Brown, Chimanski, **Coles**, Mattera, Morse, Nobre, Ota, Ricard, **Sonzogni**, Pritychenko, & **Wu**)
- 2 postdocs (Kim & Waniganeththi)
- 3 contractors (Gritzay, Gurdal, & Symochko)



Legend

NNDC member, partly funded by USNDP

NNDC member, fully funded by USNDP

Non-NNDC member, partly funded by USNDP



What we're up to



You heard about these projects from the rest of the NNDC

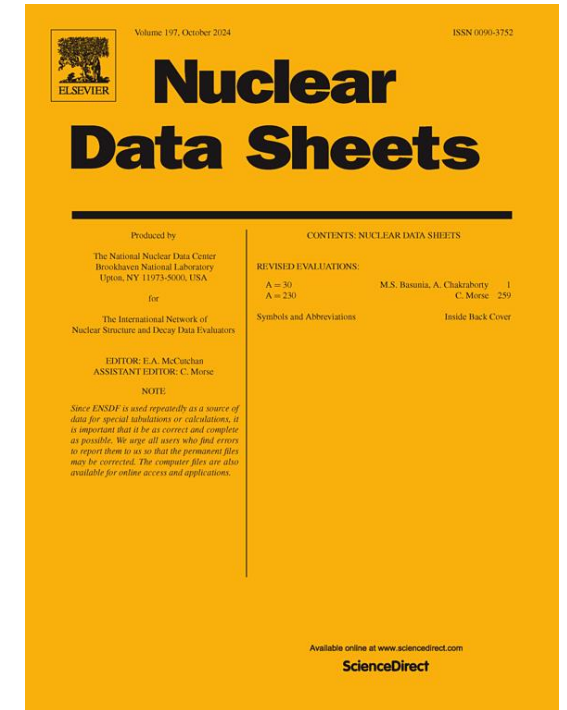
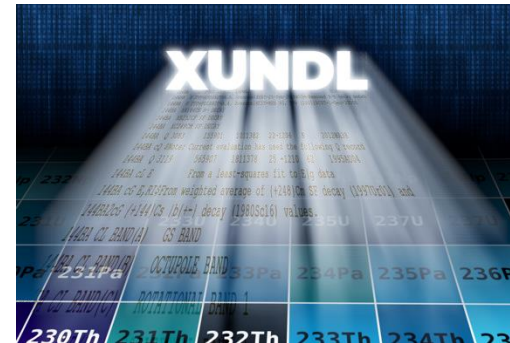
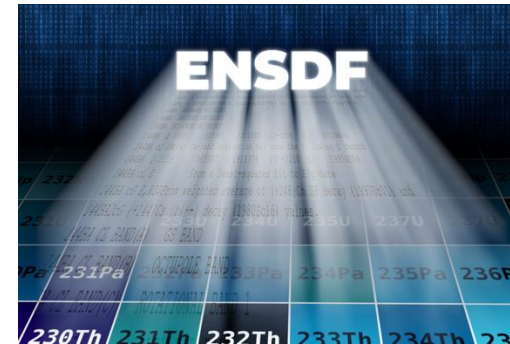
Gustavo Nobre

ENDF/B VIII.1

Boris Pritychenko

NSR and EXFOR

Libby Ricard



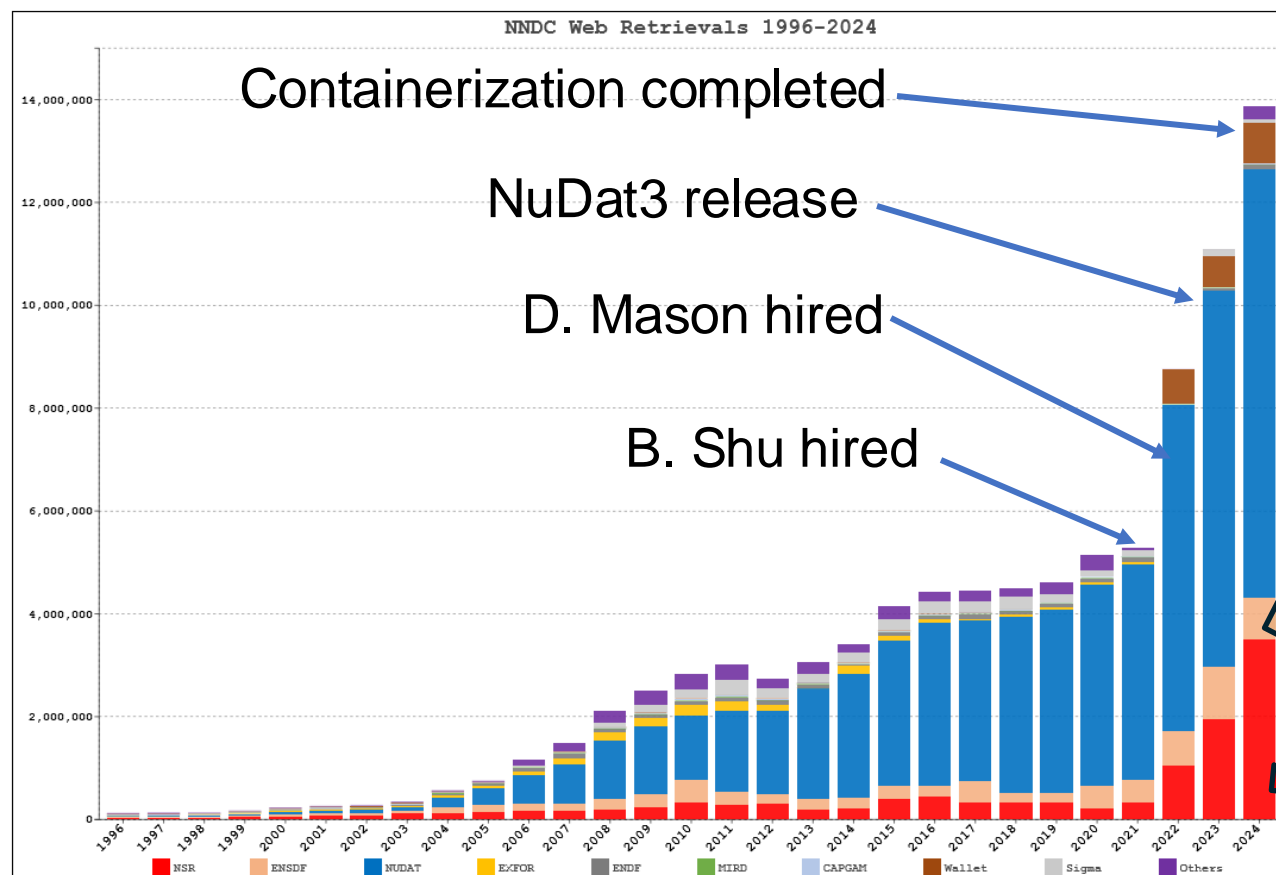
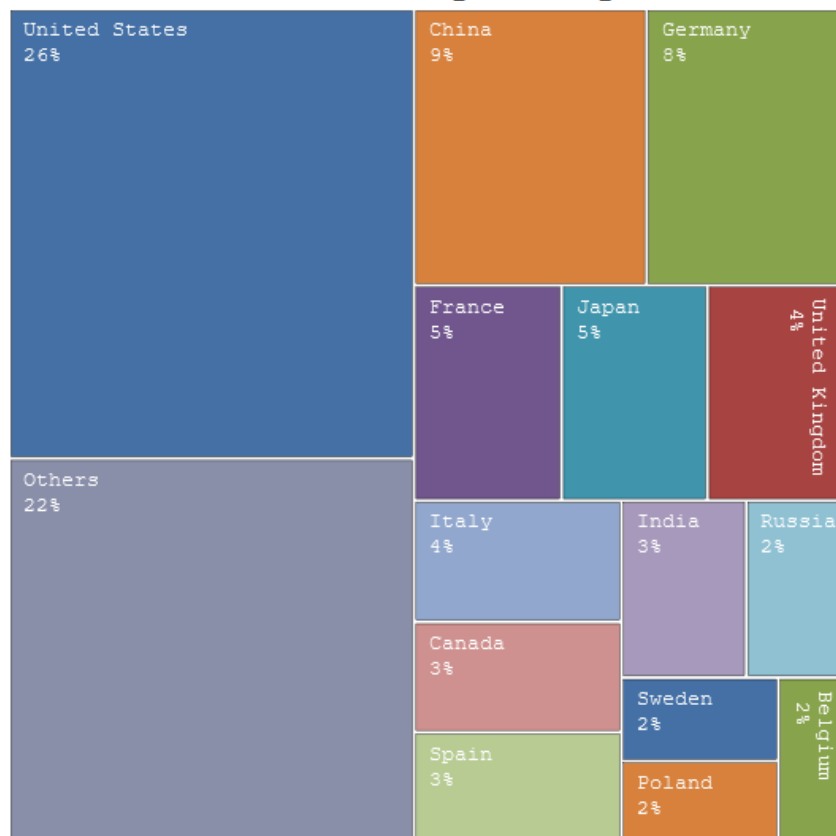
Chris Morse, Donnie Mason & Ben Shu

Modernization Efforts

Web Analytics

- Approximately **12 million** retrievals in FY24
 - Most notable growth in **Wallet Cards** and **NuDat 3**

Nudat Web Retrievals By Country (FY 2024)



Wallet

NuDat

ENSDF

NSR

The essential drivers behind web dissemination

A dedicated team

- Ramon Arcilla – System Administrator
- Ben Shu – Webmaster, software development
- Donnie Mason – Web and software development



Web servers upgraded after 5-year lifecycle

- **Machines** : 5 → 3
- **Cores**: 10 → 28
- **RAM**: 192GB → 384GB
- **Storage**: 4.2 TB → 14 TB
- Total cost under budget of \$75k



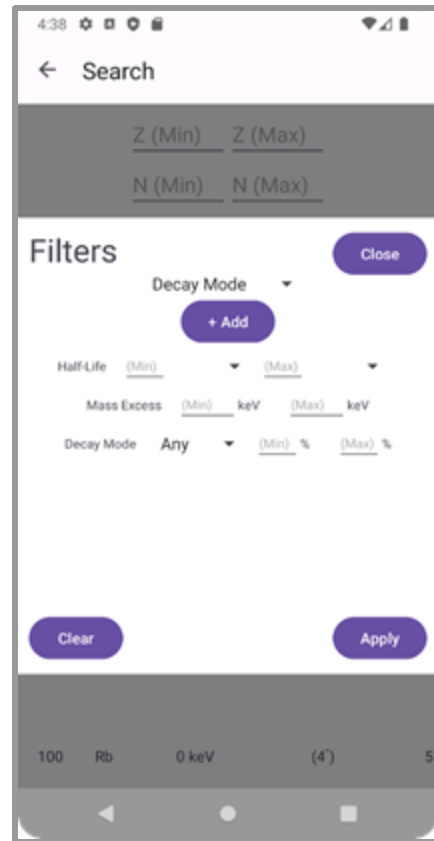
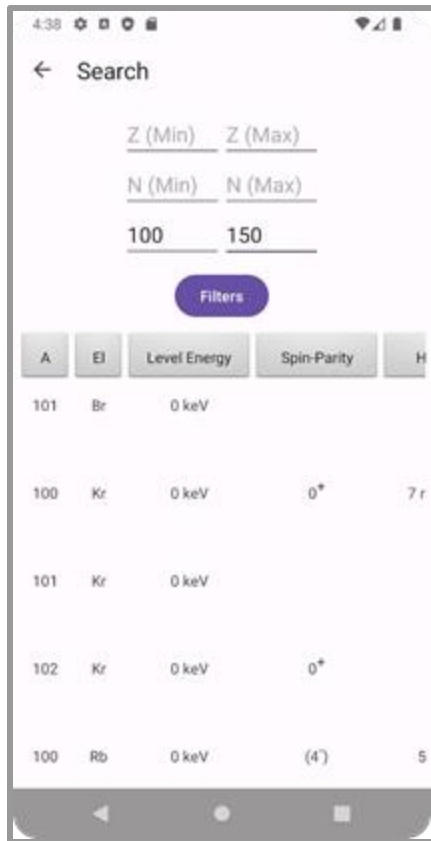
NNDC Mobile Apps

- Offline, search-able access to NNDC data
 - [Nuclear Wallet Cards](#)
 - Ground- and isomer-state observable properties
 - [CapGam](#)
 - Gamma ray energies from thermal neutron capture
- Currently available on Google Play Store
- iOS versions created by SULI student Hamnah Irfan
 - [Currently applying to publish on App Store]

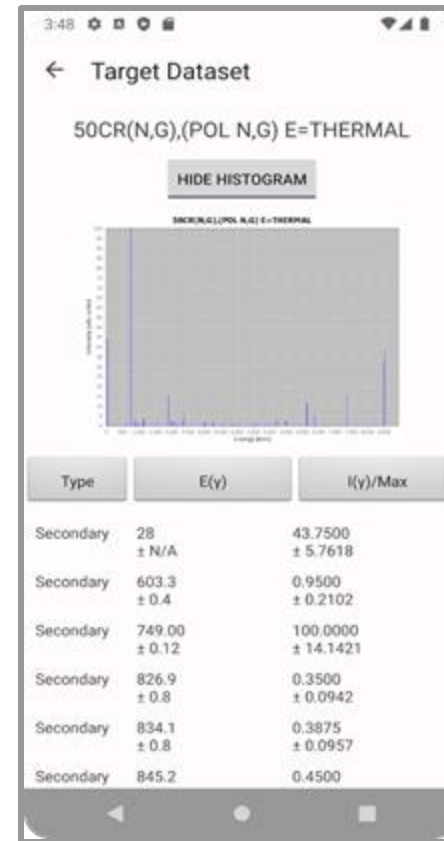


NNDC Mobile Apps (Android)

Nuclear Wallet Cards



CapGam



Search by Energy

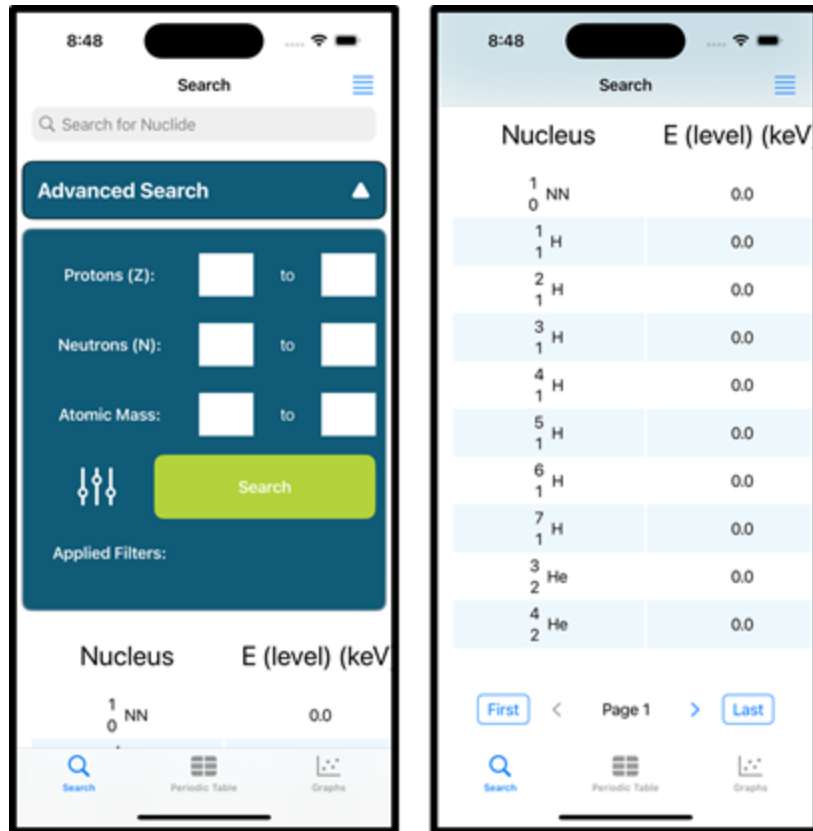
45 keV

50 keV

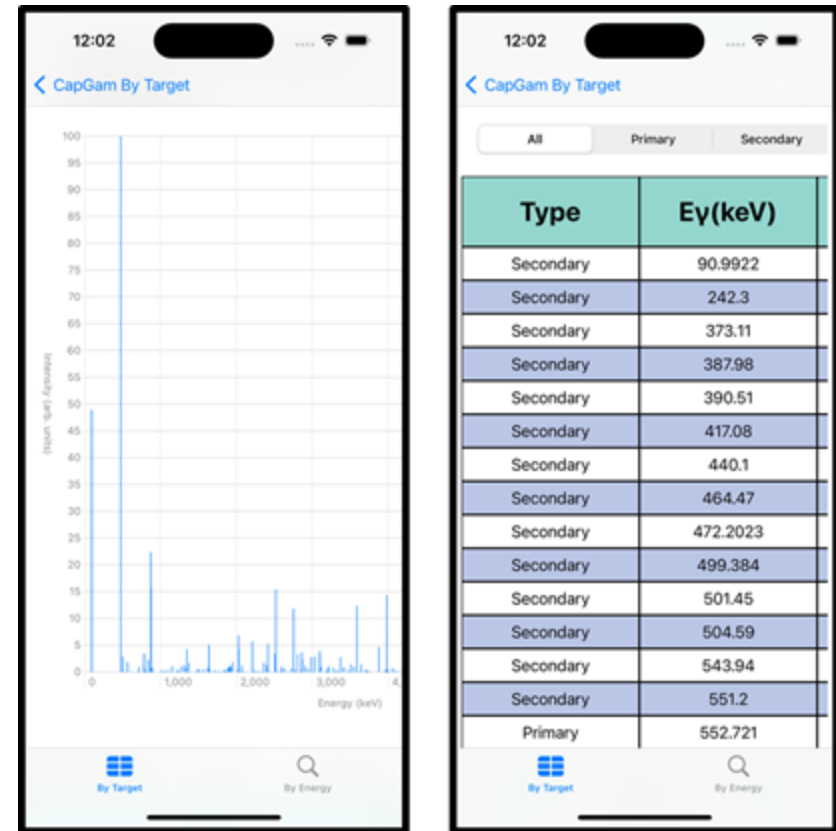
| Type | E(y) | I(y)/Max | Target | Strongest ys |
|------|------------------|-----------------|--------|----------------------------|
| S | 45.00 ± 0.05 | 0.5392 ± 0.1494 | 115In | 6470.4, 6559.3, 6656.3 |
| S | 45.0579 ± 0.0010 | 0.0382 ± 0.0062 | 151Eu | 885.2, 1136.0, 1175.7 |
| S | 45.074 ± 0.010 | 0.1572 ± 0.0498 | 243Am | 1407.04, 1408.32, 1409.94 |
| S | 45.197 ± 0.004 | 0.9353 ± 0.2412 | 237Np | 633.56, 646.75, 648.27 |
| S | 45.243 ± 0.002 | N/A | 235U | 5584.9, 6395.5, 6499.5 |
| S | 45.2680 ± 0.0020 | 0.0260 ± 0.0130 | 178Hf | 5484.7, 5677.804, 5723.620 |
| S | 45.300 ± 0.001 | 4.5556 ± 0.8509 | 154Gd | 6168.6, 6329.9, 6436.0 |
| S | 45.483 ± 0.009 | 0.9836 ± 0.3314 | 81Br | 7428.65, 7517.68, ... |

NNDC Mobile Apps (iOS)

Nuclear Wallet Cards



CapGam



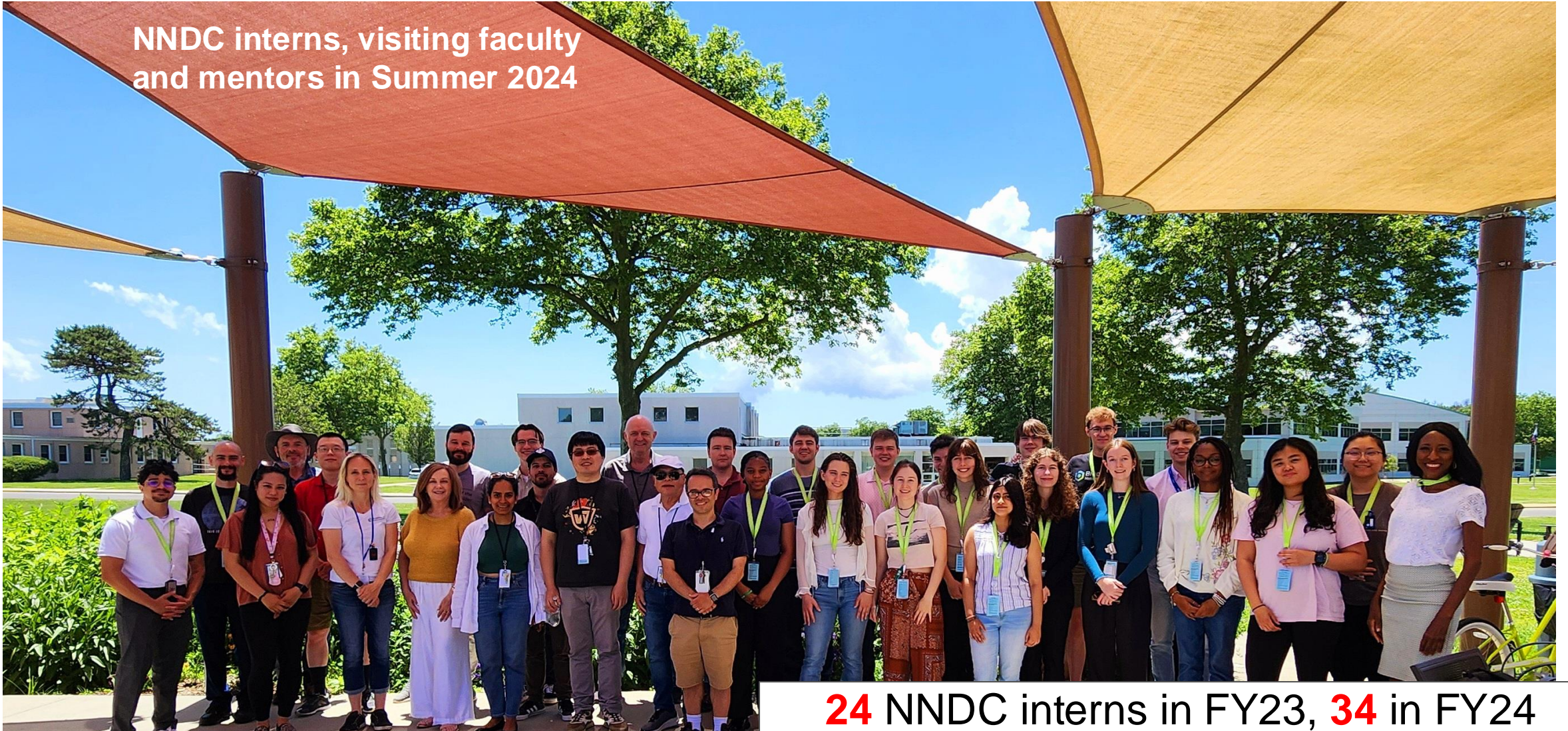


Student highlights



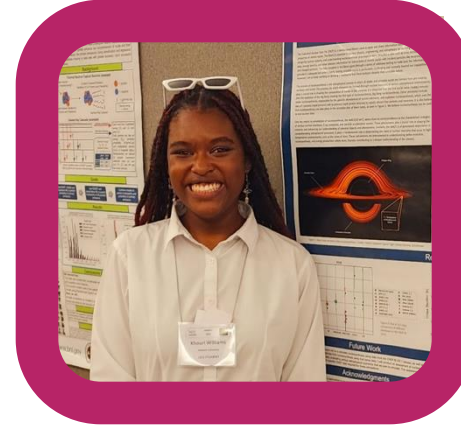
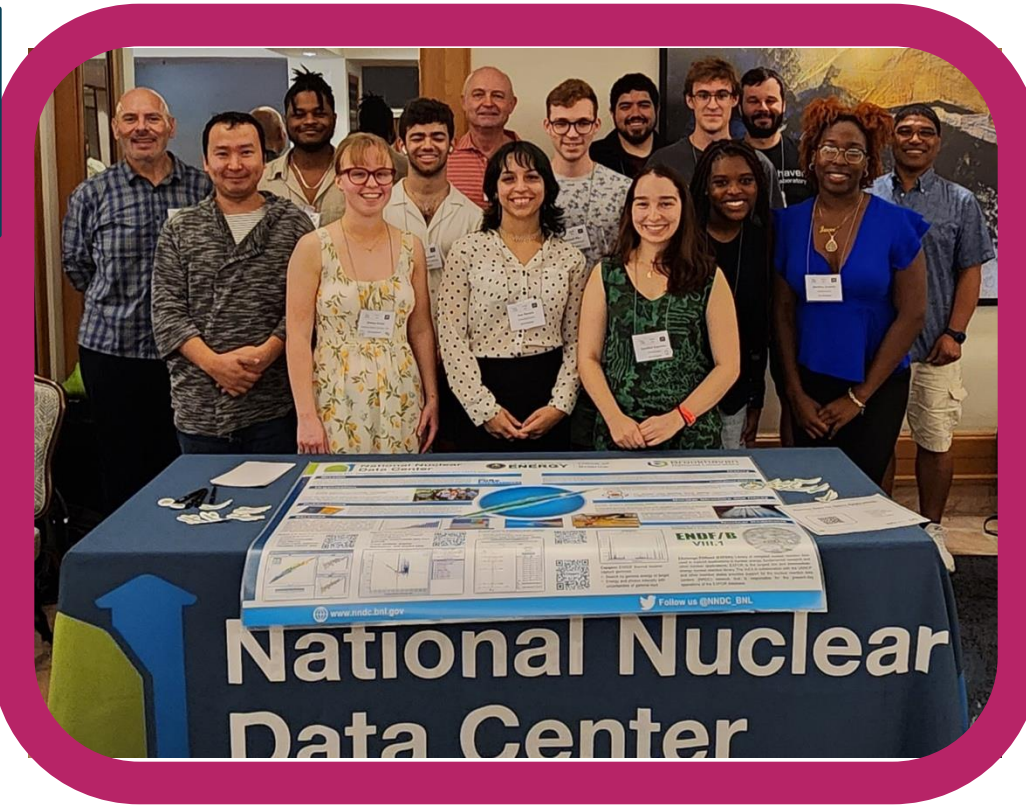
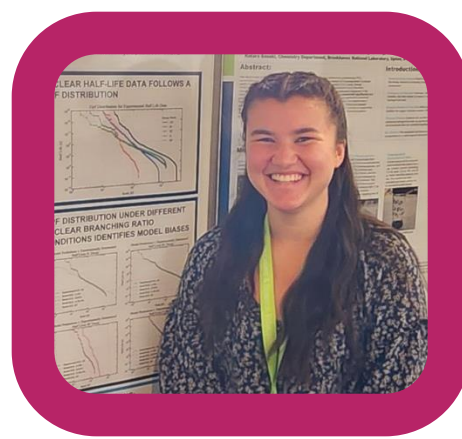
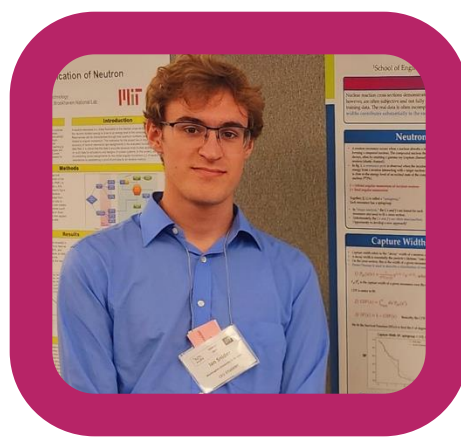
Training the next generation workforce

NNDC interns, visiting faculty
and mentors in Summer 2024



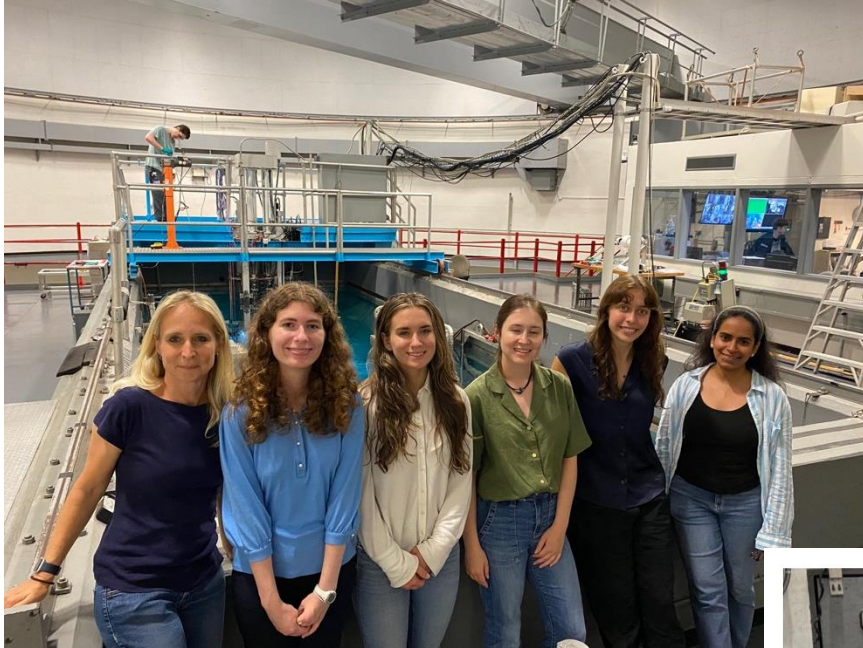
24 NNDC interns in FY23, **34** in FY24
142 interns since 2014 | 61% from URG

NNDC Interns
8 interns attended
DNP24 with partial
NNDC support.

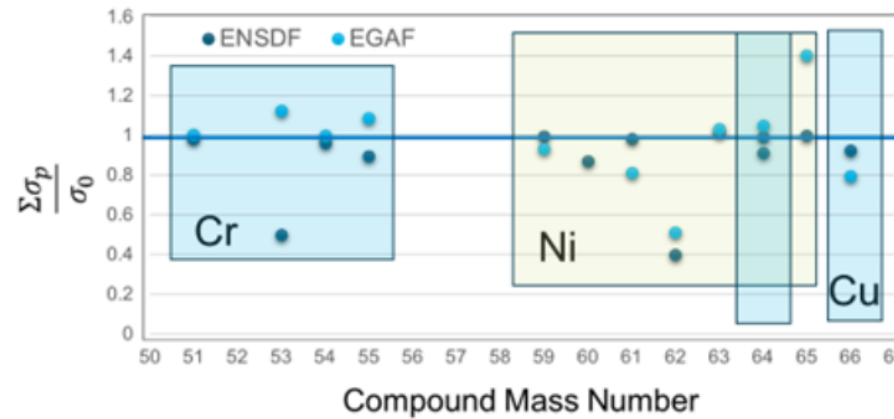


FAIR grant with UMASS Lowell

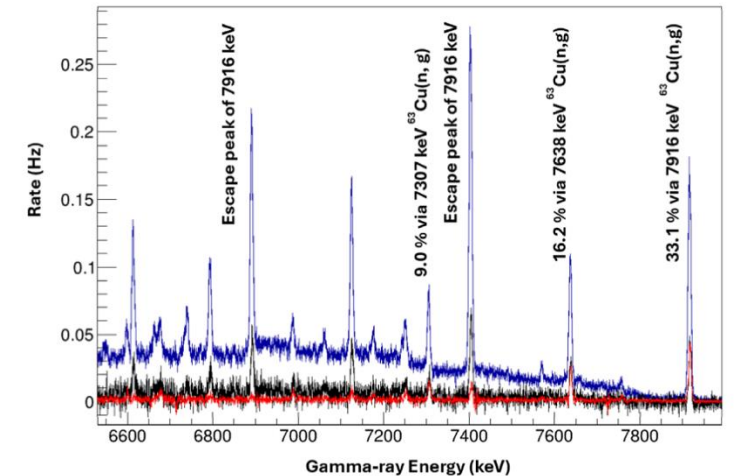
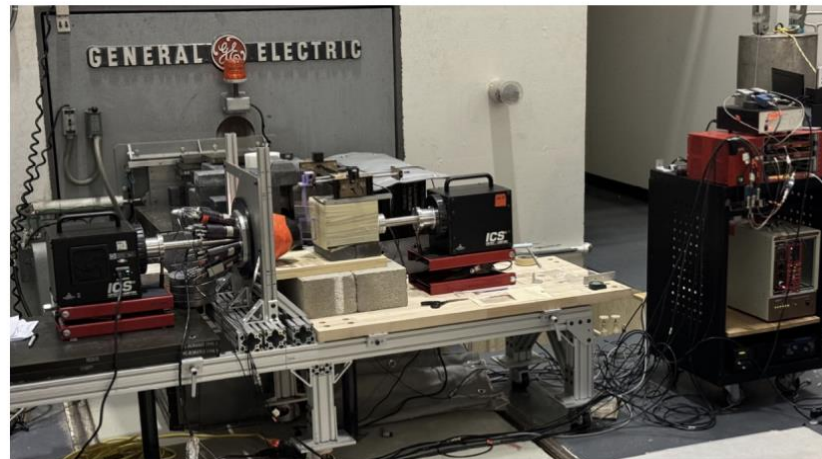
Improving diversity in STEM



AND Improving thermal neutron capture data for ENSDF & ENDF



$\text{NatCu}(n,g)$



NNDC Outreach Activities - FY 2024

Women In Science & Engineering (2 full-day events)



50 undergrads from Stony Brook University

BNL mini-Semester program



1 half-day event

28 undergraduate students from traditionally unserved and underrepresented groups in STEM

New This Year

Science Accelerating Girls' Engagement



1 half-day event

20 Long Island high-school students (grade 10-12)

New This Year

Introduction to Nuclear Physics, Nuclear Data and the work of the NNDC

Hands-on experiences to showcase NNDC products (NuDat, ENSDF, ENDF) and explain basic nuclear physics concepts



NNDC Publications



Data collection for NNDC publications is in progress

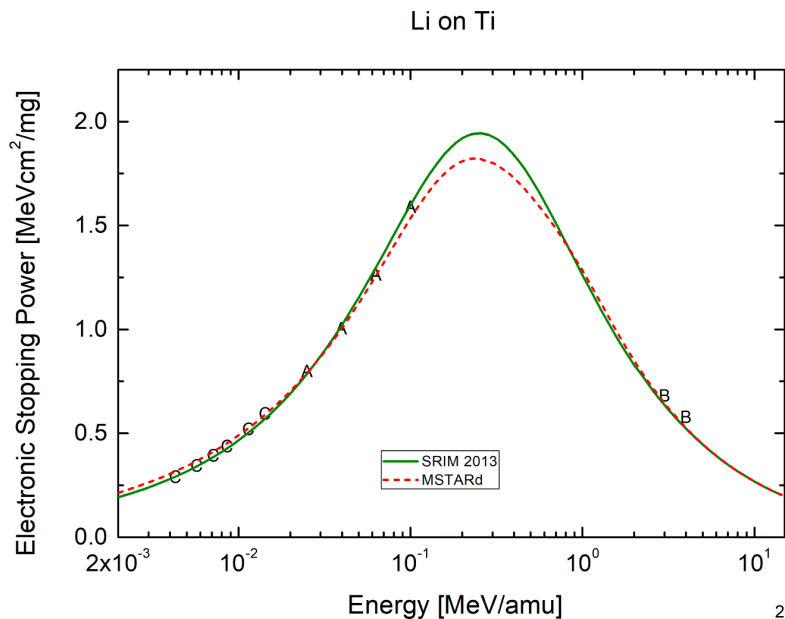
- 11 peer review publications identified so far, including 1 PRL
- 10 lab reports identified so far including
 - USNDP Annual Report 2023,
 - USNDP Work Plan 2024,
 - ENDF Format manual,
 - CSEWG Meeting Minutes 2024
- 1 book: GNDS-2.0
- 3 conference proceedings identified so far



NNDC Initiatives

Ion stopping power measurements

- The stopping power of ions in matter is critical information for many activities, e.g. nuclear science, radiotherapeutics, radiation shielding
- Data on stopping powers are sparse or non-existent for many materials, as shown in the figure on the right
- The NNDC is setting up a program to measure stopping powers of ions in various materials to address this need



A typical stopping-power curve. The letters indicate data points while the lines are calculations. Note how the predictions of the peak height differ due to lack of data.

26 May 2021

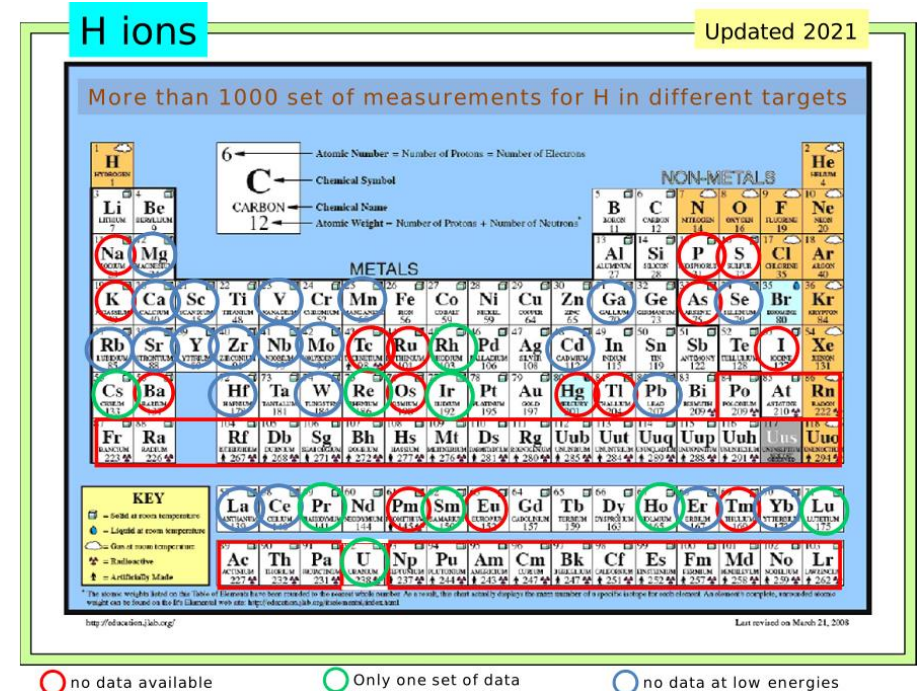
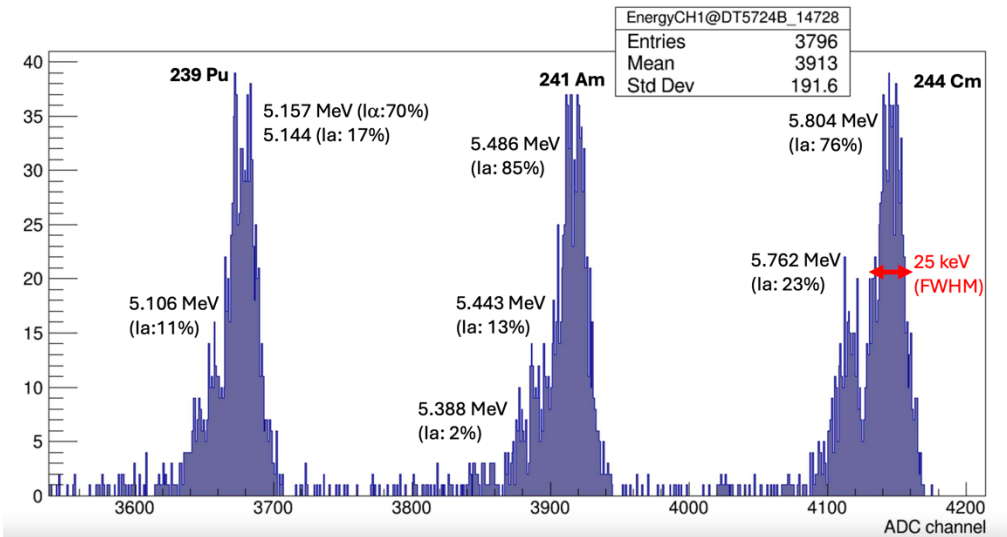
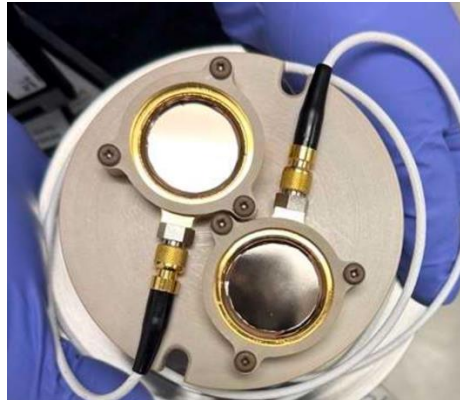
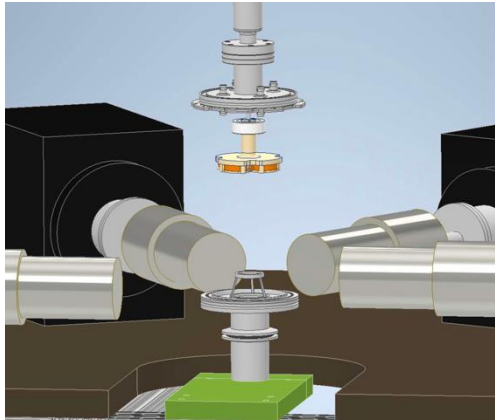


Figure from talk by Claudia Montanari at WANDA2022. Circles indicate elements for which there is little to no data for the stopping power of protons.

1 year LDRD to demonstrate feasibility of measurements.
PI: C. Morse

NNDC In-house Decay Measurements

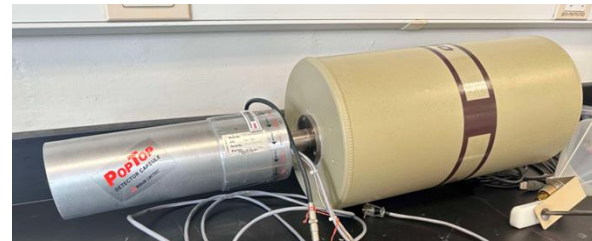
α – gamma spectroscopy system complete



Measurement of ^{225}Ac in progress

NN department and NNSA gave us

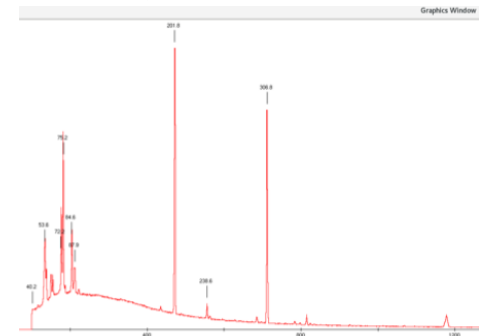
- 10 HPGe detectors
- 2 LEPS detectors
- 15 NaI detectors
- Low background well shield
- Electronics, cables, etc



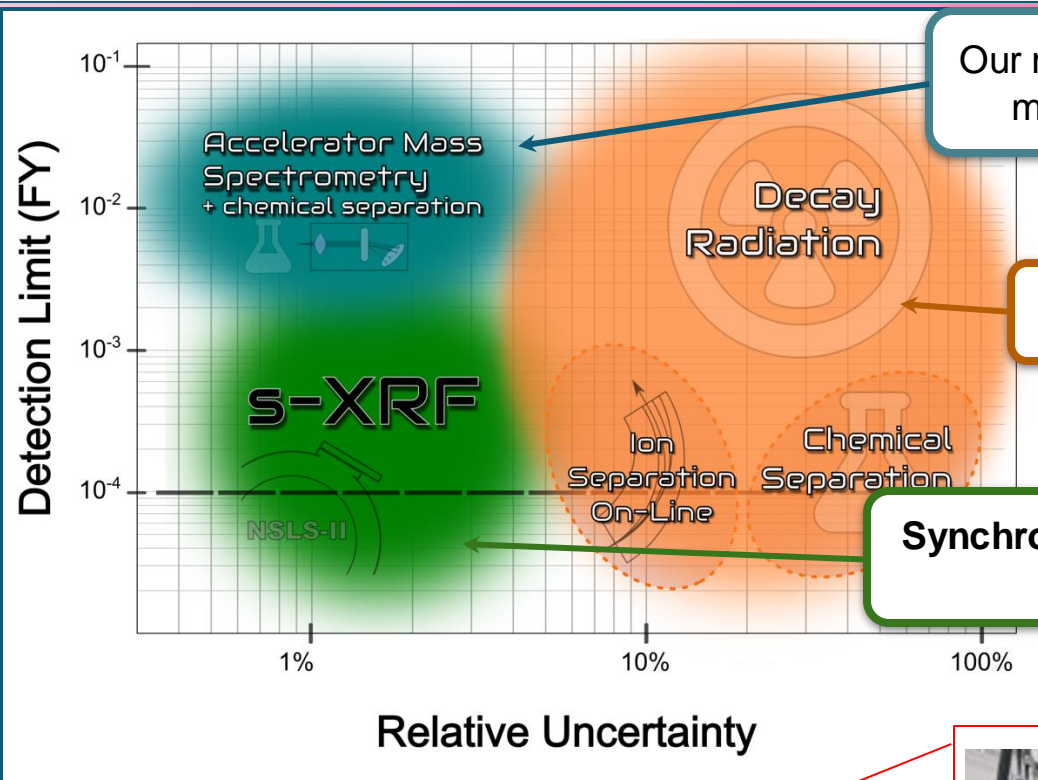
Follow on LDRD from BNL to

- Construct pumping/annealing station
- Purchase 2nd DAQ, sources, misc bits

Measurement of ^{176}Lu $T_{1/2}$ in progress



Precise fission yield measurements at NSLS-II using X-ray fluorescence, A. Mattera & M. Topsakal



Our recommended fission yields are based on Atomic Mass Spectrometry (AMS) measurements from the 1970s never published in a peer-reviewed journal.

Activation methods rely on nuclear data which introduce additional uncertainty to the yield determination.

Synchrotron-based x-ray fluorescence can achieve similar precision to AMS but much lower detection limit thanks to NSLS-II brightness.

National Synchrotron Light Source - II @ BNL



Two-year LDRD project, taking advantage of the bright X-ray beams and advanced detectors at NSLS-II to precisely measure charge yields of long-lived fission products from neutron-induced fission of $^{235,238}\text{U}$ and $^{239,241}\text{Pu}$ using synchrotron-based X-ray Fluorescence (s-XRF).

Proof of concept:
Transmutation of Rh into Pd following neutron capture.



Maintaining and improving nuclear data for world-wide use

Nuclear Structure and Decay

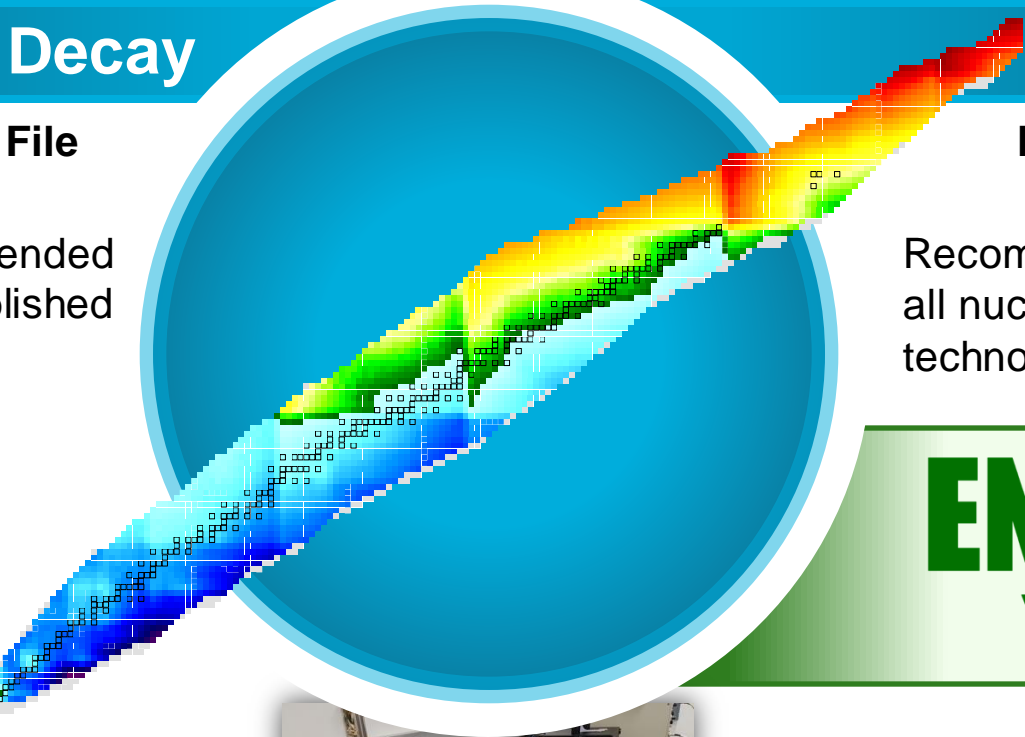
Evaluated Nuclear Structure Data File (ENSDF)

One and only database of recommended values derived from all published experimental nuclear structure and decay data.



Experimental Unevaluated Nuclear Data List (XUNDL)

Compiled nuclear structure and decay data from recently published articles



Nuclear Reactions

Evaluated Nuclear Data File (ENDF)

Recommended neutron reaction data for all nuclei relevant for nuclear science and technology

ENDF/B VIII.1



Experimental Nuclear Reaction Data (EXFOR)

World's only repository of experimental nuclear reaction data



Precision measurements of decay radiation properties