NNDC report

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NNDC-BNL/USNDP funding

	FY14	FY15	FY16		
			Guidance	Proposed	%
Universities	250	250	316	266	4
ANL + MSU	400	496	498	548	8
BNL	**3,745**	**4,224**	**4,270**	**4,270**	**63**
LANL	657	657	679	679	10
LANL (Jandel)	500	500	500	500	7
LBNL + UCB	557	857	863	863	13
LLNL	133	133	134	134	2
ORNL	789	131			11
Total	**7031**	**7248**	**7260**	**7260**	

Early Career Award expires in FY16

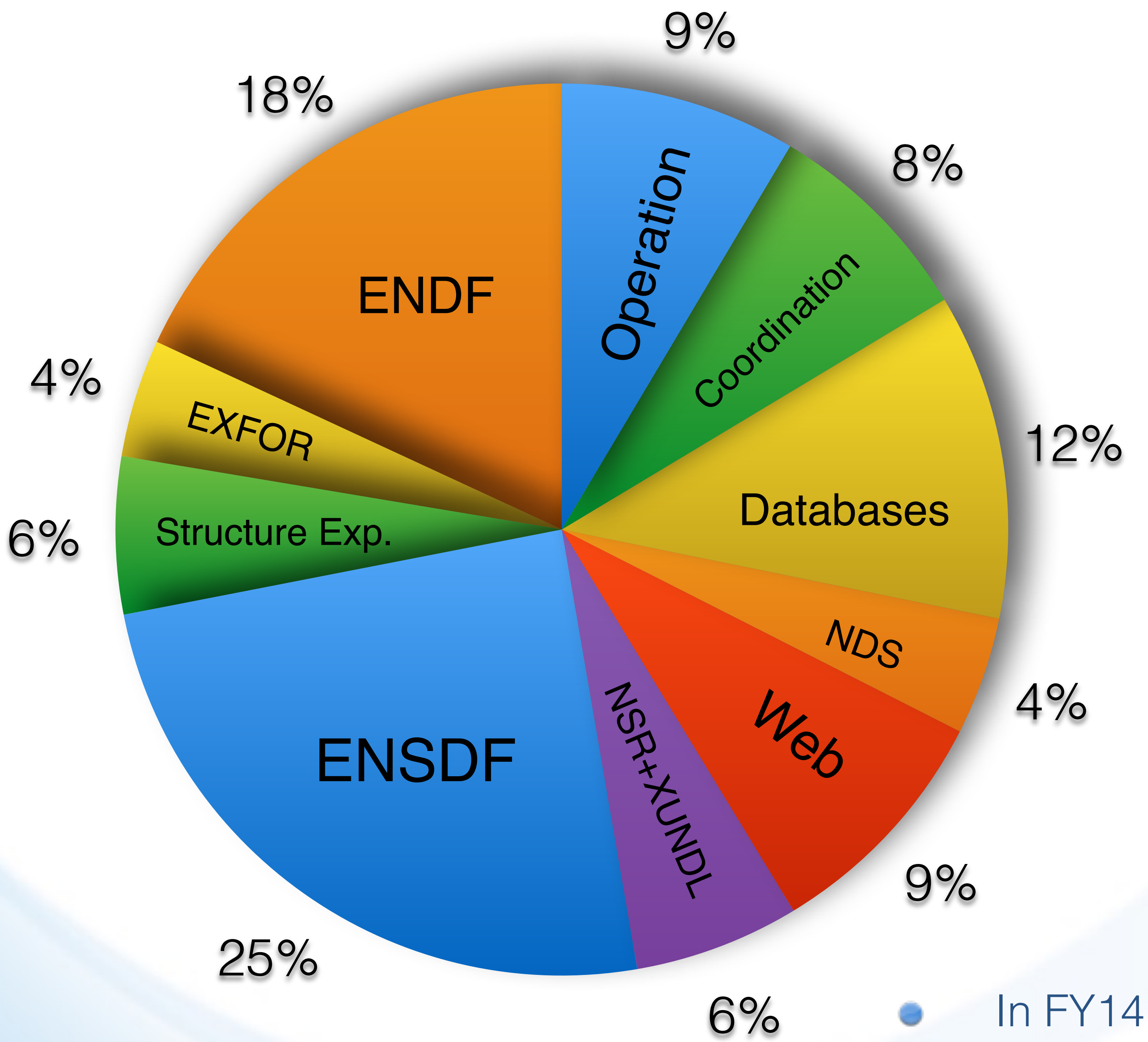
Carryover in FY15-16 % given for FY14

NNDC staff

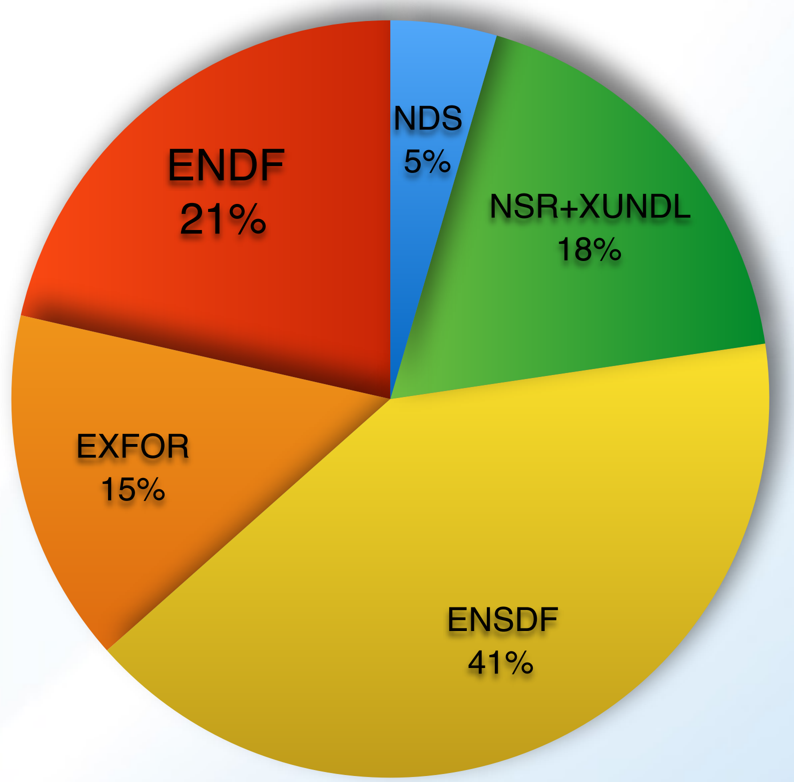
FY2015

Staff	FTE	Heads	FTE-NCSP
Permanent	7.02	8	0.30
Postdoc	0.71	0	0.00
Professional	2.82	3	0.18
Contractors	2.60	8	
Total	13.15	19	0.48

Ph. D. Permanent 7.02



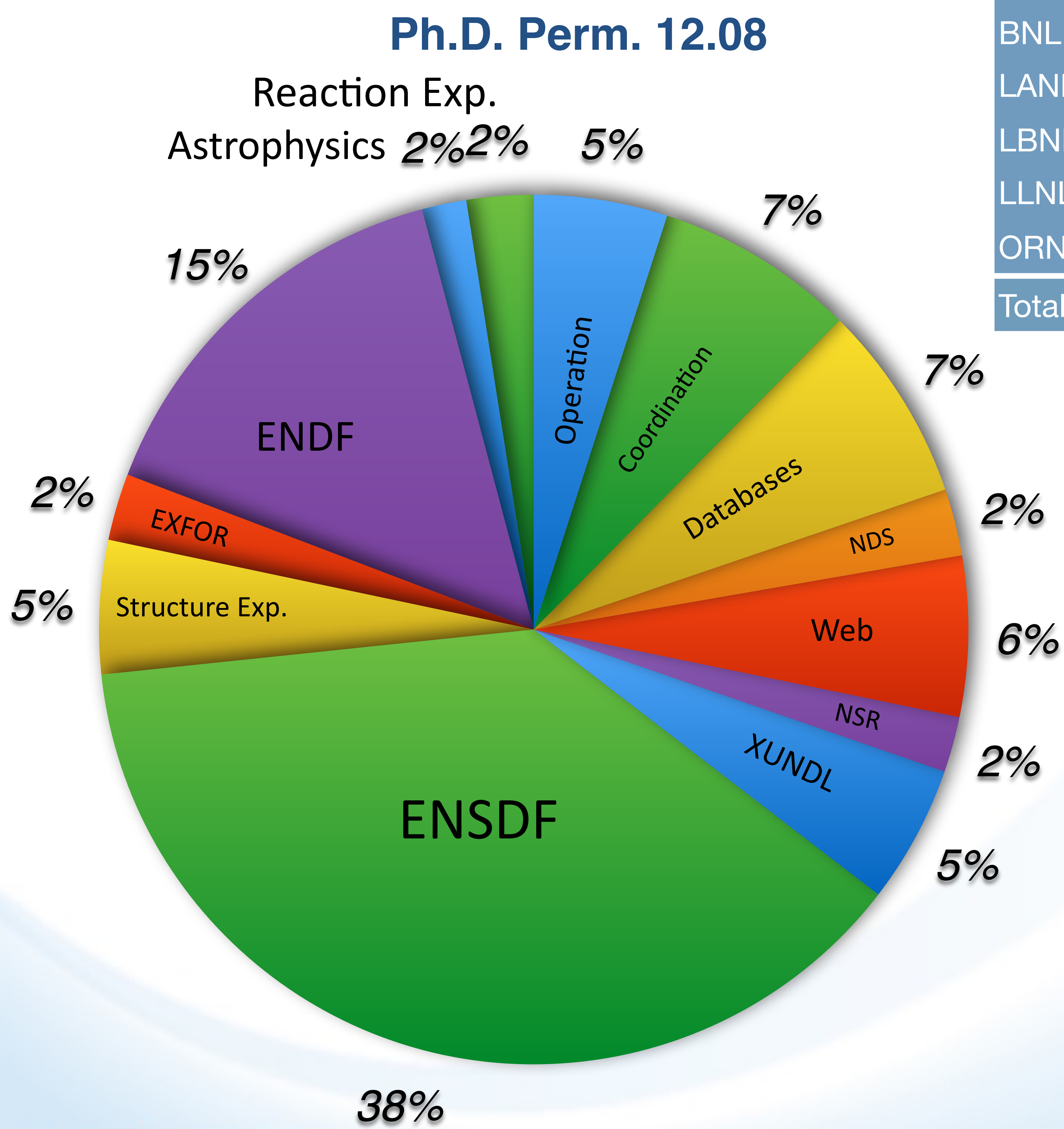
Ph. D. Temp. 3.31
postdoc + contractors

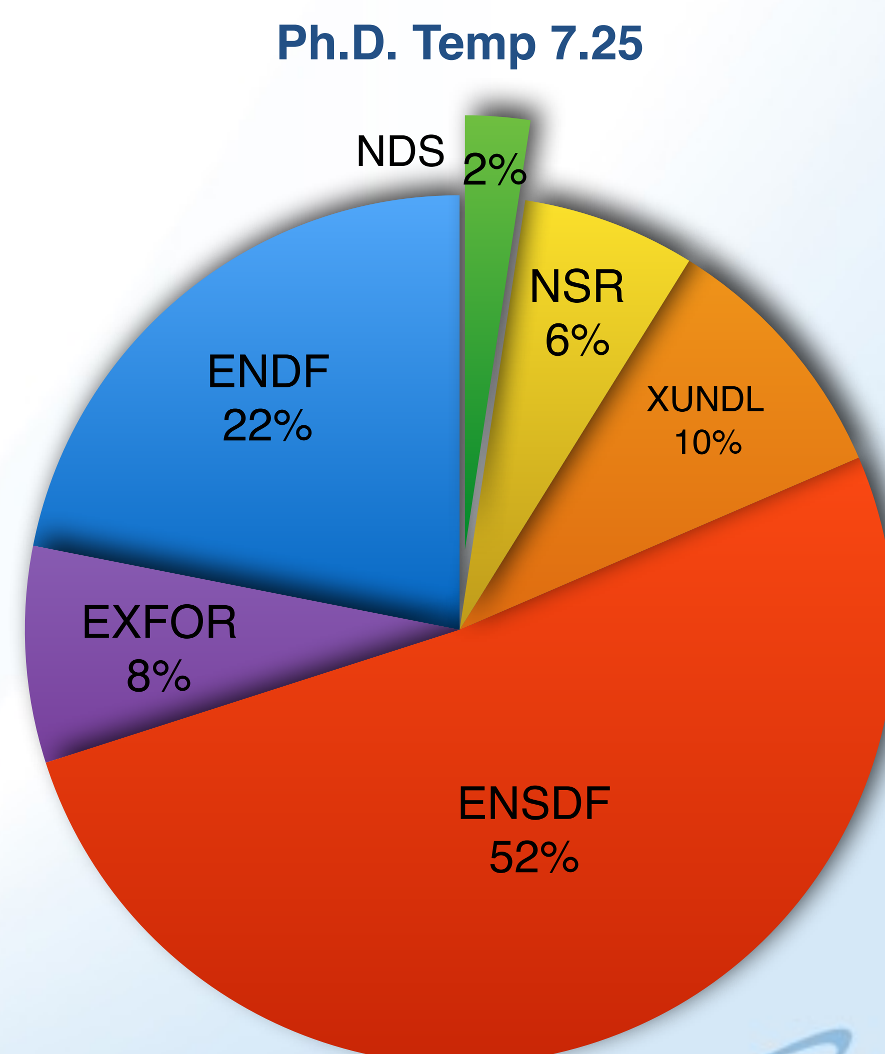


- In FY14 NNDC lost 1 postdoc
- In FY15 NNDC lost 1 postdoc & 1 prof.

USNDP staff

	USNDP FTE FY2015		
	Ph.D.	Ph.D. Temp.	Prof.
Universities	0.85	0.60	0.75
ANL	0.80	1.00	
BNL	7.02	3.31	2.82
LANL	1.10	0.15	
LBNL	1.00	2.03	
LLNL	0.11	0.01	
ORNL	1.20	0.15	0.10
Total	12.08	7.25	3.67





Performance metrics

Laboratory	Compilations		Evaluations		Dissemination (in thousands)		Reports		Papers		Invited Talks	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
ANL + MSU	8	110	0	27	40	60	0	0	26	37	5	3
BNL	3,617	4,605	117	214	3,269	3,972	3	3	30	16	30	15
LANL	-	-	12	0	-	-	1	2	17	22	21	17
LBNL + UCB	30	45	15	12	-	-	0	0	8	15	6	9
LLNL	-	-	0	0	6	0	0	2	1	0	1	0
ORNL	30	28	16	7	88	120	0	1	9	4	13	6
Universities	53	61	6	11	107	94	1	4	12	4	1	0
Total	3,738	4,849	166	271	3,411	4,246	7	12	107	98	81	50

Generally, very good year with substantial increase in number of compilations, evaluations and retrievals. Statistically insignificant decrease in published papers and 40% decrease in invited talks.

NNDC functions

- Dissemination (Web services, retrieval tools, databases, cyber-security)
- Archival (backup of ND libraries)
- Database management (NSR, EXFOR, XUNDL, ENSDF, ENDF)
- QA (ENDF verification & validation)
- Traditional library (~120 requests/year)
- ND formats (maintenance and development (GND))
- Computation facility (180-CPU cluster - EMPIRE calculations, covariances, ENDF validation)
- GForge server

- ENSDF (evaluation, coordination, management)
- ENDF (evaluation, coordination, management)
- NSR (compilation, coordination, management)
- EXFOR compilation
- XUNDL (compilation, coordination, management)
- Reaction code development EMPIRE
- ND targeted experiments
- Cooperation with BLIP
- Nuclear Data Sheets (editorial and management)
- National & international coordination (USNDP, CSEWG, WPEC, NRDC, NSDD, INDC)

NNDC unique responsibilities (in US)

- Dissemination (Web services, retrieval tools, databases, cyber-security)
- Archival (securing ND libraries)
- Database management (NSR, EXFOR, XUNDL, ENSDF, ENDF)
- QA (ENDF verification & validation)
- Traditional library (~120 requests/year)
- ND formats (maintenance and development (GND))
- Computation facility (180-CPU cluster - EMPIRE calculations, covariances, ENDF validation)
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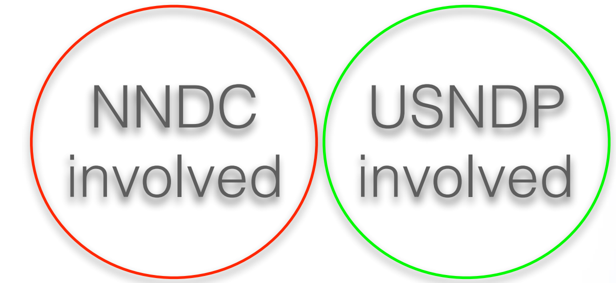
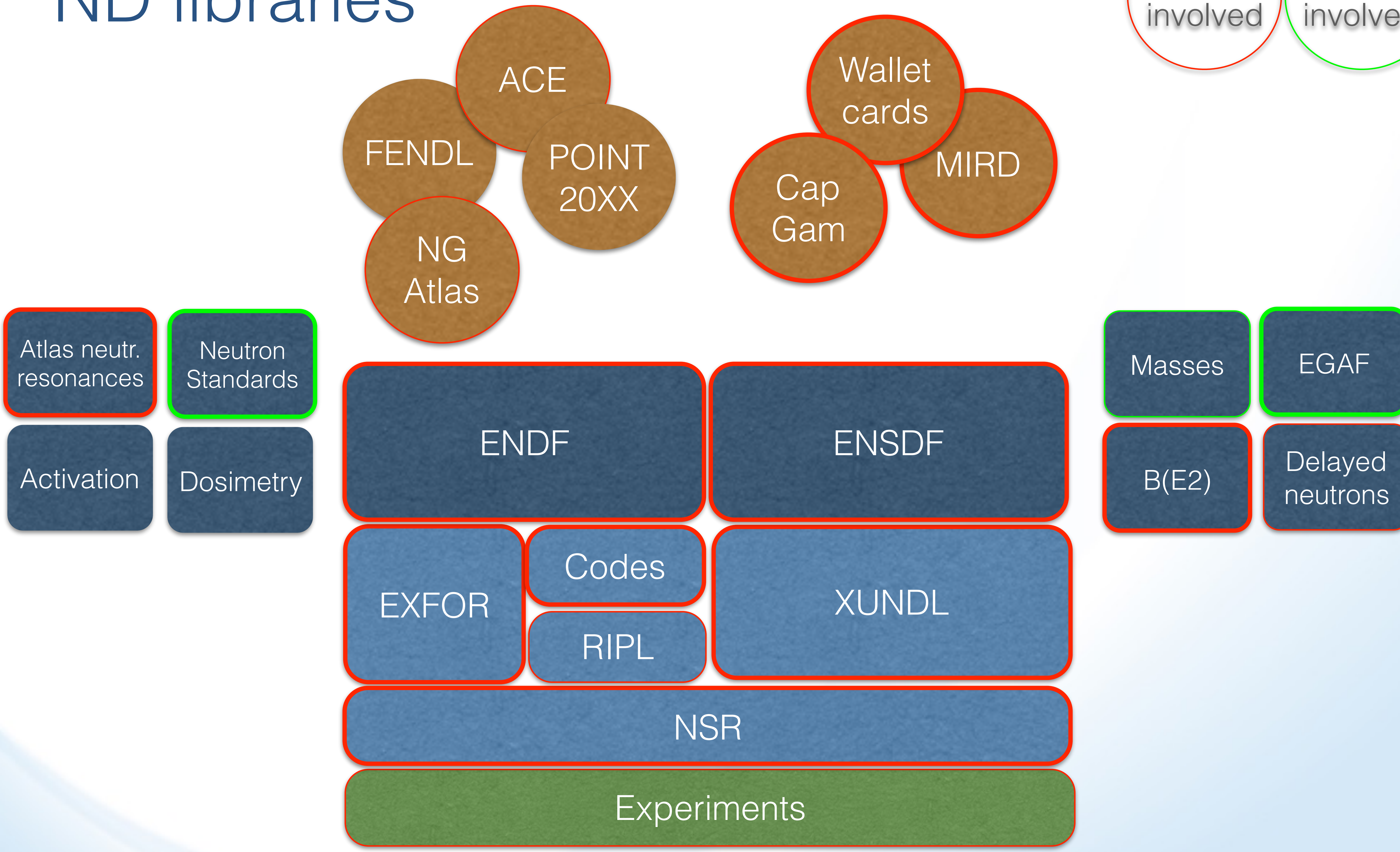
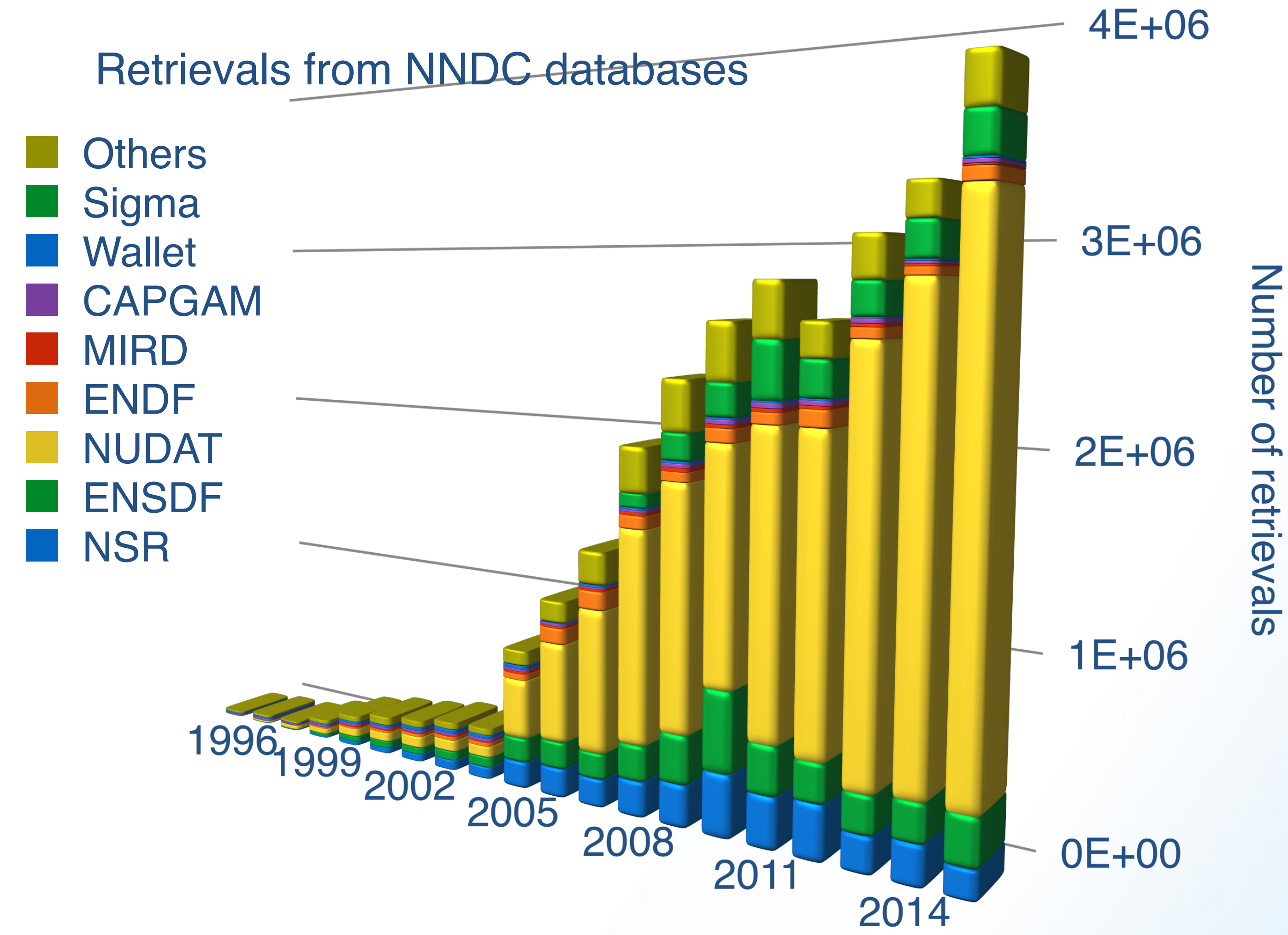
- ENSDF (evaluation, coordination, management)
- ENDF (evaluation, coordination, management)
- NSR (compilation, coordination, management)
- EXFOR compilation
- XUNDL (compilation, coordination, management)
- Reaction code development EMPIRE
- ND targeted experiments
- Cooperation with BLIP
- Nuclear Data Sheets (editing, preparing camera ready NDS volumes)
- National & international coordination (USNDP, CSEWG, WPEC, NRDC, NSDD, INDC)

ND libraries





Preamble to highlights

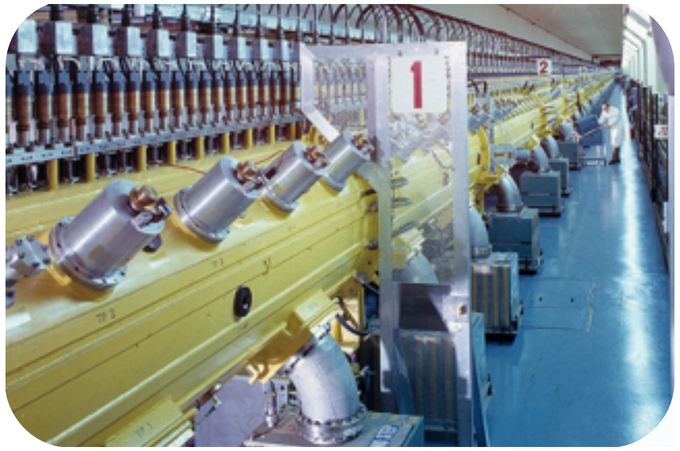


NNDC is like an utility company - everyone takes it for granted until there is no power in the outlet.

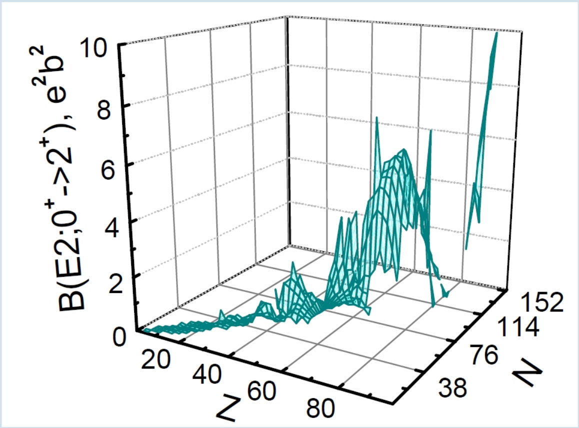
Most of the NNDC effort, and funding, goes towards USNDP mission goals - compilation, evaluation, and dissemination.

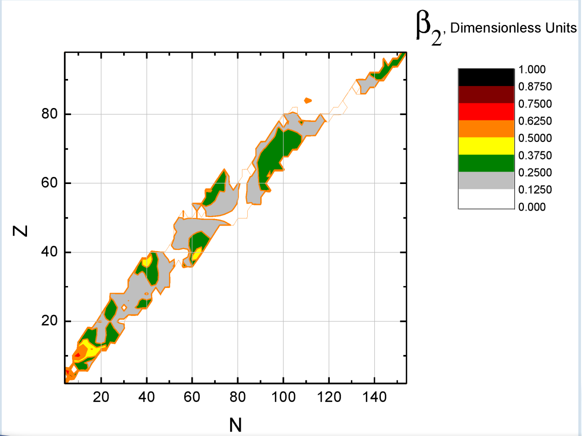
The highlights on the next viewgraph represent relatively small part of the NNDC funding and effort. These activities take advantage of our closeness to ND databases to make significant impact on basic science and applications.

FY2015 highlights

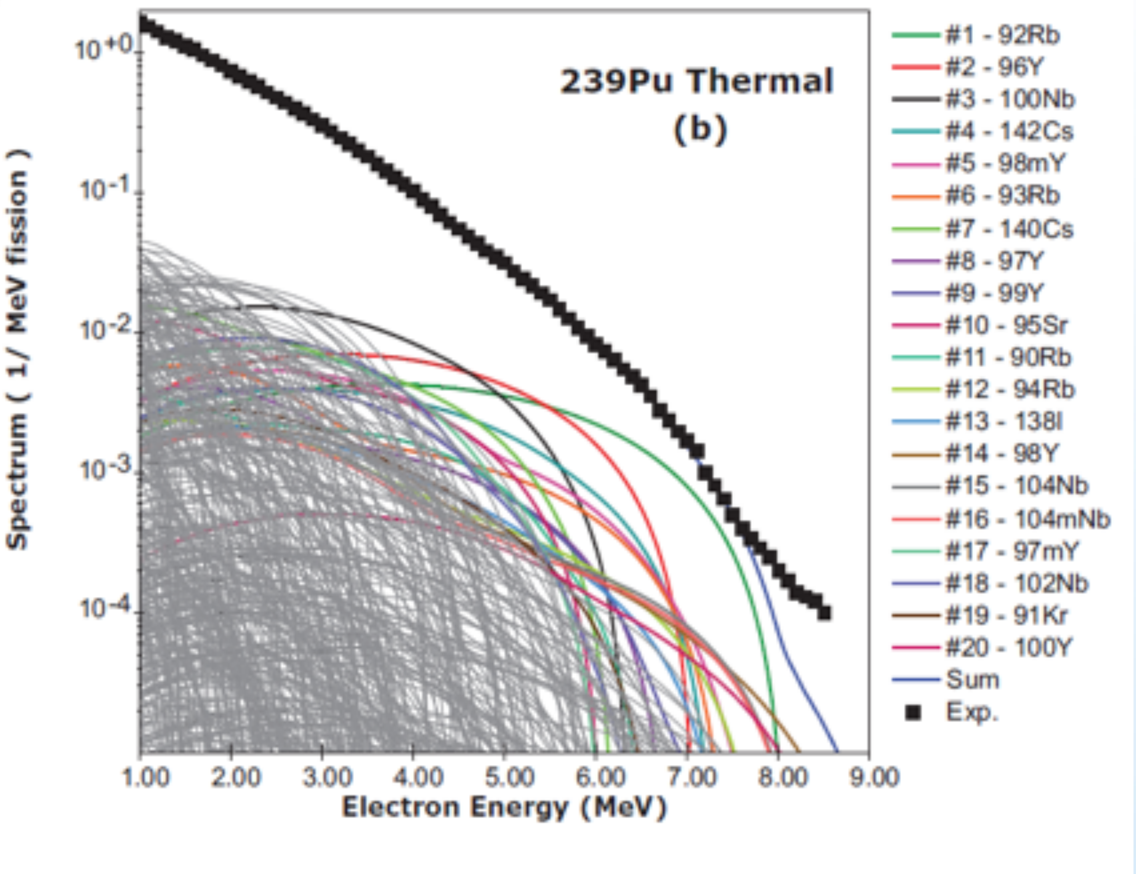


Collaboration with BLIP to address data needs relating to medical isotope production and dosimetry





Evaluated 2+ state energies, B(E2)↑ values, τ and β_2
447 even-even nuclei vs. 328 in Raman 2001.
Accepted for Atomic Data and Nuclear Data Tables in 2015



Calculations of antineutrino spectra published in Phys. Rev. C stimulated DOE funded experiment at ORNL

Concern

- Viability of operation of the NNDC - risk of breaking the vital chain:
  compilation => evaluation => archival => dissemination

Challenge

- Modernization of Web services and USNDP infrastructure

Opportunities

- Reactor anti-neutrino spectra; fission product yields
- Neutron resonance evaluation capability
  (see D. Brown, reaction physics session)
- Isotope production - collaboration with BLIP
  (see this morning talk by E. McCutchan)

Concern: Viability of operation of the NNDC

- Over last 2 years NNDC lost 3 FTE (2 postdocs and 1 professional)
- 18 data center functions,mentioned before, are covered by 12 staff members
- Loss of any staff position puts in jeopardy at least two data center functions (16 out of 18 are either unique to the NNDC or indispensable for the data center, e.g., dissemination)
- There is zero redundancy at the NNDC

Any further loss of staff would have disastrous consequences

Concern: Viability of operation of the NNDC

NNDC is striving to cut costs of operation

- use of contractors (compilation, structure evaluation, NDS editing) - estimated saving ~$1,000K/y
- use of students at Lowell Univ. to process results of BLIP experiments
- hosting summer students (4 in FY2015)
- cost free Atlas of Neutron Resonances (Said Mughabghab)
- support from the Department (~100K from organizational burden in FY2015)

Challenge: programming support at NNDC

NNDC Web services, designed over 10 years ago, have served us well but need modernization.

Modern Web services

- use technology not available a decade ago
  - multimedia
  - single-page Web apps
  - CSS frameworks
  - SVG + JavaScript on Canvas …
- are mobile friendly
- require time consuming maintenance of cyber-security standards

USNDP codes need maintenance and some need to be rewritten.

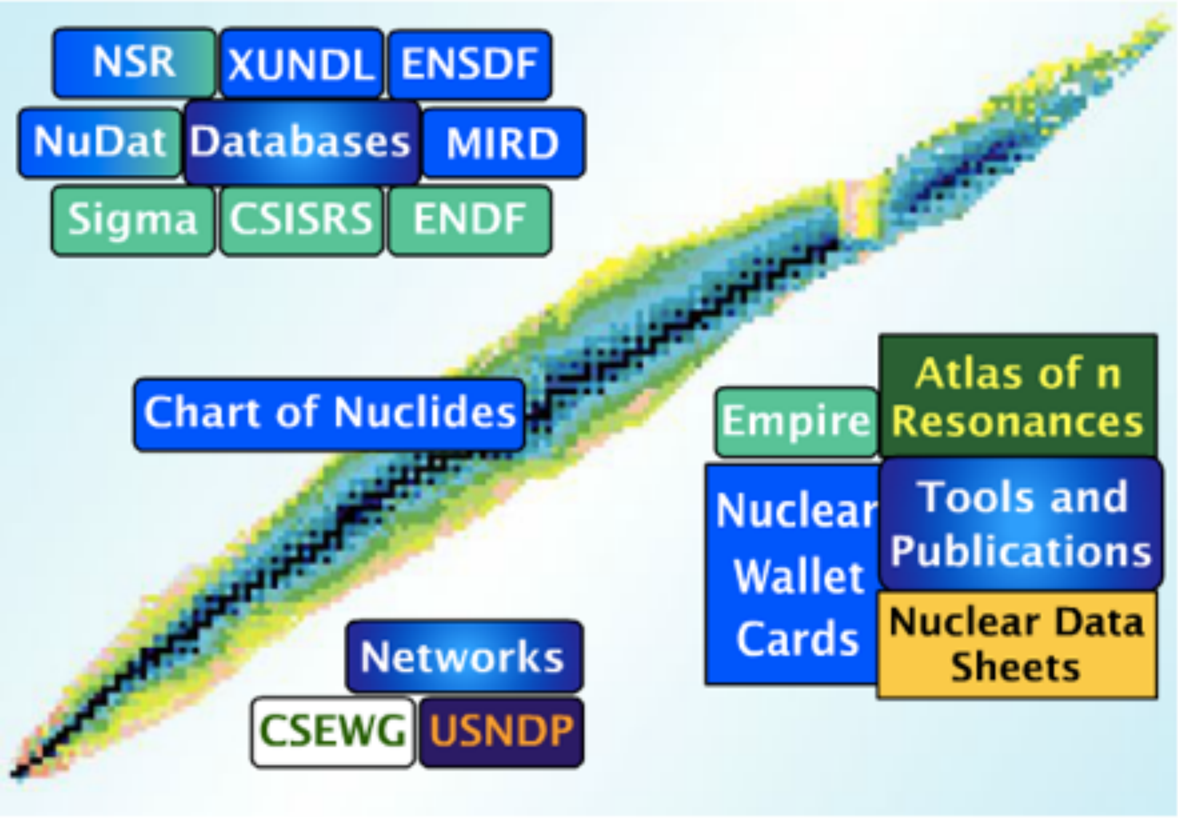
New data structure (format) will require additional programming effort

All software development and maintenance is done by Ph.D. physicists that reduces skilled personnel available for evaluation.

USNDP Review Panel:
The current infrastructure for ENDF and ENSDF is antiquated and limits capabilities of potential users. Options were presented for updating these databases, and should be pursued in order to provide enhanced capabilities to the user communities.

Strengthening programming support at NNDC

- Major upgrade of the Web services
  - look and feel
  - content management system
  - user oriented retrieval in addition to data driven (e.g., isotope production, medical, first responders, …
  - horizontal retrievals
  - cross-libraries retrievals
  - simplified access for educational purposes and general public
  - mobile accessible
  - video-based help system

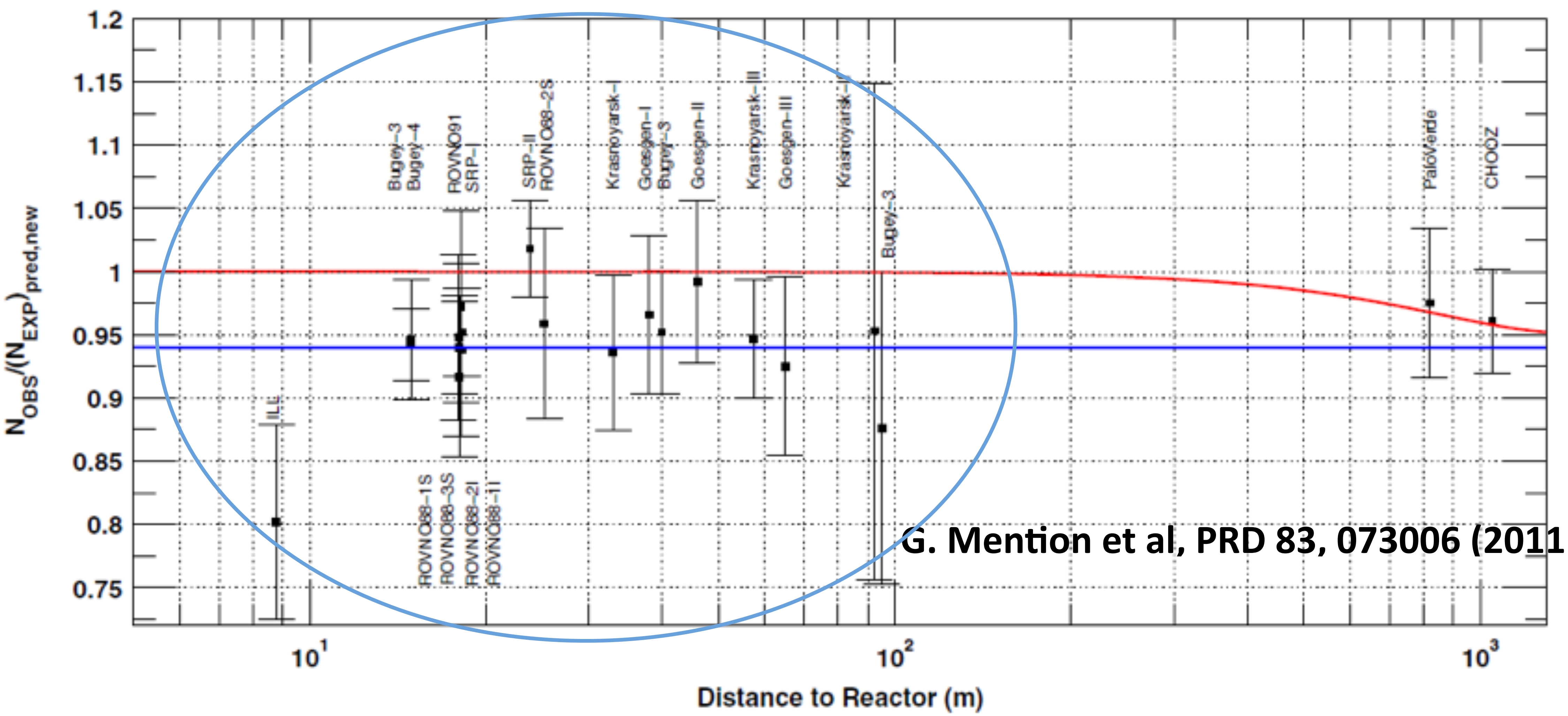


NNDC needs to catch up with advancing technology to maintain its position of the leading nuclear data center.

- Side benefits
  - recovery of the evaluators manpower
  - better integration of the USNDP

Opportunity: Two puzzles in reactor antineutrino experiments

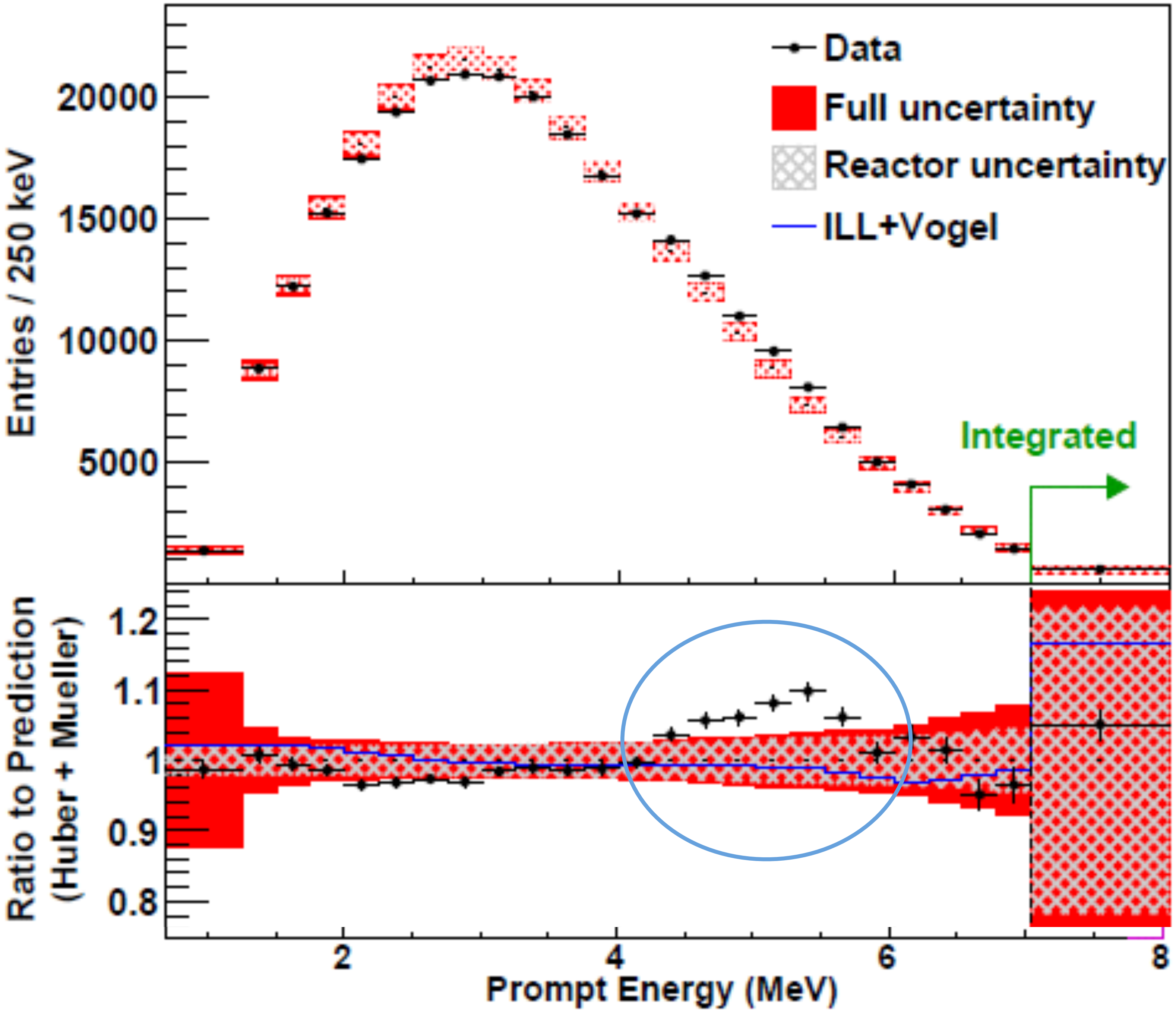
1) Fewer antineutrinos than expected at short distance (Reactor antineutrino Anomaly)



Potential for new physics including 4th neutrino

Million dollar detectors are being built to further investigate

2) An excess of antineutrinos at 5.5 MeV observed in all the three current nuclear power reactor experiments, Daya Bay, Double Chooz and RENO.



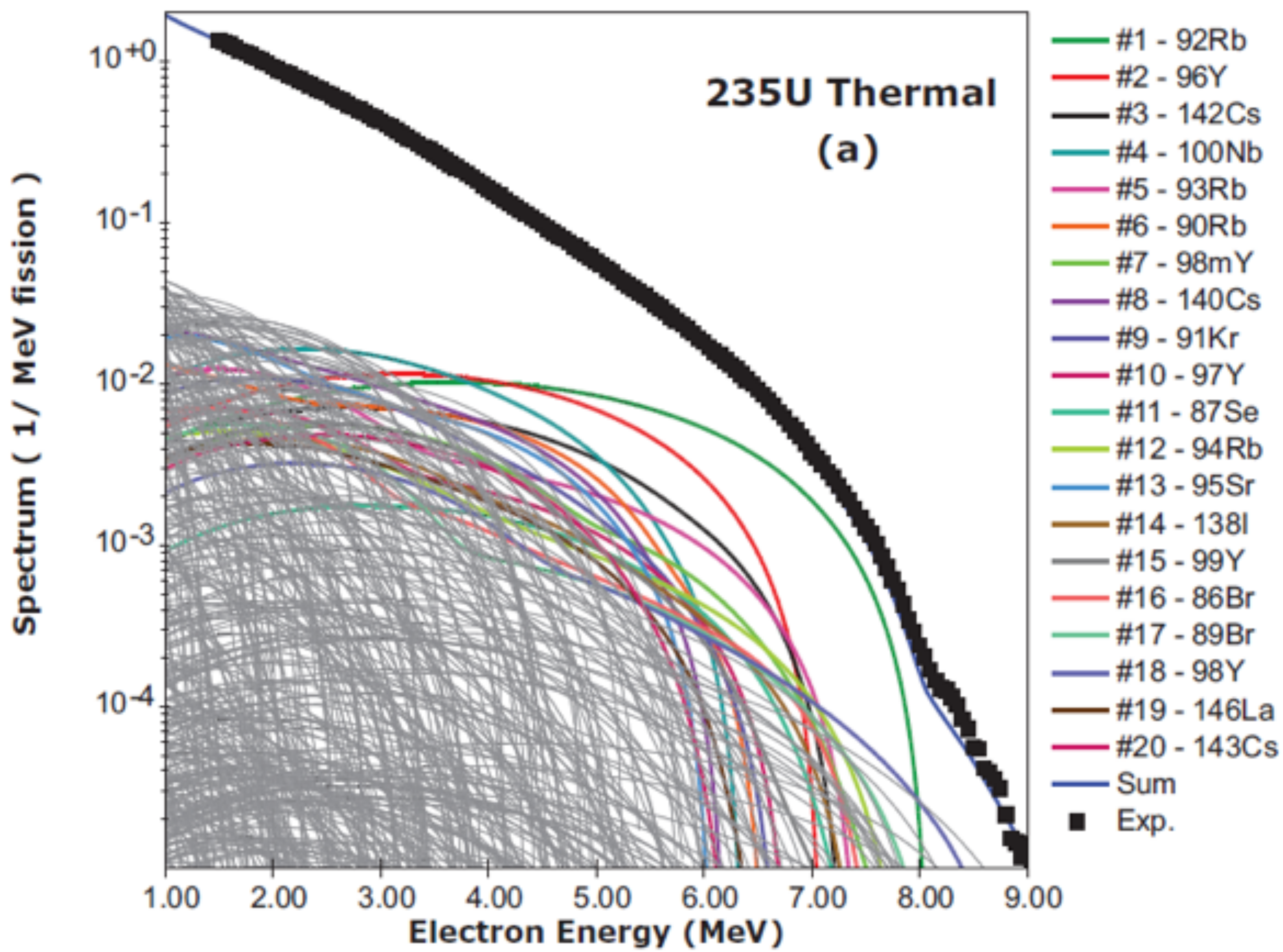
F.P. An et al (Daya Bay Collaboration), ArXiv: 1508.04233

The antineutrino spectrum is directly related to Nuclear Data

The USNDP databases can shed light in several key aspects of this problem.

NNDC Contributions

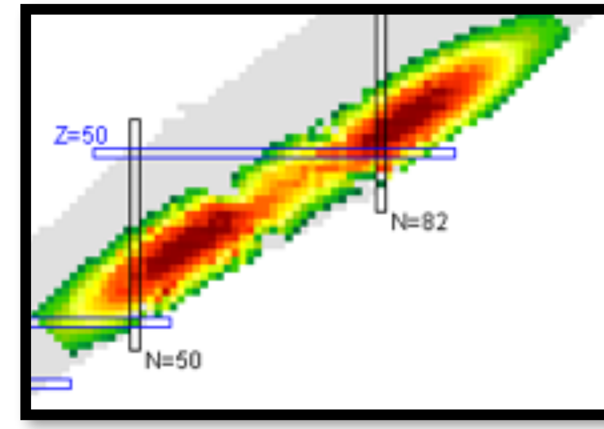
- Update ENDF/B decay data sub-library with new beta-decay measurements (TAGS).
- Decompose spectrum into individual contributors and identify high priority nuclides
- Analyzed systematics of average antineutrino properties for all actinides
- High priority list has motivated new ORNL TAGS measurements funded by ND.



This is only half of the story !!

A.A. Sonzogni, T.D. Johnson, E.A. McCutchan, PRC 91, 011301(R) (2015)

The other half : fission yields



The antineutrino spectrum is the sum of the cumulative fission yield times the antineutrino spectrum for each fission fragment

$$S(E_e) = \sum_i CFY_i * S_i\,(E_i)$$

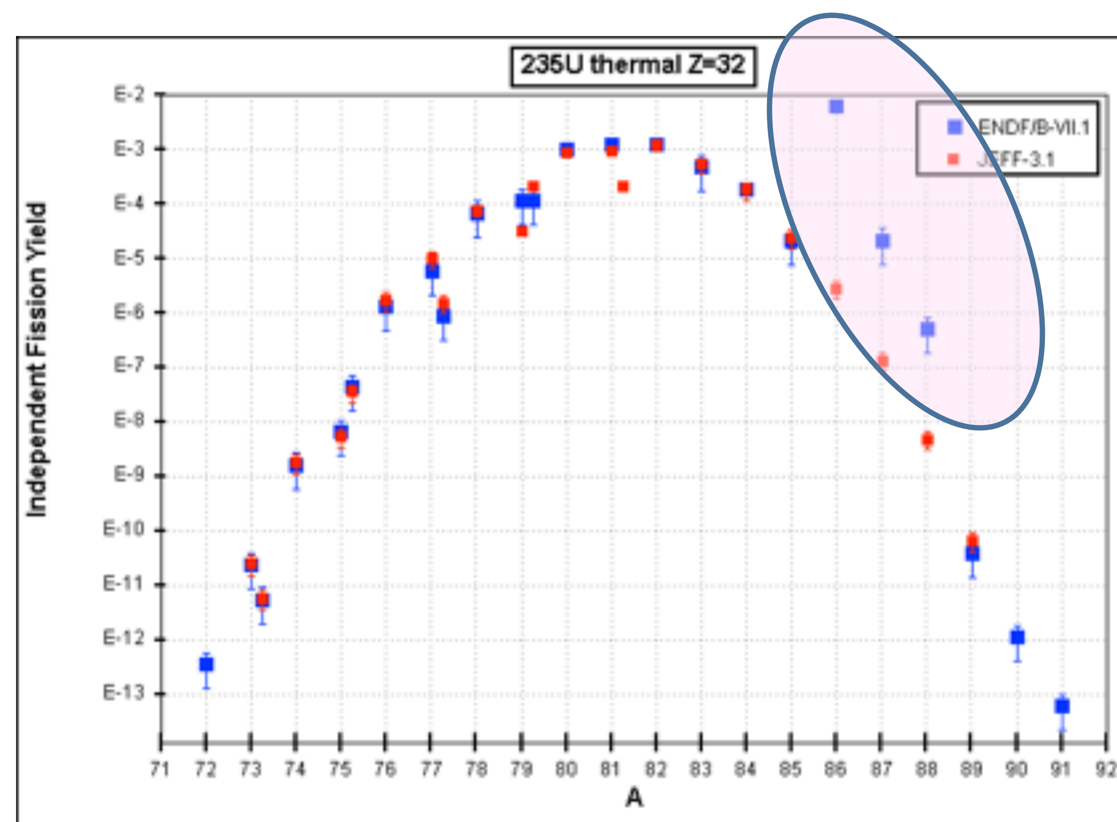
Fission yields have been completely **NEGLECTED**.

ALL of the effort has focused on this term

- Fission yields were last evaluated in 1993 !!!
- Major incompatibility between fission yield evaluation and decay data sub-library which was updated in 2011.

The NNDC has begun Ad hoc corrections

- Corrected erroneous yields
- Improved compatibility
- Better physics for isomer ratios



These “quick fixes” already have major implications

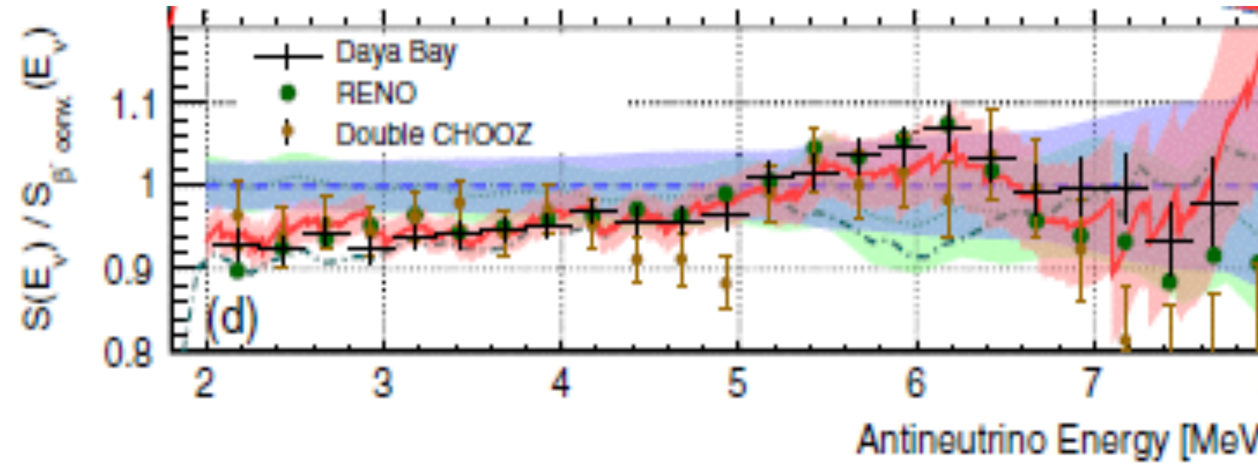
PRL 114, 012502 (2015) PHYSICAL REVIEW LETTERS week endi[ng] 9 JANUARY

Spectral Structure of Electron Antineutrinos from Nuclear Reactors

D. A. Dwyer*
Lawrence Berkeley National Laboratory, Berkeley, California 94720, USA

T. J. Langford†
Yale University, New Haven, Connecticut 06520, USA

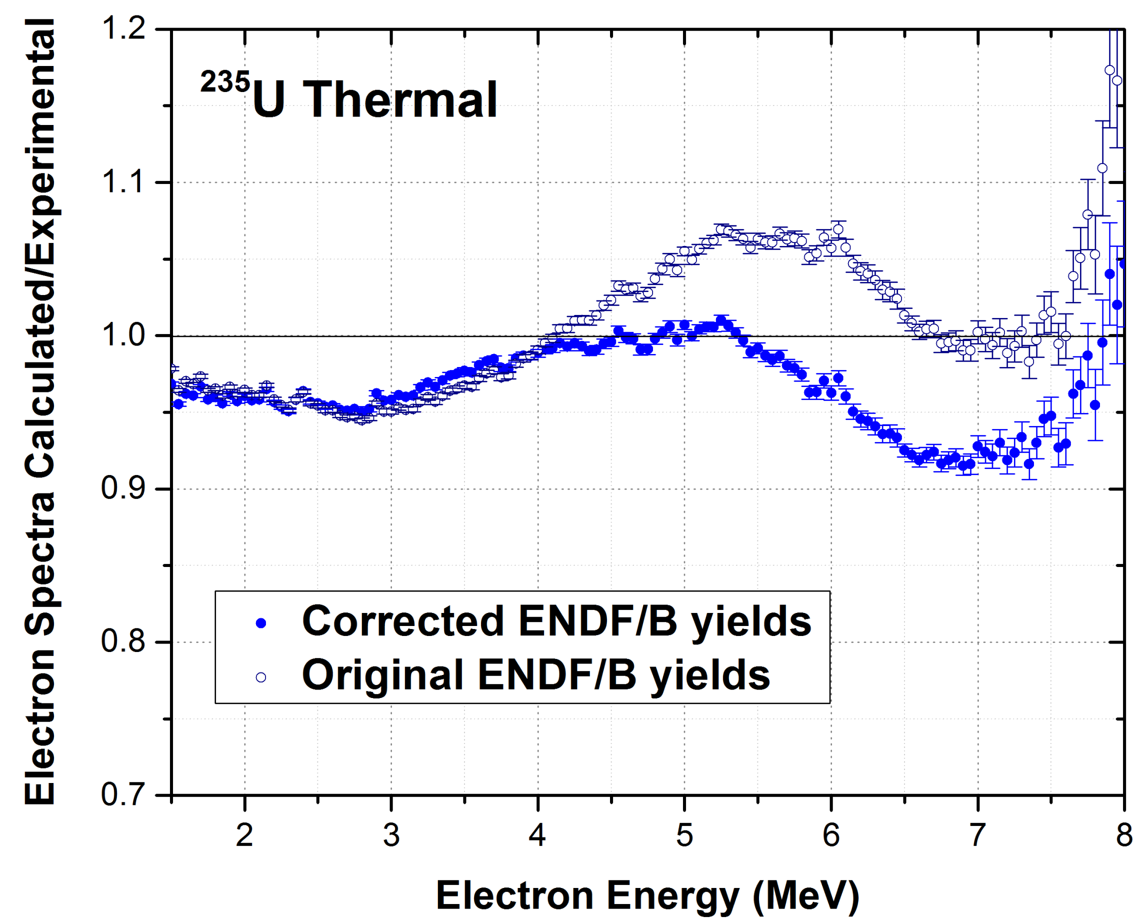
(Received 18 September 2014; published 7 January 2015)



- Dwyer and Langford found the “bump” in nuclear data calculations
- “Case closed” for the antineutrino community

- In fact, the bump is merely an artifact of the erroneous Ge fission yields
- Corrected yields are featureless, “case opened”

A.A . Sonzogni, E.A. McCutchan, T.D. Johnson, P. Dimitriou, PRL– submitted.



Fission yields - a cross-cutting need

- Fission yields pervade NUMEROUS applications (antineutrinos, decay heat, delayed nu-bar, forensics, ….)
- The need for a new fission yield evaluation was stressed throughout the Berkeley NDNCA workshop
- New Antineutrino experiments funded by DoE will produce data soon, ex. PROSPECT in ORNL
- New TAGS data from ORNL/Valencia and fission yields from Spider@LANL will be available soon.
- Incorporating these data promptly in freely distributed databases, and understanding their influence will be desirable.
- This is a major effort which cannot be undertaken with current NNDC staffing levels. A staff position working part time in ENSDF and part time in antineutrinos / fission yields will impact the project positively.

Summary - NNDC is seeking to:

- Maintain integrity of operation capabilities
- Strengthen software support to catch up with advancing technology
- Provide support to isotope production program through collaboration with BLIP
- Bring ENSDF productivity to the level of 300 nuclei/year (the whole USNDP + NSDD)
- Strengthen interaction with users

Expanded responsibilities (ND targeted experiments, collaboration with BLIP, evaluation of fission yields, responding to specific needs) will require additional resources.

Conclusions

In US the NNDC is:

- the only nuclear data center providing comprehensive data services in support of basic science and wide variety of applications
- the unique provider of numerous functions essential to development of nuclear data within USNDP
- the major producer of compiled and evaluated nuclear structure data
- the only compiler of reaction data

NNDC strength & capabilities:

- combined reaction and structure expertise
- ability to propose and perform experiments
- reaction code EMPIRE
- covariance capabilities
- privileged access to databases
- computational capacity (NNDC cluster)

The NNDC has a capabilities, *but not necessarily manpower*, to respond to most of the requests for nuclear data needs