



BNL Report

Libby Ricard

On behalf of the National Nuclear Data Center



@BrookhavenLab



National Nuclear Data Center



U.S. DEPARTMENT OF
ENERGY

Office of
Science

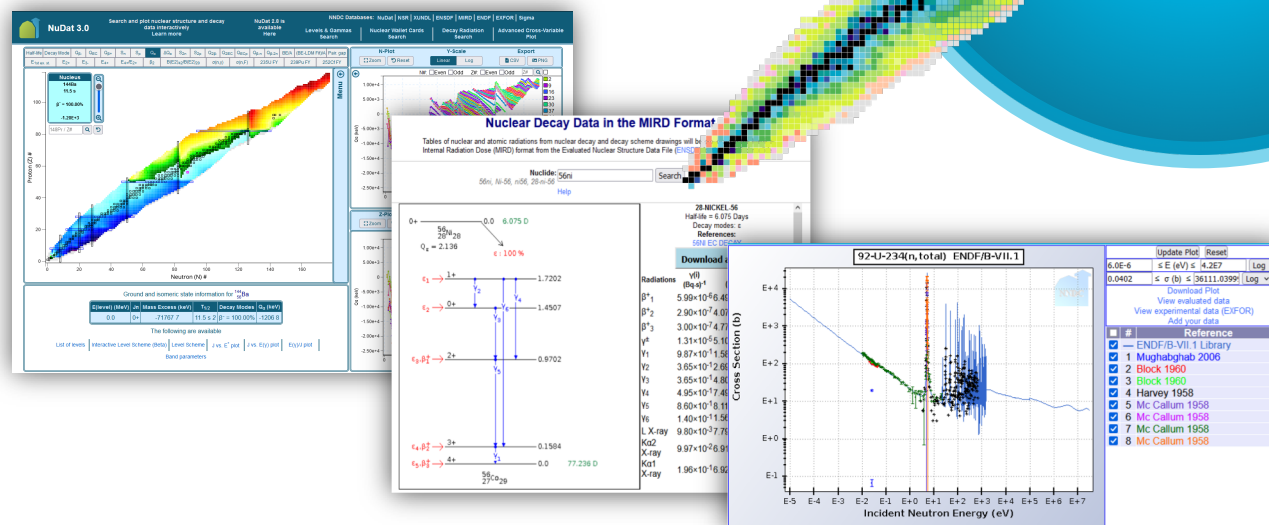
Maintaining and improving nuclear data for world-wide use

Mission

To provide current, accurate, authoritative data for workers in pure and applied areas of nuclear science and engineering

Services

Disseminate nuclear data through feature-rich web applications



Databases

Nuclear Structure & Decay:

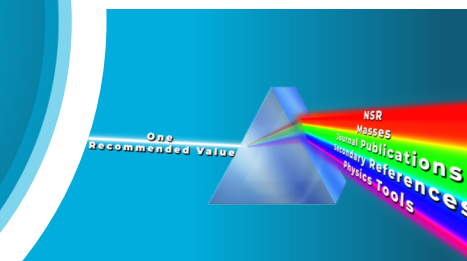
- ENSDF
- XUNDL

Nuclear Reaction:

- ENDF
- EXFOR

Bibliographic:

- NSR



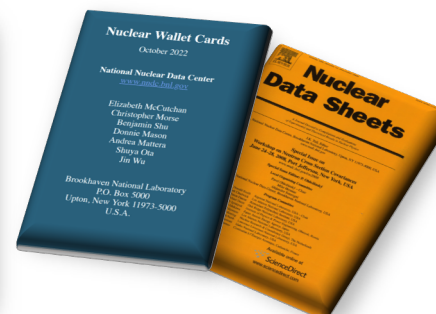
Publications

Nuclear Data Sheets:

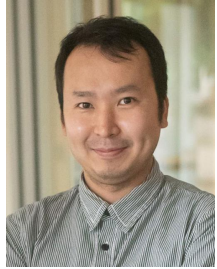
World leading journal on nuclear data evaluations and research

Nuclear Wallet Cards:

Ground and isomeric state nuclear properties of all-known nuclei



Personnel changes at the NNDC



Shuya Ota joined May 2022 as scientific staff primarily working on ENSDF and developing the NNDC decay station.

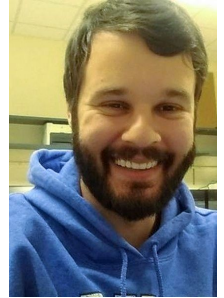


Jin Wu joined September 2022 as scientific staff working on ENSDF/XUNDL and gamma-ray spectroscopy.

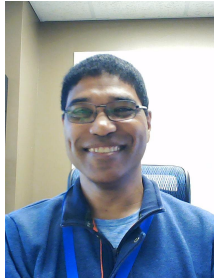


Chris Morse joined March 2021 as scientific staff working on ENSDF and leading the ENSDF modernization project.

Emanuel Chimanski joined the NNDC April 2022 as a post doc working on the NA-22 GRIN project. Converted to staff May 2023.



Sam Kim joined the NNDC March 2022 focusing on joint BLIP/NNDC LDRD project studying ^{125}Xe trapped in silicate nanostructures.



Amber Coles joined NNDC in March 2021 as a postdoc working on Intentional Forensics project, left July 2023 for staff position in SRNL.

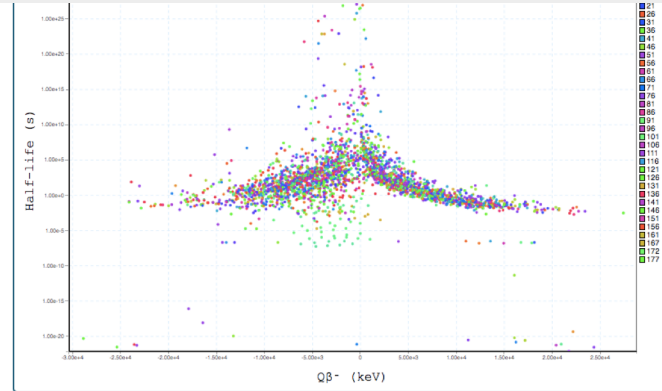


Spotlight on Interns



Ben Shu

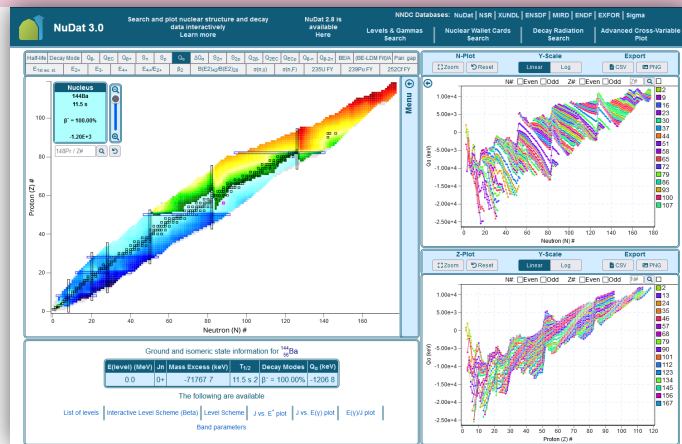
SULI and SURP Internships
Developed 1st version of Cross Variable Plot



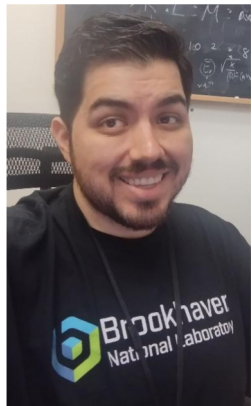
- Technology Analysts (full time staff position)
- Focusing on

- Web applications
- Server architecture
- Modernization projects
- Database design

SULI and SURP Internships
Initial design of NuDat3



BONUS (for them and us)
BNL funding Masters Degree in CS



Donnie Mason



Database Activities



@BrookhavenLab

NSR and EXFOR databases

NSR	2022	2023
New Entries	3280	3411
Corrected Entries	315	340
Keyworded	2457	2487
Database Updates	169	169

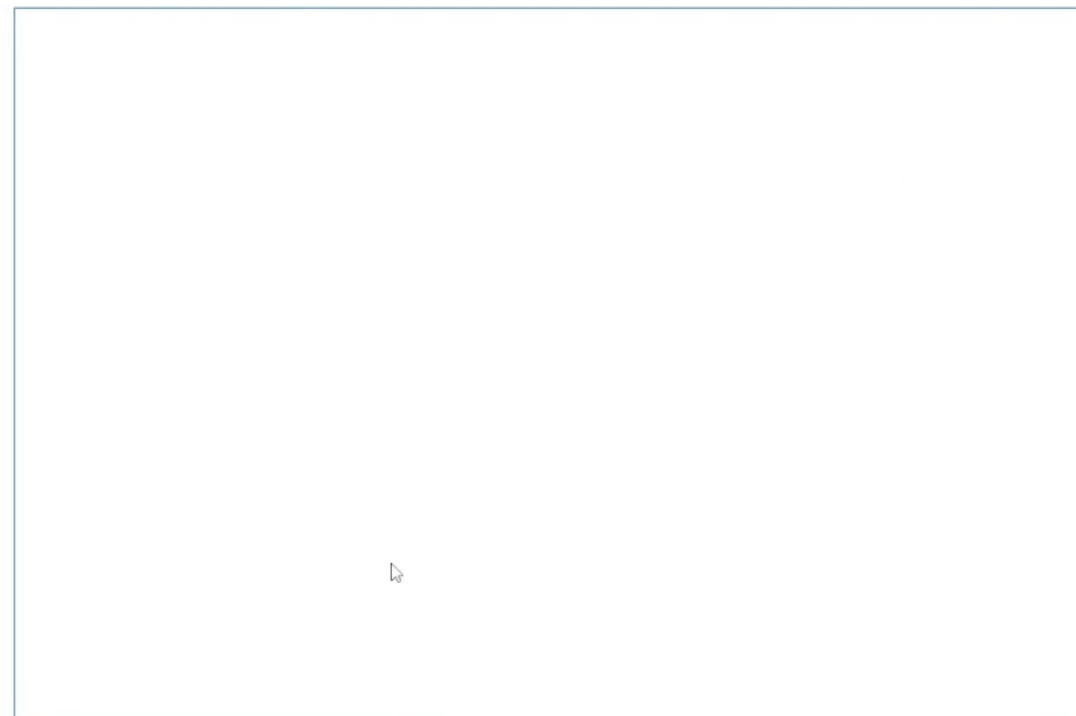
B. Pritychenko, J.Totans (BNL),
D.Symochko, B.Singh (BNL Contractors),
V.Zerkin (IAEA)

EXFOR	FY2022	FY2023
New Compilations	158	152
Updated Compilations	210	98
Preliminary Transmissions	29	19
Final Transmissions	31	22
Database Updates	41	39

B.Pritychenko (BNL), O.Schwerer, S.Hlavac,
O.Gritsay (BNL Contractors).

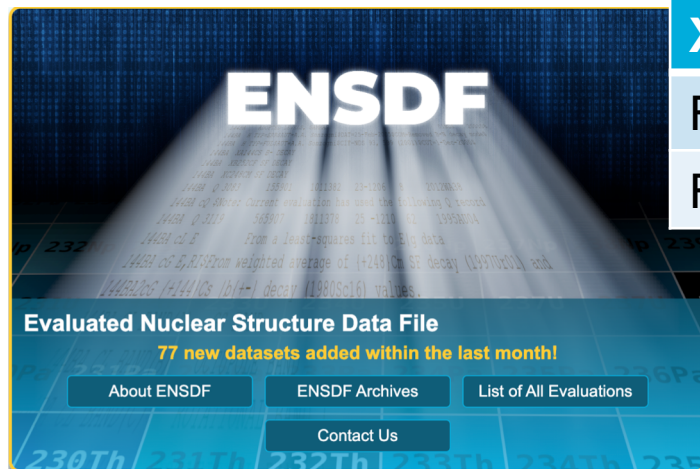
Highlight: NSR contents were verified against **FRIB Discovery of Nuclides Project** in collaboration with M. Thoennessen and J. Chen **200** additions and **200** fixes to NSR

▶ 1890 ●



More on NSR and EXFOR modernization plans tomorrow

XUNDL/ENSDF Metrics for FY21/22



XUNDL	Datasets	Papers
FY21	356	218
FY22	336	187

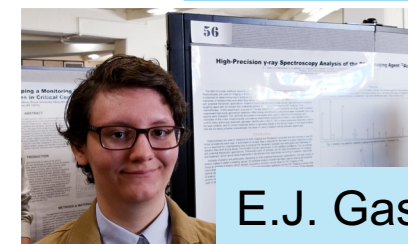


G. Gurdal under contract for XUNDL compilations

ENSDF	Mass Chains	Nuclei
FY21	5	90
FY22	2	54

Loss of Zhu and Hayes; training Ota and Wu

Our first priority is to meet the 1 medium mass chain per 0.5 FTE metric



E.J. Gass under contract for ENSDF evaluations

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 $A=269, 273, 277, 281, 285, 289, \text{ and } 293$ ", NDS **182**, 167 (2022)

S. Zhu, "Nuclear Data Sheets for $A=236$ ", Nucl.Data Sheets **182**, 2 (2022)

A.M. Mattera, S. Zhu, A.B. Hayes, E.A. McCutchan, "Nuclear Data Sheets for $A=252$ ", NDS **172**, 543 (2021)

S. Zhu and E.A. McCutchan, "Nuclear Data Sheets of $A=214$ ", NDS **175**, 1 (2021)



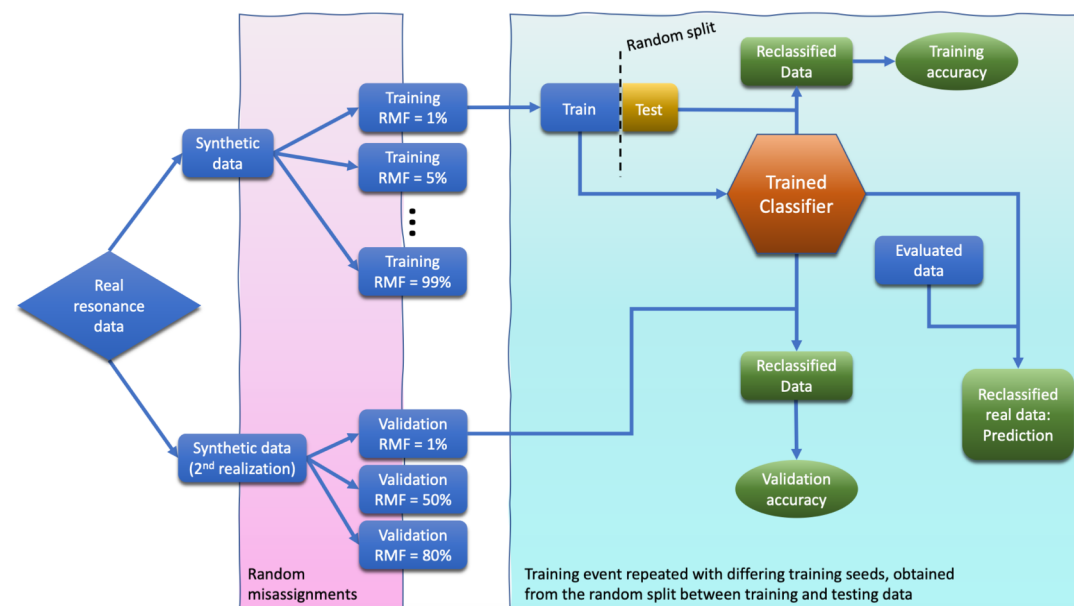
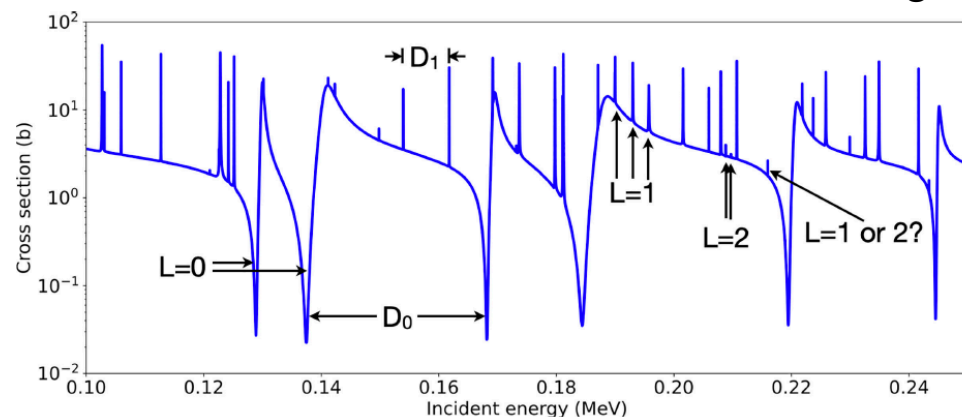
Highlights



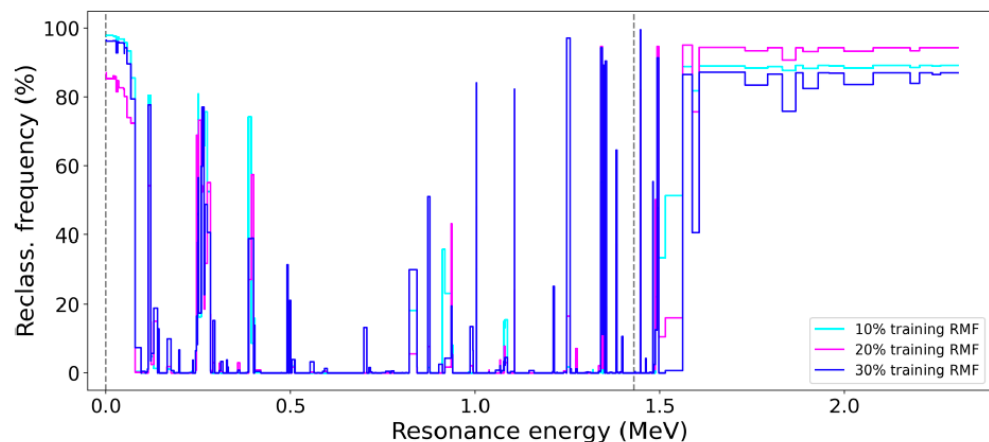
Bayesian Resonance Classification

First paper on ML method for reclassification of neutron resonances

- Evaluator makes prior estimates of widths, energies and quantum numbers
- For 100's of resonances – time consuming & tedious



Frequency of reclassification of resonances in ^{52}Cr



PHYSICAL REVIEW C **107**, 034612 (2023)

Novel machine-learning method for spin classification of neutron resonances

G. P. A. Nobre^{*} and D. A. Brown[✉]

National Nuclear Data Center, Brookhaven National Laboratory, Upton, New York 11973-5000, USA

S. J. Hollick[✉]

Department of Physics, Yale University, New Haven, Connecticut 06520, USA

S. Scoville[✉]

University of Pittsburgh, Pittsburgh, Pennsylvania 15217, USA
and Rensselaer Polytechnic Institute, Troy, New York 12180, USA

P. Rodríguez[✉]

Pacific Northwest National Laboratory, Richland, Washington 99354, USA
and University of Puerto Rico, Mayagüez Campus, Mayagüez 00682, Puerto Rico

(Received 29 September 2022; accepted 16 February 2023; published 22 March 2023)

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

National Nuclear Data Center
www.nndc.bnl.gov

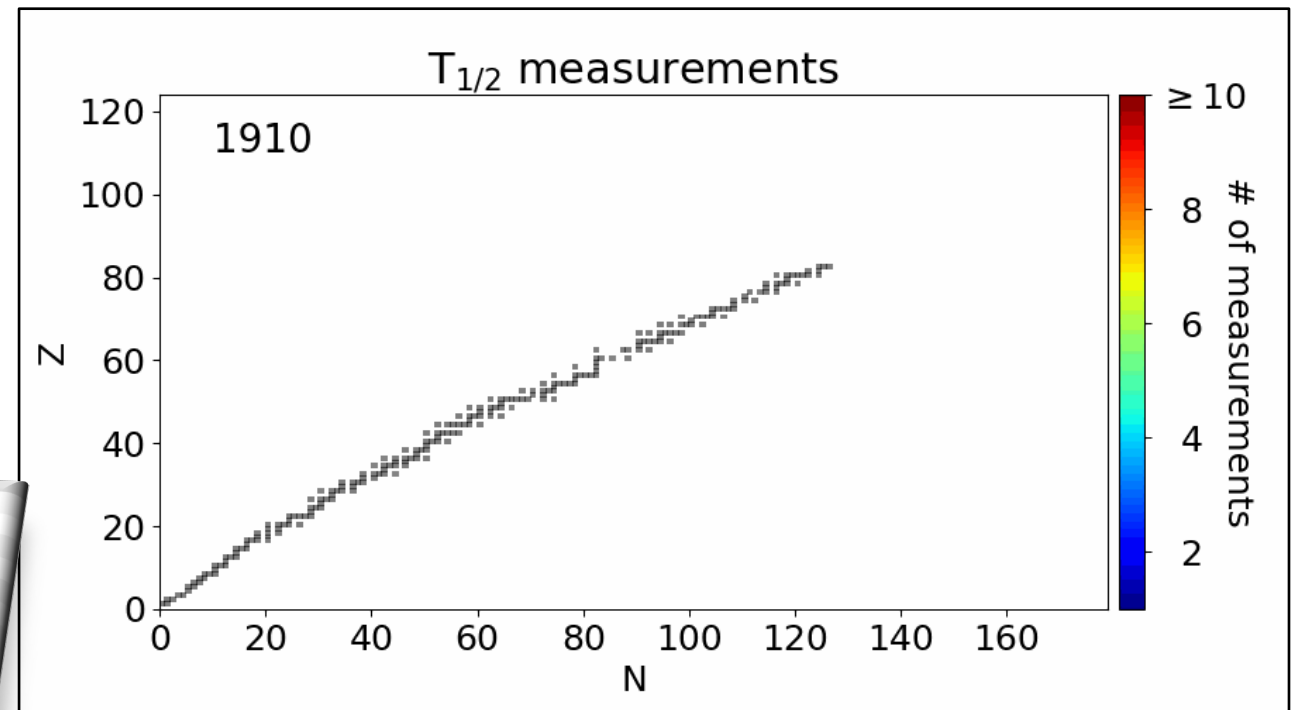
Elizabeth McCutchan
Shaofei Zhu
Christopher Morse
Benjamin Shu
Donnie Mason
Andrea Mattera
Shuya Ota
Jin Wu

Brookhaven National Laboratory
P.O. Box 500
Upton, New York 11974-5000
U.S.A.

WALLETCRAFT

Z = 4, Be - Beryllium

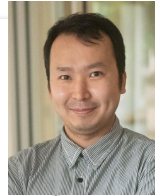
6	0 ⁺	18375.5	92 keV 6	2p
7	3/2 ⁻	15769.00 7	53.30 d 10	ϵ
8	0 ⁺	4941.672 35	5.57 eV 25	α
9	3/2 ⁻	11348.45 8	100%	
10	0 ⁺	12607.49 8	1.386 $\times 10^6$ y 12	β^-
11	1/2 ⁺	20177.17 24	13.77 s 7	β^- , $\beta^- \alpha = 3.3\%$
12	0 ⁺	25077.8 19	21.46 ms 5	β^- , $\beta^- n = 0.50\%$
13	(1/2 ⁻)	33659 10	450 keV 30	n?
14	0 ⁺	3.995 $\times 10^4$ 13	4.65 ms 12	β^- , $\beta^- n = 86\%$, $\beta^- 2n = 5\%$, $\beta^- \alpha < 0.004\%$
15	(5/2 ⁺)	4.983 $\times 10^4$ 17	5.8 $\times 10^2$ keV 20	n



Maintaining a diverse scientific portfolio

2023 FRIB VISITING SCHOLAR PROGRAM FOR EXPERIMENTAL SCIENCE NAMES AWARD WINNERS

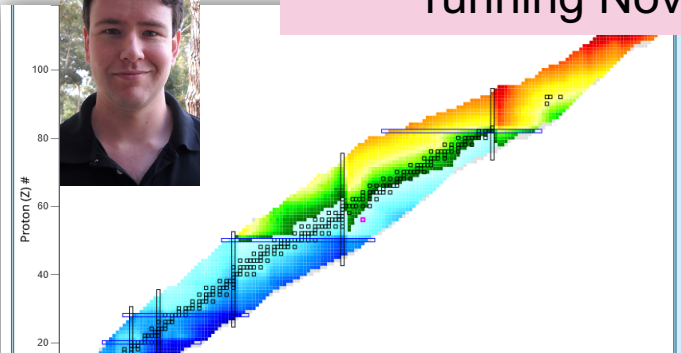
11 April 2023



Shuya Ota

Ota's current research focuses on nuclear and stellar astrophysics, nuclear structure of halo nuclei, nuclear data, and development of radiation detector equipment. He is currently interested in working with FRIB's **Modular Neutron Array** and **Large Multi-Institutional Scintillator Array (MoNA-LISA)** to study exotic neutron-halo nuclei near the drip line.

PI on ^{249}Md structure exp at ANL, running November 2023



PI on DSAM in Li isotopes
Accepted last TRIUMF PAC



PHYSICAL REVIEW C **106**, 064328 (2022)

First observation of isomeric states in ^{111}Zr , ^{113}Nb , and ^{115}Mo

J. Wu^{1,*}, S. Nishimura,² P.-A. Söderström,³ A. Algora,^{4,5} J. J. Liu,^{2,6} V. H. Phong,² Y. Q. Wu,⁷ F. R. Xu,⁷ J. Agramunt,⁴ D. S. Ahn,² T. A. Berry,⁸ C. G. Bruno,⁹ J. J. Bundgaard,¹⁰ R. Caballero-Folch,¹¹ A. C. Dai,⁷ T. Davinson,⁹ I. Dillmann,¹¹ A. Estrade,¹² A. Fijałkowska,^{13,14} N. Fukuda,² S. Go,² R. K. Grzywacz,^{10,15} T. Isobe,² S. Kubono,² G. Lorusso,^{2,8,16} K. Matsui,^{2,17} A. I. Morales,⁴ N. Nepal,¹² S. E. A. Orrigo,⁴ B. C. Rasco,¹⁵ K. P. Rvkaczewski,¹⁵ H. Sakurai,² Y. Shimizu,² D. W. Stracener,¹⁵ T. Sumikama,² H. Suzuki,² M. Wolin

PI on accepted FRIB PAC1 proposal



FRIB

By submitting this proposal, the spokesperson certifies that all collaborators listed have read the Description of Experiment and have agreed to participate in the experiment.

Title

Decay spectroscopy in the vicinity of the N=126 shell closure

Proposal 21080

Facility for Rare Isotope Beams

Proposal Form - PAC1

PHYSICAL REVIEW C **106**, 064326 (2022)

Decay spectroscopy of the blocked fission product ^{130}I

A. Mattera^{1,*}, E. A. McCutchan,^{1,†} S. Zhu,^{1,‡} C. Morse,¹ M. P. Carpenter^{1,2}, P. Copp,² C. Müller-Gatermann^{1,2}, W. Reviol^{1,2}, J. P. Greene,² and M. Gott²

¹National Nuclear Data Center, Brookhaven National Laboratory, Upton, NY 11973-5050

²Physics Division, Argonne National Laboratory, Lemont, IL 60469

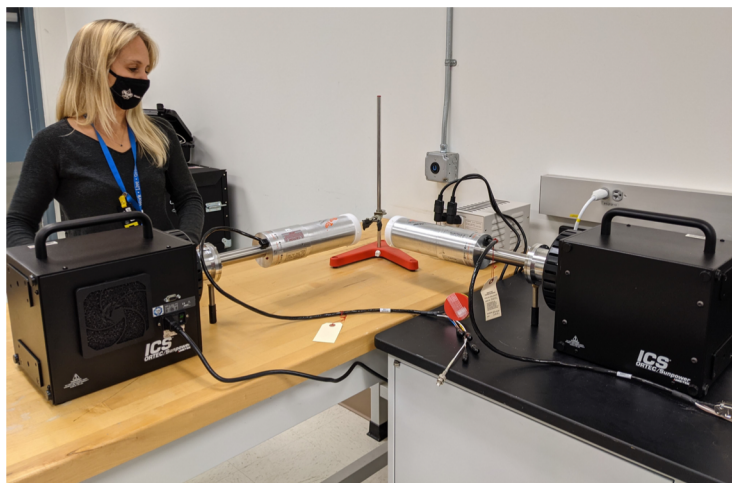


NA-22 funded program to improve decay data for nuclear forensics

BNL is making significant investment in Nuclear Data and Related Infrastructure

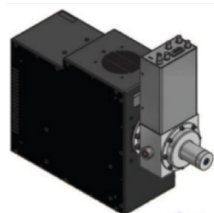
Program Development funds for $\alpha\beta\gamma$ spectrometer

Precision decay studies
Complements in-house production capabilities (BLIP and tandem)

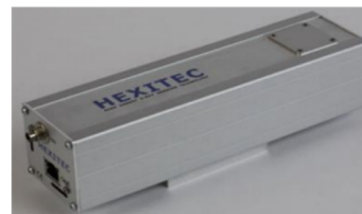


PD and LDRD funds for fission yield measurements at NSLSII

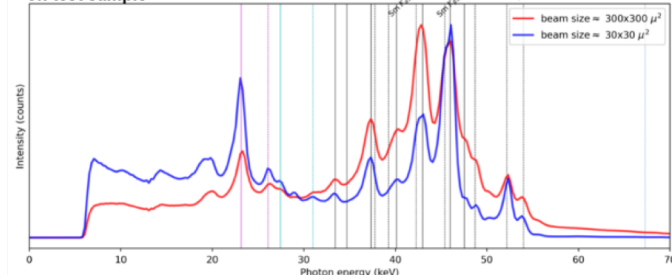
(a) MIRION XRF detector
(ordered, fabricated in EU, will arrive BNL in September 2021)



(b) HEXITEC XRF detector
(loaned, tested at NSLS-II)

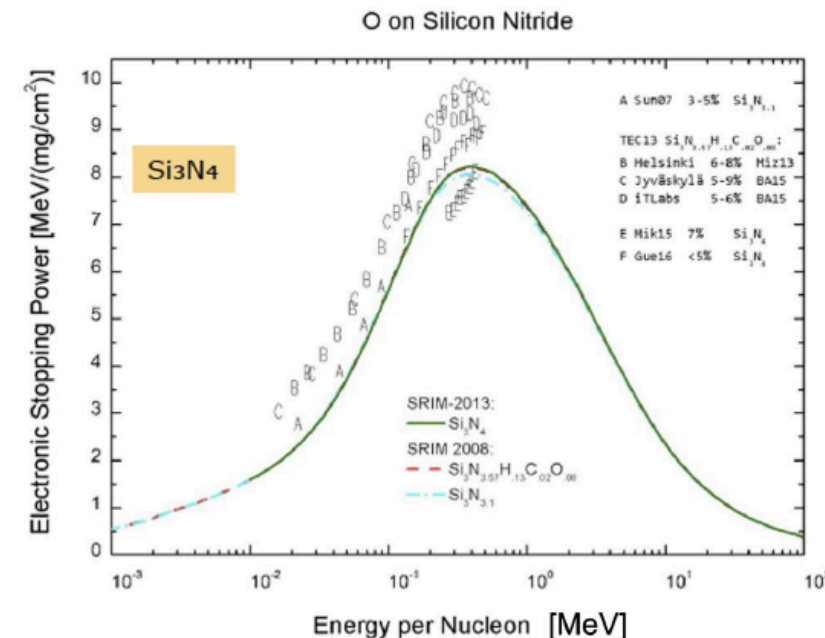


(c) XRF data on test sample



LDRD to Establish Stopping Power Measurement Capabilities

Use of BNL Tandem and SBU accelerator
Variety of applications AND supports DSAM measurements



Supplemental

For FY 23, the NNDC fully supported

- 3 IT professionals (Arcilla, Mason and Shu),
- 1 librarian (Totans)
- 8 permanent scientists (Brown, Mattera, Morse, Nobre, Ota, Pritychenko, Ricard, Wu)
- 1 postdoc (Kim)

Additionally, it partially supported

- 4 permanent scientists (Coles, Cuadra, Chimanski, Sonzogni),
- 2 post-docs (Lauer-Coles, Chimanski),
- 3 administrative staff (Dunn, Krejci and Frekja)



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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

Precision measurements of decay radiation properties



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