

US Nuclear Data Program

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www.nndc.bnl.gov

www.nndc.bnl.gov/usndp

The logo for Brookhaven National Laboratory, featuring the text "BROOKHAVEN NATIONAL LABORATORY" in a bold, sans-serif font. A stylized, curved line with a red dot at its end arches over the text.

BROOKHAVEN
NATIONAL LABORATORY

a passion for discovery



U.S. DEPARTMENT OF
ENERGY

Office of
Science

The Beginning

International Congress of Radiology and Electricity

2nd congress, Brussels, September 13-15 1910.

788

SCIENCE

[N. S. Vol. XXXII. No. 831

The proceedings were begun by Professor Rutherford, who stated that he had recently compared, by the γ -ray method, the radium standards employed in the leading laboratories of several different countries and had observed very considerable differences, amounting in some cases to 20 per cent., between them. He pointed out the importance of a uniform, international standard by which the results and experiments of workers in all parts of the world might be brought into accord.

It is to be hoped that the International Radium Standards Committee, in its efforts to place radioactive measurements on the same accurate basis as electrical and other measurements, will be supported financially by the governments of the countries represented. All questions with regard to the international radium standard should be addressed to Professor Stefan Meyer, the secretary of the International Committee. Institut für Radiumforschung, Waisenhausgasse 3, Vienna IX, Austria. BERTRAM B. BOLTWOOD

Some goals have not changed:

- Reduce uncertainties below **20%**
- Request **financial support**

Vienna still a major center for applied nuclear physics (**IAEA**)

Nuclear Data

The need to count with a list of measured nuclear properties (compilation), that was critically reviewed (evaluation) and published for the use of other researchers (dissemination) has been present since the earliest times

REVIEWS OF MODERN PHYSICS
JULY, 1931

REVIEWS OF MODERN PHYSICS
JANUARY, 1940

REVIEWS OF MODERN PHYSICS
VOLUME 12

A Table of Induced Radioactivities
J. J. Livingood
Jefferson Physical Laboratory
and Departments of Chemistry and Physics

Table of Isotopes
Firestone, Shirley, Baglin, Chu, Zipkin

NEUTRON CROSS SECTIONS
Donald J. Hughes and John A. Harvey
July 1, 1955

Nuclear Data Sheets
Volume 147, January 2018
ISSN 0969-3752

Table of Isotopes
8th Edition
Volume I
Firestone, Shirley, Baglin, Chu, Zipkin

NEUTRON CROSS SECTIONS
Donald J. Hughes and John A. Harvey
July 1, 1955

Nuclear Data Sheets
Produced by
The National Nuclear Data Center
Brookhaven National Laboratory
Upton, NY 11973-5000, USA

for
The International Network of
Nuclear Structure and Decay Data Evaluators

EDITOR: E.A. McCutchan

NOTE
Since ENSDF is used repeatedly as a source of data for special tabulations or calculations, it is important that it be as correct and complete as possible. We urge all users who find errors to report them to us so that the permanent files may be corrected. The computer files are also available for online access and applications.

CONTENTS: NUCLEAR DATA SHEETS

Cumulated Index to A-Chains	Index page
REVISED EVALUATIONS:	
A = 164	B. Singh, J. Chen 1
A = 217	ICTP-Trieste 2016 Workshop Group 382
Symbols and Abbreviations	Inside Back Cover

Available online at www.sciencedirect.com
ScienceDirect

Brookhaven National Laboratory
Upton, NY 11973-5000
Associated Universities Inc. under contract with the United States Atomic Energy Commission

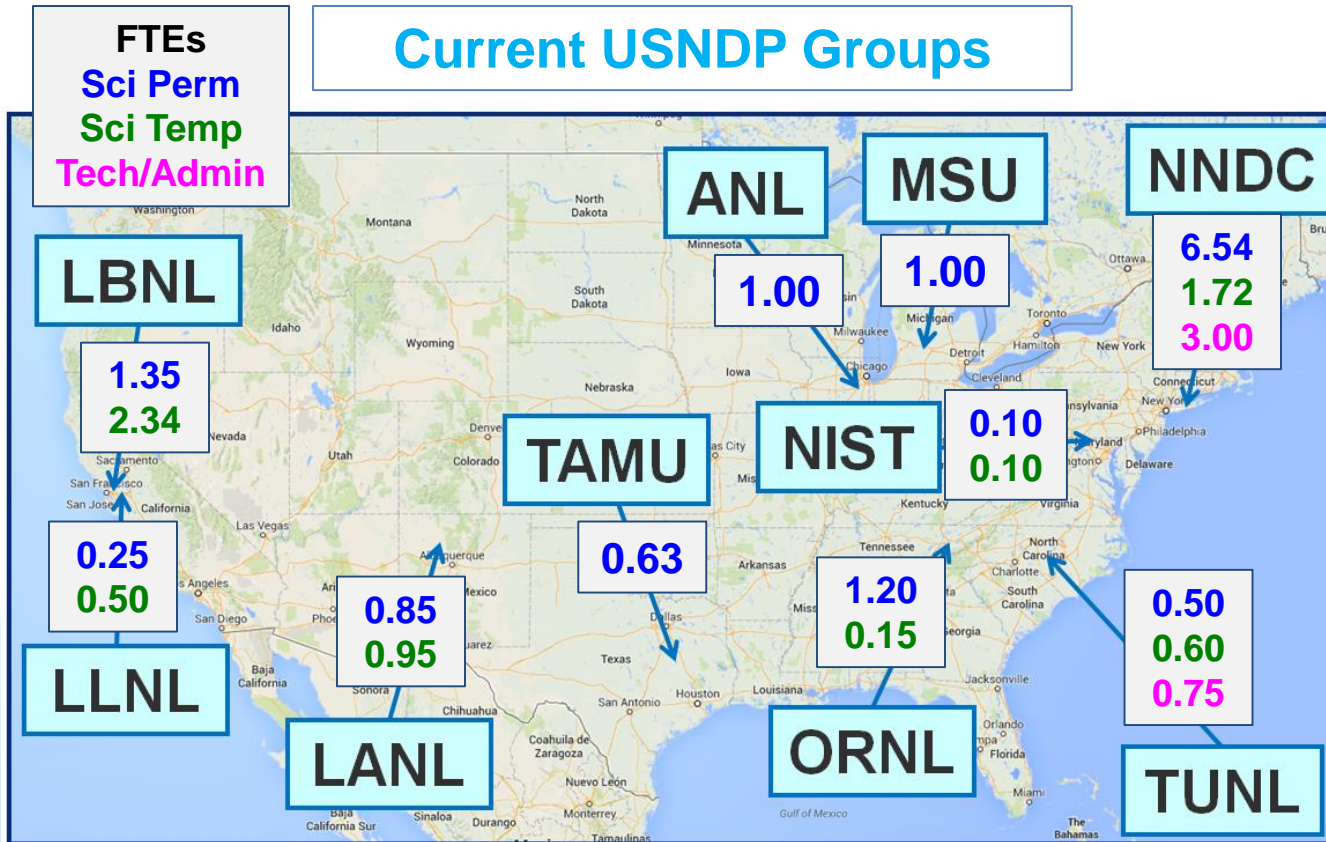
For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. - Price \$3.50 (up)

Brookhaven Science Associates
AT&T Intellectual Property

US Nuclear Data Program

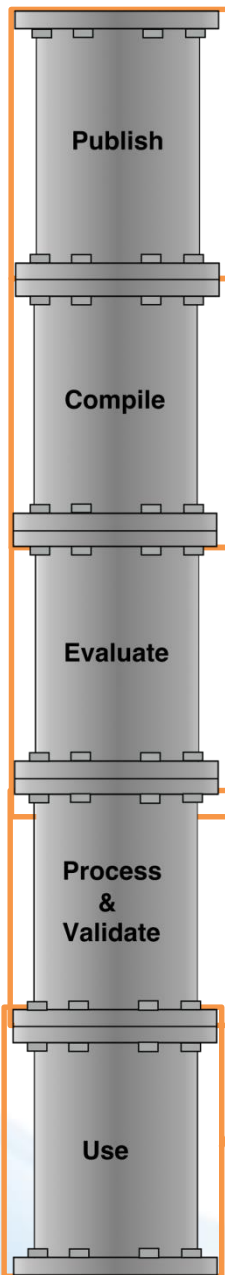
The mission of the United States Nuclear Data Program (USNDP) is to provide current, accurate, authoritative data for workers in pure and applied areas of nuclear science and engineering. This is accomplished primarily through the compilation, evaluation, dissemination, and archiving of extensive nuclear datasets. USNDP also addresses gaps in the data, through targeted experimental studies and the use of theoretical models. (Updated in 2014).

Current USNDP Groups



- Some ND groups trace back their roots to the Manhattan Project (**LBNL**).
- Other ND groups (**BNL**, **ORNL**) were formed by Manhattan Project alumni.
- Current organization follows a mid-1990s DoE review.

The USNDP main products and the nuclear data pipeline



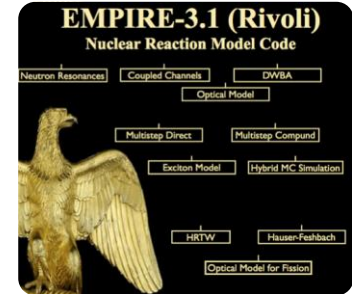
NSR XUNDL ENSDF www.nndc.bnl.gov

Our work begins when data is (or should be) published

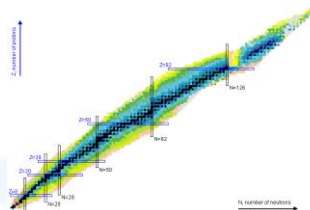
Code development: Actively develop codes that support our work

Archive: Seek “abandoned” data and archive it before it is lost

Address gaps: Perform targeted experiments to address gaps in databases



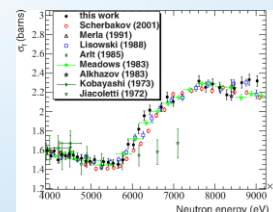
NuDat



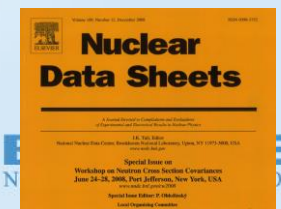
SIGMA



EXFOR searches



Nuclear Data Sheets



An example of our databases

Let's say we want a list of articles that measured neutron induced fission cross sections on Uranium-235.

Keywords

We could go to google scholar (free)

27,700 Results!

And the first articles, while very relevant, don't have the experimental data we need!

The screenshot shows a Google Scholar search interface. The search bar contains the text "measured neutron fission cross section uranium 235". Below the search bar, it indicates "Articles" and "About 27,700 results (0.09 sec)". On the left side, there are filters for "Any time" (with sub-options: "Since 2018", "Since 2017", "Since 2014", "Custom range..."), "Sort by relevance" (selected), "Sort by date", and checkboxes for "include patents", "include citations", and "Create alert". The search results list several articles:

- ENDF/B-VII. 1 nuclear data for science and technology: cross sections, covariances, fission product yields and decay data**
MB Chadwick, M Herman, P Obložinský, ME Dunn... - Nuclear data sheets, 2011 - Elsevier
... Elsevier. Nuclear Data Sheets. Volume 112, Issue 12, December 2011, Pages 2887-2996.
Nuclear Data Sheets. ENDF/B-VII.1 Nuclear Data for Science and Technology: **Cross Sections**, Covariances, **Fission** Product Yields and Decay Data ...
☆ 🔗 Cited by 1359 Related articles All 9 versions
- Energy Spectrum of Neutrons from Thermal Fission of U^{235}**
BE Watt - Physical Review, 1952 - APS
... spectrum obtained as a composite of these three independent **measurements**. In developing the instrumental techniques applied to this **measurement** I have been generously supported and assisted ... The distribution in energy of the fast **neutrons** was **measured** by means of the ...
☆ 🔗 Cited by 375 Related articles All 3 versions
- ENDF/B-VII. 0: next generation evaluated nuclear data library for nuclear science and technology**
MB Chadwick, P Obložinský, M Herman, NM Greene... - Nuclear data sheets, 2006 - Elsevier
... in December 2006, contains data primarily for reactions with incident **neutrons**, protons, and ... We describe each of the 14 sublibraries, focusing on **neutron** reactions. Extensive validation, using radiation transport codes to simulate **measured** critical assemblies, show major ...
☆ 🔗 Cited by 1919 Related articles All 11 versions
- Rb and Cs Isotopic Cross Sections from 40-60-MeV-Proton Fission of ^{238}U , ^{232}Th , and ^{235}U**
BL Tracy, J Chaumont, R Klapisch, JM Nitschke... - Physical Review C, 1972 - APS
... Corrections for this effect were made from **measured** diffusion curves, i.e., recordings of the ion current of a stable or long-lived isotope as a function of time ... In some cases it was not possible to **measure** the ... The quoted errors indicate only the precision of the **measurements** ...
☆ 🔗 Cited by 152 Related articles All 5 versions

Using the Web of Science (\$\$\$) will not help either.

Alternatively, we could use NSR, www.bnl.gov/nsr

Initialization Parameters

Publication year range: 1896 to 2018

Primary only: View All: Require measured quantity:

Output year order: Ascending Descending

Output format: HTML BibTex Text Keynum Exchange

Search all entries Search entries added since 1 / 12 / 2018 (month/day/year)

Search Parameters

- Target browse...

AND

- Incident browse...

AND

- Measured browse...

Search Reset

Search parameters

Results, 289 articles

Found 289 matches. Showing 1 to 100. [\[Next\]](#)

[Back to query form](#)

2016DI03 Phys.Rev. C 93, 034614 (2016)

[M.Diakaki](#), for the n_TOF Collaboration

Neutron-induced fission cross section of ^{237}Np in the keV to MeV range at the CERN n_TOF facility

NUCLEAR REACTIONS $^{235,238}\text{U}(n, F)$, $E=0.1-9$ MeV; $^{237}\text{Np}(n, F)$, $E=0.1-9$ MeV; measured fission $\sigma(E)$ using fast ionization chamber at high-resolution and high-intensity facility n_TOF at CERN. Comparison with previous experimental data in literature and EXFOR database, and with ENDF/B-VII.1, JEFF 3.2, and JENDL 4.0 evaluations. $^{237}\text{Np}(n, X)$, (n, F) , $E=0.1-20$ MeV; calculated cross sections for the main neutron-induced reaction channels in Hauser-Feshbach formalism using the EMPIRE code, and comparison with experimental data in the present work and EXFOR database; deduced final fission barrier parameters for $^{236,237,238}\text{Np}$.

doi: [10.1103/PhysRevC.93.034614](https://doi.org/10.1103/PhysRevC.93.034614)

Data from this article have been entered in the **EXFOR** database. For more information, access X4 [dataset22742](#). Access publication in [PDF](#) format.

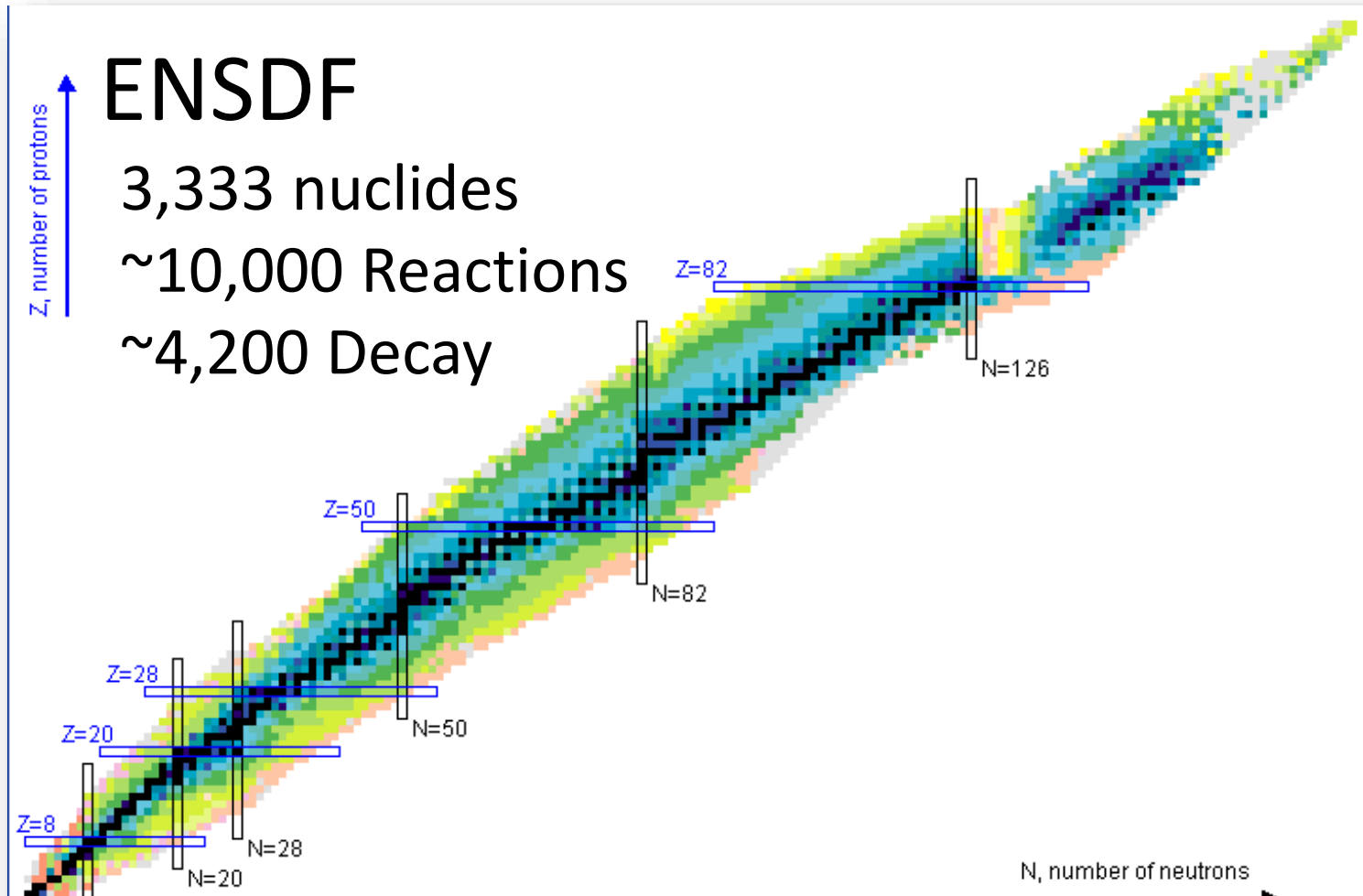
Description of the article

Link to journal

Link to data

And you can only e-mail Boris Pritychenko or Joann Totans for free help (~200 e-mails/year)

Evaluated Nuclear Structure Data File



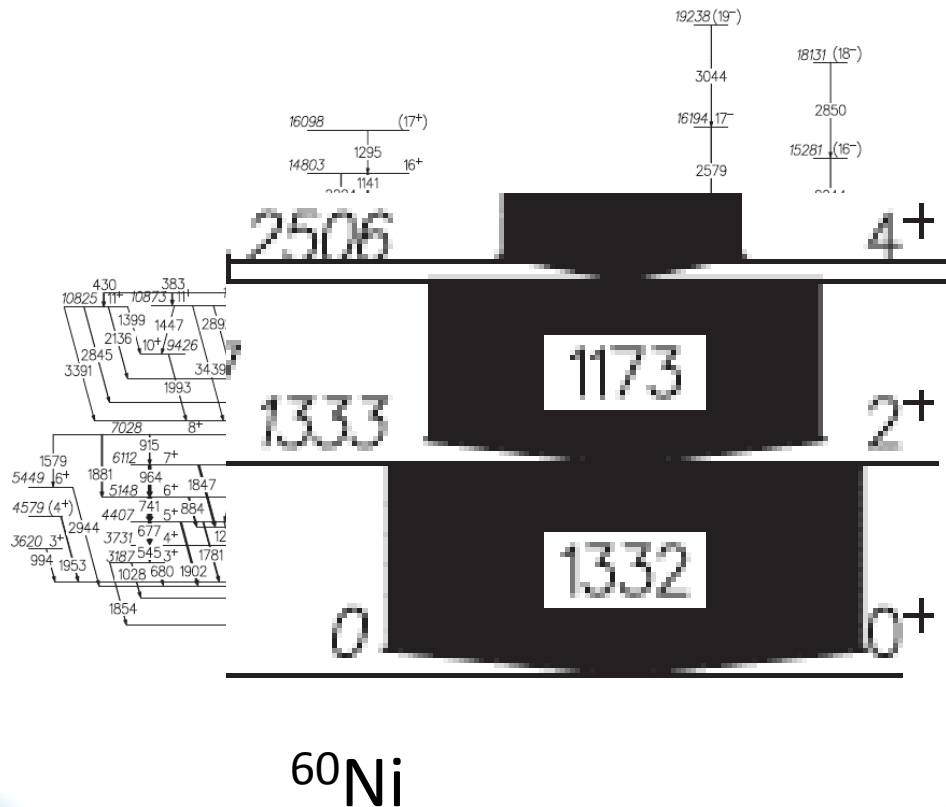
It is Unique: Only Nuclear Database of this kind in the world

It is Complete: **All** nuclei and **all** level and radiation properties

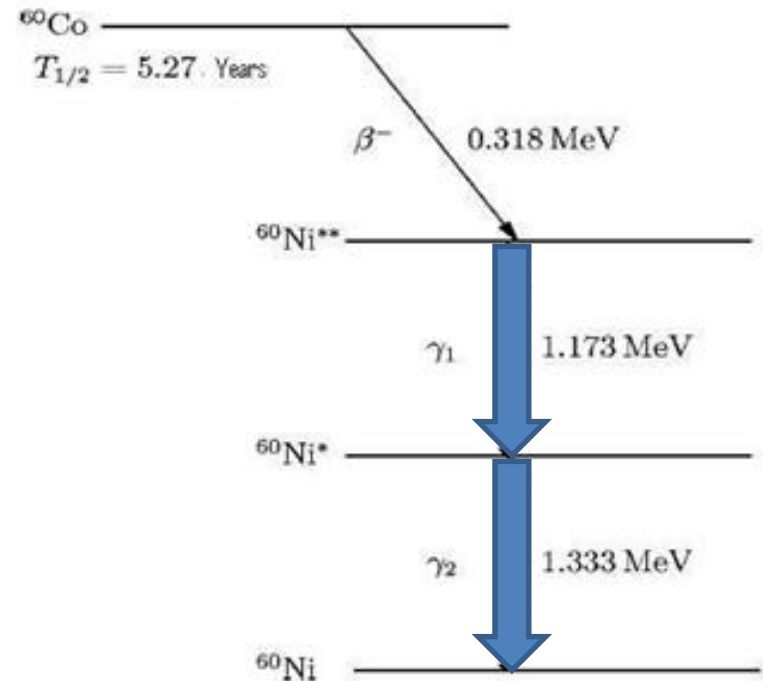
It is Versatile: Feeds back into both basic and applied sciences

ENSDF in a Nutshell

Properties of Nuclei



And how they decay

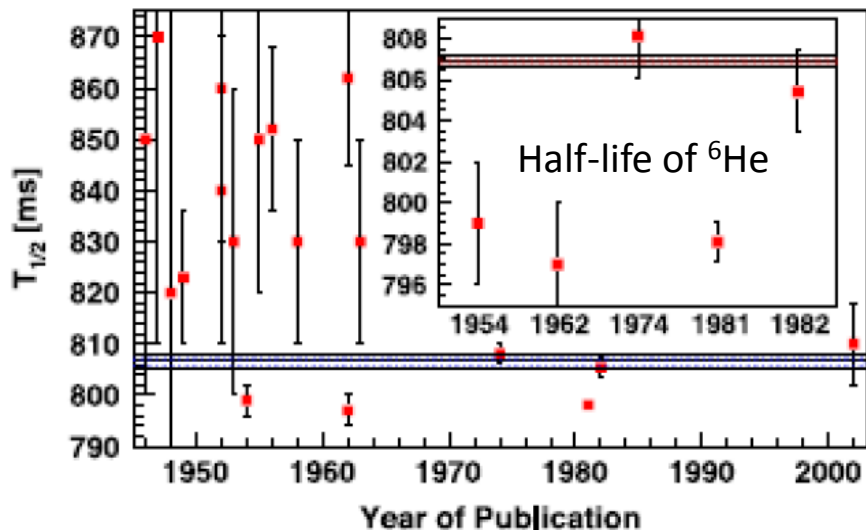


Level energies, spin, parity, half-life, ...
Gamma-ray energies, intensities, ...

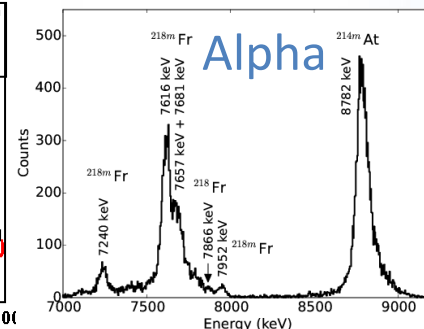
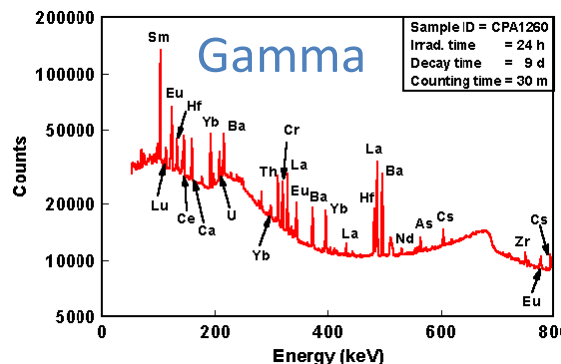
Radiation energies, intensities,
decay modes

Why do we need ENDSF?

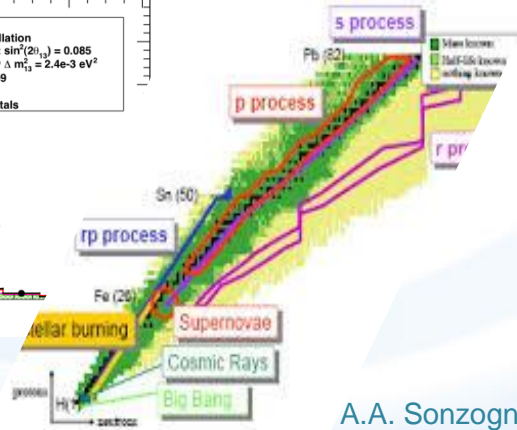
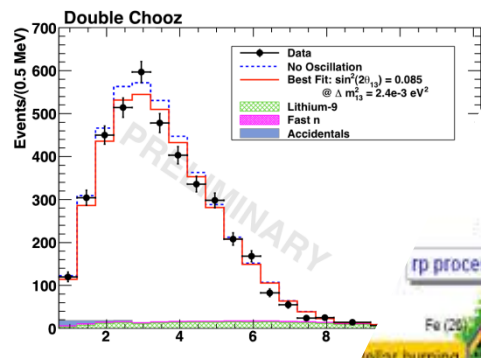
Arbiter of the "Truth"



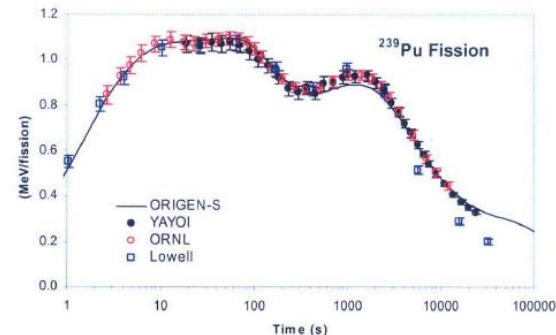
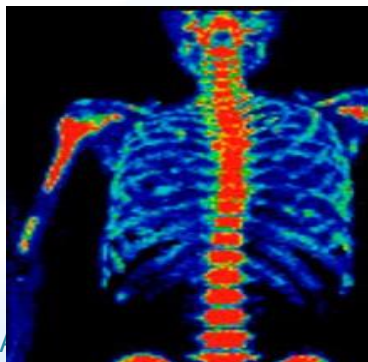
Used in all spectroscopy aspects



Input for other nuclear physics fields



Wide range of applications require decay data

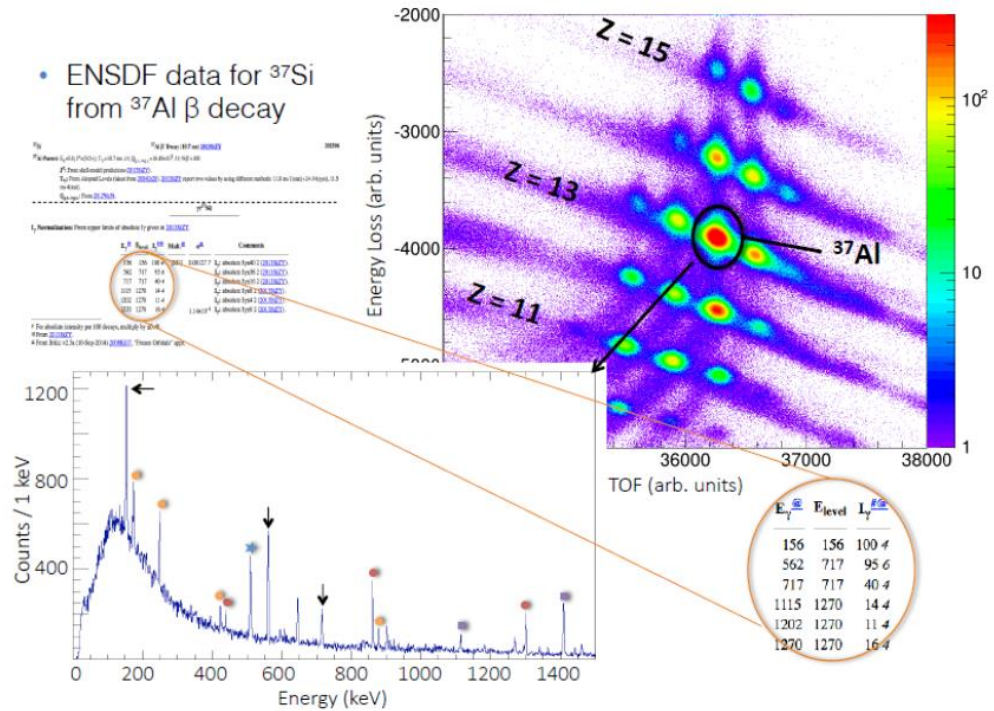


ENSDF and FRIB

ENSDF is essential for planning, designing, performing and interpreting FRIB experiments

As an example:

- Gamma-rays are routinely used to identify fragmentation products
- ENSDF is the only place to search them in live-time



FRIB USERS ORGANIZATION

FACILITY FOR RARE ISOTOPE BEAMS

JOIN! NEWS FRIB WORKING GROUPS ORGANIZATION GATHERINGS FRIB THEORY NUCLEARMATTERS

Home • Working Groups • Nuclear Data

NUCLEAR DATA

WORKING GROUP CONVENERS

Libby McCutchan (NNDC, BNL), Filip Kondev (ANL), John Kelley (TUNL)

OVERVIEW

This working group is focused on coordinating the efforts of the Nuclear Data community and the program foreseen for FRIB physics. More information is coming soon.

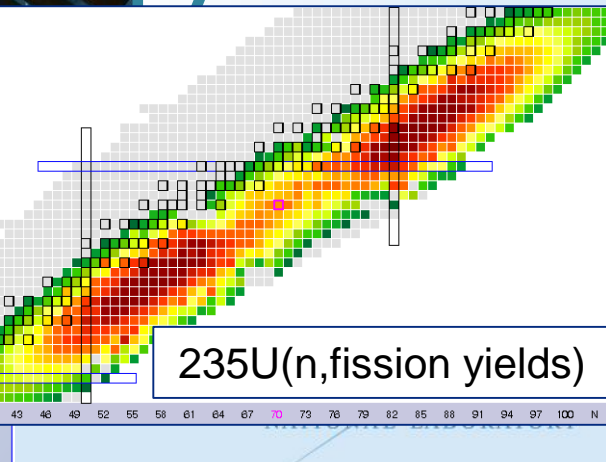
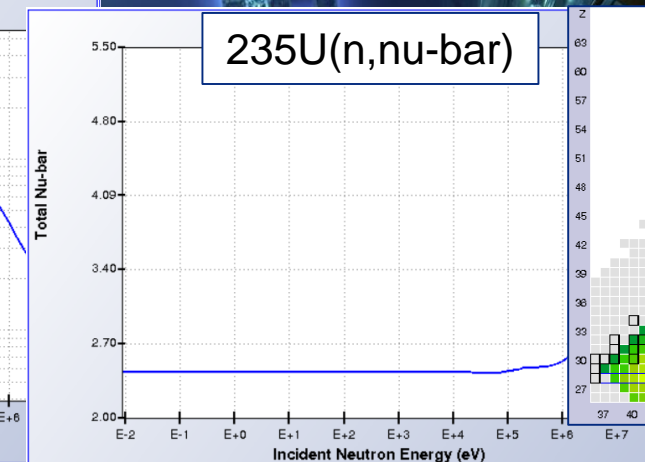
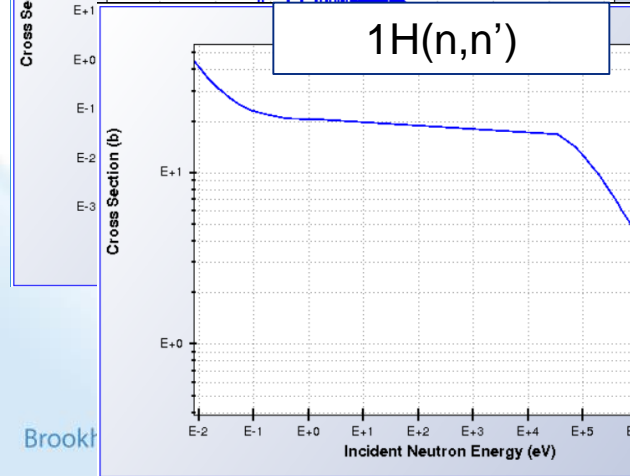
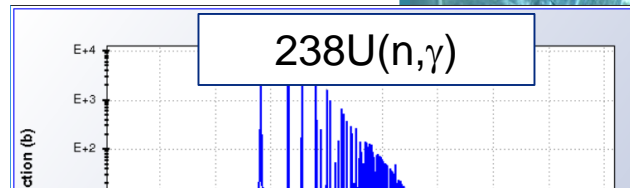
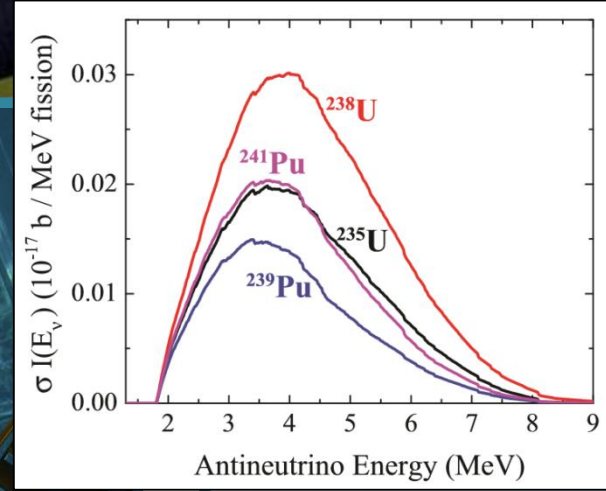
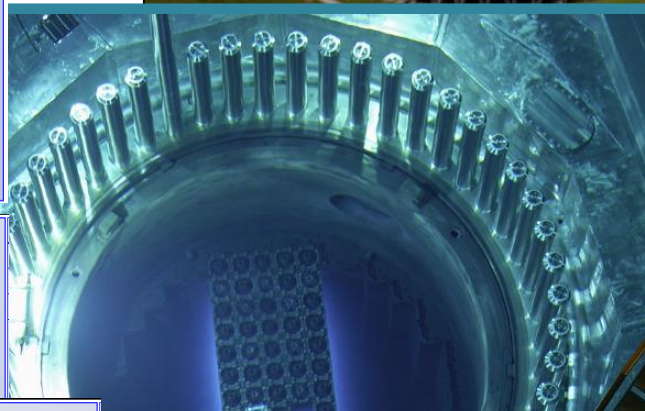
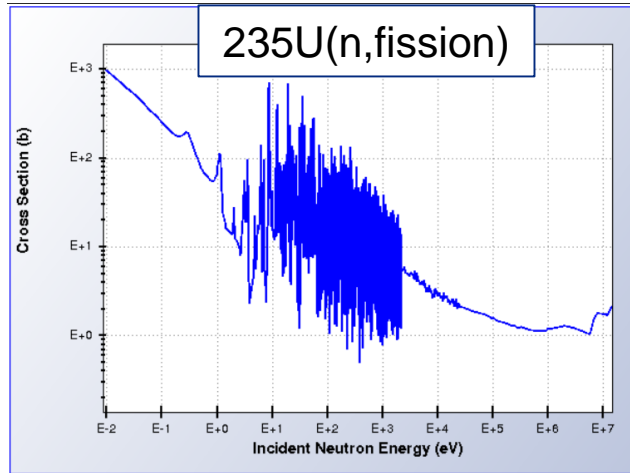
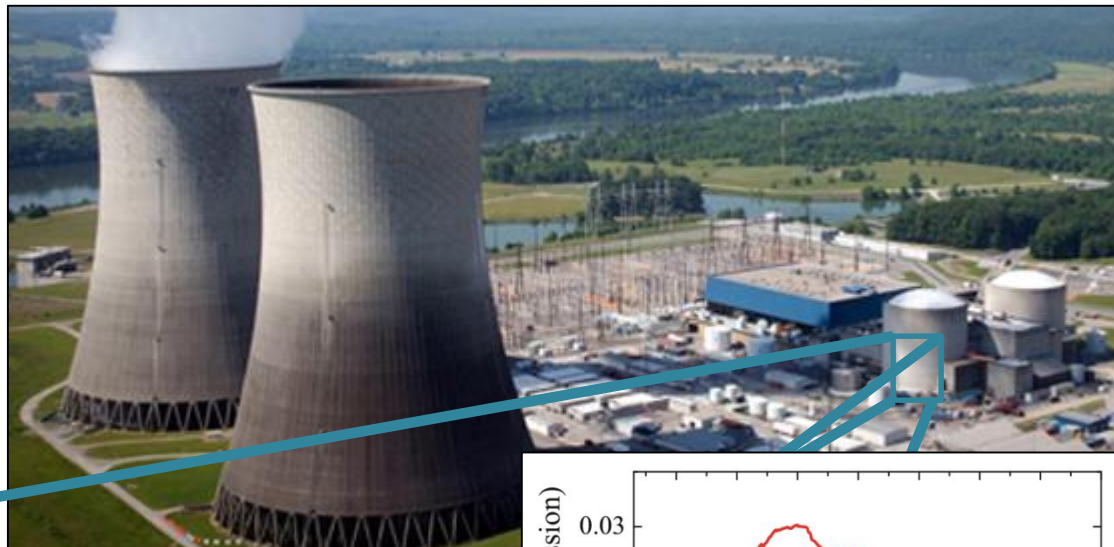
LINKS

- NNDC hosted at Brookhaven National Laboratory
- Data Session summary from 2015 LEC meeting
- Applications Data Summary from 2014 Town Hall Meeting
- Data Summary from 2013 LEC Meeting

Nuclear Data Working Group established within FRIB Users Organization in order to develop data needs for FRIB

ENDF

Data needed in many applications, for instance, design, operation and decommission nuclear reactors



ENDF

ENDF/B-I was released in June 1968.

More accurate experiments, improvements in nuclear reaction models and supercomputers have led us to **ENDF/B-VIII.0**, which was released on **February 2nd, 2018** by the Cross Section Evaluation Working Group (CSEWG)[1]

ENDF/B-VIII.0 Integrates contributions from:

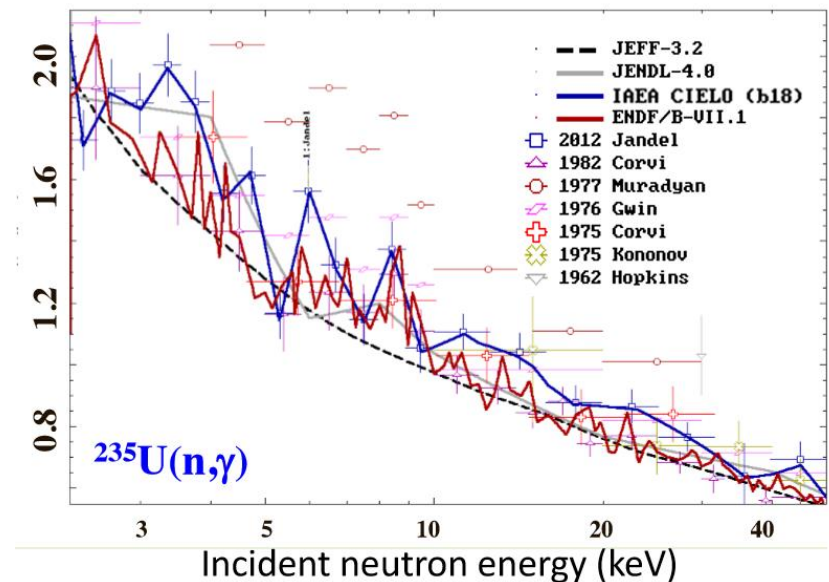
BNL, IAEA, LANL, LLNL, NIST, IAEA, Criticality Safety Program, Naval Reactors, NCSU, CNL (Canada), CAB (Argentina)

ENDF/B-VIII.0 is our best performing and highest quality library yet

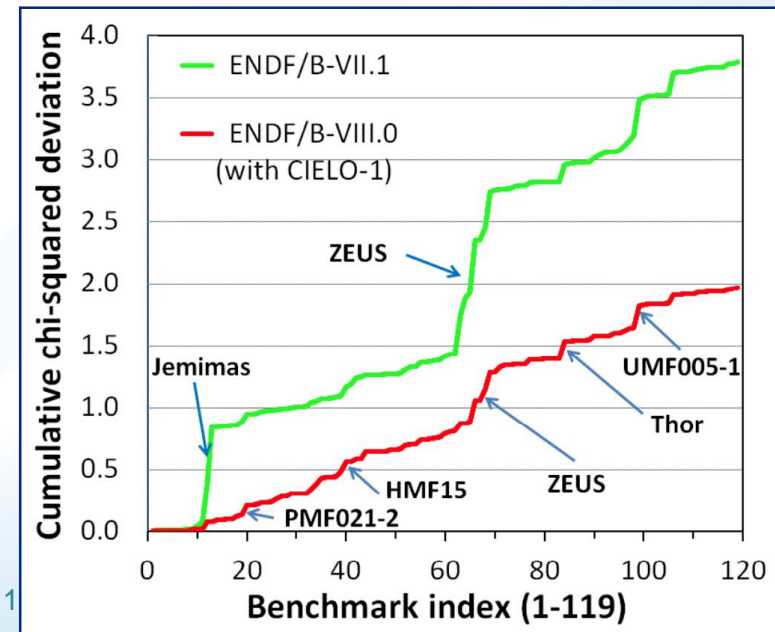
- 1198 critical assembly benchmarks
- 14 MeV source transmission
- Many other tests

ENDF is used in many applications, simulations & licensing codes such **MCNP, GEANT, SCALE, ORIGEN**

[1] D. Brown *et al.*, Nuclear Data Sheets **148**, 1 (2018)

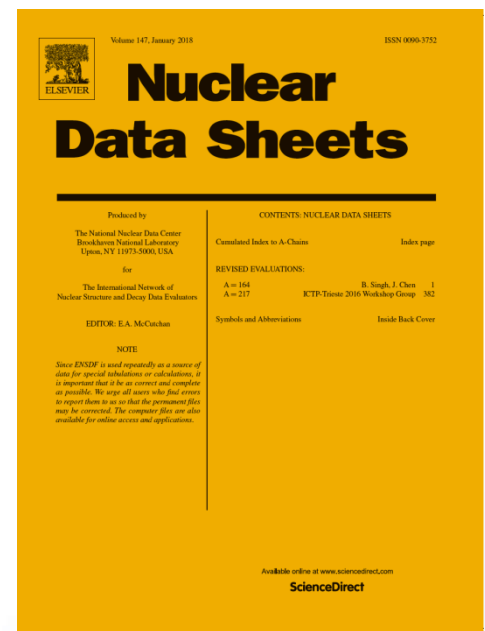


ENDF
B-VIII.0



Nuclear Data Sheets

- Began in 1966, currently published by Elsevier.
- NNDC responsible for editorial role and management
- Original mission was to publish ENSDF evaluations and Recent References (NSR).
- Starting in 2006, one issue per year is devoted to nuclear reaction related articles.
- Unusual in that we publish ~20 manuscripts per year



Topic	Reference	# of Citations
ENDF/B-VII.0	NDS 107, 2931 (2006)	1147
ENDF/B-VII.1	NDS 112, 2887 (2011)	791
RIPL	NDS 110, 3107 (2009)	497
EMPIRE	NDS 108, 2655 (2007)	335
TALYS	NDS 113, 2841 (2012)	271
FLUKA	NDS 120, 211 (2014)	258
NuShellX@MSU	NDS 120, 115 (2014)	83

} ENDF library
 Reaction library
 } Reaction codes
 Application
 Structure code

For perspective, most cited paper in PRC between 2006-2018:
 RHIC theory paper (2008) with 522 citations

Special Issue of Nuclear Data Sheets

10 articles, more than 400 pages
Essential reference for next 10 years

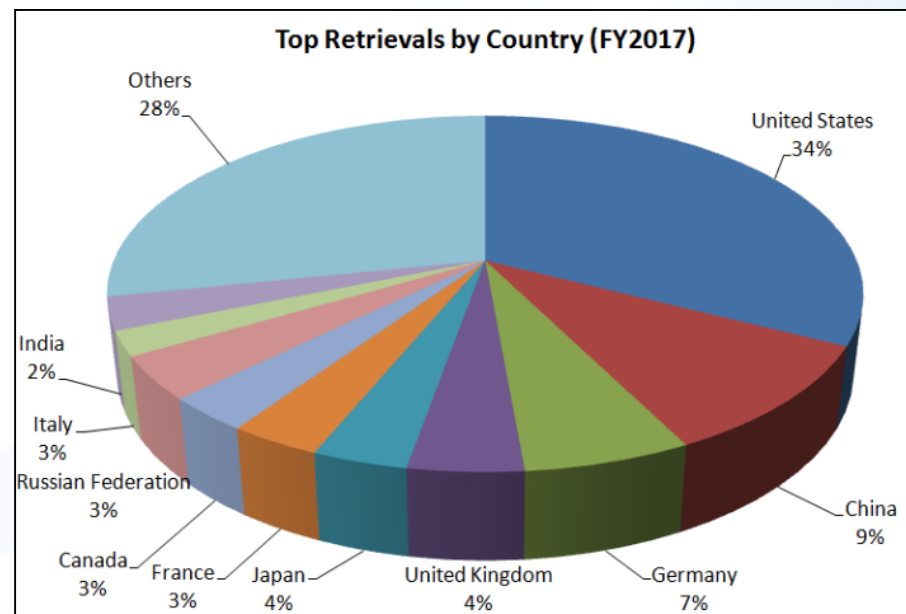
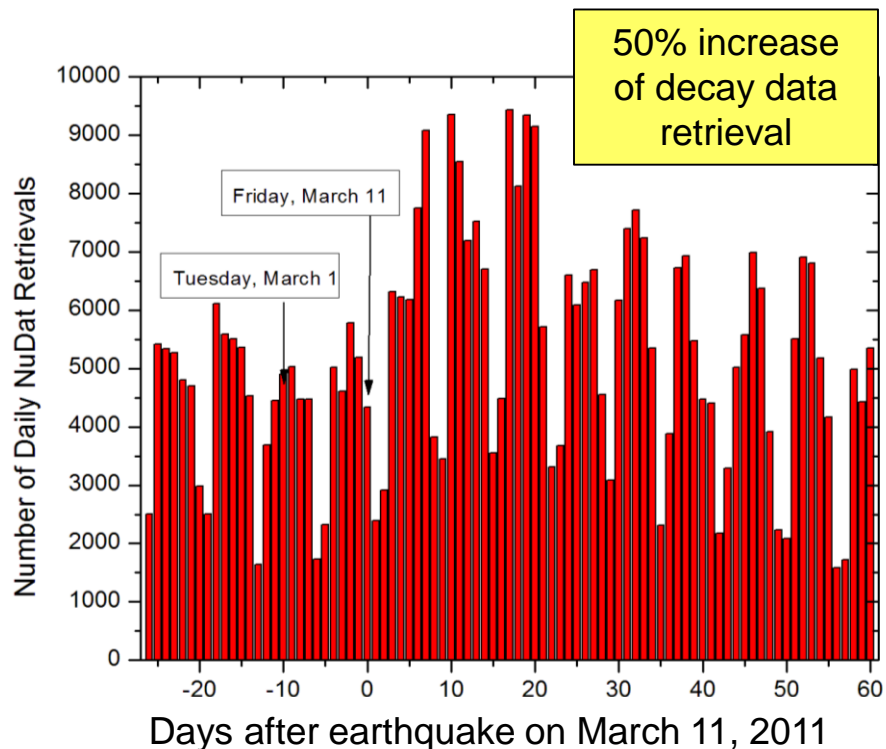
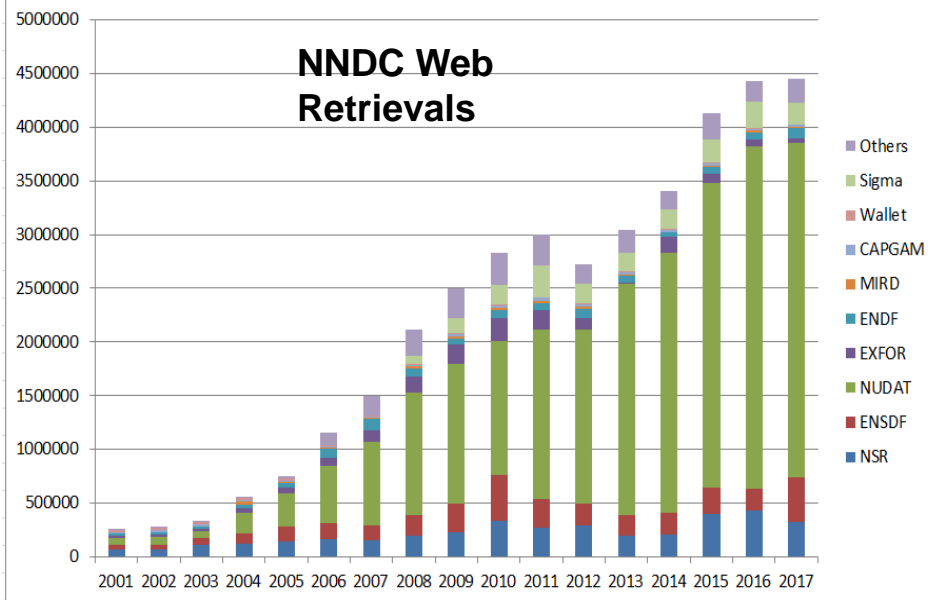
USNDP plays major role (**USNDP organization**):

- ENDF/B-VIII.0 (**BNL, LANL, LLNL, NIST**)
- Neutron Standards (**NIST, LANL**)
- CIELO overview (**BNL, LANL, NIST, LLNL**)
- CIELO Fe (**BNL, LANL**)
- CIELO 235U and 238U (**LANL, BNL**)
- PFNS (**LANL**)
- 2 Experimental Papers (**LANL**)
- Charged-particle monitor reactions (IAEA-CRP) (**ANL, LANL**)
- Evaluation Methodology



Web Dissemination

- Started with Telnet in mid 1980s.
- First generation web applications in mid 1990s.
- Mostly performed nowadays in BNL using 7 powerful servers.
- About 4.5 Million retrievals in FY17.



Web Dissemination

NuDat 2.7

Search and plot nuclear structure and decay data interactively. [More.](#)

Levels and Gammas Search

Ground and excited states (energy, $T_{1/2}$, spin/parity, decay modes), gamma rays (energy, intensity, multipolarity, coinc.)

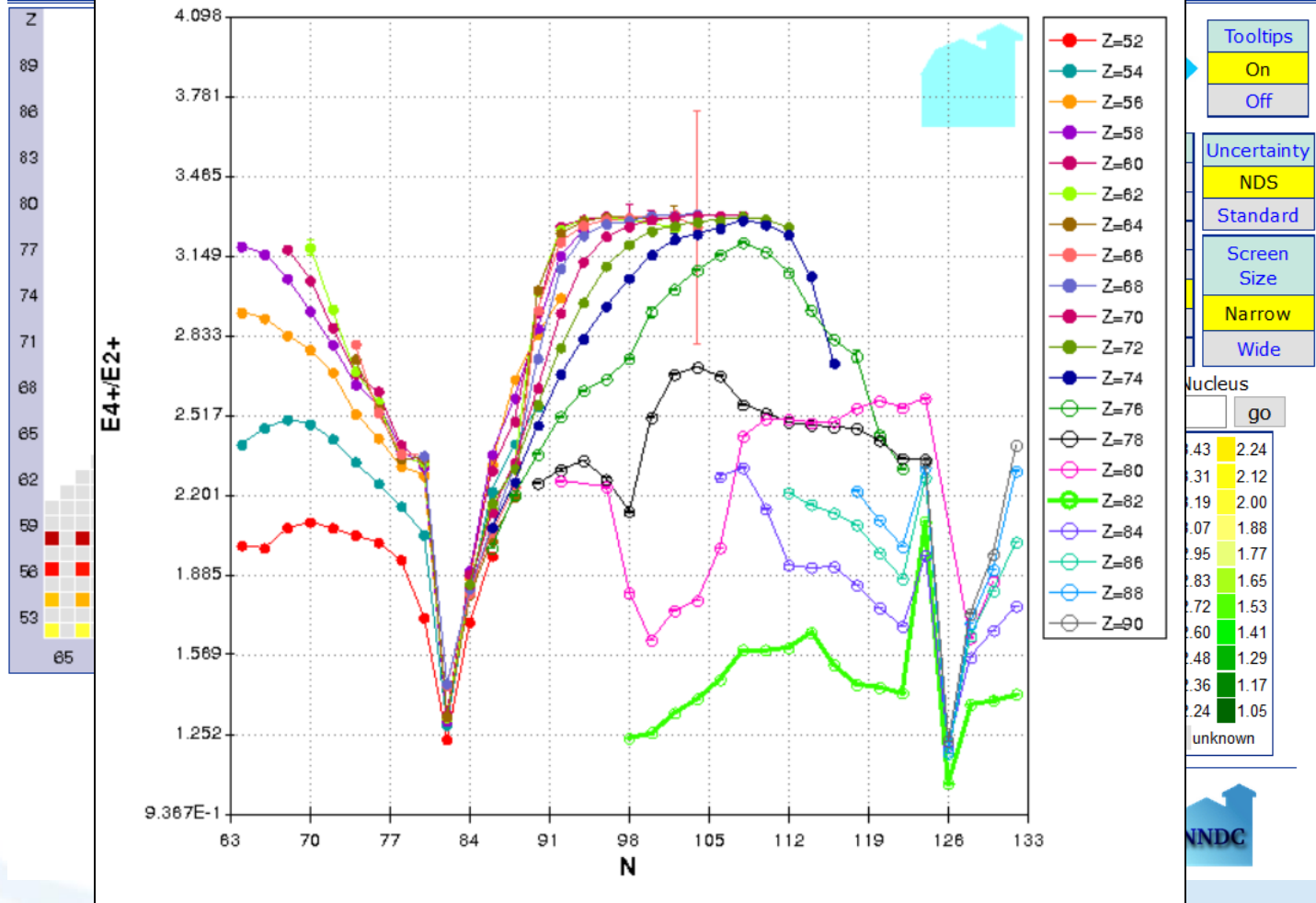
Nuclear Wallet Cards Search

Latest Ground and isomeric states properties

Decay Radiation Search

Radiation type, energy, intensity and dose following nuclear decay

Color code	Half-life	Decay Mode	Q_{β^-}	Q_{EC}	Q_{β^+}	S_n	S_p	Q_{α}	ΔQ_{α}	S_{2n}	S_{2p}	$Q_{2\beta^-}$	Q_{2EC}	Q_{ECp}	$Q_{\beta-n}$
$Q_{\beta-2n}$	BE/A	(BE-LDM Fit)/A	Pair gap	E_{stat}	E_{exc}	E_2	E_4	$E_{\alpha 1}/E_{\alpha 2}$	β_2	$B(E2)_{ex}/B(E2)_{gs}$	$g(n, \nu)$	$g(n, F)$	235U FY	239Pu FY	252Cf FY



Upgrades typically follow users recommendations

Capitalizing on advances in γ -ray spectroscopy

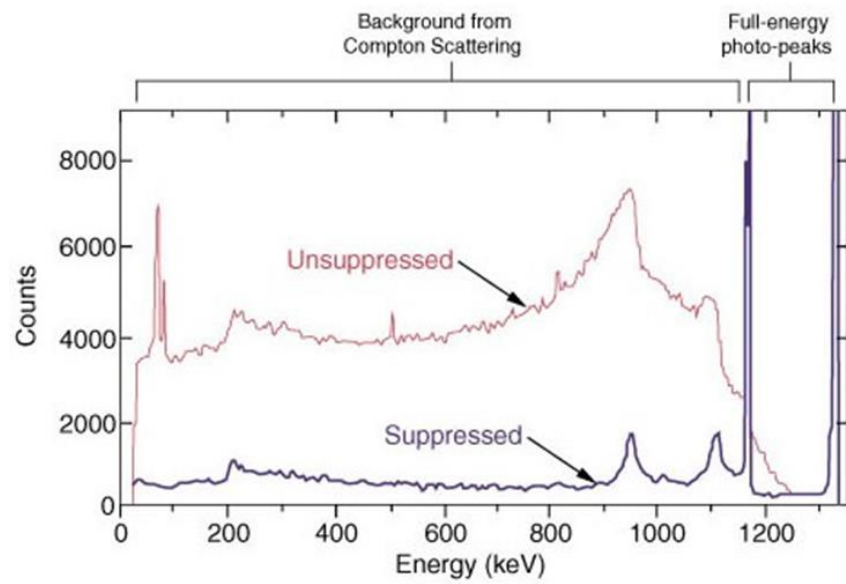
30 Years ago: 1-2 small detectors



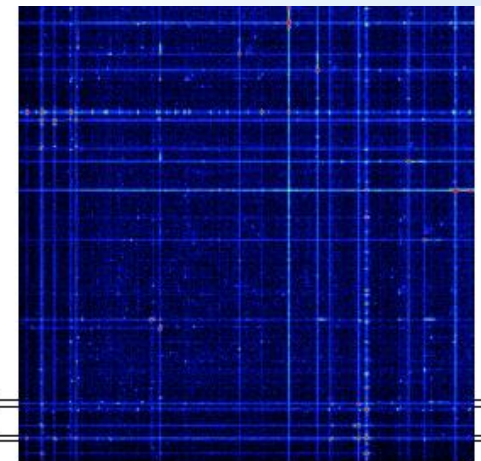
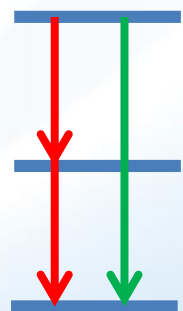
Present: 10-100 detectors



Compton suppression



$\gamma\gamma$ coincidences



Non-conventional PET agents : ^{86}Y

IOP Publishing | Institute of Physics and Engineering in Medicine

Physics in Medicine & Biology

Phys. Med. Biol. 60 (2015) 3479–3497

doi:10.1088/0031-9155/60/9/3479

PET imaging with the non-pure positron

PHYSICAL REVIEW C

VOLUME 2, NUMBER 6

DECEMBER 1970

Energy Levels in ^{86}Sr from the Decay of 14.6-h ^{86}Y

A. V. Ramayya, B. Van Nooijen,* J. W. Ford, D. Krmpotić,† and J. H. Hamilton
Physics Department,‡ Vanderbilt University, Nashville, Tennessee 37203

and

J. J. Pinajian and Noah R. Johnson
Oak Ridge National Laboratory,§ Oak Ridge, Tennessee 37803
(Received 20 April 1970)



Contents lists available at [ScienceDirect](#)

Applied Radiation and Isotopes

journal homepage: www.elsevier.com/locate/apradiso



Tailoring medium energy proton beam to induce low energy nuclear reactions in $^{86}\text{SrCl}_2$ for production of PET radioisotope $^{86}\text{Y}^{\star}$

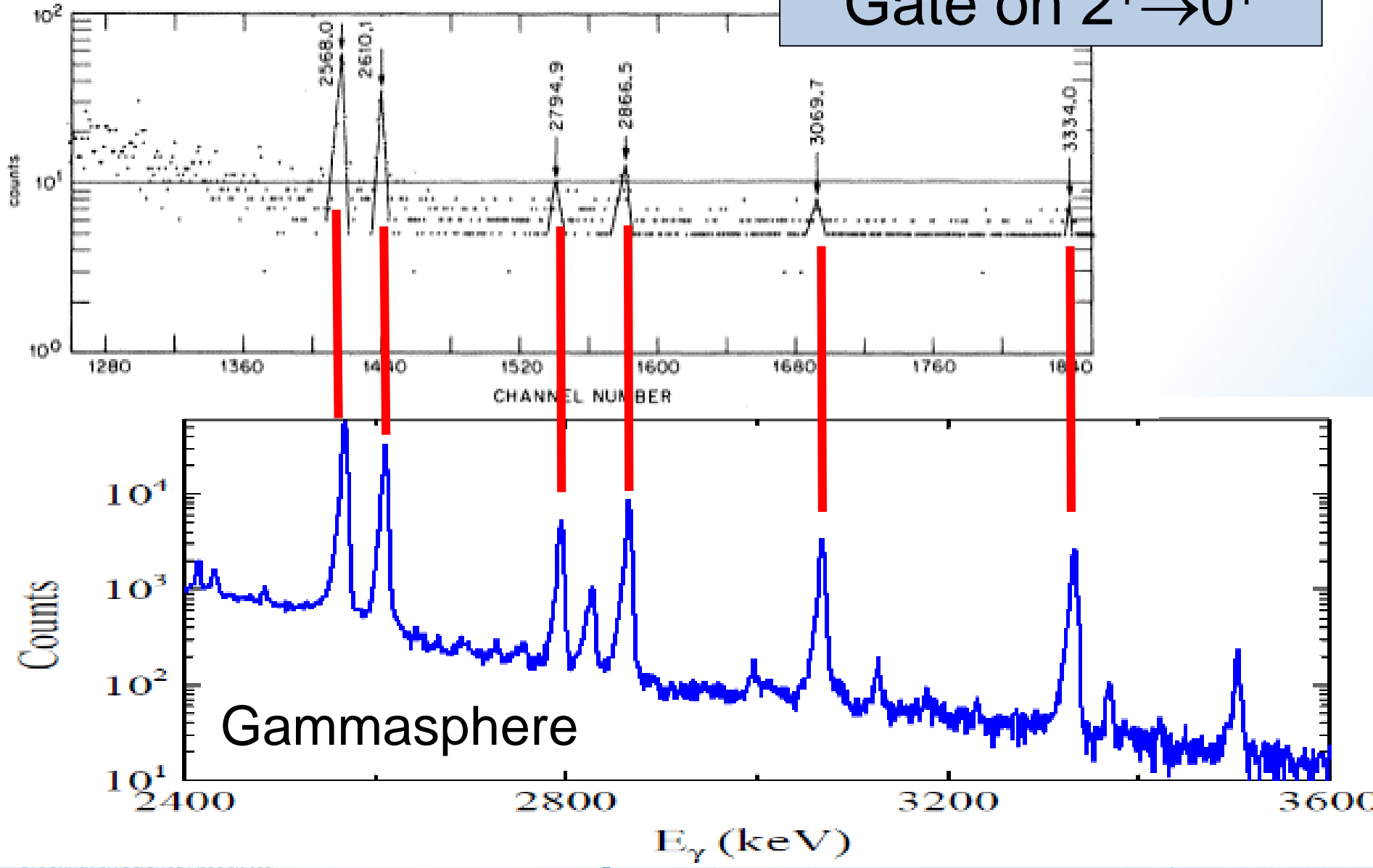
Dmitri G. Medvedev*, Leonard F. Mausner, Philip Pile



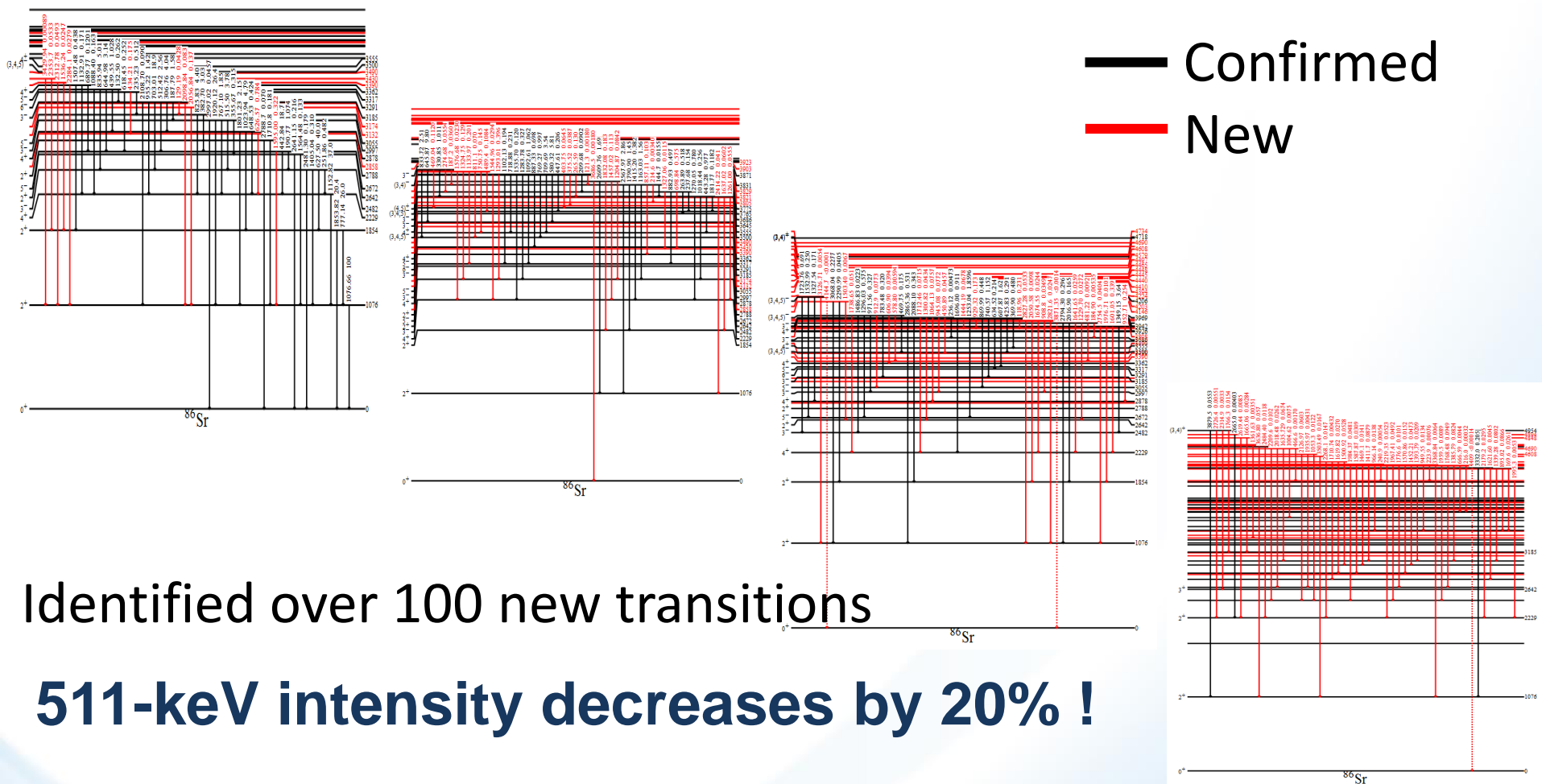
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NATIONAL LABORATORY

Results on ^{86}Y

Gate on $2^+ \rightarrow 0^+$



Revised Decay Scheme for ^{86}Y



Identified over 100 new transitions

511-keV intensity decreases by 20% !

^{86}Y source produced at UW Madison cyclotron, measurement in ANL, summer student analyzed data, article in preparation, contact: E.A. McCutchan (BNL).

Earlier experiment on ^{82}Rb has been published, M. Nino, E.A. McCutchan et al, PRC **93**, 024301 (2016).

Similar efforts at ANL (F. Kondev) and LBNL (L. Bernstein).

Reactor Antineutrino Anomaly

About 6 electron antineutrinos per fission from the beta-minus decay of the neutron rich fission products.

Each fission ~200 MeV, or

~5 x 10²⁰ antineutrinos/second for a 1 GWe reactor.



We observe 6% fewer electron antineutrinos from nuclear reactors at short distances, not accounted for the standard 3-flavor oscillation.

NEWS PARTICLE PHYSICS

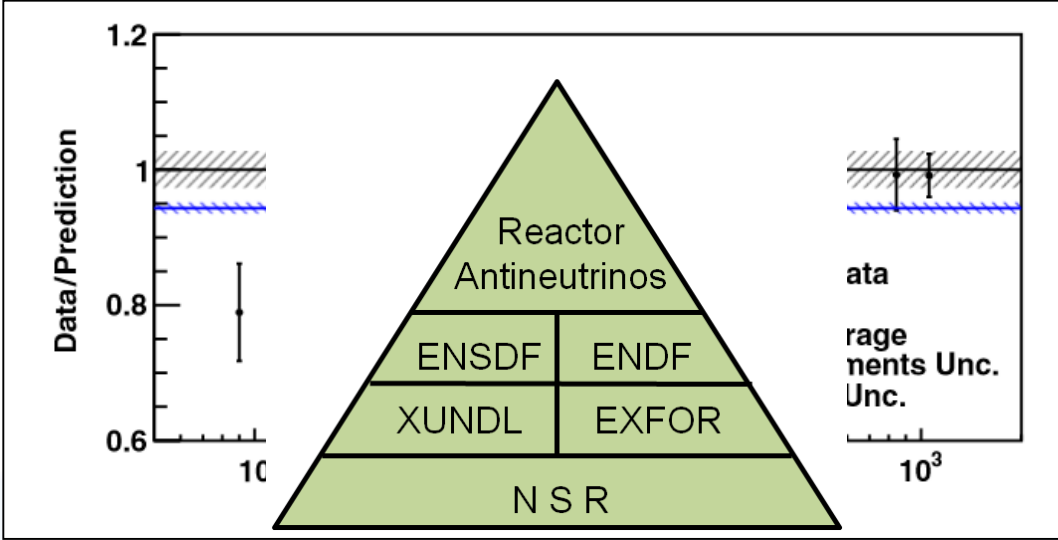
Reactor data hint at existence of fourth neutrino

Deficit in antiparticle output exceeds theoretical expectations

BY RON COWEN 1:20PM, FEBRUARY 25, 2016

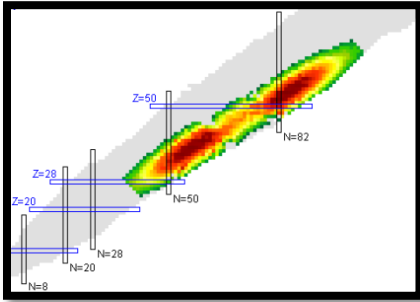
GHOST FINDER New results of experiments at the Daya Bay neutrino detector (walls lined with photomultiplier tubes, shown) hint at the existence of a lightweight sterile neutrino, about one-millionth the mass of an electron.

BROOKHAVEN NATIONAL LABORATORY/FLICKR (CC BY-NC-ND 2.0)



A problem at the top of the nuclear data pyramid.

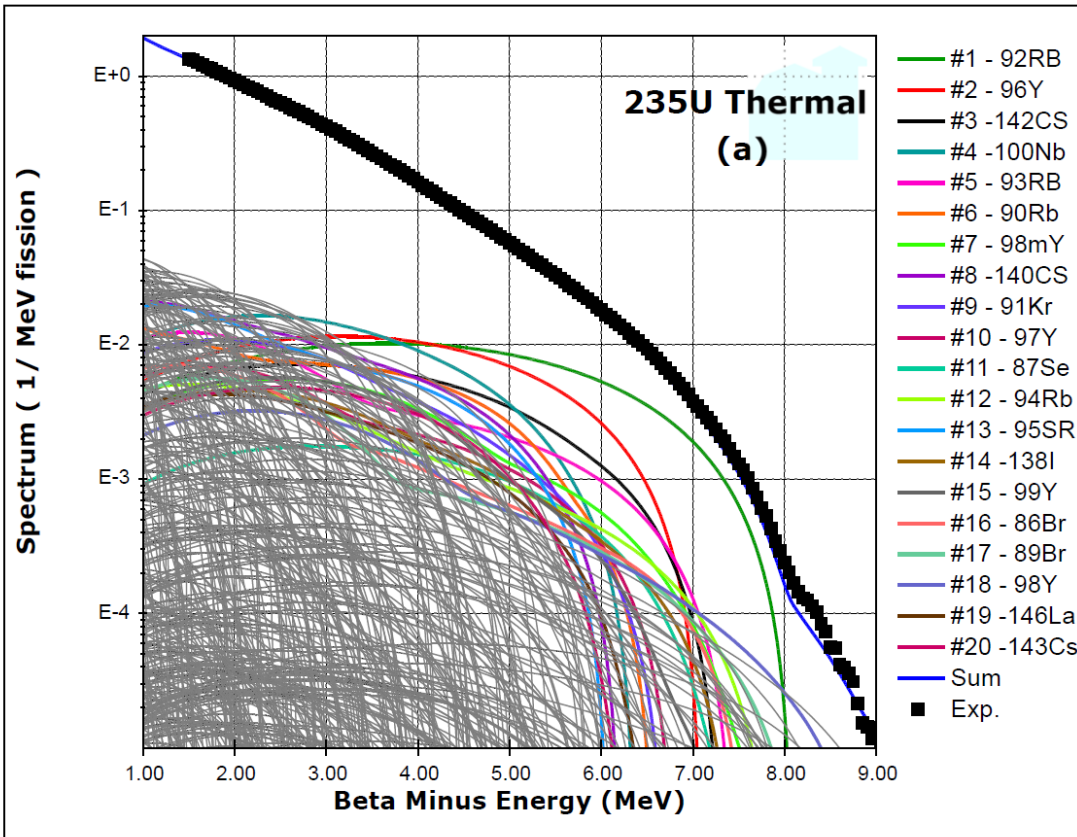
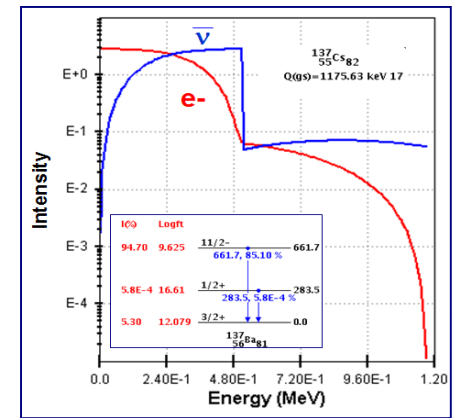
Using Our Databases



$$S(E) = \sum CFY_i S_i(E)$$

Cumulative Fission Yields

Individual Spectra



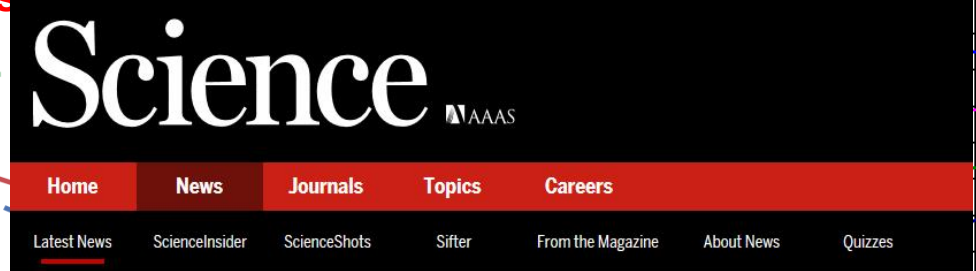
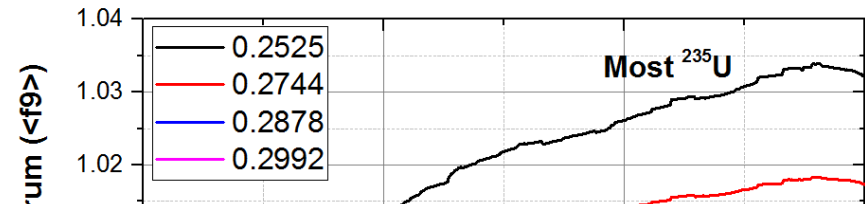
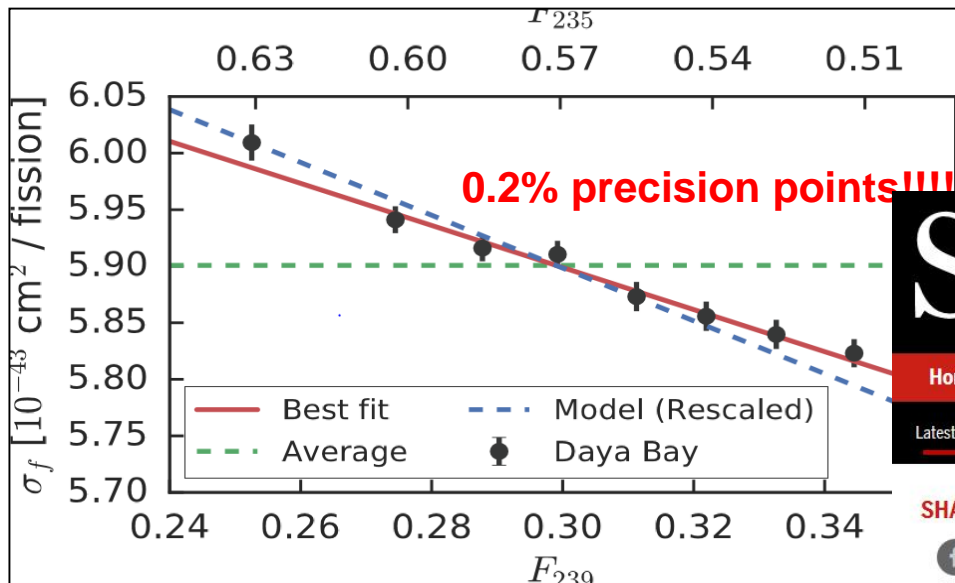
Comparison with the measured electron spectra.

Surprisingly, fewer contributors at high energy.

Results spurred a number of new measurements

First calculation of this type performed by P. Vogel et al in 1981 using ENDF/B-V.

The anomaly, or not?



SHARE



The Daya Bay Reactor Neutrino Experiment studies antineutrinos from six reactors near Shenzhen, China. Photo courtesy of Lawrence Berkeley National Laboratory/Roy Kaltachmidt © 2010 The Regents of the University of California, through the Lawrence Berkeley National Laboratory

Weird sterile neutrinos may not exist, suggest new data from nuclear reactors

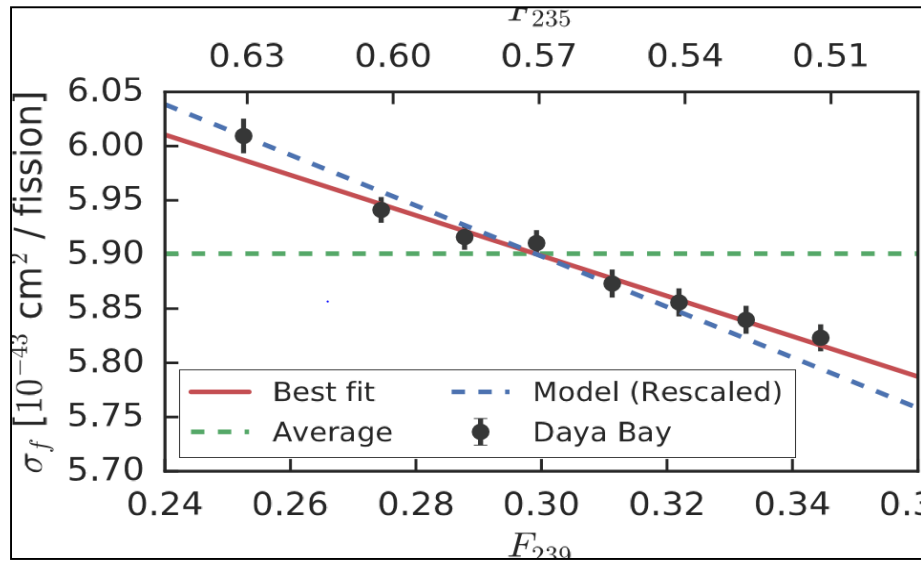
By Adrian Cho | Apr. 6, 2017, 5:30 PM

F.P. An *et al*, PRL **118**, 251801 (2017).

- Daya Bay measured the antineutrino yield as function of ^{239}Pu in the reactors
- ^{239}Pu agrees with measurement
- ^{235}U does not
- If anomaly, should be present in both

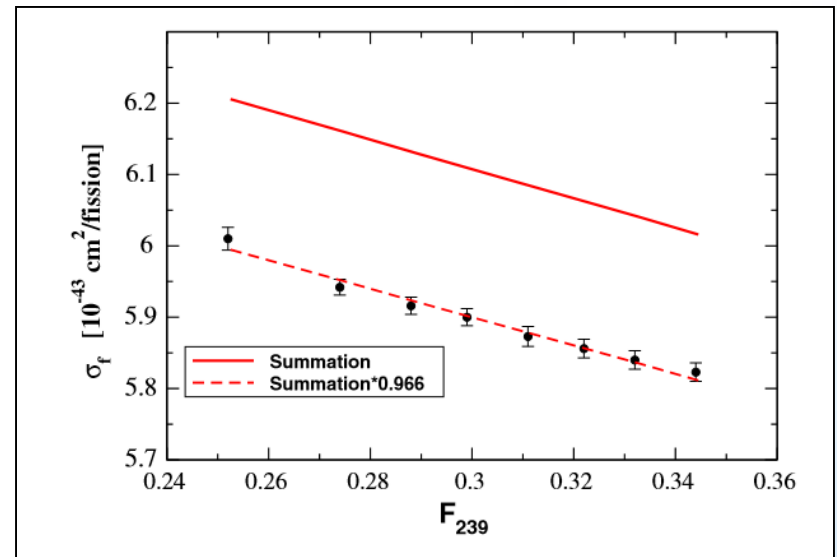
Nuclear data to answer major science question

Daya Bay Analysis (conversion of ILL data)



Our analysis

(Incorporates vast knowledge of decay data of fission fragments)
NNDC calculations using ENDF decay

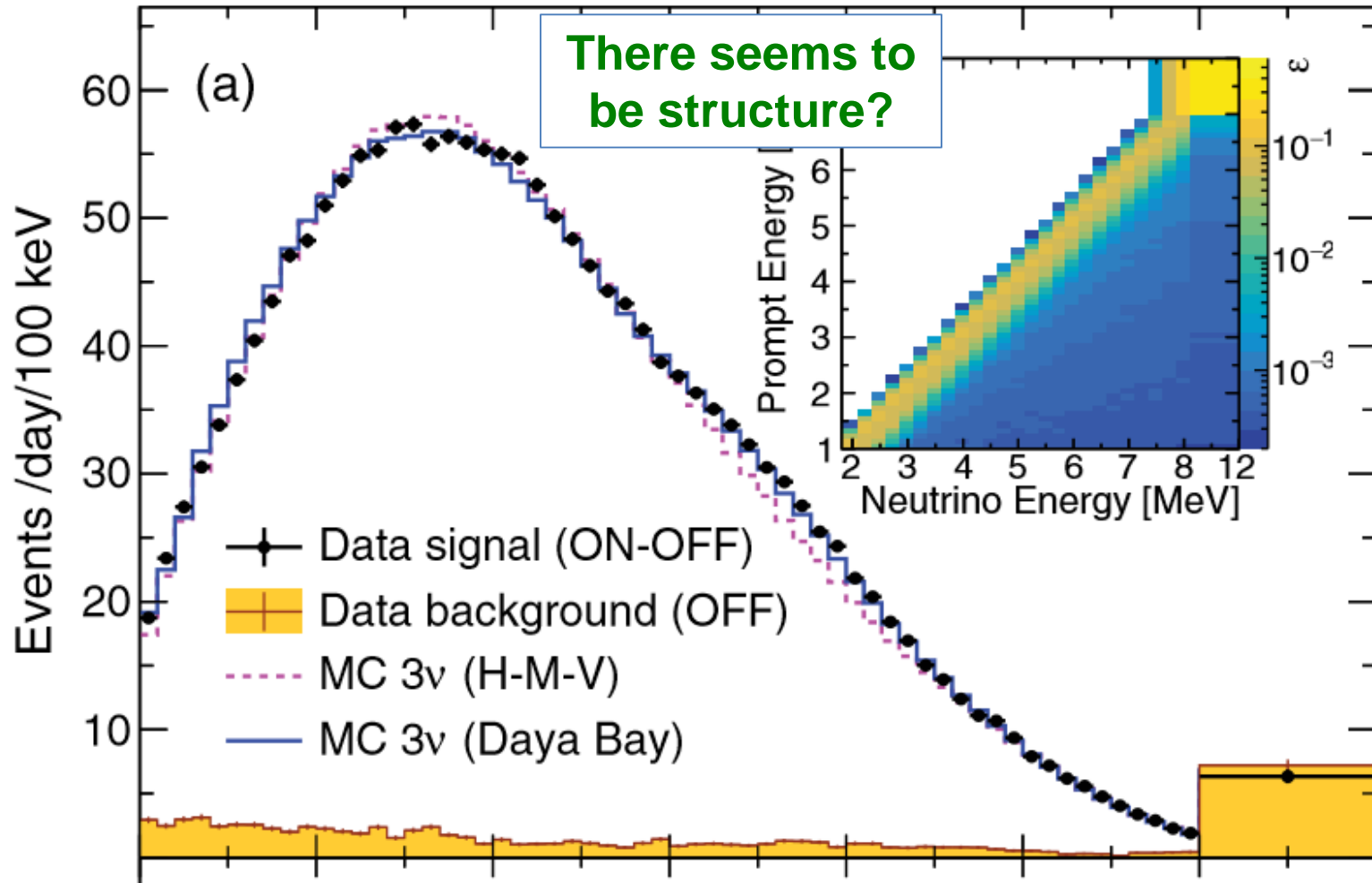


Abstract ends with:

'An analysis of the antineutrino spectra that is based on a summation over all fission fragment β decays, using nuclear database input, explains all of the features seen in the Daya Bay evolution data. However, this summation method still allows for an anomaly. We conclude that there is currently not enough information to use the antineutrino flux changes to rule out the possible existence of sterile neutrinos.'

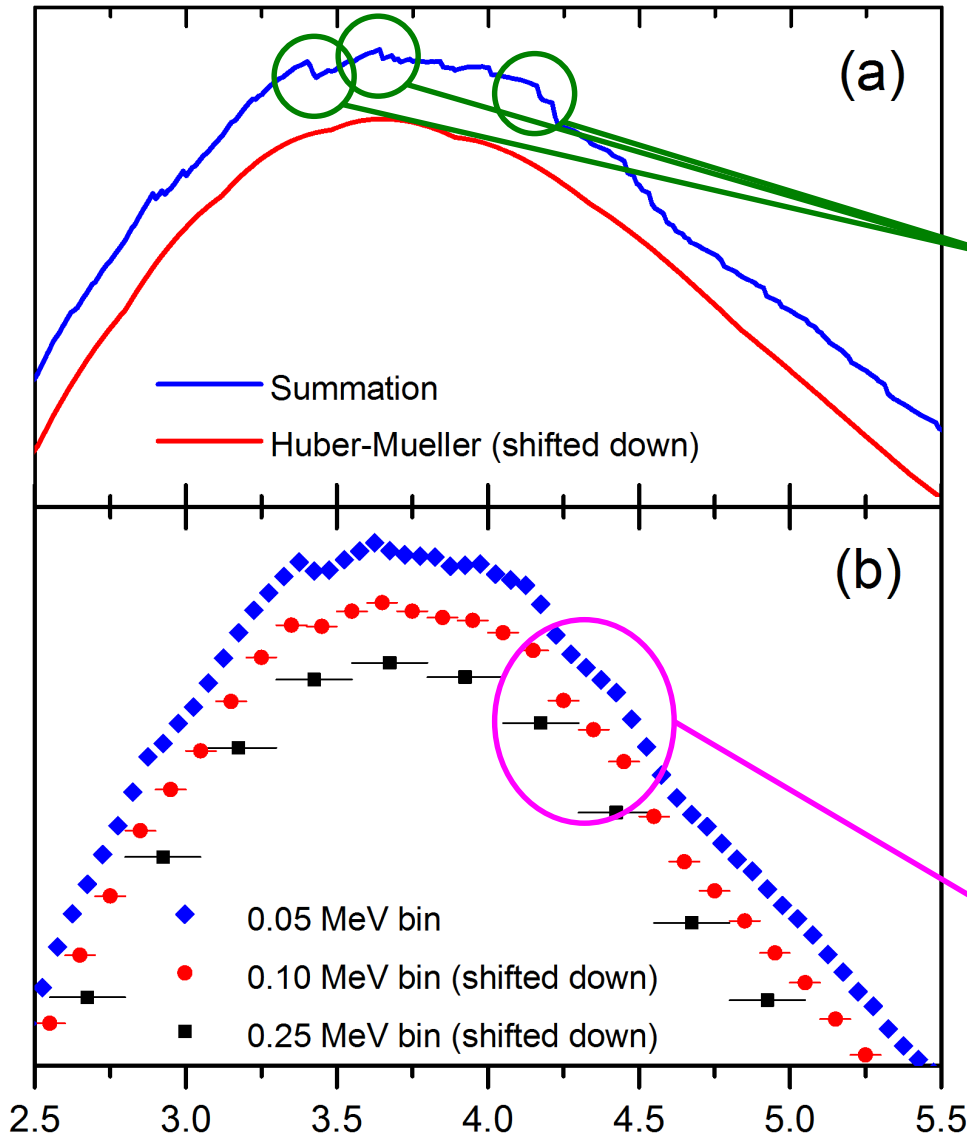
Fine Structure

NEOS data, 30 m from a power reactor

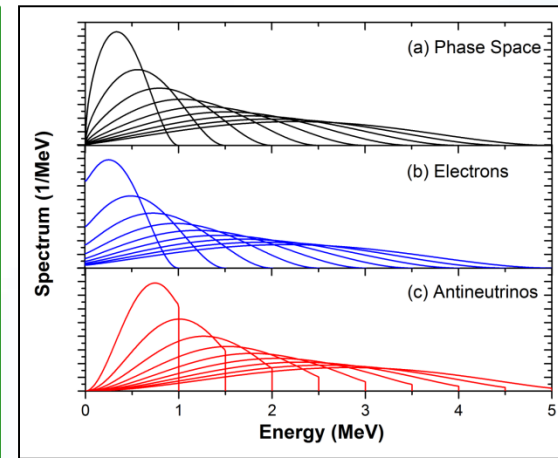


Fine Structure

As the reactor spectrum is the sum of ~800 individual spectra, can we see individual effects?



Sharp cutoffs that can be seen with 0.1 MeV binning or less



Shoulder spanning several 100s keV

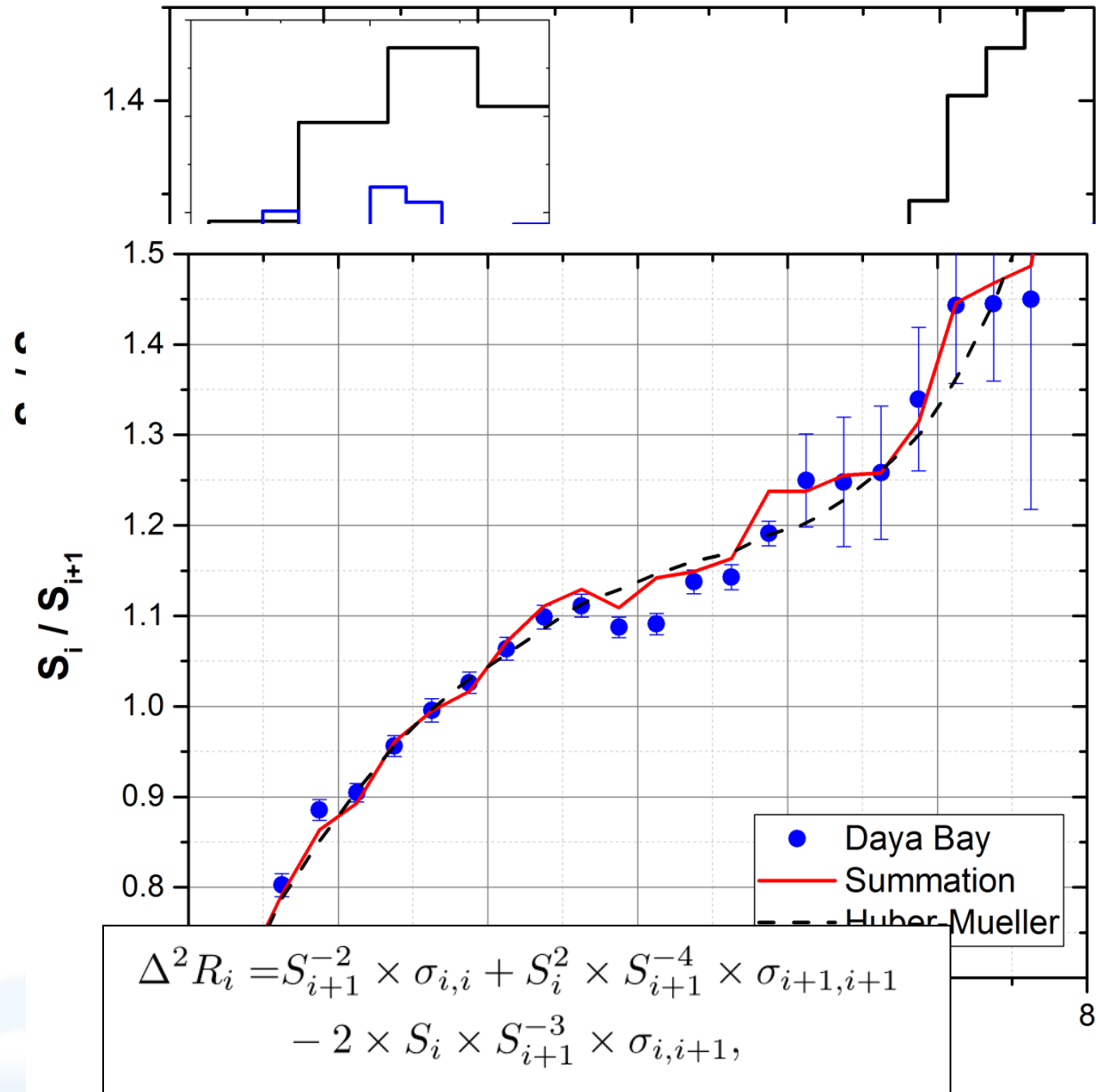
How to reveal Fine Structure?

Ratio of adjacent points:

$$R_i = S_i / S_{i+1}$$

Surprisingly, even with a 0.25 MeV binning a structure can be seen.

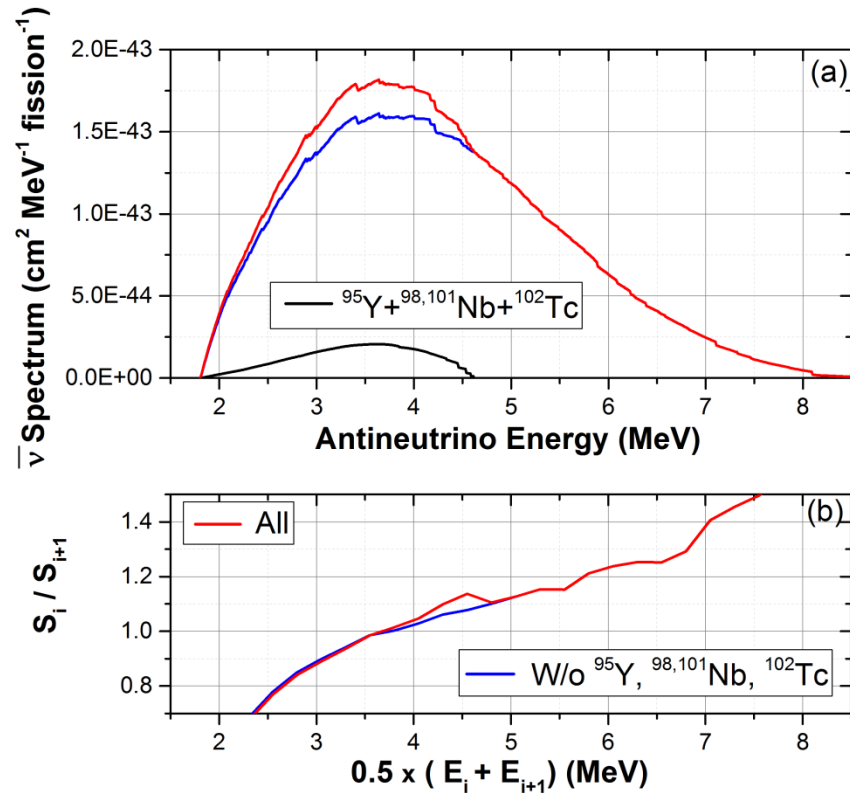
Structure observed in Daya Bay data, covariance matrix crucial for analysis.



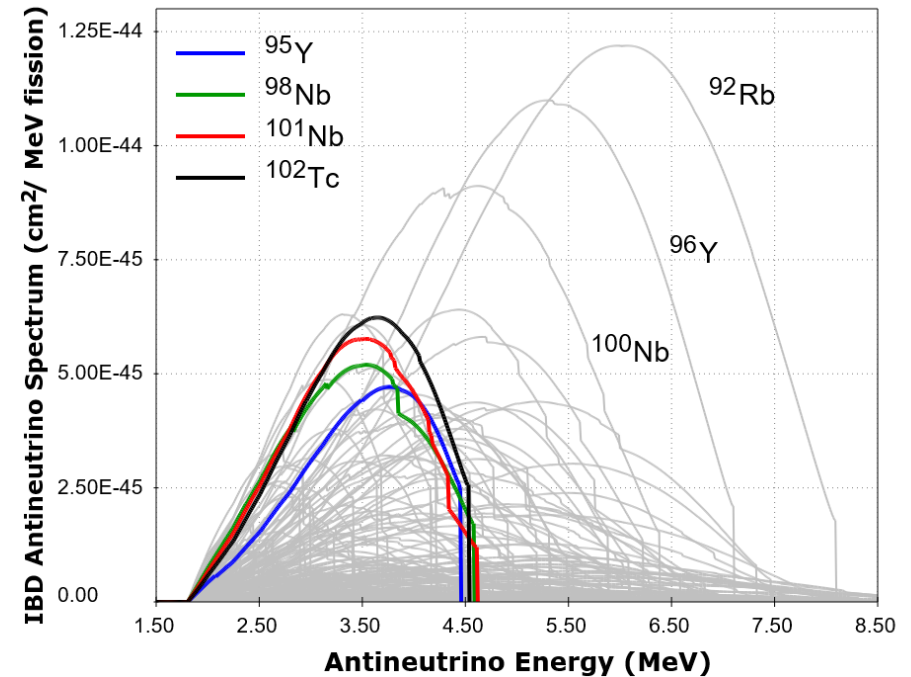
Nuclides behind fine structure



Looking for trees in the forest



This “Fine structure” can be attributed to just 4 nuclides



For more details, see:

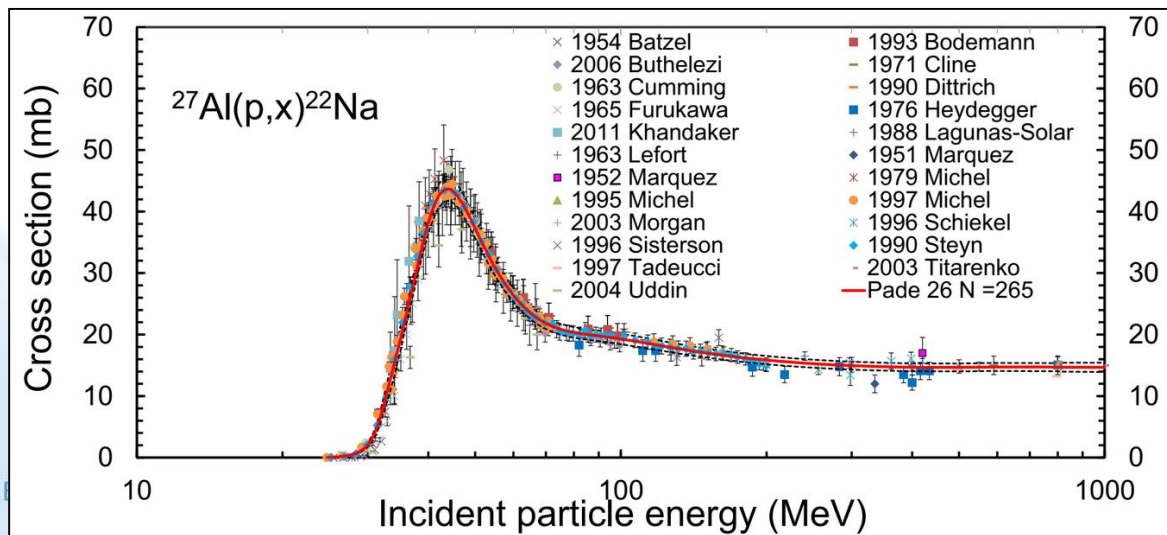
A.A. Sonzogni, M. Nino, E.A. McCutchan arXiv:1710.00092

Eagerly awaiting PROSPECT data to perform similar analysis

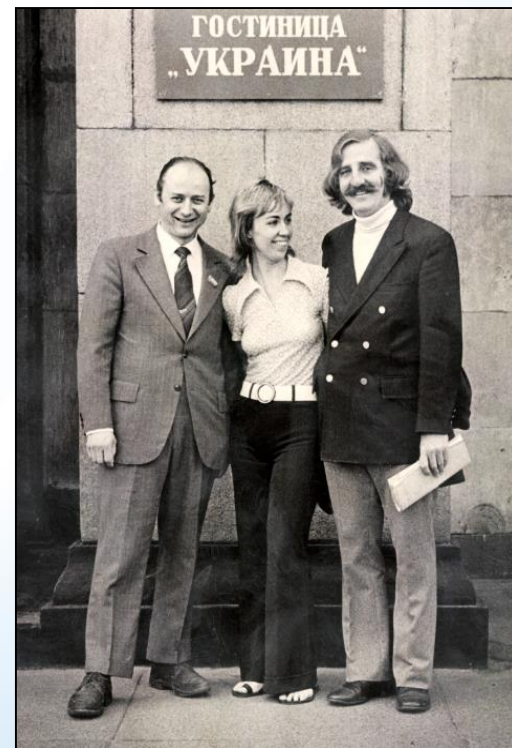
International Collaborations

Nuclear Data Section, International Atomic Energy Agency, Vienna, Austria

- EXFOR compilation
- EMPIRE code development
- ENSDF coordination
- Coordinated Research Projects, to name just a few:
 - Beta-delayed neutron emitters.
 - Charged-particle Monitor Reactions and Medical Isotope Production.



BNL bulletin, February 20 1969.



Sol Perlstein and Vicky McLane during a 1973 EXFOR meeting in Moscow (BNL Bulletin).

International Collaborations

Working Party on International Nuclear Data Evaluation Co-operation, Nuclear Energy Agency, OECD, Paris, France

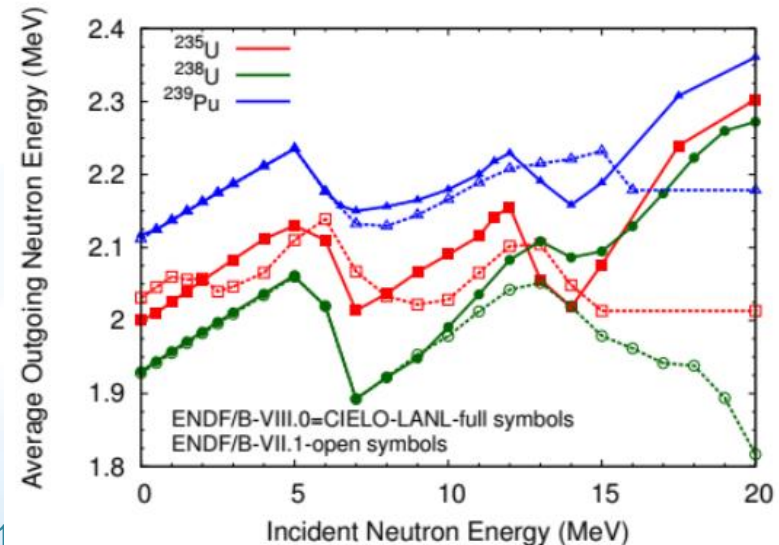
Subgroups (medium term research projects), as examples, two recent ones

- Subgroup 38, Beyond the ENDF format: A modern nuclear database structure

C.M. Mattoon et al., Nucl. Data Sheets **113**, 3145 (2012).

- Subgroup 40, Collaborative International Evaluated Library Organisation (CIELO)

M.B. Chadwick et al, Nucl. Data Sheets **148**, 189 (2018).

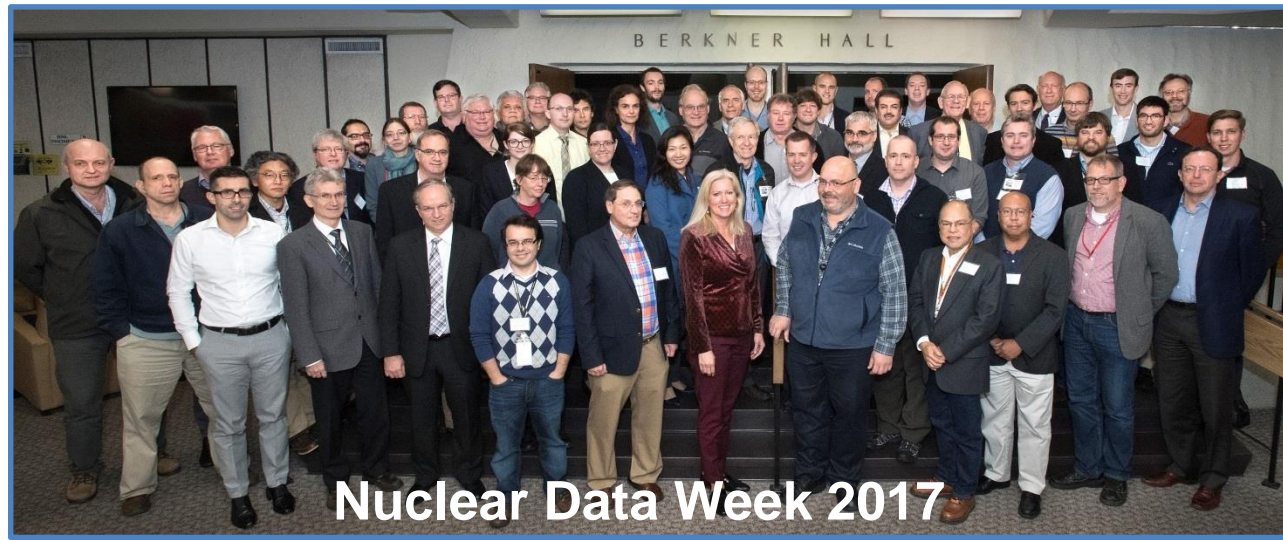


Meetings

Nuclear Data Week

Around the 1st week of November in BNL

About 80 participants



International Nuclear Data Conferences

Take place every 3 years starting in 1978. ND 2013 organized by BNL in Manhattan, 452 participants. Next one in Beijing, May 2019.



USNDP Future

- Ensure completeness and currency of all databases. In particular work closely with FRIB and other new facilities exploring neutron rich nuclide.
- Improve nuclear data for nuclides relevant in medical, national security and antineutrino applications. Several experimental projects have received funding following recent FOA.
- New experiments and evaluations following inter-agency coordination.
- Improve the description of the fission process. Produce new ENDF evaluated fission yields.
- Improve physics in nuclear reactions model codes. Less phenomenology and more physics.
- Modernize formats and infrastructure.
- Implement technology advances in dissemination efforts.

One more slide!

- We are a small but vibrant group! Organization chart in the additional material section.
- Only a couple of examples shown due to time limitations. Many more capabilities!
- Free assistance is available with any of our products. See the contact page in the additional material.
- Actively seeking feedback in terms of new compilations, evaluations, applications and experiments.

Additional Material

US Nuclear Data Program

FY17 Organizational Chart

Nuclear Data and Nuclear Theory Computing Ted Barnes

USNDP Chair	Alejandro Sonzogni
Nuclear Structure Coordinator	John Kelly
Nuclear Reactions Coordinator	Toshihiko Kawano

ANL	
<u>Filip Kondev</u>	1.00

LLNL	
<u>Ian Thompson</u>	0.24
Sofia Quaglioni	0.01
Nicole Vash ^{pd} (FIRE ND)	0.50
Yonglin Zhu ^{gs} (FIRE NCSU)	1.00

MSU	
<u>Jun Chen</u>	1.00
<u>Hiro Iwasaki</u>	0.00

NIST	
<u>Alan Thompson</u>	0.10
Allan Carlson ^c	0.10

BNL	
<u>Alejandro Sonzogni</u>	0.93
Ramon Arcilla ^p	1.00
Letty Krejci ^a	1.00
David Brown	0.70
Mike Herman	1.00
Tim Johnson	1.00
Libby McCutchan	1.00
Gustavo Nobre	1.00
Boris Pritychenko	1.00
Joann Totans ^a	1.00
Emil Betak ^c	0.25
Stanislav Hlavac ^c	0.25
Pavel Oblozinsky ^c	0.15
Otto Schwerer ^c	0.25
Balraj Singh ^c	0.72
Said Mughabghab ^e	0.00

LANL	
<u>Toshihiko Kawano</u>	0.50
HyeYoung Lee	0.25
John Ullmann	0.10
Alex Long ^{pd}	0.65
Matthew Mumpower ^{pd}	0.40
Jack Winkelbauer ^{pd}	0.10
Daniel Hatcher ^{gs}	0.25
Zachary Purcell ^{gs}	0.15

ORNL	
<u>Michael Smith</u>	0.20
Caroline Nesaraja	1.00
Murray Martin ^c	0.15
Larry Zhang ^{gs}	0.20

LBNL	
<u>Lee Bernstein</u>	0.75
Shamsu Basunia	0.90
Eddie Browne ^c	0.36
Jon Batchelder ^c	0.75
Aaron Hurst ^c	0.60
Rick Firestone ^c	0.47
Jag Tuli ^c	0.16

Texas A&M	
<u>Ninel Nica</u>	0.63

TUNL	
<u>John Kelley</u>	0.50
Kent Leung ^{pd}	0.50
Jim Purcell ^c	0.10
Grace Sheu ^p	0.75

PI is underlined. FTEs are given in the right column.

a: administrative, c: contractor, p: professional, pd: post-doc, gs: graduate student, e: emeritus.

US Nuclear Data Program

FY 17 Project Organizational Chart

NSR
<u>Boris Pritychenko</u>
Emil Betak
Balraj Singh
Joann Totans

EXFOR
<u>Boris Pritychenko</u>
Stanislav Hlavac
Otto Schwerer

XUNDL
<u>Libby McCutchan</u>
Shamsu Basunia
Jun Chen
John Kelley
Filip Kondev
Caroline Nesaraja
Balraj Singh

ENSDF
<u>Libby McCutchan</u>
Eddie Browne
Shamsu Basunia
Jun Chen
Aaron Hurst
Tim Johnson
John Kelley
Filip Kondev
Murray Martin
Caroline Nesaraja
Ninel Nica
Jim Purcell
Balraj Singh
Alejandro Sonzogni
Jag Tuli

ENDF
<u>David Brown</u>
Ramon Arcilla
Allan Carlson
Mike Herman
Toshihiko Kawano
Said Mughabghab
Libby McCutchan
Gustavo Nobre
Sofia Quaglioni
Alejandro Sonzogni
Alan Thompson
Ian Thompson

Web dissemination
<u>Tim Johnson</u>
Ramon Arcilla
Boris Pritychenko
Michael Smith
Alejandro Sonzogni

Nuclear Data Sheets
<u>Libby McCutchan</u>
Jun Chen
Pavel Oblozinsky
Boris Pritychenko

Nuclear Astrophysics
Filip Kondev
Boris Pritychenko
Matthew Mumpower
Michael Smith
Nicole Vash
Larry Zhang
Yongling Zhu

Nuclear Structure Experiments
Filip Kondev
Libby McCutchan
Ninel Nica

Nuclear Reaction Experiments
John Batchelder
Lee Bernstein
Aaron Hurst
HyeYoung Lee
John Ullmann

Database/Project manager is underlined when applicable.

USNDP Databases & Products Contacts

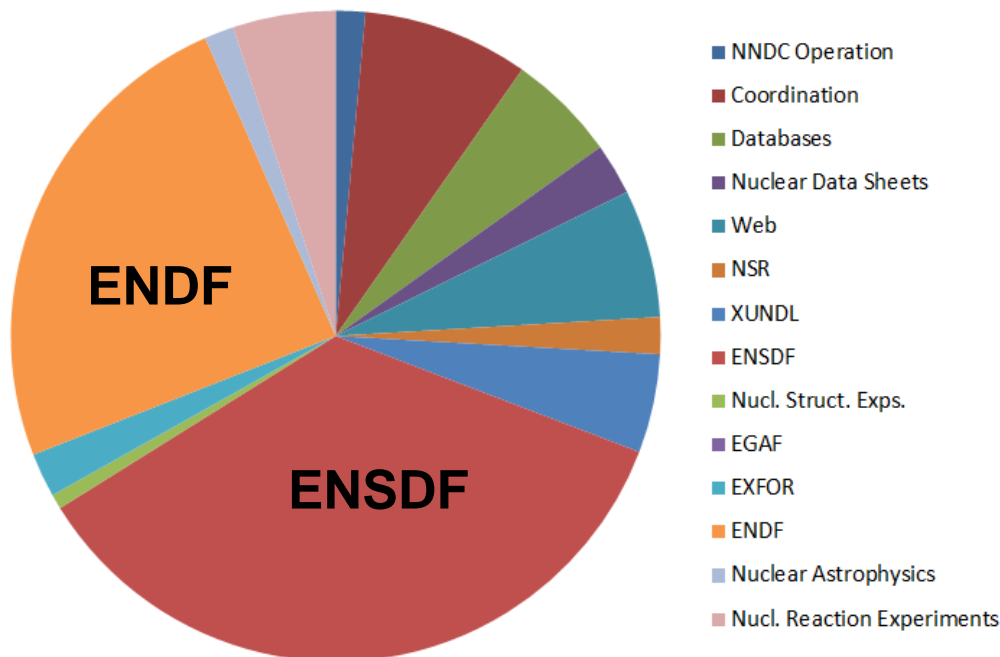
NSR/EXFOR: Boris Pritychenko, pritychenko@bnl.gov

XUNDL/ENSDF/NDS: Libby McCutchan,
mccutchan@bnl.gov

ENDF: David Brown, dbrown@bnl.gov

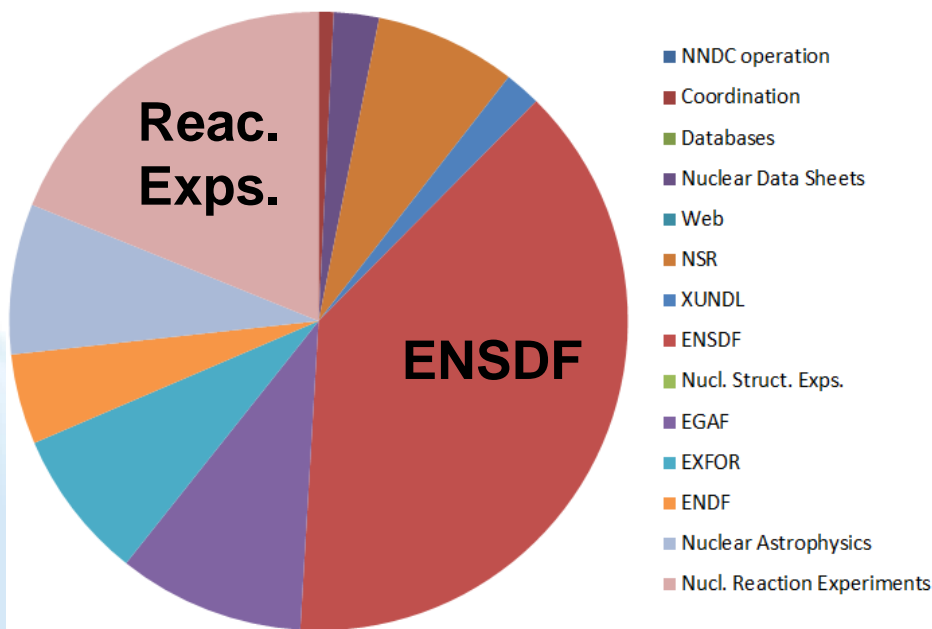
Web: Tim Johnson, tdjohnson@bnl.gov

FY2017 FTE Distribution

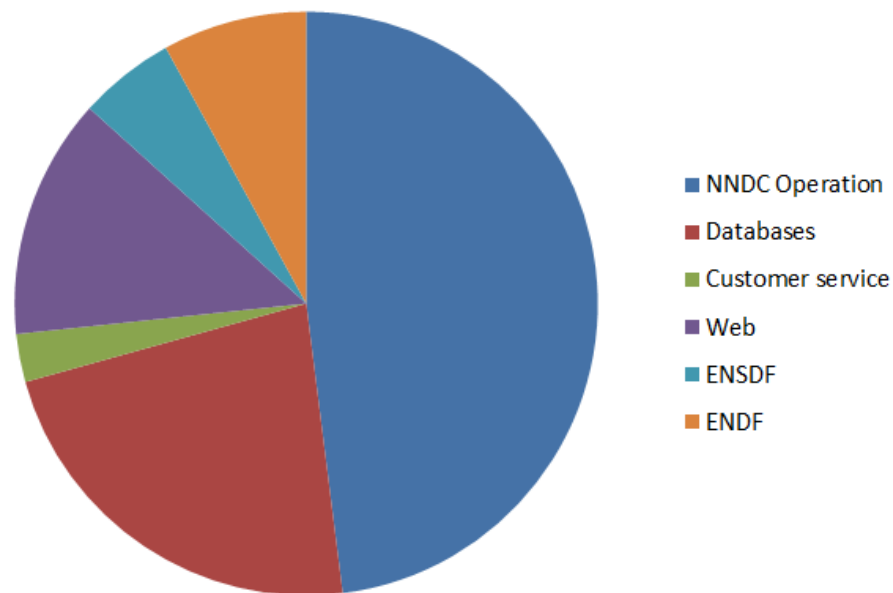


**13.72
Scientific
Permanent
FTEs**

6.36 Scientific Temp. FTEs



3.75 Tech/Admin FTEs



USNDP Oversight

USNDP 2014 Review

James Vary (Iowa State U., chair), Robin Forest (IAEA), Alexandra Gade (MSU), Witek Nazarewicz (MSU), Meiring Nortier (LANL), Erich Ormand (LLNL).

USNDP 2015 NDAC

Dennis McNabb (LLNL, chair), Roberto Capote (IAEA), Mike Carpenter (ANL), Erich Ormand (LLNL), Meiring Nortier (LANL), Jasmina Vujic (UCB)

USNDP 2016 NDAC

Dennis McNabb (LLNL, chair), Roberto Capote (IAEA), Mike Carpenter (ANL), Witek Nazarewicz (MSU), Meiring Nortier (LANL), Jasmina Vujic (UCB)

USNDP 2018 NDAC

Dennis McNabb (LLNL, chair), Mike Carpenter (ANL), Mark Chadwick (LANL), Witek Nazarewicz (MSU), Alan Nichols (ex IAEA), Meiring Nortier (LANL), Karl van Bibber (UCB)

April 9-10 2018 – the USNDP white paper will be presented

NNSA/NA-22 hosted a Nuclear Data Roadmapping Enhancement Workshop (NDREW) to develop a investment plan for the Defense Nuclear Nonproliferation program

- 120 participants from 12 different institutions
- Seven Government agencies represented:
 - DOE: Nuclear Physics, Nuclear Energy, Isotope Program,
 - NNSA:NA-22 (Counter-proliferation), NA-113 (Defense Programs),
 - DHS/DNDO, DTRA
- Topic areas covered:
 - Data Uncertainty, Sensitivity, and Covariance,
 - Neutron Capture/Inelastic Scattering and Associated Spectra,
 - Fission Independent and Cumulative Fission Yields, Decay Data
 - (α ,n) Reactions,
 - Targets, Facilities and Detector Systems
 - Benchmark Development
 - Data Processing & Transport Code Needs
 - Actinide Cross Sections

The result will be a multi-year roadmap for nuclear data investments from multiple government agencies