US Nuclear Data Program

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www.nndc.bnl.gov

www.nndc.bnl.gov/usndp

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.

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 fur Radiumforschung, Waisenhausgasse 3, Vienna IX., Austria.

Bertram B. Boltwood

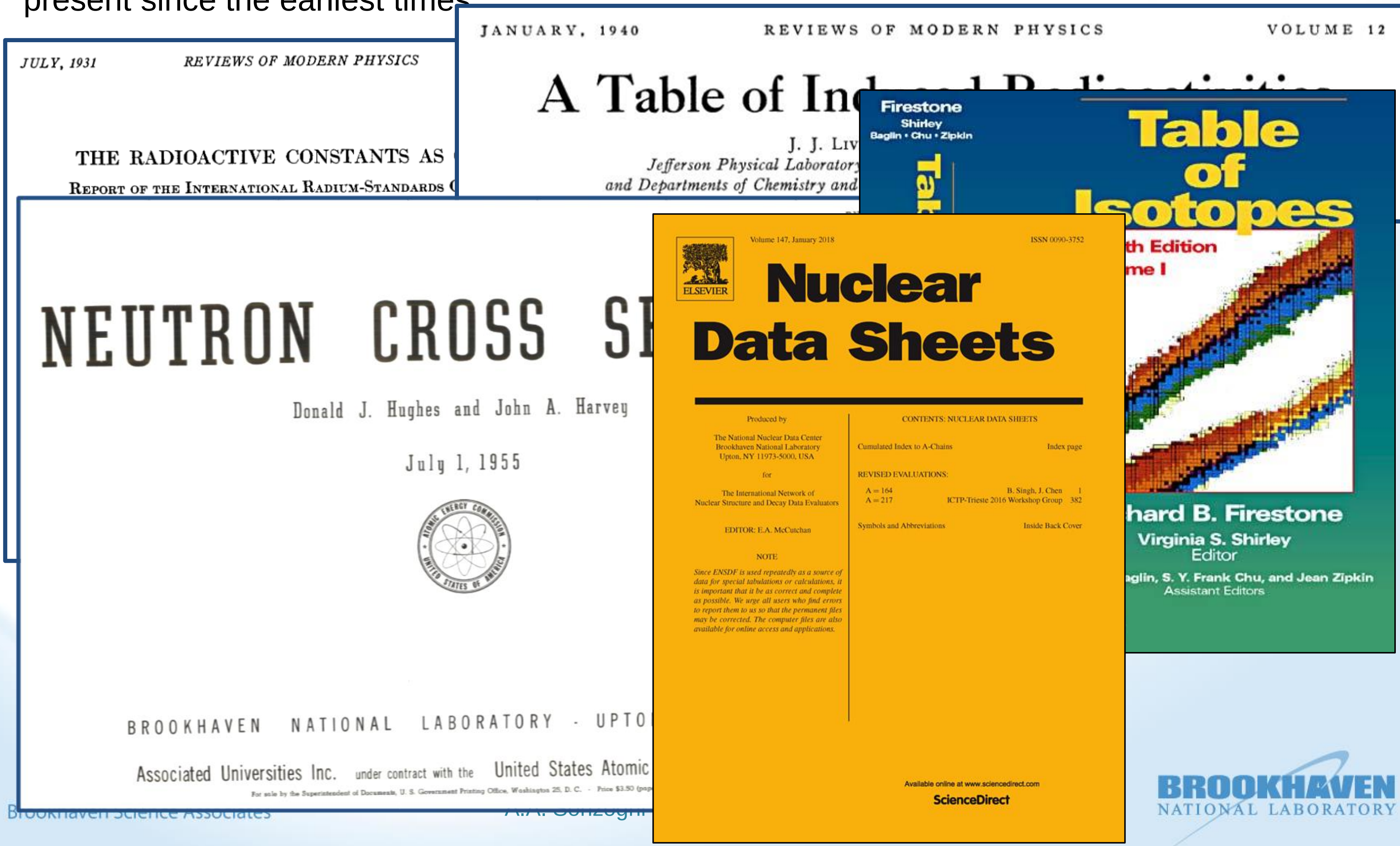
Some goals have not changed:

- 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.

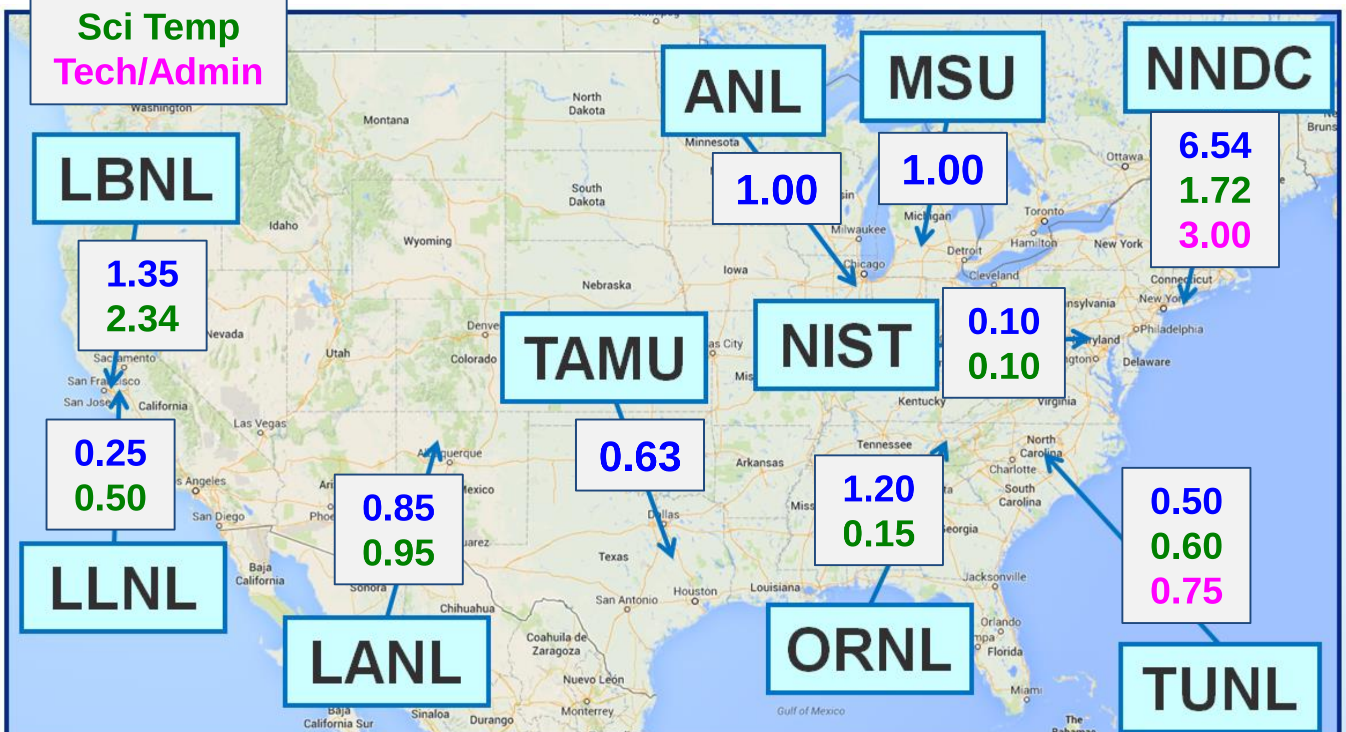


US Nuclear Data Program

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).

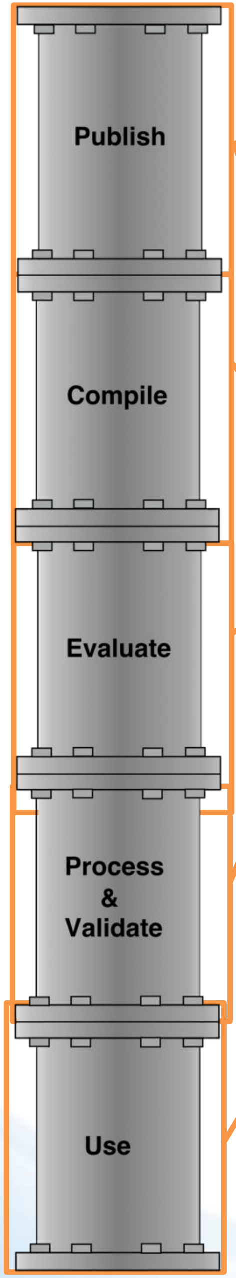
Current USNDP Groups

FTEs
Sci Perm
Sci Temp
Tech/Admin



- 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.

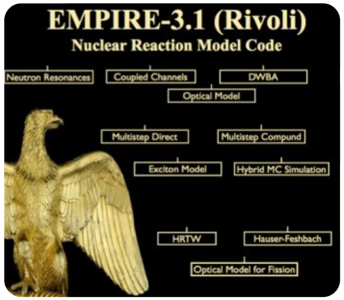
The USNDP main products and the nuclear data pipeline



NSR XUNDL ENSDF www.nndc.bnl.gov

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

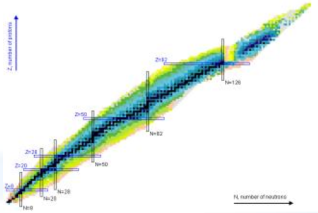
Code development: Actively develop codes that support our work



Archive: Seek "abandoned" data and archive it before it is lost

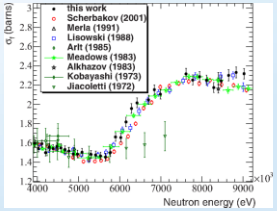
Address gaps: Perform targeted experiments to address gaps in databases

NuDat

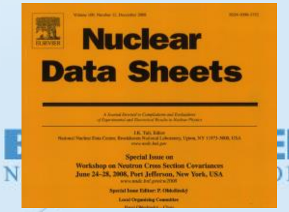


SIGMA

EXFOR searches



Nuclear Data Sheets



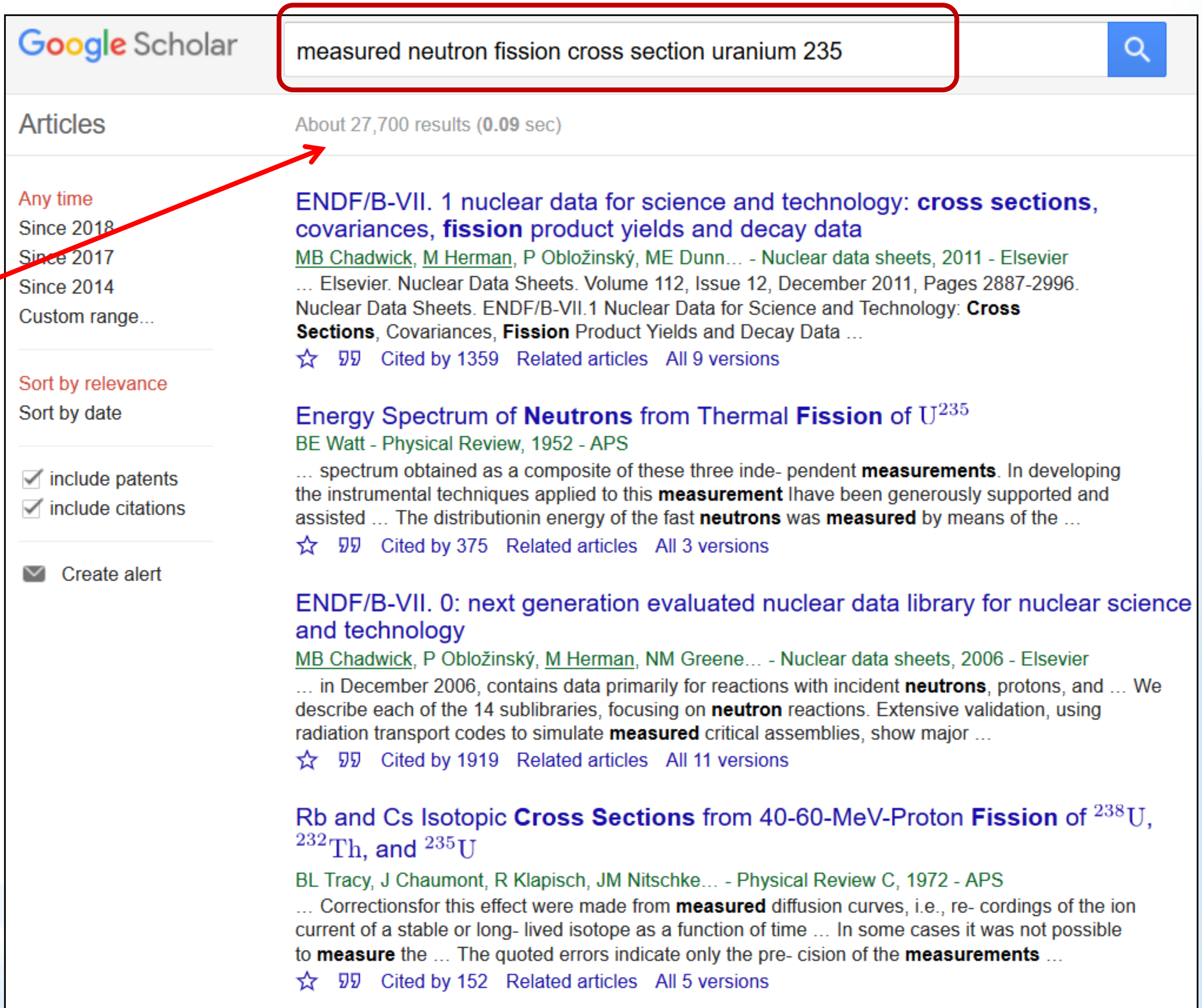
An example of our databases

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)

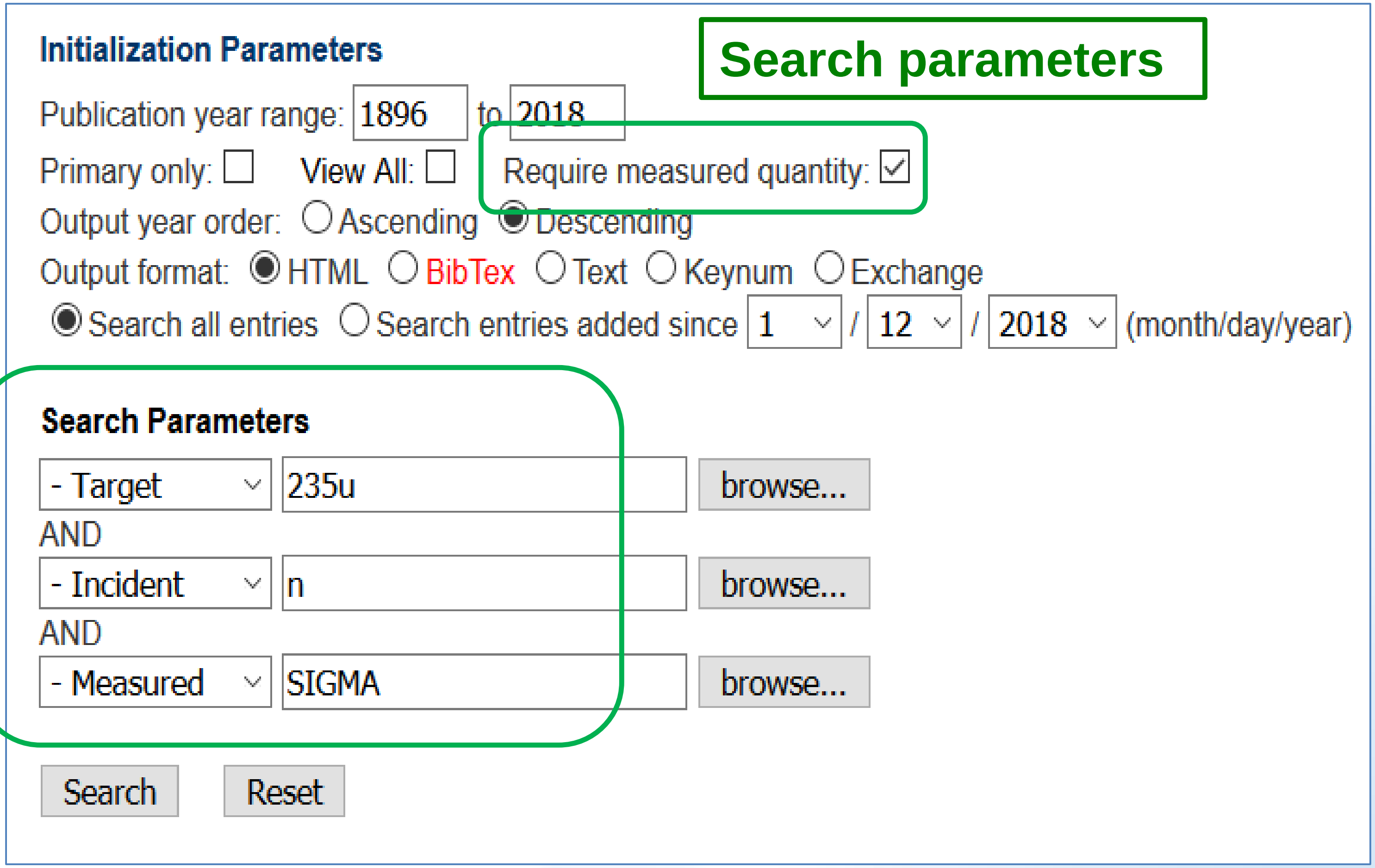
27,700 Results!



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

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

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



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}U(n, F), E=0.1-9 MeV; ^{237}Np(n, F), E=0.1-9 MeV; measured fission σ(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}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}Np.

doi: 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.

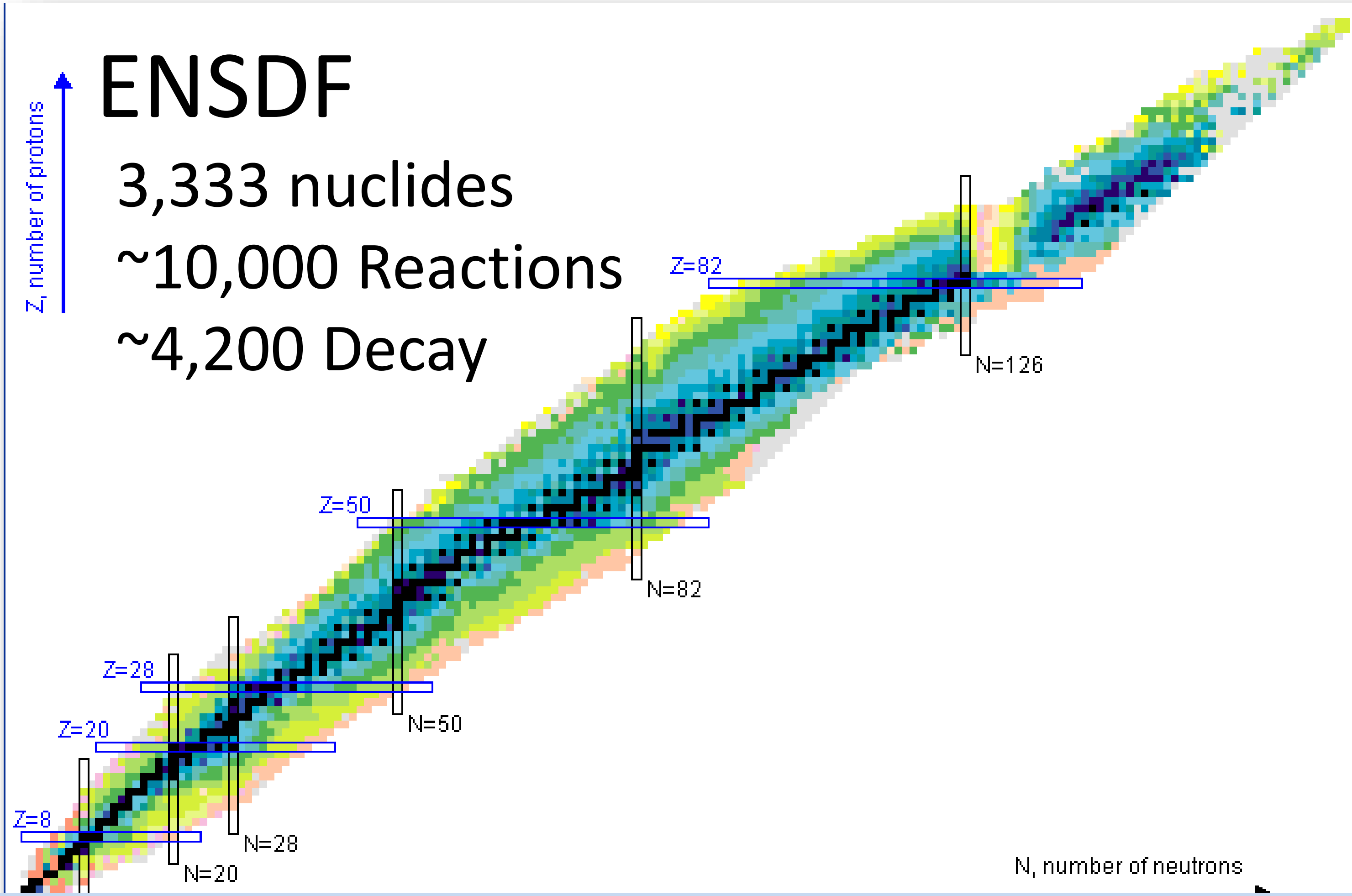
Description of the article

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

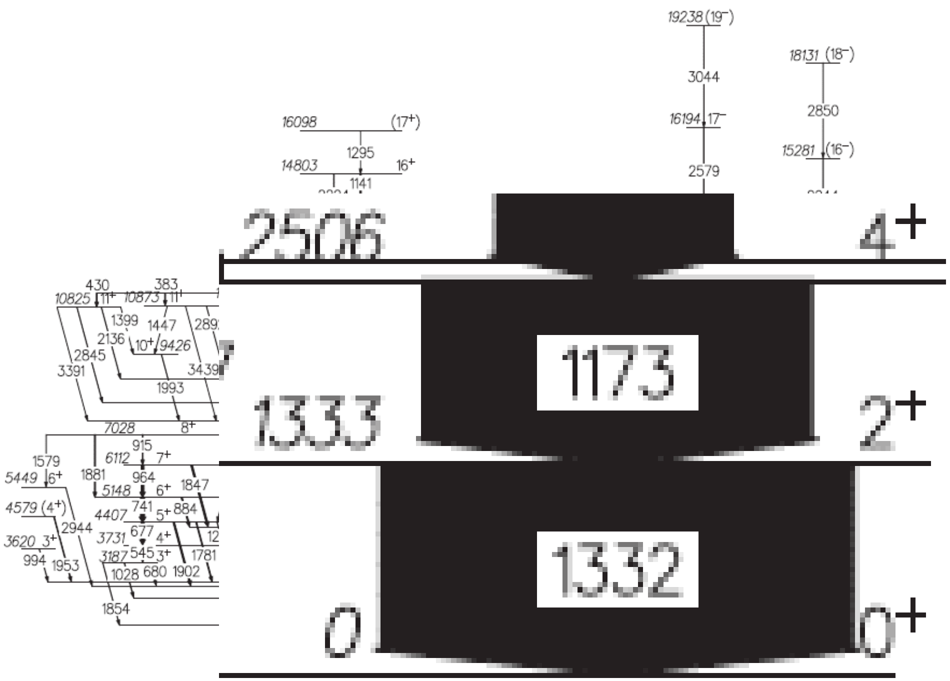
It is Complete: **All** nuclei and **all** level and radiation properties

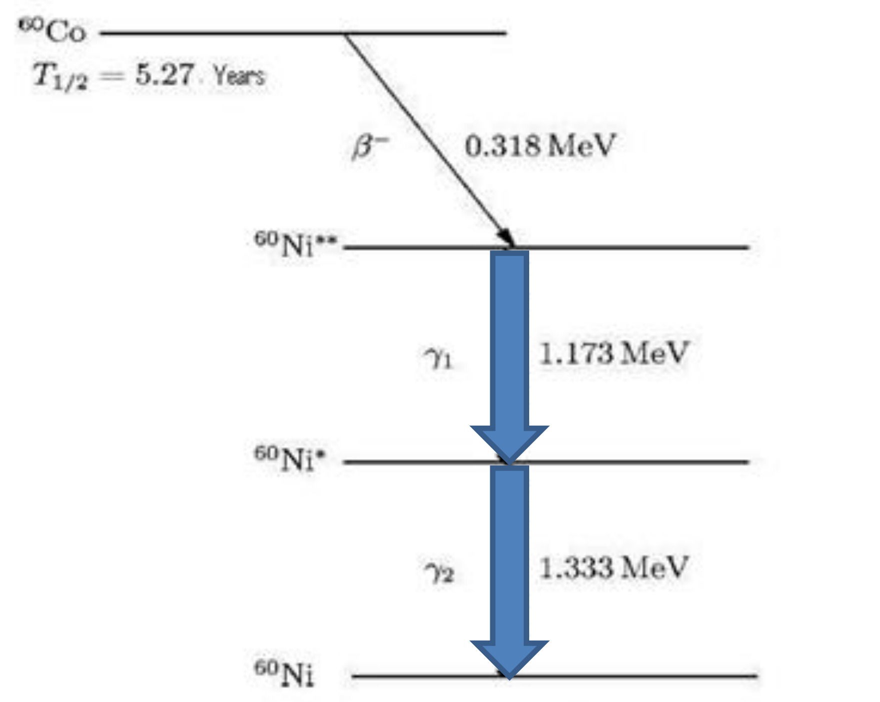
It is Versatile: Feeds back into both basic and applied sciences

ENSDF in a Nutshell

Properties of Nuclei

And how they decay





^{60}Ni

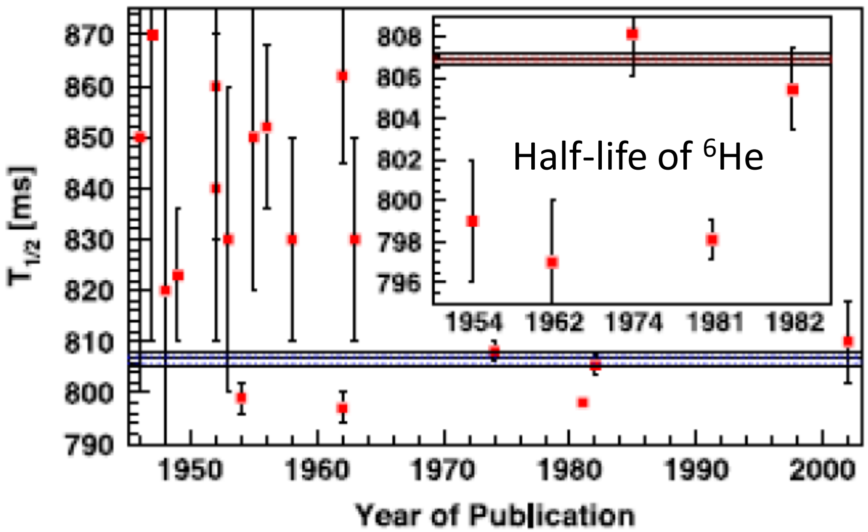
Level energies, spin, parity, half-life, …

Gamma-ray energies, intensities, …

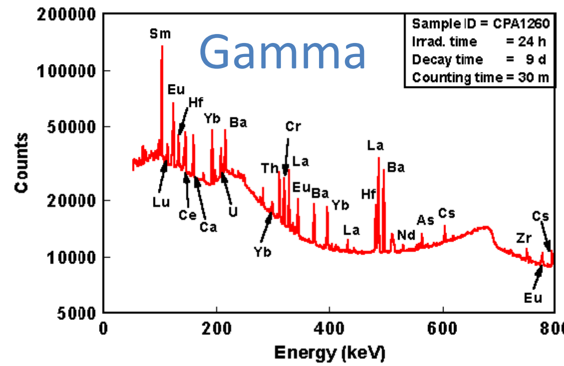
Radiation energies, intensities, decay modes ….

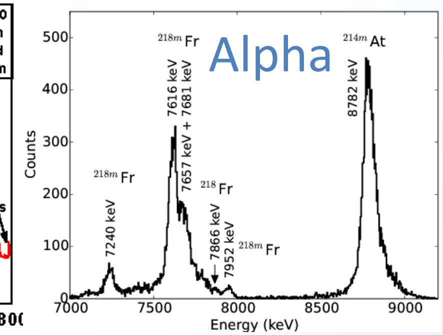
Why do we need ENDSF?

Arbiter of the “Truth”

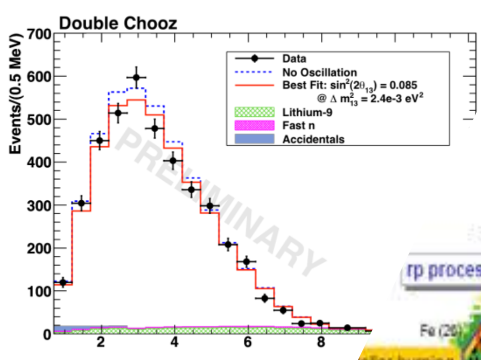


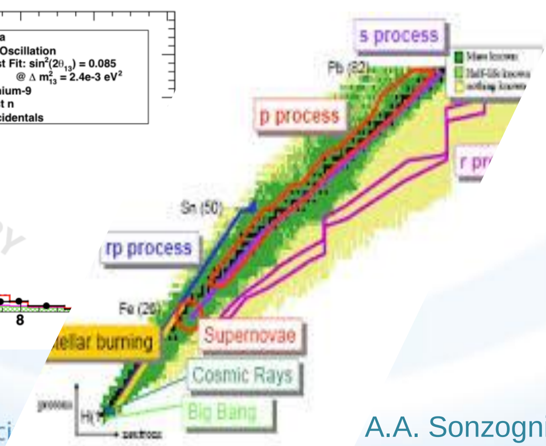
Used in all spectroscopy aspects



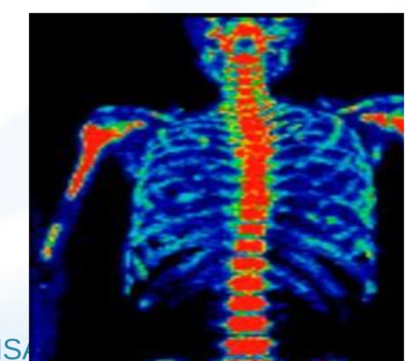


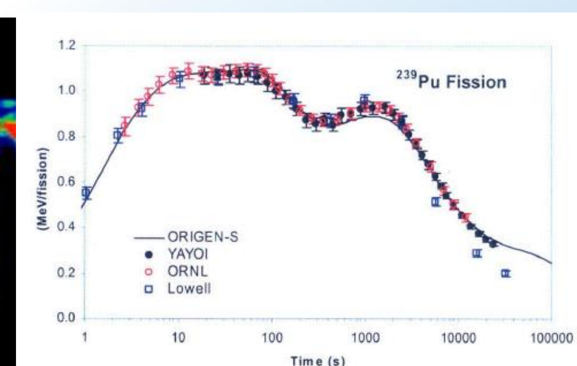
Input for other nuclear physics fields





Wide range of applications require decay data



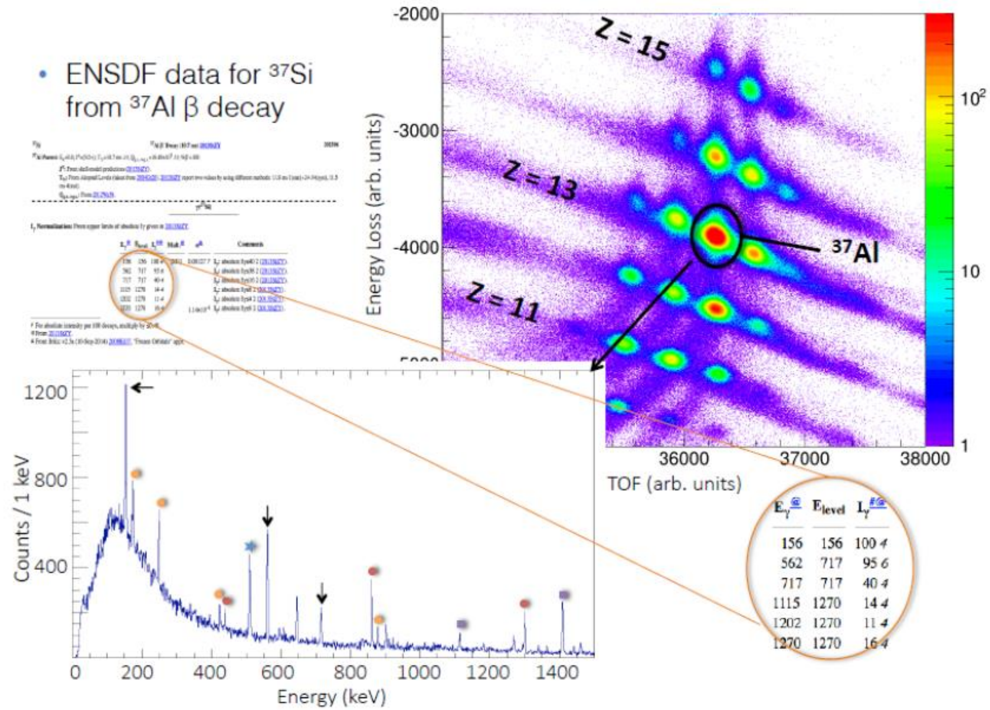


ENSDF and FRIB

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

As an example:

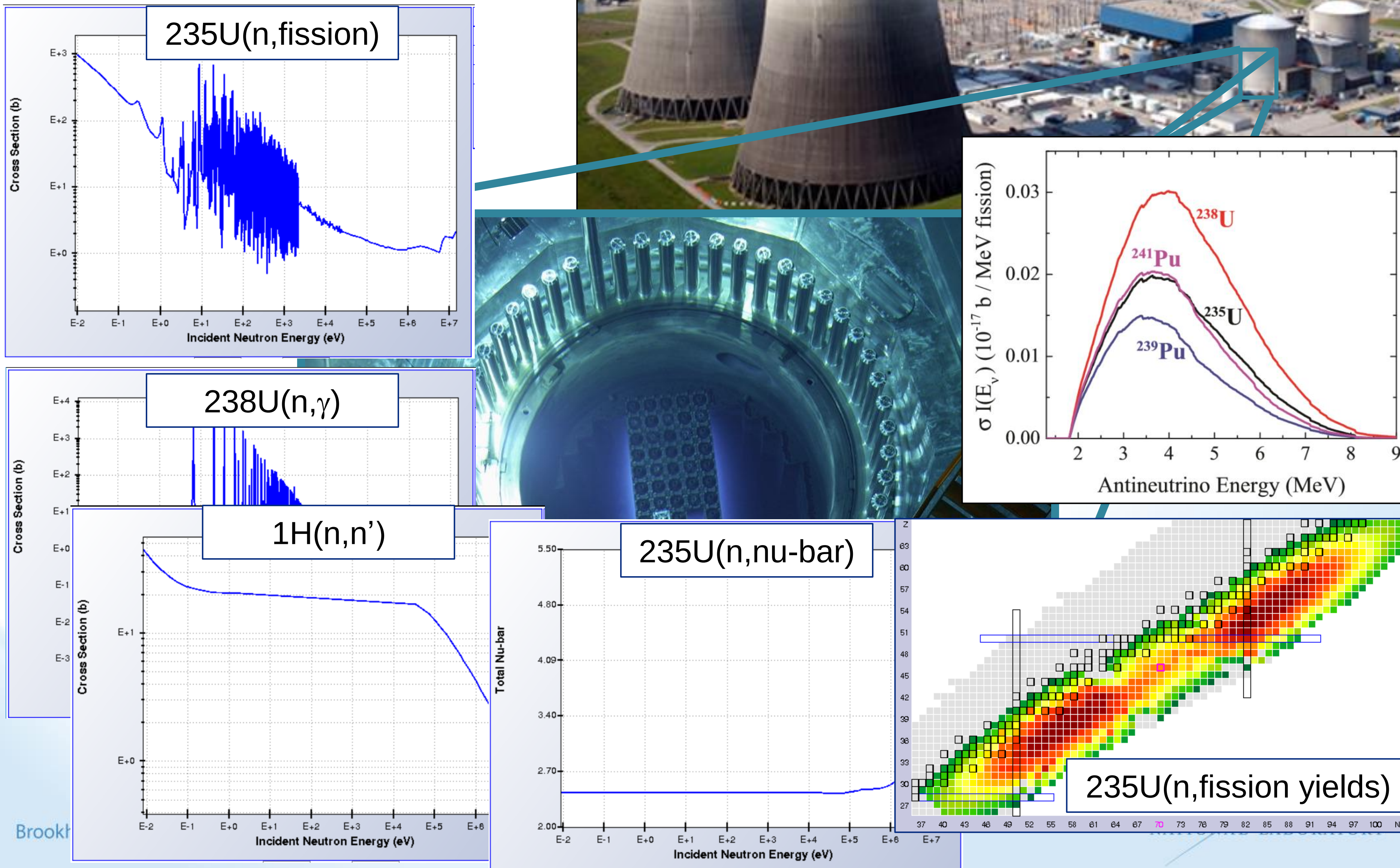
- Gamma-rays are routinely used to identify fragmentation products
- ENSDF is the only place to search them in live-time



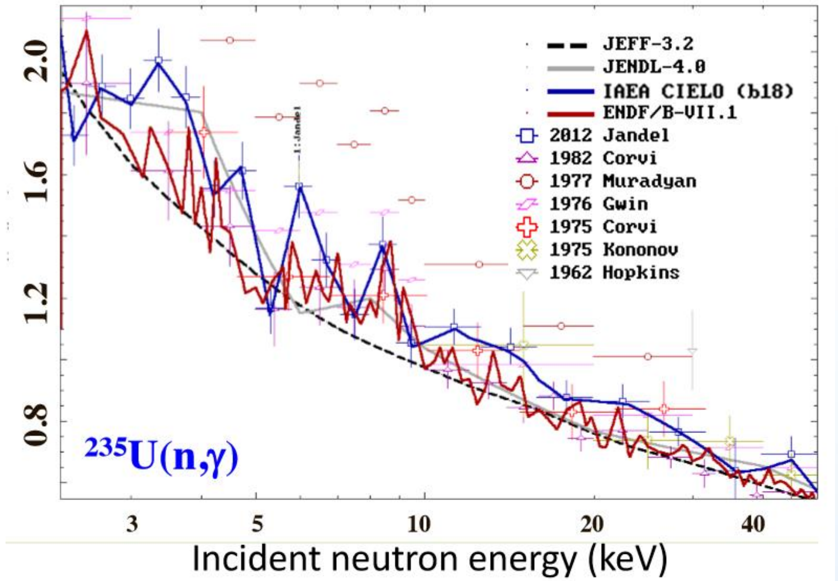
Nuclear Data Working Group established within FRIB Users Organization in order to develop data needs for FRIB

ENDF

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



ENDF



ENDF/B-I was released in June 1968.

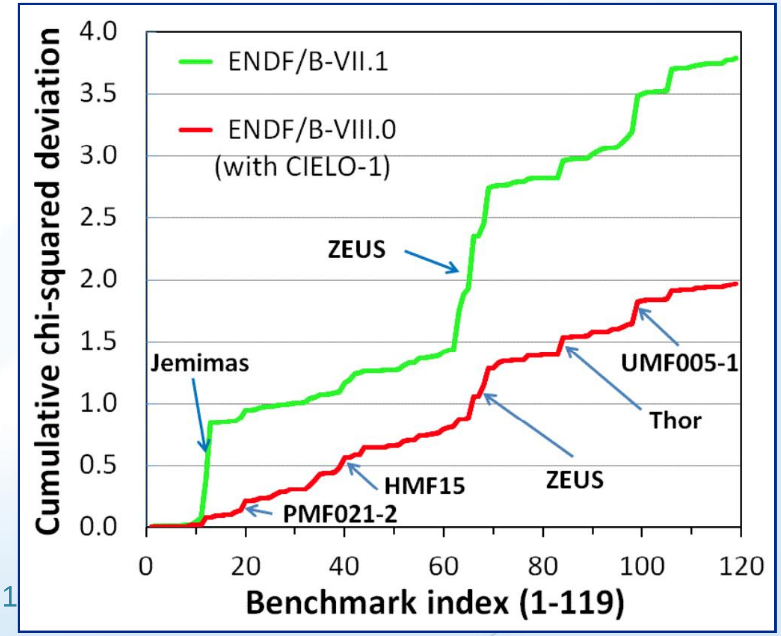
More accurate experiments, improvements in nuclear reaction models and supercomputers have led us to ENDF/B-VIII.0, which was released on February 2nd, 2018 by the Cross Section Evaluation Working Group (CSEWG)[1]

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

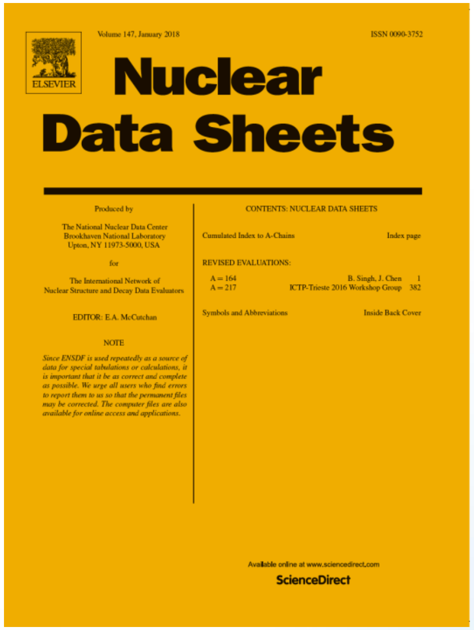


ENDF is used in many applications, simulations & licensing codes such MCNP, GEANT, SCALE, ORIGEN

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

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


Volume 147, January 2018 ISSN 0090-3752

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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

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


Volume 148, February 2018 ISSN 0090-3752

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Nuclear Data Sheets

A Journal Devoted to Compilations and Evaluations of Experimental and Theoretical Results in Nuclear Physics

E. A. McCutchan, Editor
National Nuclear Data Center, Brookhaven National Laboratory, Upton, NY 11973-5000, USA
www.nndc.bnl.gov

Special Issue on Nuclear Reaction Data

Special Issue Editor: Pavel Obložinský
Special Issue Assistant Editor: Boris Pritychenko

Contents

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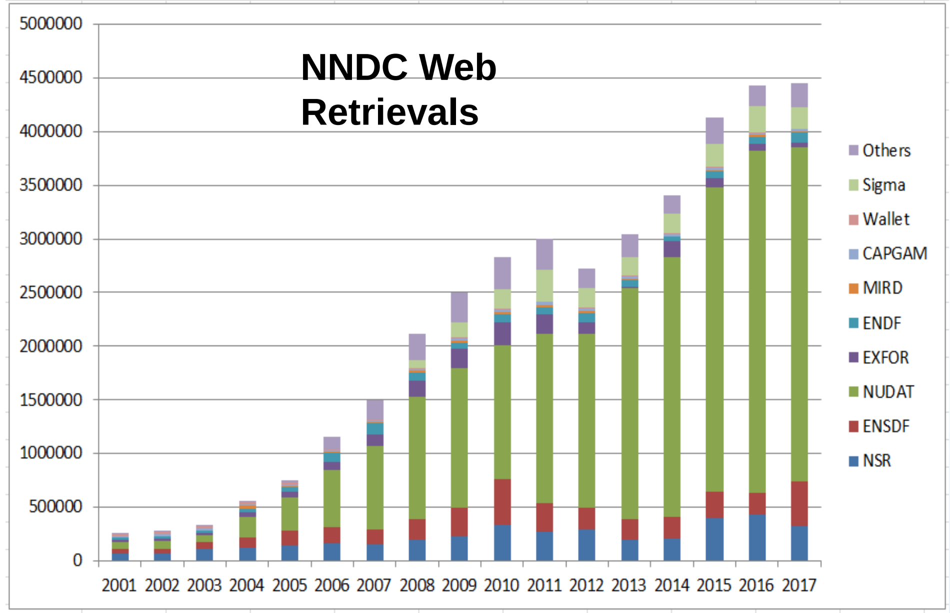
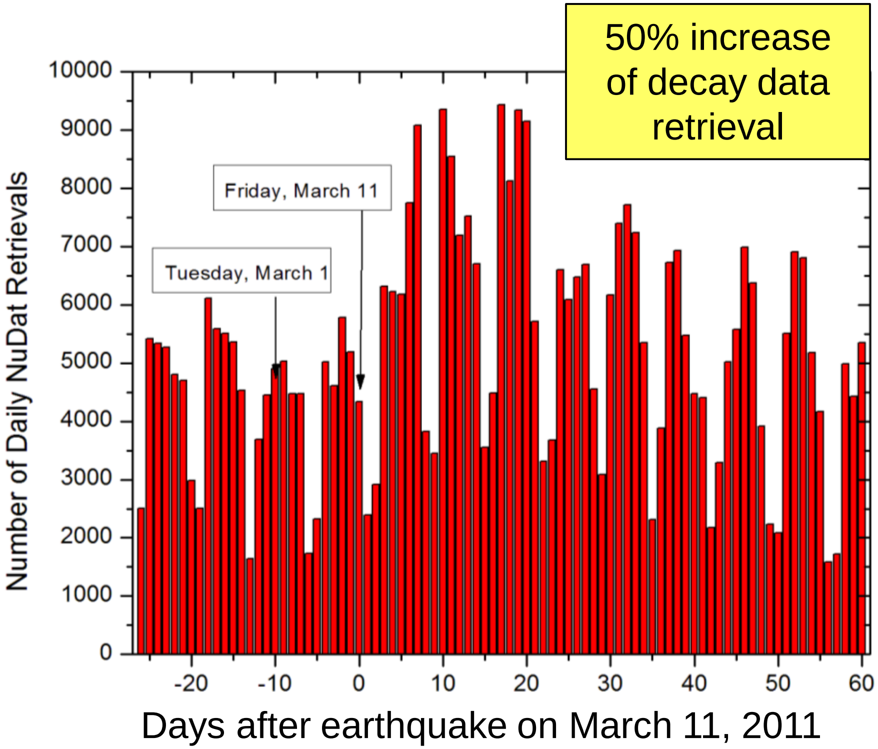
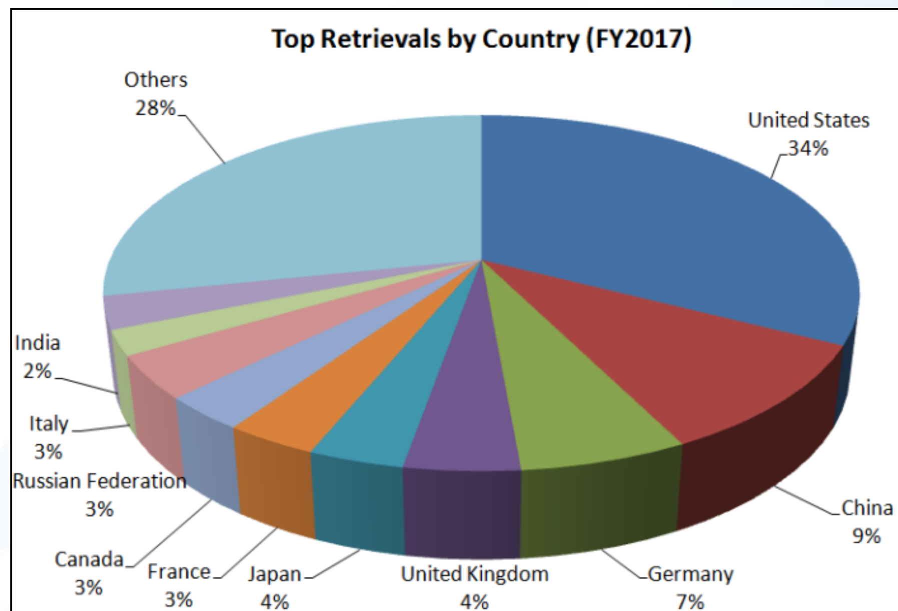
Web Dissemination

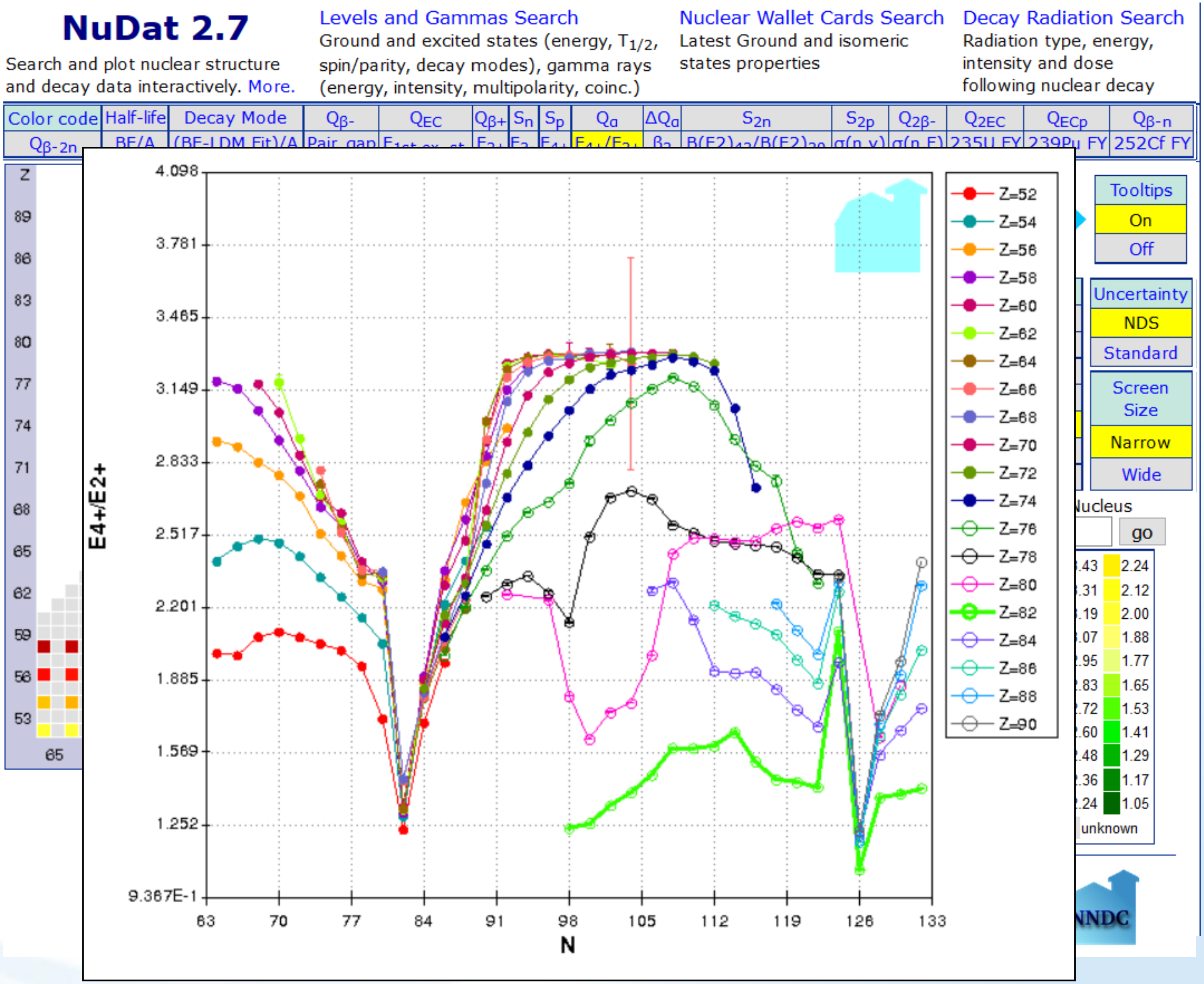
- Started with Telnet in mid 1980s.
- First generation web applications in mid 1990s.
- Mostly performed nowadays in BNL using 7 powerful servers.
- About 4.5 Million retrievals in FY17.







Web Dissemination



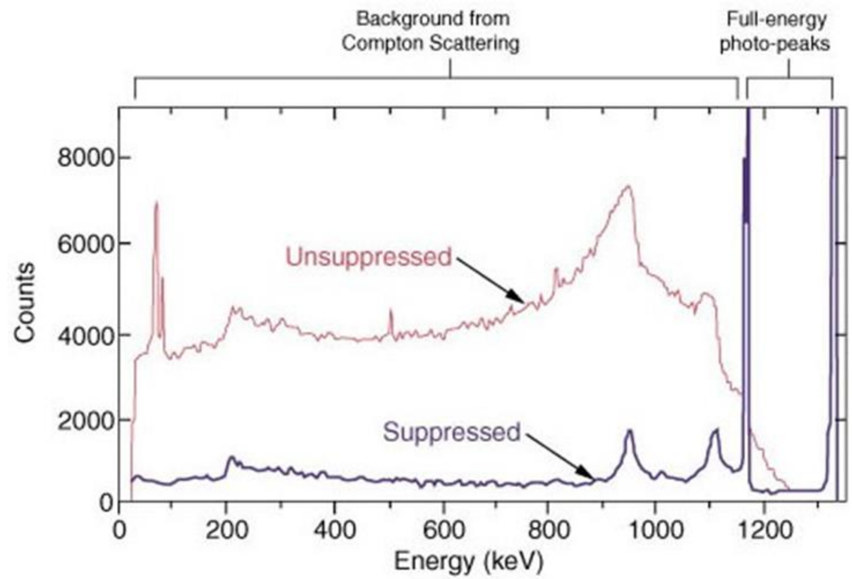
Upgrades typically follow users recommendations

Capitalizing on advances in γ-ray spectroscopy

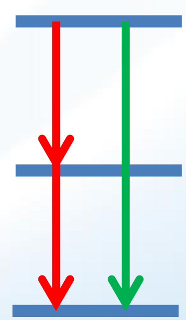
30 Years ago: 1-2 small detectors

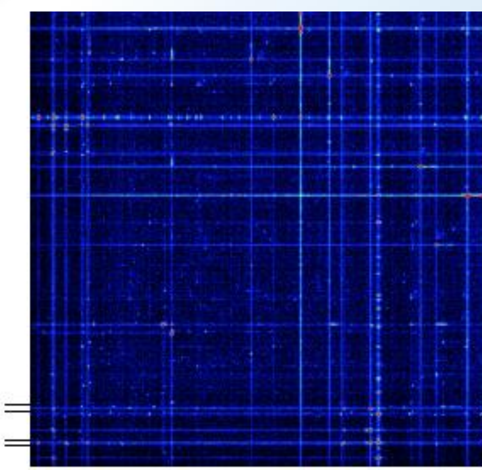
Present: 10-100 detectors

Compton suppression



γγ 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)

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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 $^{86}SrCl_2$ for production of PET radioisotope ^{86}Y☆

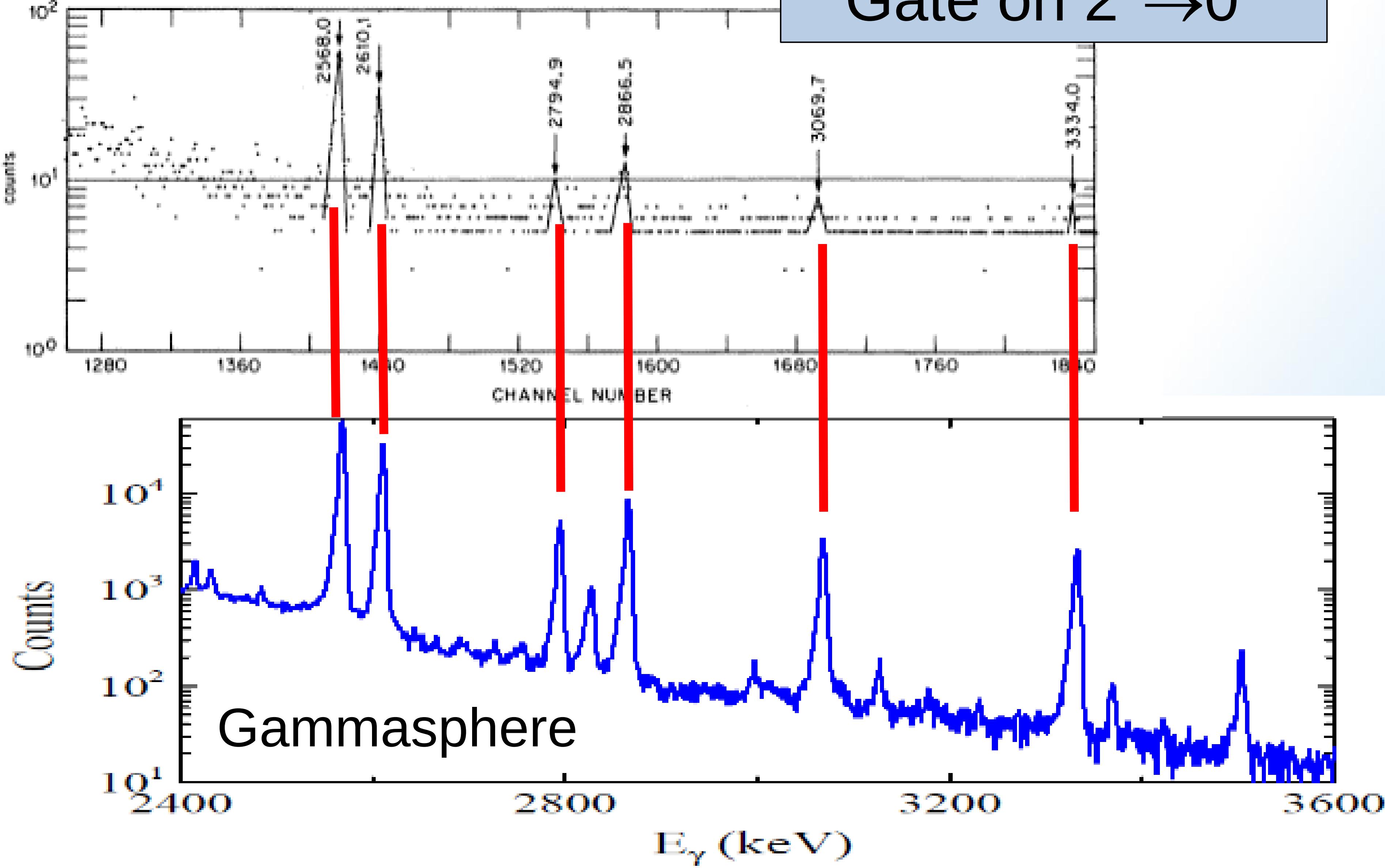
CrossMark

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

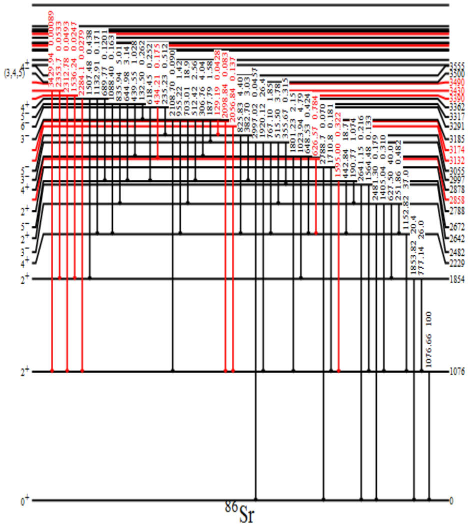
BROOKHAVEN NATIONAL LABORATORY

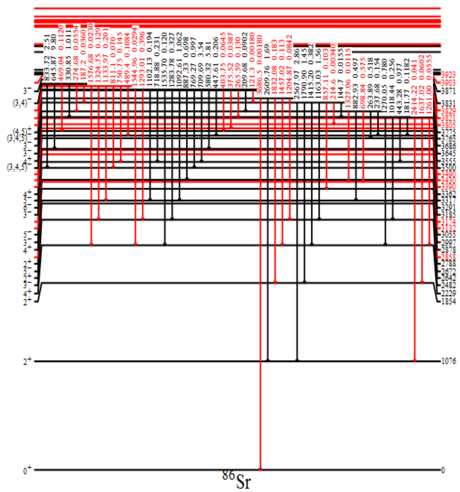
Results on ^{86}Y

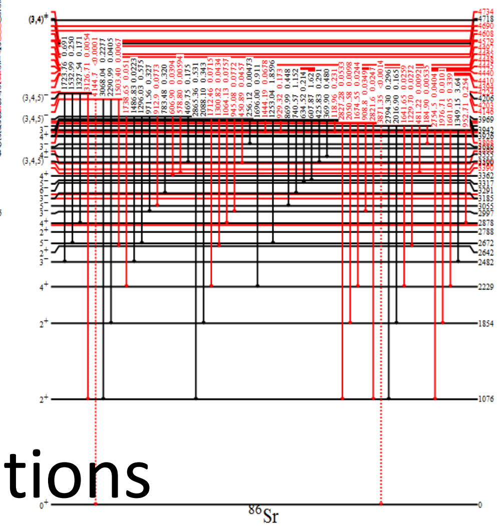
Gate on $2^+ \rightarrow 0^+$

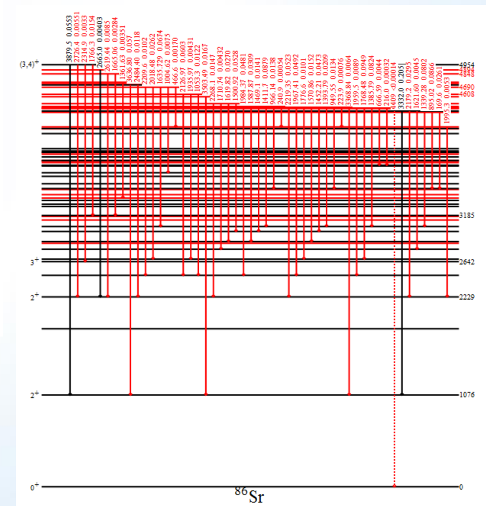


Revised Decay Scheme for ^{86}Y









Confirmed

New

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 10^{20} 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.

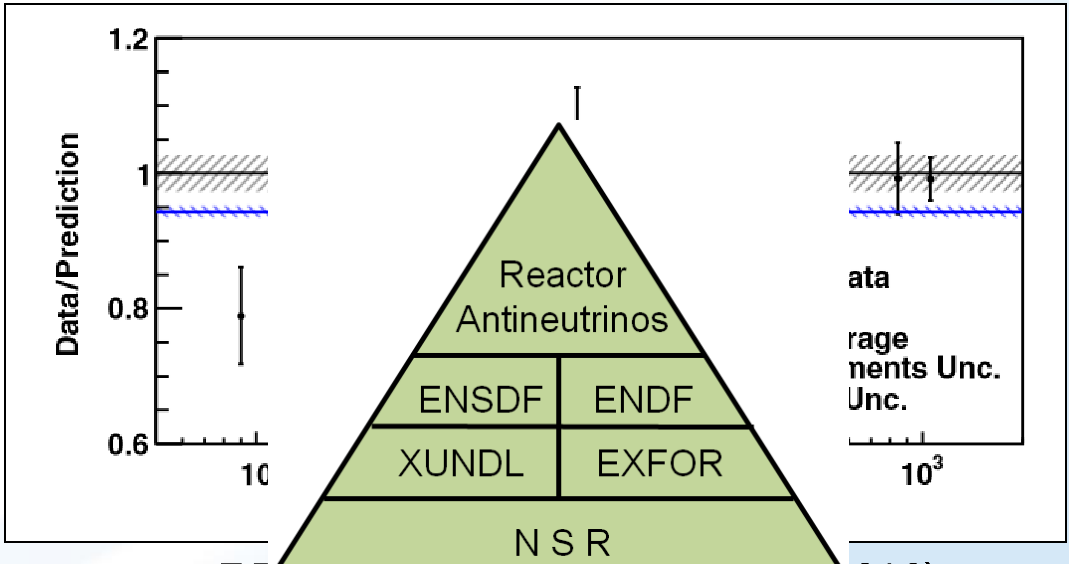

NEWS PARTICLE PHYSICS

Reactor data hint at existence of fourth neutrino

Deficit in antiparticle output exceeds theoretical expectations

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

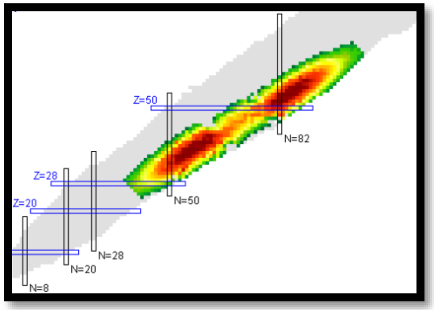
GHOST FINDER New results of experiments at the Daya Bay neutrino detector (walls lined with photomultiplier tubes, shown) hint at the existence of a lightweight sterile neutrino, about one-millionth the mass of an electron.



F.P. An *et al.*, PRL **116**, 061801 (2016).

A problem at the top of the nuclear data pyramid.

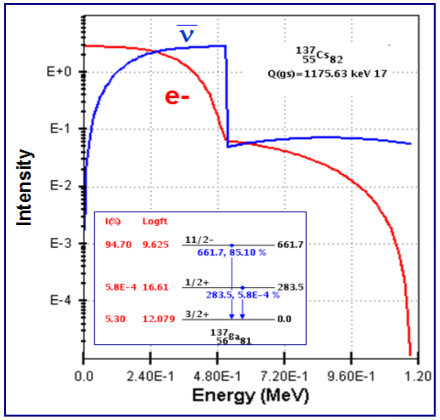
Using Our Databases

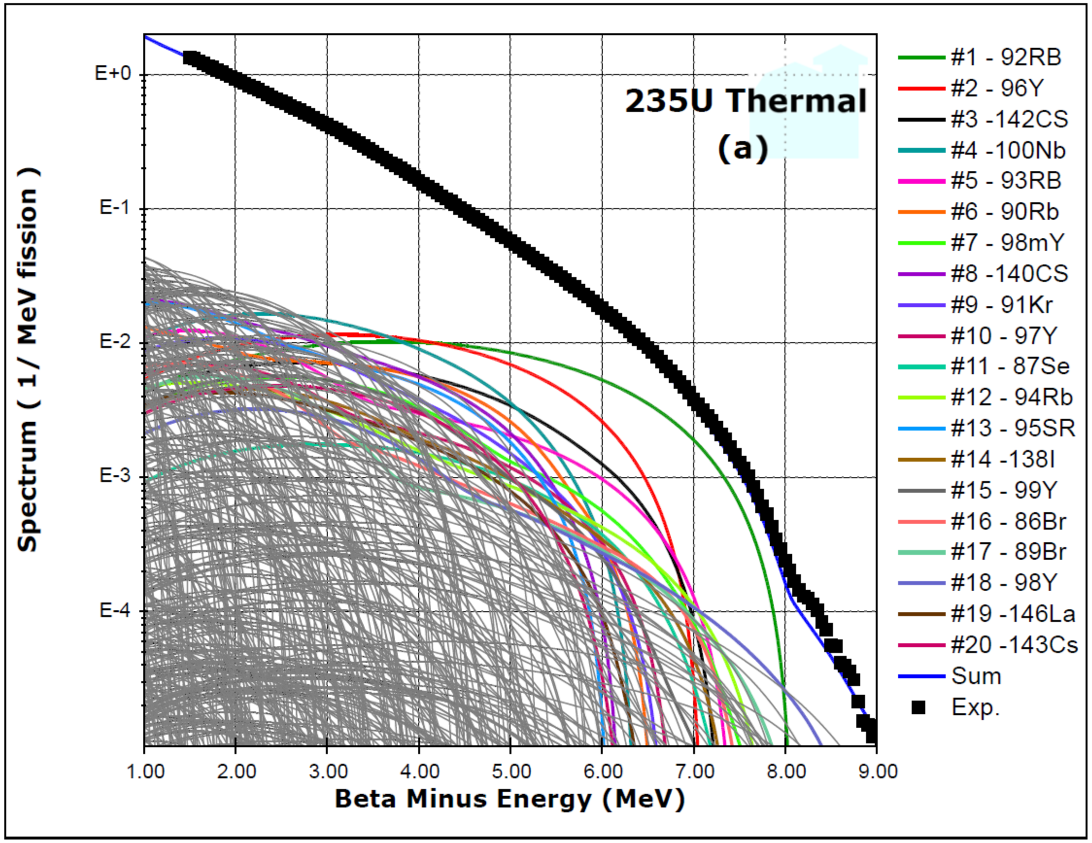


$$S(E) = \sum CFY_i S_i(E)$$

Cumulative Fission Yields

Individual Spectra





Comparison with the measured electron spectra.

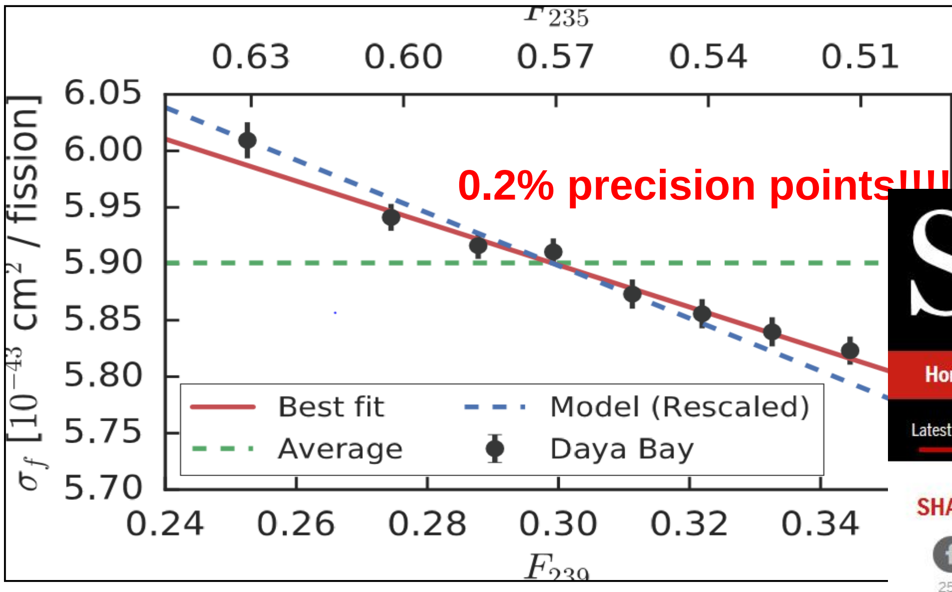
Surprisingly, fewer contributors at high energy.

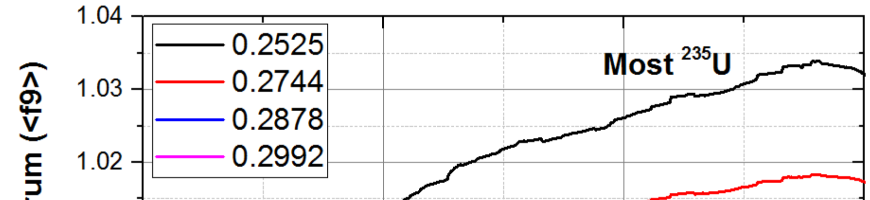
Results spurred a number of new measurements

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

A.A. Sonzogni, T.D. Johnson, E.A. McCutchan, PRC91, 011301(R) (2015)

The anomaly, or not?



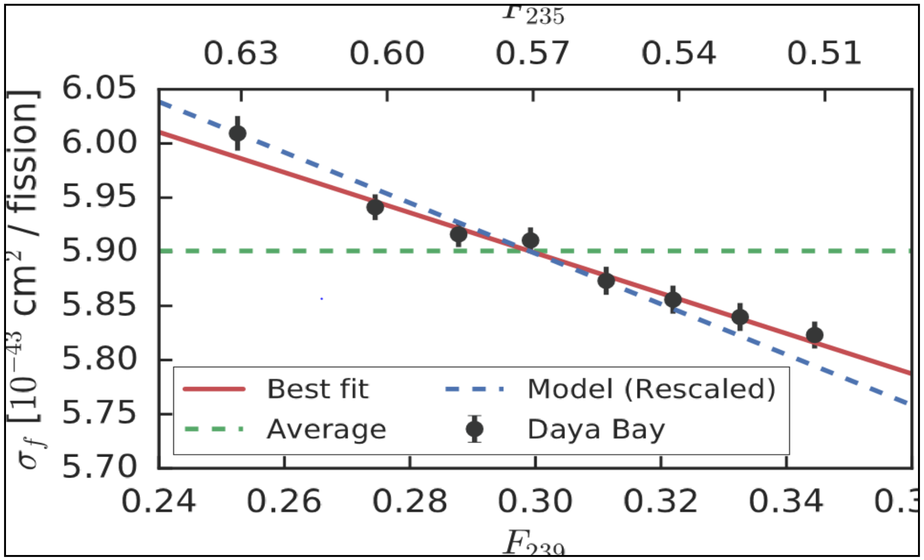


F.P. An *et al*, PRL **118**, 251801 (2017).

- 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

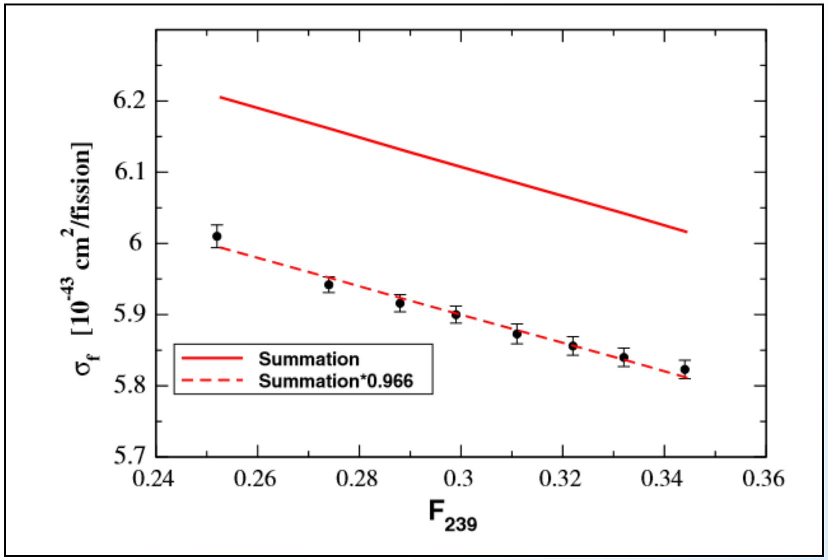
Nuclear data to answer major science question

Daya Bay Analysis
(conversion of ILL data)



Our analysis
(Incorporates vast knowledge of decay data of fission fragments)

NNDC calculations using ENDF decay



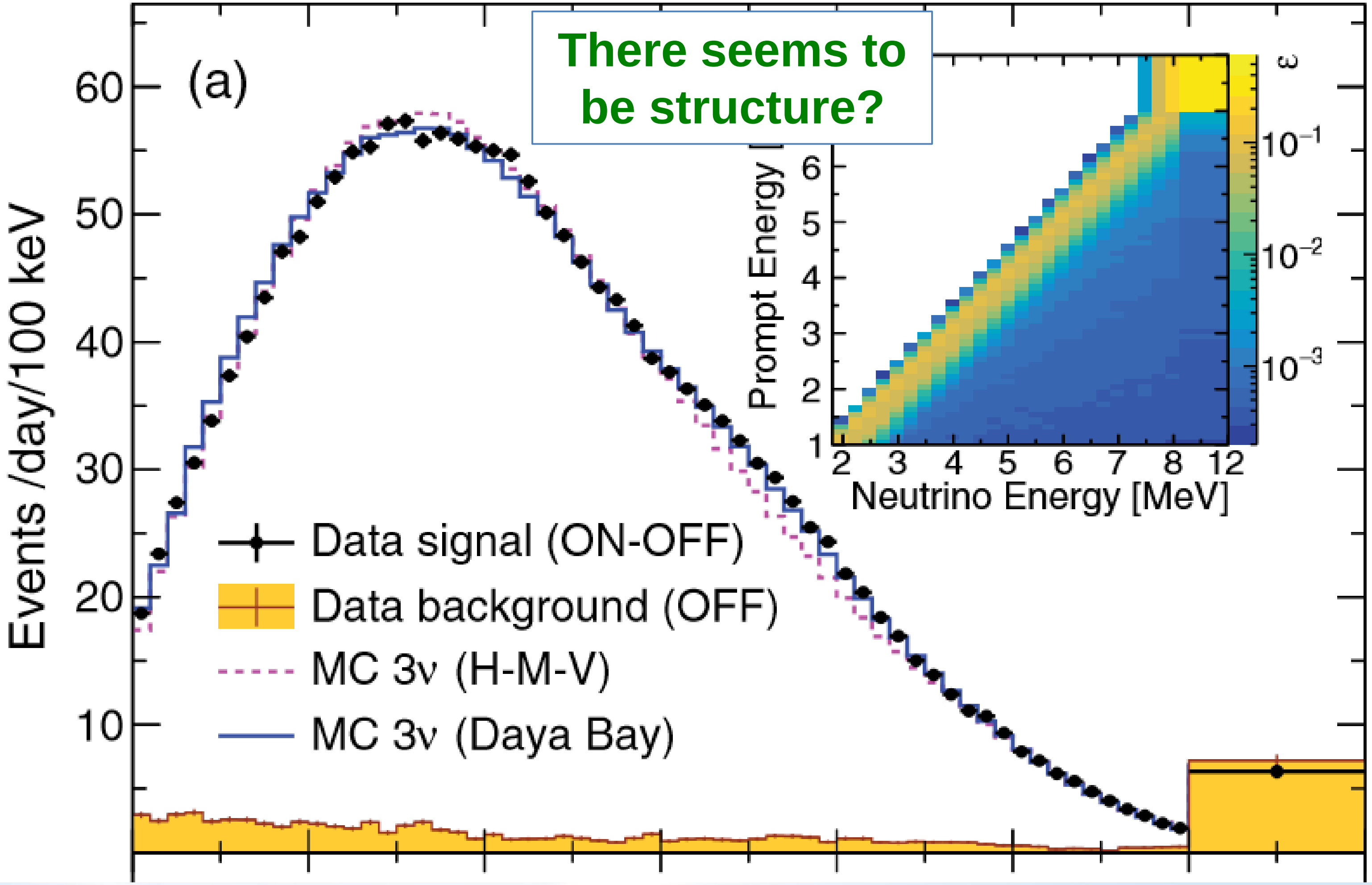
Abstract ends with:

'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.'

Bro

Fine Structure

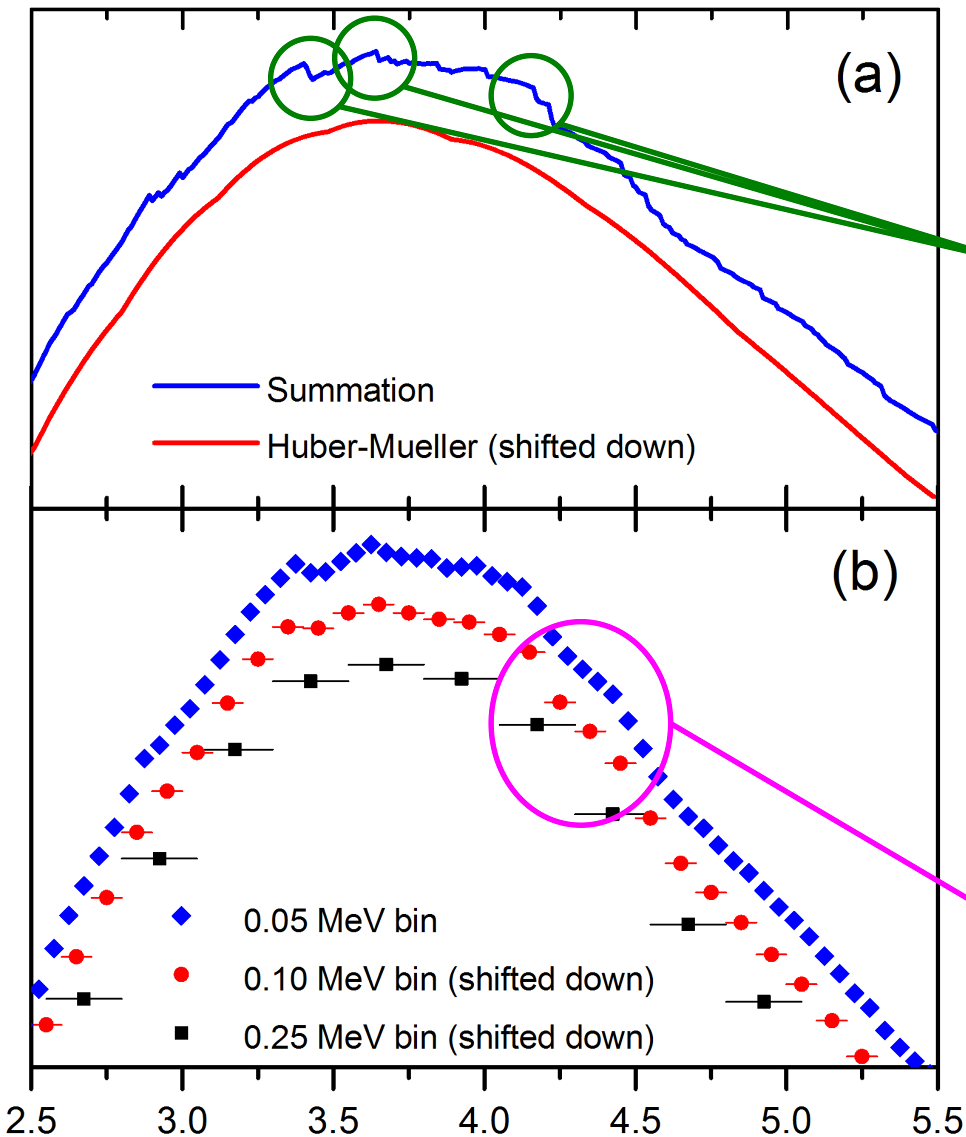
NEOS data, 30 m from a power reactor



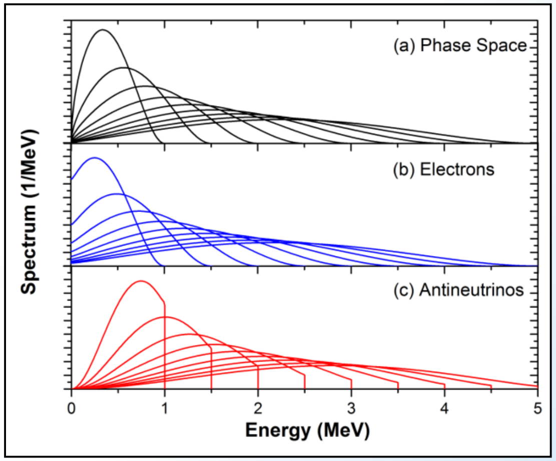
Ko et al, PRL **118**, 121802 (2017)

Fine Structure

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



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



Shoulder spanning several 100s keV

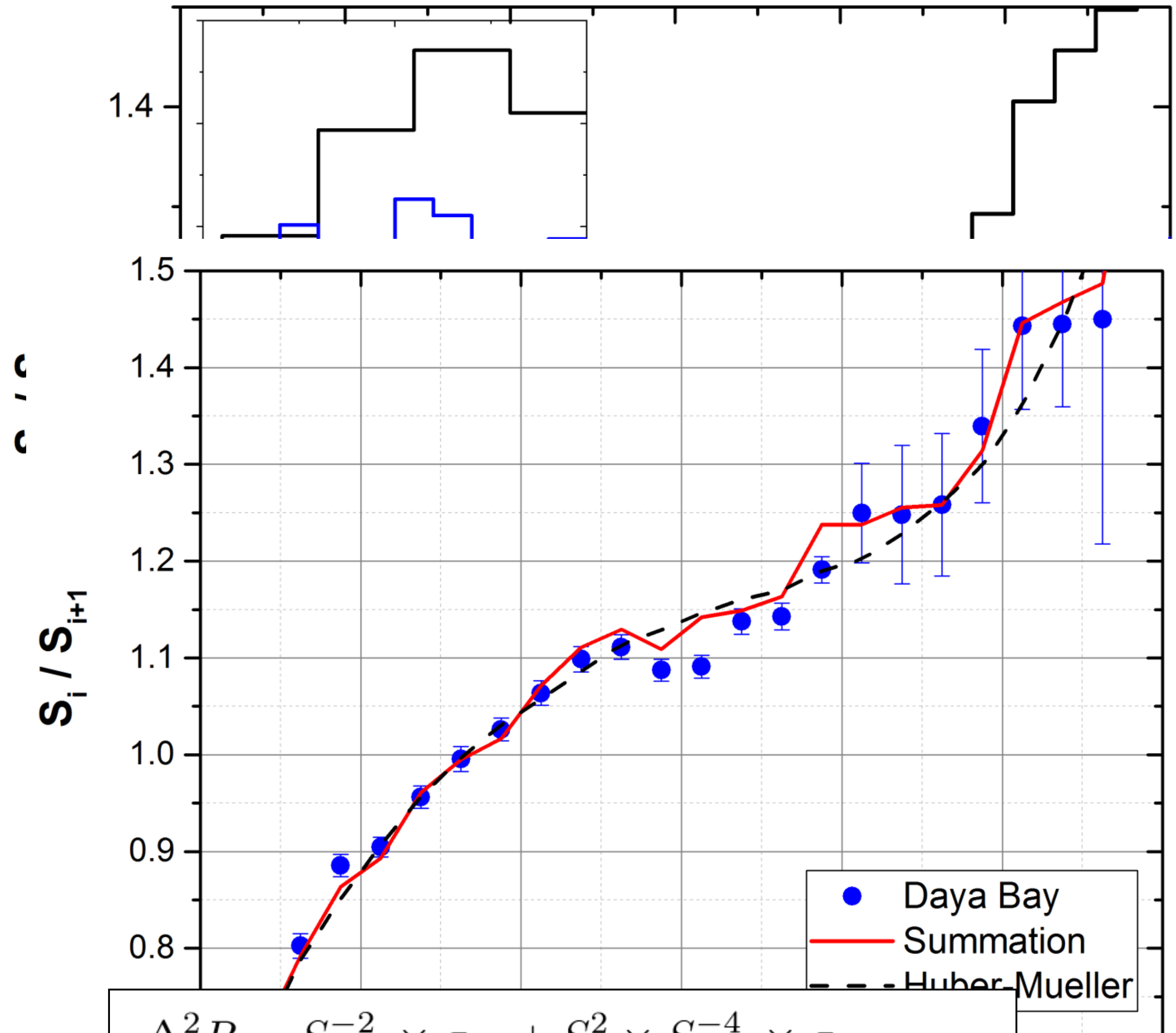
How to reveal Fine Structure?

Ratio of adjacent points:

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

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

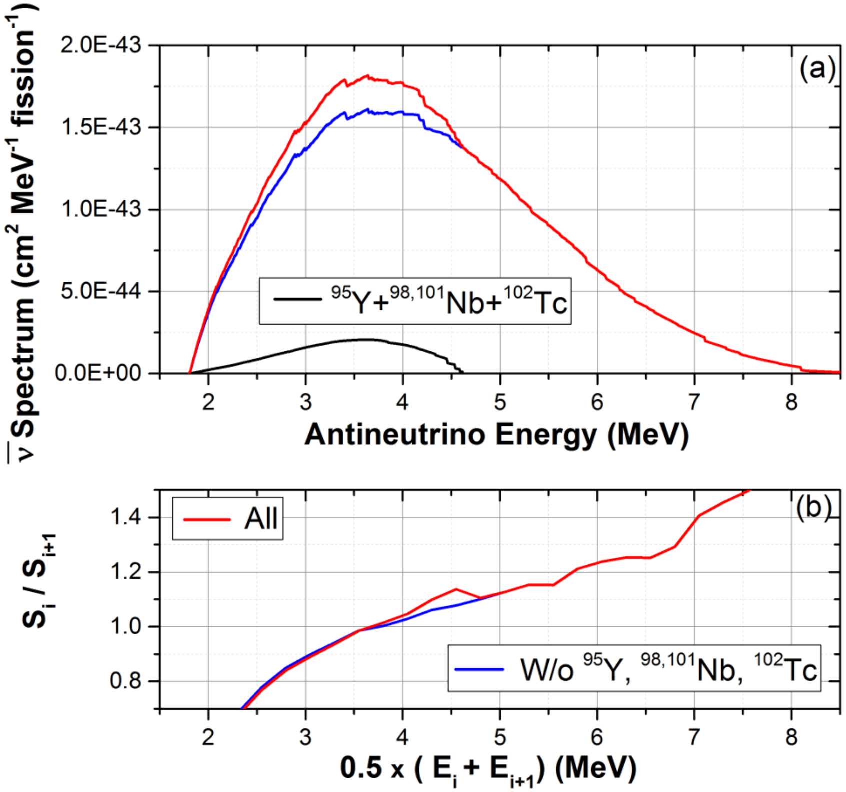
Structure observed in Daya Bay data, covariance matrix crucial for analysis.



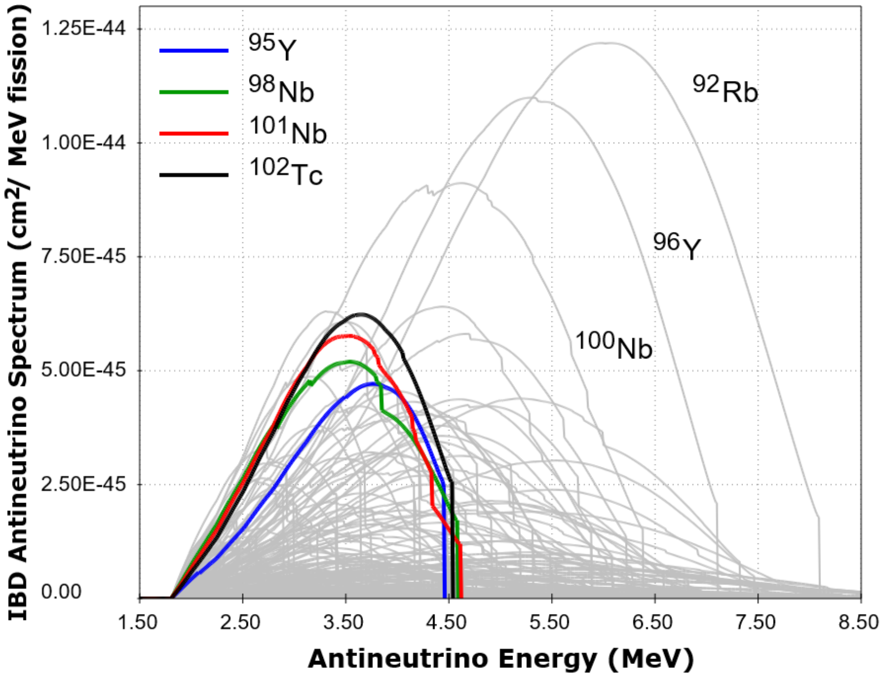
$$\Delta^2 R_i = S_{i+1}^{-2} \times \sigma_{i,i} + S_i^2 \times S_{i+1}^{-4} \times \sigma_{i+1,i+1} - 2 \times S_i \times S_{i+1}^{-3} \times \sigma_{i,i+1},$$

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

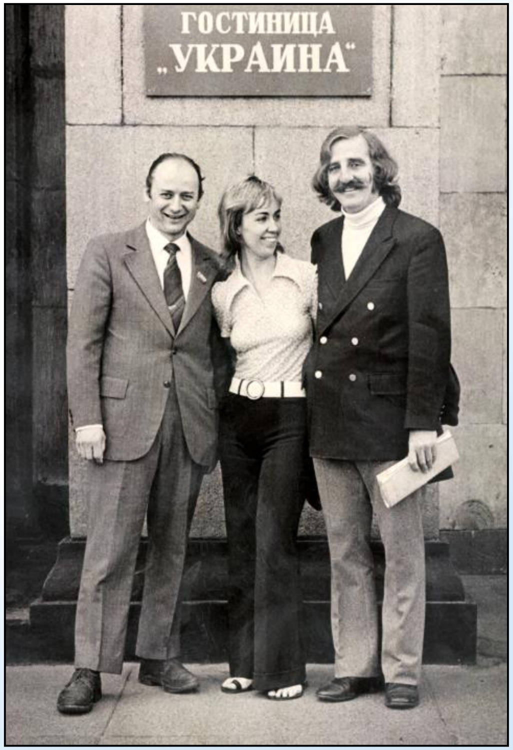
Eagerly awaiting PROSPECT data to perform similar analysis

International Collaborations

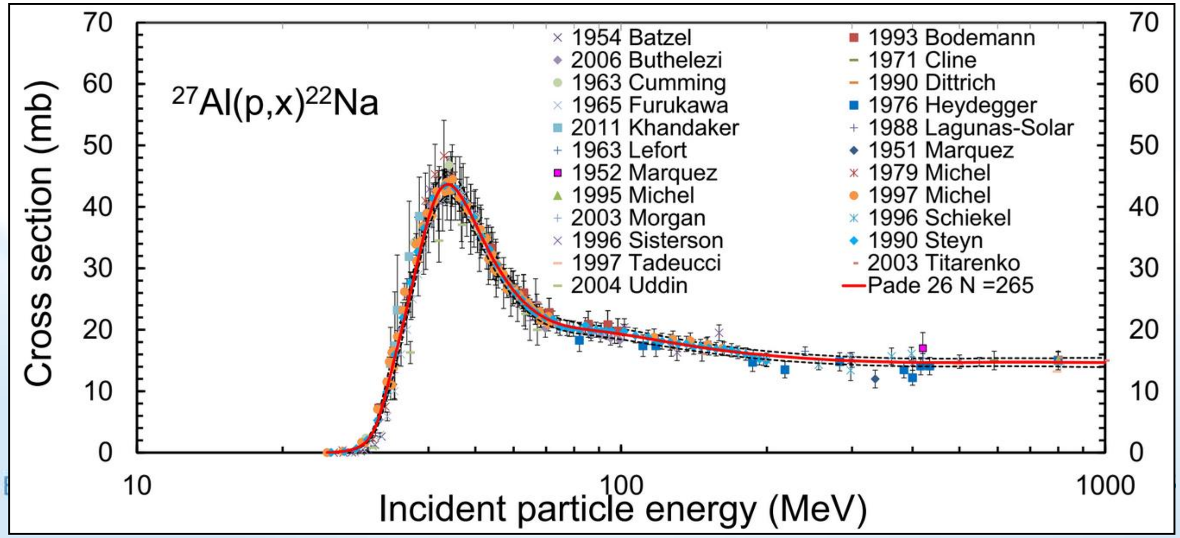
Nuclear Data Section, International Atomic Energy Agency, Vienna, Austria

- 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

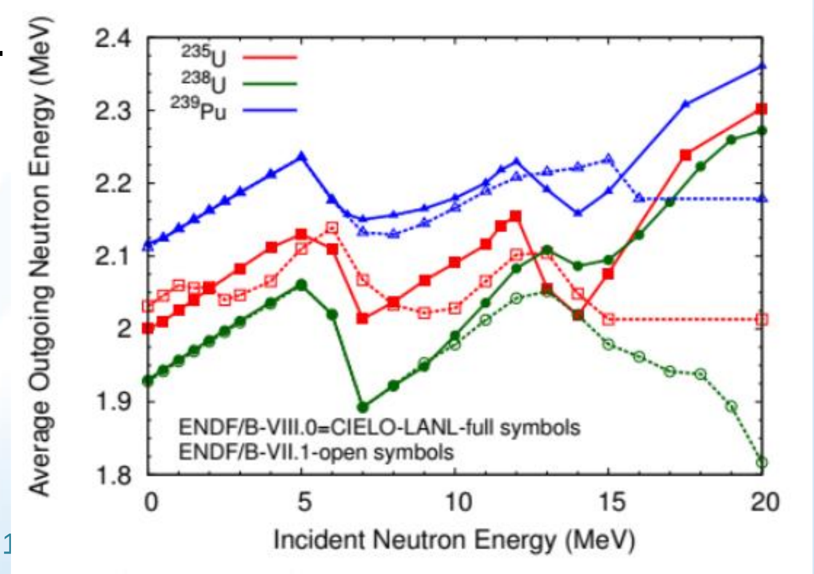
Subgroups (medium term research projects), as examples, two recent ones

- 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).

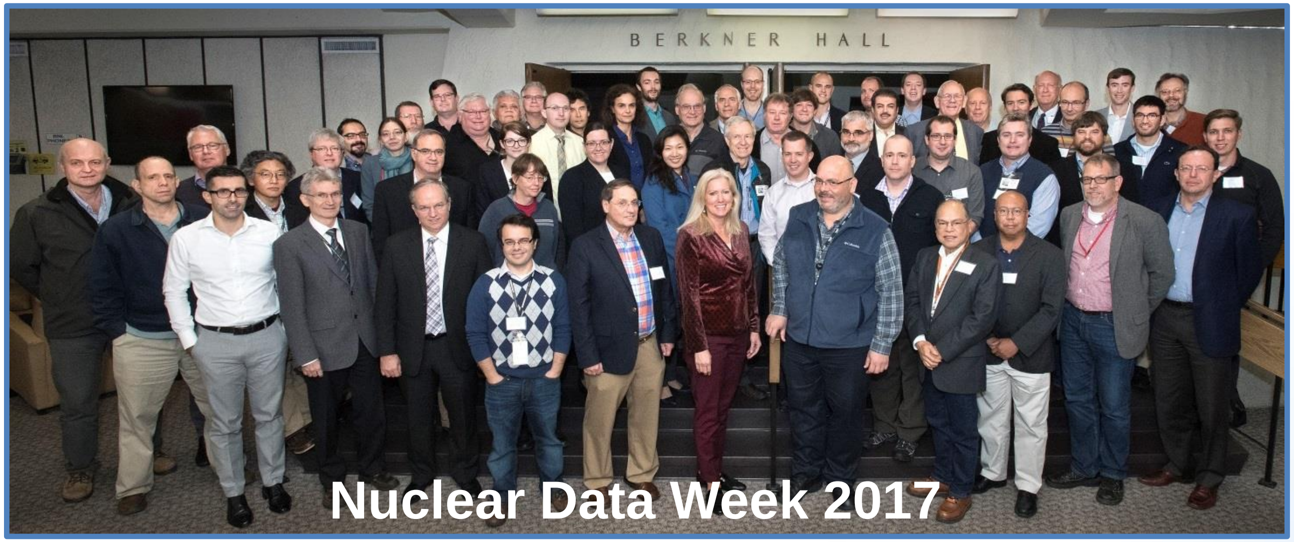


Meetings

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	
Filip Kondev	1.00

LLNL	
Ian Thompson	0.24
Sofia Quaglioni	0.01
Nicole Vash [pd](FIRE ND)	0.50
Yonglin Zhu[gs] (FIRE NCSU)	1.00

MSU	
Jun Chen	1.00
Hiro Iwasaki	0.00

NIST	
Alan Thompson	0.10
Allan Carlson[c]	0.10

BNL	
Alejandro Sonzogni	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	
Toshihiko Kawano	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	
Michael Smith	0.20
Caroline Nesaraja	1.00
Murray Martin[c]	0.15
Larry Zhang[gs]	0.20

LBNL	
Lee Bernstein	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	
Ninel Nica	0.63

TUNL	
John Kelley	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
- Boris Pritychenko
- Emil Betak
- Balraj Singh
- Joann Totans

EXFOR
- Boris Pritychenko
- Stanislav Hlavac
- Otto Schwerer

XUNDL
- Libby McCutchan
- Shamsu Basunia
- Jun Chen
- John Kelley
- Filip Kondev
- Caroline Nesaraja
- Balraj Singh

ENSDF
- Libby McCutchan
- 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
- David Brown
- Ramon Arcilla
- Allan Carlson
- Mike Herman
- Toshihiko Kawano
- Said Mughabghab
- Libby McCutchan
- Gustavo Nobre
- Sofia Quaglioni
- Alejandro Sonzogni
- Alan Thompson
- Ian Thompson

Web dissemination
- Tim Johnson
- Ramon Arcilla
- Boris Pritychenko
- Michael Smith
- Alejandro Sonzogni

Nuclear Data Sheets
- Libby McCutchan
- 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

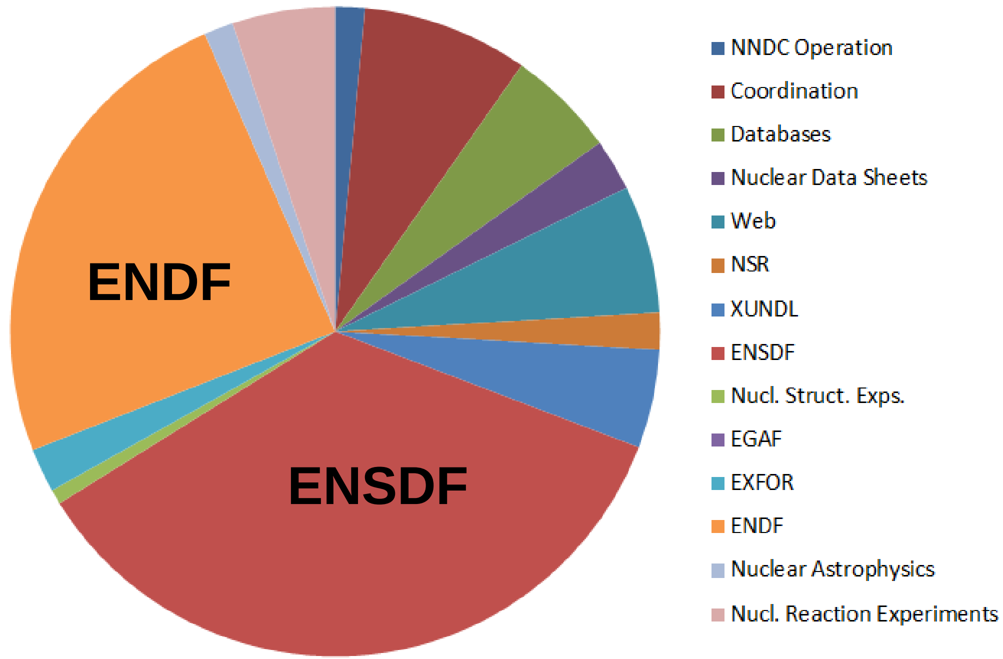
XUNDL/ENSDF/NDS: Libby McCutchan, mccutchan@bnl.gov

ENDF: David Brown, dbrown@bnl.gov

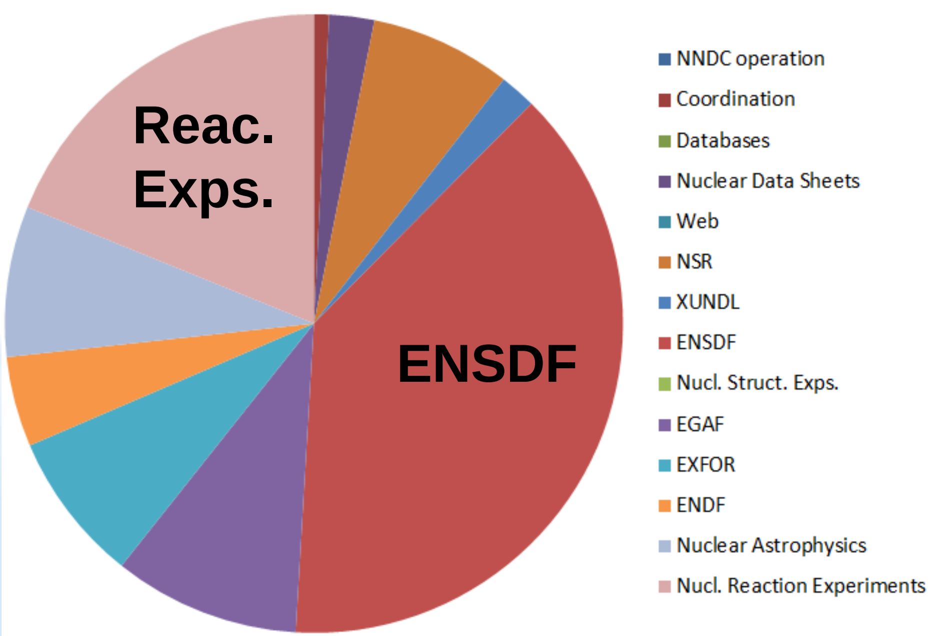
Web: Tim Johnson, tdjohnson@bnl.gov

FY2017 FTE Distribution

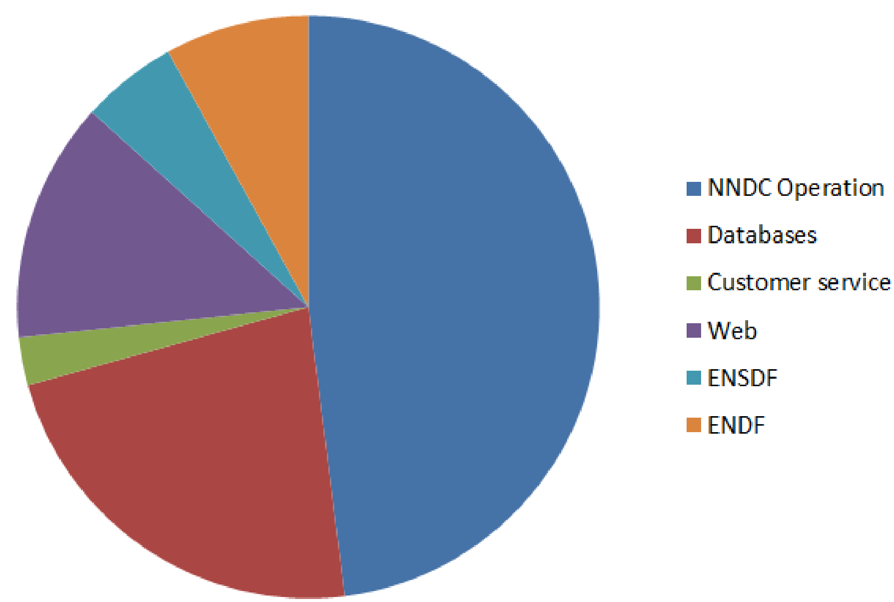
13.72 Scientific Permanent FTEs



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