Annual Report for FY2017

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I. Introduction

The USNDP Annual Report for FY2017 summarizes the work of the U.S. Nuclear Data Program (USNDP) for the period of October 1, 2016 through September 30, 2017 with respect to the work plan for FY2017 that was prepared in February 2016. The work plan and final report for the U.S. Nuclear Data Program are prepared for the DOE Office of Science, Office of Nuclear Physics. The support for the nuclear data activity from sources outside the nuclear data program is described in the staffing table and in Appendix A. This leverage amounts to about 11.6 FTE scientific, mostly at NNSA laboratories, to be compared with 24.7 FTE scientific (permanent + postdocs + contractors) at USNDP laboratories funded by the DOE Office of Science, Office of Nuclear Physics. Since it is often difficult to separate accomplishments funded by various sources, some of the work reported in the present report was accomplished with nuclear data program support leveraged by other funding.

Fiscal year 2017 was the 18th year in which the Nuclear Data Program has operated under a work plan developed by the program participants. The program continued to carry out important work in support of the DOE mission. The work balances the ongoing collecting, analyzing, and archiving of nuclear physics information critical to basic nuclear research and to the development and improvement of nuclear technologies with the electronic distribution of this information to users in a timely and easily accessible manner. The present section of the report consists of activity summaries for the major components of the U.S. Nuclear Data Program. This is followed by an updated staff level assignment table that reflects the final distribution of effort among the tasks carried out during FY2017. Then, we continue with the detailed status of work done in FY2017. Total staff assigned to USNDP activities during the year represented 24.7 FTE.

In terms of personnel changes, Eddie Browne and Jag Tuli started working under contract with LBNL in 2017. Jun Chen is now PI of the Michigan State University grant. Texas A&M University started to receive funds directly in FY17 with Ninel Nica as PI. The Fission on Rapid Process Elements (FIRE) collaboration was funded in FY17 with Nicholas Shunck as PI, more details can be found on its web site.

Table 1 summarizes the USNDP metrics since 2001. Table 2 shows the breakdown of the metrics by laboratory for the reported fiscal year and comparison with the previous fiscal year. The tables are followed by a definition of each metric.

Table 1: Summary of the USNDP metrics in FY2001- FY2017, the definitions of the various terms follow the table.

Fiscal Year	USNDP Funding	Change	Compilations	Evaluations	Dissemination (in thousands)	Reports	Articles	Invited Talks
2001			7,139	334	667	21	25	22
2002	$4,890K		6,159	300	799	23	40	22
2003	$4,932K	+0.9%	4,975	260	966	27	40	23
2004	$5,015K	+1.7%	6,241	276	1,212	35	36	43
2005	$5,437K	+8.4%	6,623	422	1,642	74	59	42
2006	$5,099K	-6.6%	4,936	318	1,863	47	60	48
2007	$5,841K	+14.6%	5,355	366	2,239	40	56	51
2008	$5,967K	+2.2%	5,104	385	2,996	48	72	68
2009	$6,267K	+5.0%	4,047	400	3,294	26	61	56
2010	$6,549K	+4.5%	4,662	395	2,843	27	83	51
2011	$6,534K	-0.2%	4,662	479	3,252	29	96	67
2012	$6,785K	+3.8%	5,221	209	3,013	22	90	48
2013	$6,249K*	-7.9%	4,925	282	3,447	29	84	79
2014	$7,031K*	+12.5%	3,738	166	3,411	7	107	81
2015	$7,381K*	+5.0%	4,849	271	4,246	12	98	50
2016	$7,597K*	+2.9%	3,936	375	4,655	7	82	72
2017	$7,123K	-6.2%	3,684	404	4,730	11	95	51

*:Includes an Early Career Award of $500K to LANL.

In particular:

1. **Compilations**: Includes compilations for the NSR, EXFOR and XUNDL databases. The compilation activities are on a healthy situation and these databases are updated regularly with newly published material.
2. **Evaluations**: There were 150 ENDF evaluations as several beta releases of ENDF/B-VIII were made through the year as well as 254 ENSDF evaluations, 240 of which came from USNDP members. The number of ENSDF evaluations remains well below the number needed, about 340, to evaluate each of the ENSDF nuclides on average every 10 years.
3. **Dissemination**: The number of database retrievals has not changed significantly from last year's.
4. **Articles**: The number of articles has remained relatively constant in the last few years. A selected list of articles published is given in the Appendix B.
5. **Invited Talks**: The number of invited talks has decreased this year, mainly due to the presentations made in the ND2016 conference.

Table 2: USNDP metrics in FY2017, numbers for FY2016 are shown for comparison.

Laboratory	Compilations		Evaluations		Dissemination (in thousands)		Reports		Papers		Invited Talks	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
ANL	83	13	32	60	68	0	0	1	24	31	3	5
BNL*	3,712	3,543.5	213.5	241	4,364	4,413	3	4	13	21	25	15
LANL	-	-	90	16	-	-	1	0	14	21	20	18
LBNL	44	18	23	15	-	-	1	1	23	13	11	8
LLNL	-	-	-	-	0	10	0	0	0	0	7	3
MSU	N/A	60	N/A	22	N/A	-	N/A	-	N/A	-	N/A	-
ORNL	39	11.5	9.5	0	120	200	1	1	4	3	6	2
TAMU	N/A	-	N/A	17	N/A	-	N/A	-	N/A	3	N/A	4
Universities	58	38	7	9	103	117	4	1	2	1	0	0
Total	3,936	3,684	375	404	4,655	4,730	7	11	82	98	68	55

*: BNL compilations for FY2017 consist of a) 3,277 NSR articles, including key-words for 1825 of them; b) 98 articles for EXFOR; c) 168.5 articles encompassing 342 XUNDL datasets. BNL evaluations for FY2017 consist of a) 117 nuclides for ENSDF and 124 for ENDF/B-VIII.0. For the remaining groups, all compilations are for XUNDL, while all evaluations are either ENSDF (ANL, LBNL, MSU, ORNL and TAMU), or ENDF/B (LANL, LLNL, NIST).

Definitions:

- *Compilations*: The sum of the new entries added to the USNDP bibliographic (NSR - articles) and experimental databases (EXFOR - reactions, XUNDL - structure data sets).
- *Evaluations*: The sum of new evaluations submitted or accepted for inclusion in the USNDP evaluated nuclear databases. For ENSDF, it is the number of evaluated nuclides, while for ENDF, it is the number of evaluated reactions/covariances.
- *Dissemination*: The number of electronic data retrievals made from USNDP maintained web sites. Data retrieval is defined as a request for data from any of the databases that receives a result. Total pages, gifs, etc. accessed is not tallied.
- *Reports*: The number of technical documents (includes papers in conference proceedings) or papers other than journal publications and invited talks. No administrative documents such as meeting minutes are reported.
- *Papers*: The number of articles published in refereed journals.
- *Invited talks*: The number of presentations given at the explicit invitation of the organizers of conferences, symposia, workshops and training courses.

II. Network Coordination and Data Dissemination

The National Nuclear Data Center (NNDC) continues to serve as the core facility of the U.S. Nuclear Data Program (USNDP). It has the main responsibility for national and international coordination, database maintenance, and data dissemination. However, other program participants are also involved in coordination and dissemination activities.

National and International Coordination

The NNDC, while serving as the secretariat for the program, has prepared the work plan for FY2017 in cooperation with the members of the Coordinating Committee. The NNDC Head serves as a chair of the USNDP Coordinating Committee, which consists of the Principal Investigators from each of the participating groups, and chairs the annual meeting of the program held at the Brookhaven National Laboratory. LANL chairs the Nuclear Reaction Data Working Group, and LBNL the Nuclear Structure Working Group. ORNL chairs the Astrophysics Task Force and LLNL chairs the Homeland Security Task Force.

In February 2017, DOE Office of Nuclear Physics conducted its annual Budget Briefing. Shamsu Basunia, Lee Bernstein, Toshihiko Kawano, John Kelley, Filip Kondev, Elisabeth McCutchan, Alejandro Sonzogni, Michael Thoennessen and Ian Thompson represented USNDP and made the case for the 2019 funding.

The NNDC serves as the focal point for U.S. collaboration in international nuclear data activities. This collaboration continued both in nuclear structure and decay data (Network of Nuclear Structure and Decay Data Evaluators, NSDD) and reaction data (NEA Working Party on International Nuclear Data Evaluation, WPEC, and Network of Nuclear Reaction Data Centers, NRDC).

The NNDC continues to chair the Cross Section Evaluation Working Group, which produces the ENDF/B evaluated nuclear data library for nuclear science and applied nuclear technology use. As in the past, the 2016 CSEWG meeting was held at BNL. The major topic of the CSEWG meeting was the progress on the CIELO evaluations. Additionally, a miniCSEWG meeting took place in LANL on May 4-5 2017, to work finalizing the release of the ENDF/B-VIII.0 library.

USNDP Databases

The NNDC operates six Dell servers running the Linux operating system to support its compilation, evaluation, database maintenance, and information dissemination functions. These computers archive and serve the nuclear data produced by the U.S. Nuclear Data Program and the data obtained by other national and international collaborations. In addition, the NNDC maintains the collaboration GForge server that facilitates data and codes development and employs Subversion to keep track of changes.

The NNDC maintains seven nuclear physics databases for USNDP. These databases were updated continuously in FY2017 with new and revised information from efforts of the NNDC, USNDP and international collaborators. Distributions of all or parts of these databases have been made to national and international collaborators as scheduled.

Data Dissemination

In FY2017, there were 4,655 million database retrievals, about 9.6% higher than the number of retrieval in the previous year. Most of these retrievals, 95%, were from the NNDC web site, with NuDat as the most popular product.

Major Publications

USNDP continues to publish the refereed journal Nuclear Data Sheet, 8 issues were published this fiscal year, 7 dedicated to ENSDF evaluations and one issue devoted to nuclear reactions.

III. Nuclear Structure and Decay Data

The nuclear structure working group emphasizes the evaluation of measured nuclear structure and decay properties for all isotopes. These data are maintained at the National Nuclear Data Center (NNDC) in the Evaluated Nuclear Structure Data File (ENSDF). Production of ENSDF is an international effort operating under the auspices of the IAEA Nuclear Structure & Decay Data (NSDD) network. ENSDF is an important source of information for derivative databases and applications including NuDat, Nuclear Wallet Cards, RIPL, MIRD and ENDF/B. Evaluations are published as peer-reviewed articles in Nuclear Data Sheets for A>20 and in Nuclear Physics A for A = 20. Nuclear Science Reference (NSR) and Experimental Unevaluated Nuclear Structure Data List (XUNDL) have been kept up-to-date. The combination of ENSDF and XUNDL database represents nearly a complete experimental nuclear structure data of the literature, which is a salient feature of these databases.

The 22nd Technical Meeting of the Nuclear Structure and Decay Data (NSDD) Network of the International Atomic Energy Agency (IAEA) was held at Lawrence Berkeley National Laboratory (LBNL), Berkeley, CA from 22-26 May 2017. The meeting was co-sponsored by Nuclear Science and Security Consortium at the UC Berkeley. There were a total of 32 participants from 25 institutions and 13 countries. Five UC graduate students were also attended as observer. This is a biennial IAEA NSDD meeting and was held in the US twice in 1994 (Berkeley) and 1977 (Oak Ridge).

Status of ENSDF & Nuclear Data Sheets: The ENSDF database has increased in size by roughly ~1.3% over the past year. Presently there are 3330 nuclides in the database, compared to 3312 of FY2016. The total number of datasets is 18818. In this fiscal year, 9 mass chain (113 nuclides) evaluation articles were published in the Nuclear Data Sheets. Another 11 mass chains were submitted for review and publication. A total of 237 evaluated nuclides were submitted, including nuclides from 11 mass chains and nuclides for ENSDF update. The number of mass chains in the review/publishing process is listed as 24 and 268+ and 270+ groups. An additional 26 mass chains are listed as currently being evaluated with A206-265 and A267+ groups. General usage statistics for ENSDF and products derived from ENSDF (Nuclear Data Sheets, NuDat, etc.) shows a high usage and popularity on the NNDC website and the Elsevier site.

The network works to revise all the mass chains within a time frame of 10 years, along with considerations of new data, age, importance, and request from users. One of the many indicators to measure the currency of the database is the average life of a mass chain, which was 6.9 years at the end of FY2004 and 8.3 years in Nov, 2017. Here it should be noted that the size of the ENSDF database has increased from 148 MB to 219 MB (Oct, 2017), an increase of about 48%, from FY2004 to FY2017. The total effort for ENSDF database while remained nearly the same in the US, combining permanent and temporary (postdoc/contracts) staff, however, the non-US effort has been dropped in recent years.

Status of XUNDL: Based on regular scanning of nuclear physics journals, 710 datasets were compiled from 310 papers. Communications with the authors were being made to resolve many data-related issues and obtain additional data in support of their findings. As of ~Oct 31, 2017, XUNDL contains compiled experimental nuclear structure data of 7605 datasets for 2542 nuclides.

Status of NSR: In FY2017, 3277 new articles were added to the NSR database and the database contains a total number of 225,695 articles. USNDP contributions are from B. Pritychenko (manager), E. Betak, B. Singh, J. Totans, and V. Zerkin from IAEA participates as a collaborator. The database is up-to-date and in good shape. The database now contains a total of 6867 nuclides and 8168 reactions, of which new entry of 592 nuclides and 265 reactions were made in this fiscal year. The number of NSR web retrievals was 316,147.

Horizontal Evaluations and Other Data Related Activities: A summary list of "Horizontal Evaluations and Other Data Related Activities" involving USNDP structure evaluators includes the following:

- IAEA technical meetings on ENSDF evaluation and analysis codes: Kondev, Singh, Chen
- IAEA-CRP on Delayed Neutron Emission Probabilities: Singh, Sonzogni, McCutchan, Johnson.
- IAEA-CRP on Nuclear Data for Charged-Particle Monitor Reactions and Medical Isotope Production: Kondev,
- IAEA-CRP on Updating Photonuclear Data Library and Generating a Reference Database for Photon Strength functions: Firestone
- IAEA consultant's work on evaluation of fission yields – will turn to a CRP: Sonzogni
- The Atomic Mass Evaluation effort (AME) and NuBase: Kondev
- Atlas of Nuclear Isomers: Singh
- B(E2) evaluation for first 2+ states in all the e-e nuclei: Pritychenko, Singh
- Horizontal evaluation of beta-delayed proton emitting nuclei: Batchelder
- Update of 1998Ak04 table of r_0 radius parameter: Singh, Dhindsa
- nucastrodata.org and the Computational Infrastructure for Nuclear Astrophysics (CINA): M. Smith,
- Compilation of current papers on mass measurements on a yearly basis and make data file available on nuclearmasses.org: Singh

Status of ENSDF codes: In the last few years, significant development has been made in McMaster's JAVA-NDS code by Jun Chen, which is useful to prepare the print-ready documents for publication in the Nuclear Data Sheets and incorporated many recommended changes for the print-ready document. In this fiscal year, the code has been implemented both to produce print-ready documents for the Nuclear Data Sheets and web retrieval of ENSDF data sets at NNDC site. JAVA-NDS (version 1.6) was release in June, 2017, while periodic updates are ongoing based on reported bugs by network members. Some other codes also have been updated in this fiscal year, like JGAMUT, GABS, ALPHAD, etc. RULER has known bugs but not fixed yet. Evaluators pay extra attention for identifying and fixing erroneous RULER outputs manually.

IV. Nuclear Reaction Data

The nuclear reaction data effort focuses on evaluation of nuclear reaction data and the related measurement and compilation activities. The USNDP also makes important contributions to nuclear reaction model code development and improvement of reaction cross-section standards.

Reaction Data Highlights

Most of the work during FY17 was devoted to the release of ENDF/B-VIII.0, scheduled for early 2018. ENSDF/B is a library widely used in nuclear science and technology applications. It has been the product of the Cross Section Evaluation Working Group collaboration since 1967. USNDP plays a leading role coordinating reaction data research activity of 10+ US government agencies. Additionally USNDP participation in EXFOR and neutron standards project strengthens ENDF as both are considered foundations for ENDF.

ENDF/B-VIII.0 will contain evaluations produced under the auspices of the Collaborative International Evaluated Library Organization (CIELO) Pilot Project. BNL will contribute the n + Iron evaluation, also part of CIELO, a number of neutron evaluations on unstable nuclides as well as an updated decay data sub-library to ENDF/B-VIII.0. LANL will mainly contribute n+H and n+239Pu evaluations as well as prompt fission gamma spectra. LANL also organized a miniCSEWG meeting during May 4-5, 2017, to coordinate work for an effective release of the library. LLNL will contribute a number of charged-particle evaluations to ENDF/B-VIII.0, such as α+α, d+7Li, h+h, p+α, p+7Li, t+α and t+7Li.

Finally, considerable progress has been achieved by LANL in improving the description of the fission process, which the goals of calculating independent fission yields, as well as with implementing M1 gamma strength functions.

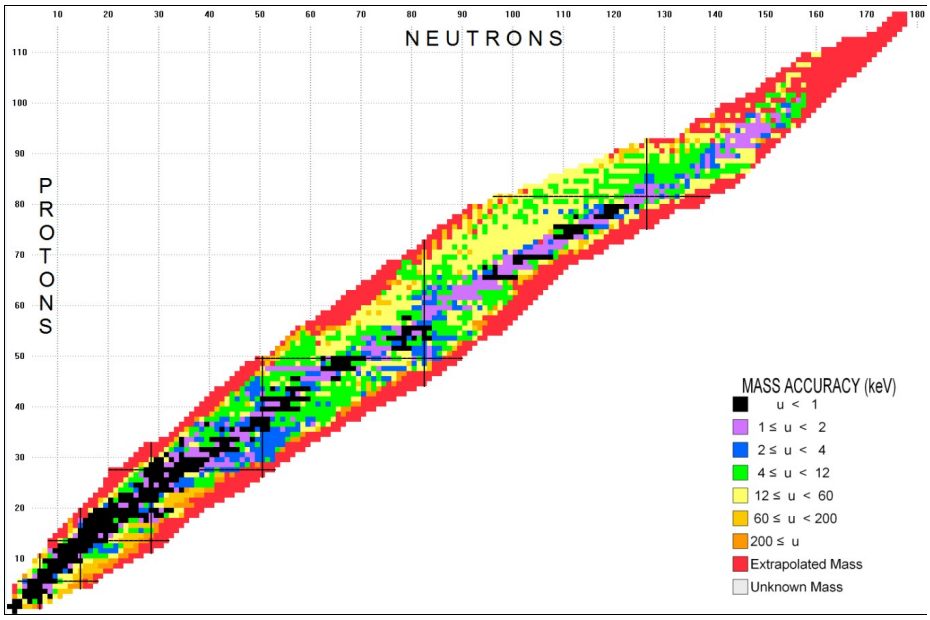
Nuclear Astrophysics highlights

At BNL, Maxwellian-averaged cross sections for the ENDF/B-VIII.beta4 library have been produced and were found to be comparable to those in the KADoNiS library. At LANL, neutron capture reaction modeling on unstable nuclei continues using semi-microscopic level densities. Also, beta-delayed neutron and fission work relevant for the r-process continues. At LLNL, work within the FIRE collaboration includes estimating the masses of unstable nuclei from r-process abundance peaks, and estimating the dependence of r-process abundance patterns on different fission yield models. At ORNL, levels in ^{21}Na, ^{12}N, and ^{35}Cl were assessed for levels of astrophysical importance and included in three PRC publications. Work also continues on direct capture cross section calculations of exotic Sn isotopes based on radioactive beam measurements, with one paper submitted to PRL and another in progress. Additionally, a paper is in preparation on assessments of the cross section of ^{19}F(α,n) section that plays an important role in the creation of the long-lived radioisotope ^{22}Na, a target of gamma-ray astronomy.

Additional Highlights

Atomic Mass Evaluation

In FY2017 the new evaluations of atomic masses (AME2016) and properties of nuclei (NuBase2016) were completed and published in the journal Chinese Physics C. These libraries have significant impact on basic nuclear physics and nuclear astrophysics research, and on many practical applications.

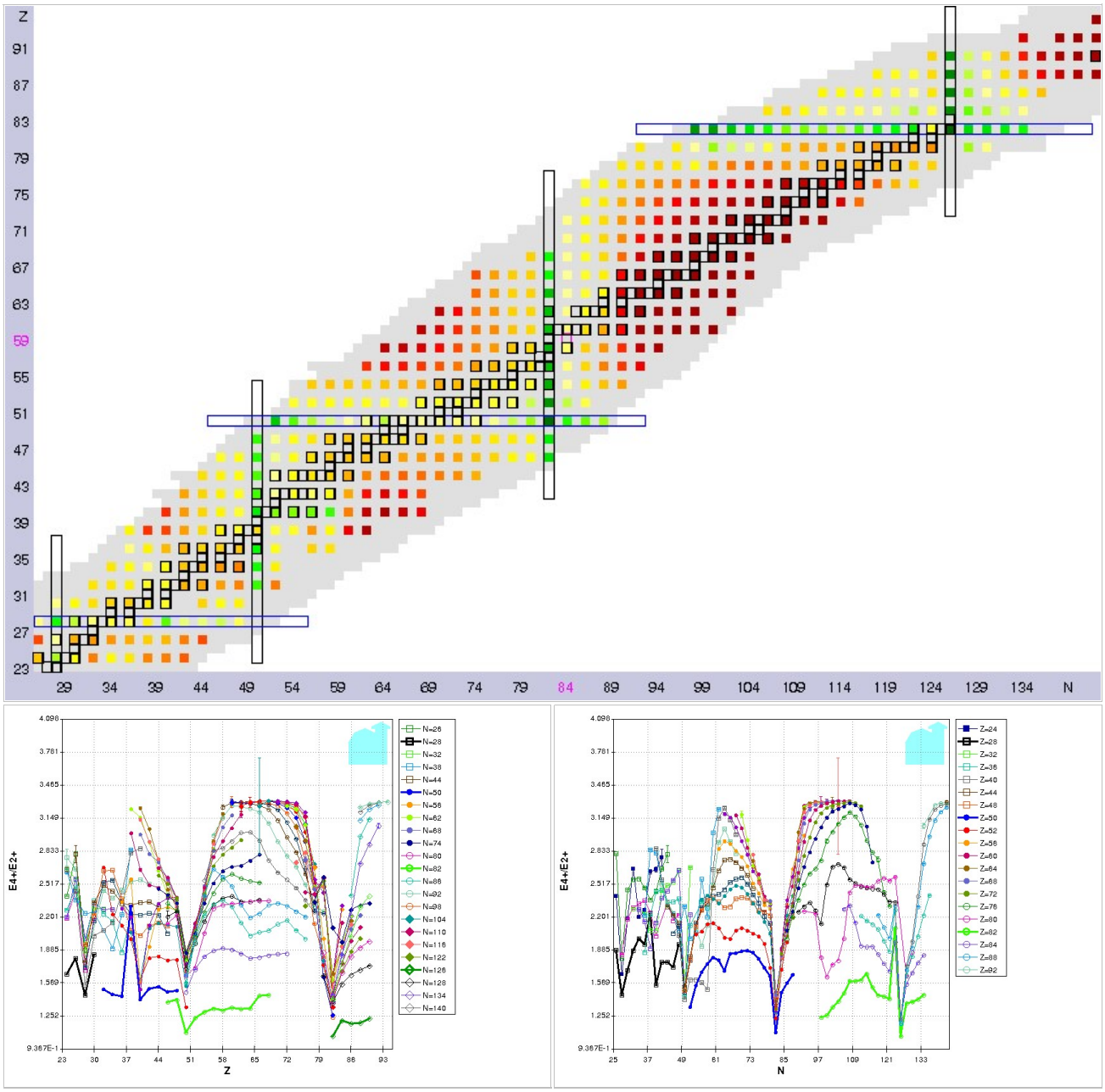


JAVA-NDS

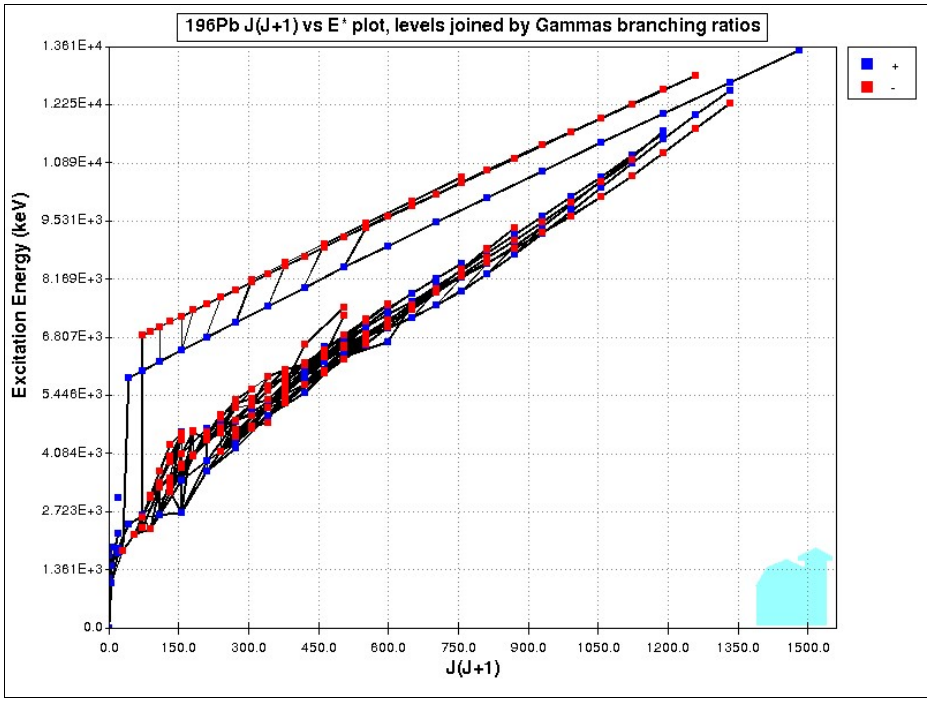
The development, testing and debuging of JAVA-NDS code was completed in early 2017 and has been under regular maintenance ever since with an undated version released every 6 months. It has been used to produce print-ready PDF outputs for the NDS publications starting February 2017 (replacing the NDS-PUB code) and for web-display of ENSDF and XUNDL databases starting March 2017 (replacing the WebTrend code). This code produces better appearence of ENSDF dataset with many new and improved features, such as new font (standard font style for most journals and bigger size than NDS-PUB), improved level schemes and band drawings, additional information added in gamma tables, hyperlinks for footnote marks and keynumbers, and so on. In addition, the simple graphical interface makes it easy to use with custom settings for the appearence of the output PDF file, which has enabled evaluators to generate pre-review output of their mass-chain evaluations by themseves with submission, instead of by the editor of Nuclear Data Sheets after submission, to facilitate the review and publicatoin process.

NuDat 2.7 Improvements

During the meeting at Notre Dame University that resulted in the white paper for science, several suggestions to the way ENSDF data is disseminated through NuDat were made. The main one was to count with 1-D projections on the N and Z axis of NuDat charts of nuclides. This was implemented in 2017, and as an example, we show a portion of the chart of nuclides colored according to the ratio of first 4+ to 2+ energies for even-even nuclides followed by the corresponding projections. The 1-D projections have mouse-over effects, so that it is possible to obtain for each point the corresponding Z, N and the property being plotted values.



Another featured that was requested and we have added is the plots of spin vs excitation energy. As an example, we show such a plot for ^{196}Pb, which clearly shows its spherical behavior at low excitation energies, a number of rotational bands for higher excitation energies, and for even higher energies, and two super-deformed bands. An interactive interface was written, so users can choose to plot J or J(J+1) vs E^{*}. The points in the plot can be joined by a line which is proportional to the gamma branching ratio or reduced transition probability in Weisskopf units if available.

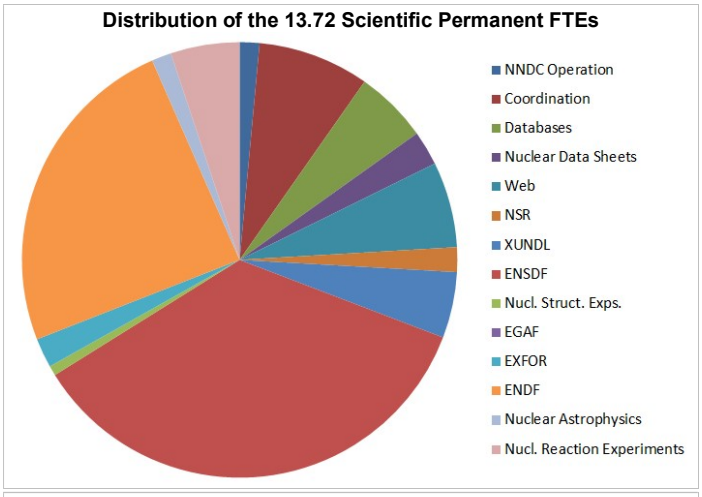

196Pb J(J+1) vs E* plot, levels joined by Gammas branching ratios
Excitation Energy (keV)
1.361E+4
1.225E+4
1.089E+4
9.531E+3
8.169E+3
6.807E+3
5.446E+3
4.084E+3
2.723E+3
1.361E+3
0.0
0.0
150.0
300.0
450.0
600.0
750.0
900.0
1050.0
1200.0
1350.0
1500.0
J(J+1)
+
-

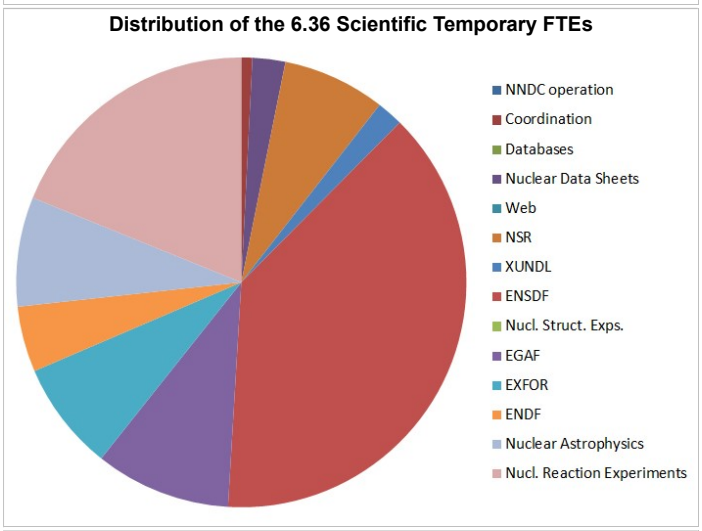
USNDP Staffing table FY2017

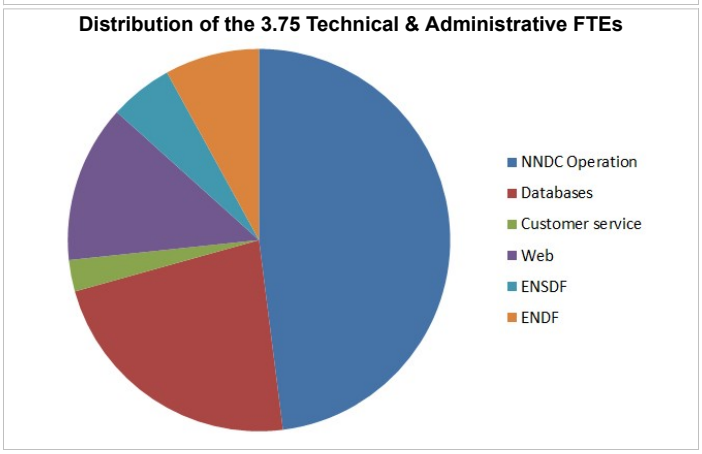
	ANL	BNL			LANL		LBNL		LLNL			MSU	NIST		ORNL			TAMU	TUNL			Sum
	PhD P	PhD P	PhD T	T/A	PhD P	PhD T	PhD P	PhD T	Ph P	PhD T	GS	PhD P	PhD P	PhD T	PhD P	PhD T	GS	PhD P	PhD P	PhD T	T/A	
I. NNDC Facility Operation		0.20		1.80																		2.00
Management		0.20																				0.20
Secretarial/Administrative Support				1.00																		1.00
Library				0.30																		0.30
Computer Operations				0.50																		0.50
II. Coordination	0.20	0.35			0.10		0.43	0.05							0.05							1.16
National Coordination	0.15	0.19			0.05		0.43								0.05							0.87
International Coordination	0.05	0.16			0.05			0.05														0.29
III. Nuclear Physics Databases		0.74		0.70																	0.15	1.63
Nuclear Science References NSR		0.25		0.60																		0.85
Exper. Nucl. Structure Data XUNDL		0.20																			0.05	0.25
Eval. Nucl. Structure Data ENSDF		0.10																			0.10	0.20
Numerical Nuclear Data NuDat		0.05																				0.05
Experimental Reaction Data CSISRS		0.10																				0.10
Evaluated Nuclear Data File ENDF		0.04																				0.08
Database Software Maintenance				0.10																		0.10
IV. Information Dissemination		1.17	0.15	0.20											0.05						0.40	1.97
Nuclear Data Sheets		0.35	0.15																			0.50
Customer Services				0.10																		0.10
Web Maintenance & Development		0.82		0.10											0.05						0.40	1.37
V. Nuclear Structure Physics	0.75	1.15	1.07				0.87	1.84				1.00			1.00	0.15		0.63	0.50	0.60	0.20	9.76
NSR Abstract Preparation		0.25	0.47																			0.72
Compilation of Exper. Structure Data	0.10	0.15	0.11				0.07	0.01				0.15			0.10				0.10			0.79
Eval. of Masses & Nuclides for ENSDF	0.40	0.55	0.49				0.80	1.21				0.55			0.90	0.15		0.63	0.20	0.60		6.48
Ground & Metastable State Properties	0.20																					0.20
Thermal Capture Gamma Data Eval.								0.62														0.62
Light Mass Eval. for Nucl. Physics A																			0.20		0.20	0.40
Nuclear Structure Data Measurement	0.05	0.10																				0.15
ENSDF Evaluation Support Codes		0.10										0.30										0.40
	ANL	BNL			LANL		LBNL		LLNL			MSU	NIST		ORNL			TAMU	TUNL			Sum
	PhD P	PhD P	PhD T	T/A	PhD P	PhD T	PhD P	PhD T	Ph P	PhD T	GS	PhD P	PhD P	PhD T	PhD P	PhD T	GS	PhD P	PhD P	PhD T	T/A	
VI. Nuclear Reaction Physics	0.05	2.93	0.50	0.30	0.75	0.95	0.35	0.45	0.25	0.50	1.00		0.10	0.10	0.10		0.20					8.60
Experimental Data Compilation		0.30	0.50																			0.80
ENDF Manuals and Documentation		0.10																				0.10
ENDF Evaluations		1.47			0.20				0.08													1.83
Nuclear Reaction Standards													0.10	0.10								0.20
Nuclear Model Development		0.30			0.20	0.10			0.14													0.74
Nucl. Reaction Data Measurements					0.35	0.75	0.35	0.45														1.90
Astrophysics Nuclear Data Needs	0.05	0.05								0.50	1.00				0.10		0.20					1.90
Covariances development		0.25				0.10																0.35
Reactor anti-neutrino & decay heat calculations		0.21																				0.20
Verification and Validation		0.25		0.30					0.03													0.58
DOE-SC Nucl. Data Funded Staff	1.00	6.54	1.72	3.00	0.85	0.95	1.65	2.34	0.25	0.50	1.00	1.00	0.10	0.10	1.20	0.15	0.20	0.63	0.50	0.60	0.75	25.03
Staff Supported by Other Funds		0.46																				0.46
TOTAL STAFF	1.00	7.00	1.72	3.00		0.95	1.65	2.34	0.25	0.50	1.00			0.10	1.20	0.15	0.20	0.63	0.50	0.60	0.75	23.54

PhD P: PhD Permanent,
PhD T: PhD Temporary, includes post-docs and scientists working under contract,
T/A: Technical and administrative,
GS: Graduate student.

USNDP FTE plots







Detailed Status of the Work Plan
Fiscal Year 2017 Report

I. NNDC Facility Operation

A. Management

This task includes planning, budgeting, personnel, interaction with BNL management, and interaction with funding authorities.

B. Library

NNDC maintains an archival collection of low- and intermediate-energy nuclear physics publications. This library supports the NNDC compilation activities and the U.S. nuclear reaction and nuclear structure data evaluation and international nuclear structure evaluation effort.

C. Computer Operation

The NNDC operates several servers running Red Hat Enterprise Linux in support of its compilation, evaluation, database maintenance, and information dissemination functions. In addition, each staff member has a PC that supports an interface to these Linux servers and supports administrative functions such as word processing and email. Furthermore, MS Windows servers provide centralized backup, printing and file serving for the PCs. This task includes software upgrades, hardware and software procurements, machine operations and internal user support for both the Linux and Windows platforms.

BNL planned activities	Status
In collaboration with ITD, ensure continuous availability of mission-critical Web services through full compliance of NNDC's computers with DOE cyber security requirements.	Achieved zero vulnerability on all NNDC mission-critical servers which ensured full compliance and passing two cyber security audits conducted by the DOE Inspector General. Moved all NNDC mission-critical servers to a more secured server room and subnetwork at BNL with minimal downtime.
Provide technical computer support to NNDC staff, visitors and external collaborators to enable them to effectively and securely use NNDC computing resources.	Provided prompt, valuable technical support to NNDC staff, visitors, external collaborators and DOE-SULI students for effective and secured use of BNL (e-mail and VPN) and NNDC (GForge collaboration server, USNDP community server and Linux cluster) computing resources. Attended a SCALE Criticality Safety and Radiation Shielding training course at ORNL. Subsequently, compiled into parallelized versions 5 SCALE modules to be used in the validation and covariance processing of ENDF/B-VIII.0.
Upgrade various software running on NNDC's mission-critical servers to meet the U.S. nuclear data community's growing computing needs.	Upgraded the GForge server and scientific workstations on which the Linux operating system and associated applications had reached end-of-life and, thus were no longer compliant because security patches were no longer available.
Procure computer hardware, software and support services to meet NNDC's computing requirements.	Purchased computer software and hardware which were essential to the NNDC staff in the performance of their daily tasks.

II. Coordination

A. National Coordination

National coordination is required for activities under the US Nuclear Data Program as well as Cross Section Evaluation Working Group. This is mostly performed by the National Nuclear Data Center, with contributions from other laboratories (USNDP Working Groups and Task Forces as well as CSWEG Committees).

ANL: Chair the Covariance Committee the Cross Section Evaluation Working Group.

ANL Planned Activities	Status
Organize and chair the CSEWG Covariance Committee	Completed
Unplanned Activity: Prepare the White Paper on Nuclear data needs and capabilities for basic science that was published in the arXiv and submitted to a broader Nuclear Physics community, including the Office of Nuclear Physics, DOE.	Completed
Unplanned Activity: Organize the Nuclear Data session at the LECM in collaboration with Libby McCutchan (NNDC) and John Kelley (NC State and TUNL)	Completed

BNL: Chair USNDP Coordinating Committee, chair Cross Section Evaluation Working Group, develop USNDP work plan, and maintain its USNDP

website.

BNL planned activities	Status
Prepare FY2018 work plan for USNDP.	Completed.
Organize and chair CSEWG Meeting at BNL in November 2015.	Completed, CSEWG took place during November 14-18, 2016.
Organize and chair USNDP Meeting at BNL in November 2015.	Completed, USNDP took place during November 16-18, 2016.
Edit and publish summary reports and proceedings of the CSEWG and USNDP meetings.	Completed. All documents available online.
Maintain CSEWG and USNDP websites.	Continuing task. Web sites are up to date.
Organize mini-CSEWG meeting in the summer if needed.	This year mini-CSEWG was organized by LANL.

LANL: Chair Evaluation and Validations Committees of the Cross Section Evaluation Working Group.

LANL planned activities	Status
Organize and chair CSEWG Evaluation Committee meeting at BNL, November 2016.	Completed.
Organize and chair Nuclear Reaction Working Group.	There was no nuclear reaction working group meeting at USNDP in 2016 due to change in the agenda.

LBNL: Serve as a member of the USNDP Coordinating Committee and chair the USNDP Nuclear Structure and Decay Data Working Group in addition to overseeing, coordinating, and directing the work of members of the Isotopes Project. The latter effort includes working with LBNL management, with other members of the USNDP, and with the program officers of the DOE.

LBNL planned activities	Status
Work with the NNDC to improve the efficiency of nuclear structure data evaluation and better integrate US efforts with other nuclear data activities.	During this time period members of the LBNL/UC group worked with representatives from the NNSA office of Counter-proliferation Research and Development (NA-22) to coordinate activities and gain support for nuclear data measurements and evaluations. This work was carried out both within the ad hoc Nuclear Data Working Group, and through workshops and technical meetings.
Coordinate EGAF Capture Gamma-ray Library evaluations with LLNL for preparation of ENDF format datasets and improved RIPL files.	This effort is ongoing, with the most recent focus being on 139La.
Coordinate the West Coast collaboration to measure and evaluate neutron cross section measurements at the LBNL Cyclotron, UC Berkeley Department of Nuclear Engineering, and National Ignition Facility neutron facilities.	This effort is ongoing. The key milestone during this period was the publication of a NIM article quantifying the neutron yield and spectrum from the 88-Inch thick target deuteron break-up neutron source.

LLNL: Chair the Task Force on Nuclear Data Needs for Homeland Security of the Cross Section Evaluation Working Group.

LLNL planned activities	Status
Organize and chair the CSEWG Task Force on Nuclear Data Needs for Homeland Security.	Continuing.

ORNL: Chair the Astrophysics Task Force, and help facilitate and coordinate nuclear astrophysics data work at different labs to advance USNDP goals; provide leadership in planning future activities in nuclear data for nuclear astrophysics.

ORNL planned activities	Status
Communicate current efforts and future plans with researchers in nuclear astrophysics and nuclear astrophysics data.	Current efforts and future plans in U.S. nuclear astrophysics data were discussed at the Low Energy Community Meeting, at an ORNL Workshop on Uncertainty Quantification, and with U.S. and international researchers in the field
Represent USNDP nuclear astrophysics efforts at international collaboration meetings on nuclear astrophysics data and in "town meetings", community meetings, and summer schools.	Future plans were discussed at the Low Energy Community Meeting and with international collaborators in China and South Korea
Initiate collaborative research projects to raise the visibility of nuclear data projects directed at astrophysics applications.	Plans for a collaborative effort in nuclear astrophysics data with a research group in South Korea were outlined and are now being further developed
Discuss future plans in nuclear astrophysics data with DOE, with USNDP/NNDC, and with other funding agencies.	Future plans in nuclear astrophysics data were discussed with NNSA representatives to explore overlapping interests

B. International Coordination

ANL: Represent the ANL in IAEA-sponsored Nuclear Structure and Decay Data Network (NSDD). Participate in IAEA-sponsored coordinated research programs (CRP) and training workshops.

ANL planned activities	Status

Participate in IAEA-sponsored nuclear data activities	Participated at the IAEA technical meeting on Nuclear Moments in Vienna and at the NSDD meeting at LBNL.

BNL: Represent the United States in IAEA-sponsored Nuclear Reaction Data Center Network (NRDC) and Nuclear Structure and Decay Data Network (NSDD). The NNDC center head is the U.S. member and vice-chair of the IAEA's International Nuclear Data Committee (INDC), the lead US member of the NEA Working Party on International Evaluation Cooperation (WPEC) in his position as chair of CSEWG. Many of the NNDC staff participates in IAEA sponsored activities such as Workshops and Technical Meetings.

BNL planned activities	Status
Participate in the IAEA-sponsored NRDC meeting in FY2017.	B. Pritychenko attended the NRDC 2017 meeting, presenting the current status of experimental nuclear reaction data compilation and dissemination of Area #1 (U.S. and Canada).
Participate in NEA WPEC annual meeting in FY2017.	M. Herman and D. Brown participated in the May 2017 NEA WPEC annual meeting. M Herman chaired the meeting and presented the BNL iron evaluation work while D. Brown provided an overview of on-going GNDS format development.
Participate in IAEA organized network coordination meetings (NSDD)	A. Sonzogni, E. McCutchan, B. Singh attended the NSDD meeting in May 2017. E. McCutchan served as co-chair of the meeting. Additionally, we participated in the beta-delayed neutron CRP meeting in Vienna.
Continue to participate in training/mentoring of new ENSDF evaluators through collaborative work (McMaster).	Continuing.
Participate in NEA-WPEC Subgroup's meetings.	M. Herman and D. Brown attended several WPEC Subgroup meetings in May 2017: SG-37 (fission product yields), SG-38 (developing GNDS format), SG-39 (data assimilation), SG-40 (CIELO project), SG-43 (GNDS API development), SG-44 (nuclear data covariances) and EG-GNDS (GNDS format management).
Complete the 56Fe evaluation within the NEA-WPEC Subgroup 40 project.	The 56Fe evaluation was completed and is available at the IAEA CIELO project site and as part of the ENDF/B library. It will be part of the ENDF/B-VIII.0 release. A paper describing the evaluation has been submitted for publication.

LANL: Participate in and chair international nuclear reaction data collaborations. This insures that the U.S. benefits from breakthroughs around the world, and plays a leadership role in new developments. LANL staff members participate in NEA/WPEC committees on covariance data and international model code development cooperation. LANL will host visits by foreign scientists with international reputations to benefit from the exchange of information and ideas.

LANL planned activities	Status
Participate in NEA-WPEC 2017 meeting	Several LANL scientists participated in WPEC meeting in 2016.
Participate in relevant IAEA coordinated meetings, such as reference input parameter library and nuclear cross section standards.	A LANL scientist participated in both the photo-nuclear and RIPL-4 CRP meetings.
Help organizing and participate in the workshop on compound nucleus and related topics, CNR17	Completed.
Host a couple of international visitors to LANL to collaborate on the evaluation of reaction data.	We invited a specialist of R-matrix theory from Austria, and a specialist of dynamical fission theory from France.
Host a couple of international visitors to collaborate on reaction experiments at LANSCE	We hosted an exchange student from South Korea to work on calibrating the LENZ chamber and detectors.

LBNL: Participate in IAEA-sponsored training workshops, planning meetings and coordinated research programs on nuclear structure and decay data.

LBNL planned activities	Status
Coordinate EGAF and RIPL evaluations with the IAEA.	This effort in ongoing
Coordinate the development of a new continuum reaction/gamma-ray database with the IAEA and researchers at the Oslo Cyclotron Laboratory. Also coordinate to create a (n,n') database with the IAEA.	We participated in the second RSF-CRP meeting and contributed a report of evaluated radiative strength functions to the RSF CRP during this time period.
Coordinate LBNL/Budapest/FRM-II/Julich TransActinide Nuclear Data Evaluation and Measurement (TANDEM) collaboration to measure actinide neutron cross sections.	This collaboration is ongoing.
Organize NSDD meeting.	We hosted the 22nd Technical Meeting of the Nuclear Structure and Decay Data Network of the International Atomic Energy Agency was held at LBNL from 22-26 May 2017. The meeting was co-sponsored by Nuclear Science and Security Consortium at UC Berkeley. This was the first time that the NSDD meeting had been held in the US since 1995. There were a total of 32 participants from 19 institutions and 9 countries plus 5 UC graduate student observers

MSU: Represent MSU at IAEA-sponsored at Nuclear Structure and Decay Data network (NSDD).

MSU planned activities	Status
Participate in the policy matters related to the NSDD network.	Continuing
Participate in NSDD/IAEA meetings	Attended the 2017 NSDD meeting in LBNL

ORNL: Represent ORNL at IAEA-sponsored at Nuclear Structure and Decay Data network (NSDD).

ORNL planned activities	Status
Participate in the policy matters related to the NSDD network.	Continuing
Participate in NSDD/IAEA meetings	Attended the 2017 NSDD meeting in LBNL

TAMU: Represent TAMU at IAEA-sponsored at Nuclear Structure and Decay Data network (NSDD).

TAMU planned activities	Status
Participate in the policy matters related to the NSDD network.	Continuing
Participate in NSDD/IAEA meetings	Attended the 2017 NSDD meeting in LBNL

TUNL: Represent TUNL at IAEA-sponsored at Nuclear Structure and Decay Data network (NSDD).

TUNL planned activities	Status
Participate in the policy matters related to the NSDD network.	Continuing
Participate in NSDD/IAEA meetings	Continuing

III. Nuclear Physics Databases

A. Nuclear Science References (NSR)

The NNDC is responsible for NSR, the bibliographic database for nuclear physics research. This task includes quality control, file update and maintenance, and file distribution to collaborators. Updates are done on a continuing basis. The preparation of NSR entries is given under Nuclear Structure Physics.

BNL planned activities	Status
Distribute database to collaborators.	Database was distributed to the IAEA and other collaborators on a monthly basis.
Perform Database updates and maintenance.	Database was updated 132 times in FY 2017 and cyber security updates were implemented.
Incorporate new additions to NNDC library (in collaboration with Oak Ridge National Laboratory).	Continuing, materials from Oak Ridge National Laboratory were brought to NNDC library, sorting and analysis in progress.
Joint project with the NRDC network on transfer of missing nuclear reaction references to NSR.	Continuing, addition of missing journal articles is finished, assessment of missing conferences and lab reports in progress.

B. Experimental Nuclear Structure Data (XUNDL)

The NNDC is responsible for maintaining, disseminating and coordinating the XUNDL database. This database contains compilations (in ENSDF format) of recently published or completed nuclear structure and decay data.

BNL planned activities	Status
Perform Weekly update of the database using input received from compilers.	Continuing.
Distribute database twice a year to the NSDD network.	Continuing.
Devise new system to streamline distribution of papers to different USNDP centers.	Completed.
Coordinate with nuclear physics journals to merge XUNDL compilations with their review process.	Continuing.

C. Evaluated Nuclear Structure Data File (ENSDF)

The NNDC is responsible for ENSDF, a database of evaluated experimental nuclear structure and decay data. The NNDC is responsible for format and content checking, preparation of manuscript, and quality control (review) of evaluations submitted for inclusion. The NNDC maintains the database, which includes database updates and distribution to collaborators. Corrections are implemented on a continuing basis.

BNL planned activities	Status
Maintain ENSDF database, includes continuous updating.	The database was regularly updated.
Process evaluations received from NSDD evaluators.	All evaluations received from NSDD network were processed.

Distribute ENSDF database to collaborators twice a year.	ENSDF database was archived on a monthly basis and made available through website.

D. Numerical Nuclear Data File (NuDat)

The NNDC is responsible for NuDat, which consists of a database and a suite of codes that access it, allowing web users to search for level and γ-ray properties extracted from ENSDF, ground and meta-stable state properties (Wallet Cards), atomic and nuclear radiations derived from ENSDF, and thermal neutron cross sections and resonance integrals. Additionally, NuDat contains an interactive Chart of Nuclides and interactive level schemes.

BNL planned activities	Status
Update NuDat database as necessary, about 10 times a year.	Continuing, NuDat was updated regularly.

E. Neutron Reaction Data Bibliography (CINDA)

The NNDC continues to contribute to the CINDA database that contains references to nuclear reaction data in the published and unpublished literature. Since 2004, CINDA also contains bibliography information on charged-particle and photonuclear reactions. The database serves as an index to the data contained in the experimental database, CSISRS. The database is maintained by the Nuclear Data Section, IAEA Vienna.

BNL planned activities	Status
Contribute to CINDA by compiling experimental cross-section data to the EXFOR and NSR databases.	CINDA database was maintained using EXFOR and NSR database contents.

F. Experimental Reaction Data File (CSISRS)

The NNDC is responsible for maintaining the CSISRS database at BNL. This database contains experimental nuclear reaction data for incident energies below 1 GeV, including neutron-induced reactions and reactions with incident charged particles of mass A ≤ 12. Many groups worldwide compile experimental data and send it to the central database in Vienna in the EXFOR format. Then, each is responsible to update its own database. The effort described here includes quality control, file update and data transfer activities. The NNDC database is updated, as compilations are exchanged and checked from the compiling centers. The compilation activity is given under Nuclear Reaction Physics.

BNL planned activities	Status
Update EXFOR database with compilations from cooperating centers (500 entries expected). The NNDC compilation work can be found under Nuclear Reaction Physics, chapter V of the present document.	The EXFOR database was updated 11 times in FY 2017 using the latest NRDC releases.

G. Evaluated Nuclear Data File (ENDF)

The NNDC is responsible for ENDF, a database of evaluated nuclear data required for many nuclear applications. The work is organized under the Cross Section Evaluation Working Group (CSEWG), coordinated by the NNDC. The ENDF file contains complete descriptions of nuclear reactions of neutrons with many nuclides and elements for energies up to 20 MeV and radiations from radioactive decay. A number of evaluations for energies up to 150 MeV and for incident charged particles and photons are also included. The data are stored in the ENDF format developed at NNDC about 35 years ago, and adopted as an international standard. In addition to the U.S. library, ENDF/B, the database contains evaluated data libraries from the European Union, Japan, Russia, and China. This activity includes the processing and quality control for the U.S. ENDF/B library, the distribution of this database in the United States and the exchange of libraries internationally. New evaluations for the next release of the library, ENDF/B-VII.1, are assembled, tested and made available to users through NNDC's Web servers and GForge collaboration server.

BNL planned activities	Status
Maintain Linux/MySQL database system.	Continuing.
Maintain GForge/Subversion system for tracking development of the ENDF/B library.	Continuing.
Maintain and improve Sigma database and web interface for users without specialized knowledge of ENDF-6 format. (See also information dissemination, chapter IV).	Continuing.
Maintain and extend ADVANCE, the ENDF continuous integration system that continually checks for modification to the ENDF database then runs all available tests on the changed data files.	Continuing.

H. Database Software Maintenance

This activity includes software bug fixes and enhancements for the five nuclear physics databases maintained by the NNDC.

BNL planned activities	Status
Fix bugs and develop enhancements for the six nuclear physics databases maintained by NNDC.	Continuing.

I. Database Systems Development

This acivity includes updating database schema, maintanace of the existing content and addition of new data.

BNL planned activities	Status
Upgrade the Linux/MySQL server software to fix bugs, provide new functionalities and improve the system's performance, security and reliability.	Installed a minor release version of Linux/MySQL server software which contained bug fixes and security patches.
Maintain the software for automatic replication of updates from the internal MySQL database server to the external to continuously comply with DOE cyber security requirements.	Done.

IV. Information Dissemination

The goal of the dissemination activities of the USNDP is to provide scientists and engineers with nuclear data from the USNDP-maintained nuclear databases in a variety of user-friendly formats and media.

A. Web Site Maintenance

The NNDC provides electronic access to the nuclear physics databases that it maintains on behalf of the USNDP as well as access to other nuclear physics information through its Web site. The NNDC Web services are powered by five Dell servers, each one has dual 2.9-GHz 8-core processors, 128-GB RAM and 15k-RPM disk drives Other USNDP members also offer nuclear physics information through their websites. These services require resources to maintain currency and improve performance.

ANL Planned Activities	Status
Maintain and upgrade the ANL/NDM report series web site.	Completed
Maintain and upgrade Experimental Resources for Nuclear Data web site.	Completed
Maintain and upgrade ANL Nuclear Data Information web site.	Completed

BNL Planned Activities	Status
Solicit user suggestions on enhancements to the ENSDF, NSR, NuDat and Sigma web interfaces and be responsive to those needs. Expand search capabilities of ENSDF.	This was done. New capabilities were added to NuDat, partly in response to user feedback. Also the ENSDF page was redesigned and enhanced to display user friendly pdf files, and a new feature for mass chain evaluation requests was added.
Maintain web interfaces for ENDF and EXFOR databases.	The ENDF and EXFOR Web interfaces were updated in collaboration with the IAEA.
Maintain currency of the CSEWG, USNDP and the NNDC web sites, proactively respond to the users requests.	The information on these pages were updated with new membership and leadership roles, reports, and activities, code status pages, and building out the conference pages in Indico for Nuclear Data Week 2017,
Maintain the NNDC Web Services availability on the 99% and higher level.	Completed.
Strictly follow all BNL and DOE cybersecurity rules and regulations during the Web application design, development and implementation. Address issues that arise during BNL scans.	Various security filters and check were implemented which reduced all vulnerabilities reported by the BNL security scans to zero.
Upgrade GForge server software to provide more powerful and advanced functionalities in the NNDC collaboration services.	Upgraded the GForge server's Linux operating system and associated applications which had reached end-of-life and, thus were no longer compliant because security patches were no longer available.
Make progress with modernization of the web site, enhancing capabilities and follow industry best practices.	Some of the lessons learned in modernization were applied to the ENSDF site.

LBNL planned activities	Status
(Unplanned Activity - LBNL): In March 2017 the LBNL/UC group released a SQL database compiled from the “Atlas of Gamma-ray Spectra from the Inelastic Scattering of Reactor Fast Neutrons” (http://nucleardata.berkeley.edu). The database contains 7376 partial gamma-ray cross sections from 76 natural and 29 isotopically enriched targets caused by the scattering of reactor fast neutrons obtained at the Al-Tuwaitha research facility in the early 1970s. The group is engaged in updating the database to reflect up-to-date ENSDF values for gamma-ray transition energies, and low-lying state spins and parities in the nuclides observed in the atlas. This work is being perfumed by UC Berkeley student Kaixin Song.	An updated version of the atlas is being prepared featuring up-to-date values for level and gamma-ray energies for fp-shell nuclei. The release is planned for early 2018.

ORNL Planned Activities	Status
Expansion of features of our online software suite that supports the new mass evaluation effort, including new evaluation tools and dissemination capabilities; this activity is at risk of termination.	This work was postponed due to lack of funding

TUNL Planned Activities	Status

Continue to improve the TUNL website and provide access to new information on A = 3 - 20 nuclei.	Continuing
Continue to prepare new PDF and HTML documents of the most recent TUNL reviews.	Continuing
Continue to provide PDF and HTML documents for FAS reviews for the A = 3 - 20 series with the most current NNDC reference keys and with the direct hyperlink of reference with TUNL keys.	We have completed FAS reviews from year 1970 to 1975.
Continue to provide Energy Level Diagrams (in GIF, PDF and EPS/PS formats) to accompany the PDF and HTML documents for the most recent TUNL reviews and preliminary reports, and for the earlier FAS reviews.	Continuing
Provide compiled and evaluated data on the decay of unstable ground states and on structure data from thermal neutron capture.	Continuing
Provide compiled data related to the level parameters for A = 3 - 20 nuclei populated in proton- and alpha-particle-induced reactions.	Continuing
Provide online access of TUNL dissertations collection.	Essentially completed and includes all presently available documents.

B. Customer Services

This task accounts for the non-electronic services which the USNDP renders to customers. At the scientific staff level, this means direct assistance to users needing advice from nuclear data experts or advice on solving complex queries via electronic access to the database. The NNDC staff allocation at the support level is for maintaining a "help desk" and for administrative/clerical support of its customer services.

BNL Planned Activities	Status
Provide technical support to nuclear data end-users as necessary.	Continuing. About 200 emails were answered.
Maintain Comments/Questions for all databases and web products.	Continuing.

C. Publications

The USNDP provides some paper publications as well as electronic access to the nuclear physics databases that it maintains. This includes the Nuclear Data Sheets published by Elsevier and various versions of the Nuclear Wallet Cards.

BNL Planned Activities	Status
Prepare issues of Nuclear Data Sheets for publication.	8 issues of Nuclear Data Sheets were prepared and submitted to Elsevier.
Work on new version of Nuclear Wallet Cards.	Continuing.
Develop software for Nuclear Data Sheets publication (McMaster)	Completed. New software was implemented. Nuclear Data Sheets published in new format February 2017 and pdf versions of ENSDF made available through web retrieval March 2017.

TUNL Planned Activities	Status
Assist with preparation of print-ready manuscripts for review and publication in Nuclear Data Sheets.	With the implementation of JAVA-NDS this activity has been discontinued. TUNL would be willing to assist if needed be.

V. Nuclear Structure Physics

A. NSR Abstract Preparation

The literature search and preparation of KEYWORD abstracts for publications included in NSR require scientific expertise. BNL continues to have the overall responsibility for this database and since July 2013 is the only provider of the new entries to the NSR database.

BNL Planned Activities	Status
Prepare entries for about 3,100 new references, and keyword abstracts for 2,000 of them. Provide coverage for 80 major journals, including complete coverage of Physical Review C and Nuclear Physics A.	3,277 new references were processed and 1,825 keyword abstracts were produced. Coverage for 80 major journals, including complete coverage of Physical Review C and Nuclear Physics A was provided.
Strengthen cooperation between NSR and NRDC network compilation activities.	Continuing, cooperation between NSR and NRDC network compilation activities.
Analyze NSR database content for publication trends and common entries with ENSDF and EXFOR databases.	NSR database content for publication trends and common entries with ENSDF and EXFOR databases was analyzed. Results have been presented at the NRDC meeting and published in journal of Scientometrics.

B. Compilation of Experimental Structure Data

This activity involves compilation of recently published or completed experimental nuclear structure data for inclusion in XUNDL and other, more

specific, databases. The XUNDL compilation is done by ANL, BNL, ORNL, and TUNL, while the NNDC is managing and maintaining the database.

ANL Planned Activities	Status
Compile and review datasets for recently published experimental nuclear structure data for inclusion in the XUNDL database. Interact with the authors for requesting additional experimental data or for further clarification of the published results.	110 XUNDL compilations were prepared and submitted to NNDC.

BNL Planned Activities	Status
Compile new B(E2) experimental data. Continue work on a B(E2) evaluation project (in collaboration with McMaster and Central Michigan Universities). Publish an experimental methods analysis and start on Grodzin's formula fits.	Continuing, 56 new B(E2) values were compiled in FY2017. The experimental methods analysis and Grodzin's formula fits have been finished and the corresponding results were published in Nucl. Phys. A.
Compile new double-beta decay experimental data. Start working on a data project with Kiev Institute for Nuclear Research.	Continuing, 9 nuclei and 16 transition modes were compiled in FY2017. Work with Kiev Institute for Nuclear Research is contingent on financial resources.
Maintain, update and distribute XUNDL.	Continuing.
Compile data sets (in ENSDF format) for current experimental nuclear structure publication. Scan the webpages of prominent journals in nuclear physics for new papers. Review compiled data sets submitted by other data centers prior to inclusion in the XUNDL database. Communicate with the authors of the original papers for data-related problems and to request additional details of unpublished data.	Continuing.
Compile new mass measurements and submit data file to nuclearmasses.org webpage at ORNL. (McMaster)	Continuing.

LBNL Planned Activities	Status
Perform XUNDL compilation.	Ongoing.

MSU Planned Activities	Status
Perform XUNDL compilation.	60 papers were compiled corresponding to 130 data sets

ORNL Planned Activities	Status
Compile XUNDL datasets as required.	11.5 sets were requested for compilation and were completed

TUNL Planned Activities	Status
Compile datasets for current experimental nuclear structure data publications on A=2-20 nuclei for inclusion in the XUNDL database.	TUNL compiled 57 data sets from 35 articles.

C. Data Evaluation for ENSDF

The USNDP evaluates nuclear structure and decay data for inclusion in the ENSDF database. This effort includes the critical analysis of all available experimental nuclear structure and radioactive decay data for a nuclide or a group of related nuclei to deduce recommended values from the measured data and prepare a file in ENSDF format that is the basis for publications in Nuclear Data Sheets ” and is used to update the contents of the USNDP nuclear structure and decay database, ENSDF. The US effort is supplemented by foreign contributions prepared under the auspices of the IAEA-sponsored international Nuclear Structure and Decay Data network.

ANL Planned Activities	Status
Evaluate at least 1 mass chain from the ANL region of responsibility.	60 ENSDF evaluations for selected nuclides were completed and submitted to NNDC. A=188 was resubmitted to NNDC following comments by the reviewer.
Review mass chain evaluations, as requested.	A=138 was reviewed. Work is continuing on A=177.

BNL Planned Activities	Status
At least 6 mass chains, or their equivanent nuclides, will be evaluated.	The equivalent of 6 mass chains were evaluated.
At least 6 mass chains, or their equivanent nuclides, will be reviewed.	6 mass chains were reviewed.
Update ENSDF for the identification of new nuclides and for the first publications on the findings of the excited states of nuclides. Collaborate with a new center/evaluator as part of mentoring process, as needed (McMaster).	Completed.
Continue mentoring new ENSDF evaluators.	Continuing.

LBNL Planned Activities	Status

Evaluate the equivalent of at least 3 mass chains (30 nuclides), including a minimum of one from the A=21-30 region. Emphasis will be placed on evaluating data of current interest to the nuclear structure and nuclear application communities.	Ongoing.
Review mass-chain evaluations, as requested.	Ongoing.
Train new compilers/evaluators.	Ongoing.
Coordinate XUNDL evaluation efforts with UC Berkeley/LBNl/LLNL Nuclear Data Collaboration.	Ongoing.

MSU Planned Activities	Status
Evaluate the equivalent of at least 1 mass chain.	Completed mass chains A=38 and A=39
Review mass-chain evaluations, as requested.	Review of A=51 and A=101 (partial)

ORNL Planned Activities	Status
3.0 equivalent mass chains and the data for new nuclides (as mentioned below) will be evaluated. Mass chains will be reviewed as requested.	A=217 review was completed, A = 76 review completed, A=244 reviewer comments were incorporated into new version and completed.

TAMU Planned Activities	Status
Evaluate the equivalent of 1 mass chain.	Progress was made to evaluate A=160 of 17 nuclides (Z=59-75) cutoff date = 6-1-2005, with 94 new experimental references. We also performed the after-review work and prepared for publication the A=158 of 16 nuclei, which was published in Nuclear Data Sheets.

TUNL Planned Activities	Status
Evaluate about 1-2 A-chains per year for publication in Nuclear Data Sheets and inclusion in the ENSDF database.	TUNL published "Energy Levels of Light Nuclei A=12" and preparing the corresponding ENSDF data sets.
Evaluate and update ENSDF for A=2-20 near drip-line nuclides, especially for first observations or when ENSDF has no previous data set.	TUNL submitted ENSDF evaluations of 4n, 6H, 10N, 11O, 17Na and 20C
Update various reaction data sets in ENSDF, such as for beta-decay and beta-delayed particle emission.	Updated beta-n data sets for 17B, 17C and 18C decay have been submitted.

D. Ground and Metastable State Properties

ANL Planned Activities	Status
Complete and publish the new Atomic Mass Evaluation and NUBASE evaluation of nuclear properties in collaboration with scientists from CSNSM, Orsay, IMP, Lanzhou and RIKEN, Japan	The new AME2016 tables and the complimentary NUBASE2016 evaluation were completed and published in Chin. Phys. C.
Complete and publish a review article on metastable states in heavy nuclei	The review article on "Review of Metastable Sates in Heavy Nuclei" was published in the journal Rep. Prog. Phys.

BNL Planned Activities	Status
Update database as new information becomes available.	Continuing.

E. Non-ENSDF Decay Data Evaluations

ANL: compile and evaluate radioactive decay data for selected nuclei that are of relevance to nuclear structure physics and astrophysics, as well as to energy and non-energy (medical radioisotopes) related applications.

ANL Planned Activities	Status
Evaluate and publish decay data evaluations for selected nuclides within the auspices of the IAEA-CRP on “Nuclear data for charged-particle monitor reactions and medical isotope production”	Completed.
In collaboration with scientists from the Australian National University and under the auspices of IAEA, develop new computational tools and corresponding database for improving data on Auger-electron emitting nuclei, which are relevant to applications of medical radioisotopes	Completed.

F. Neutron-Induced γ-Ray Data Evaluation

The EGAF (Evaluated Gamma-ray Activation File) database, disseminated by the IAEA and maintained by LBNL, currently provides discrete-line prompt γ-ray information from thermal (n,γ) reactions in a format tailored to suit the needs of the neutron activation analysis community. However, it requires ongoing maintenance and development to make it more useful to the applied communities it serves. Statistical-model calculations can generate quasi-continuum photon cascade data to complement these experimental discrete-line data. Together, the experimental and calculated data could constitute a valuable resource required for updating the ENDF database. Additionally, delayed photon data need to be added to EGAF. The k0-

value database currently used by the neutron activation analysis community needs to be assessed and compared with the corresponding decay information in ENSDF, and the resulting evaluated k0 values then need to be integrated into EGAF and, ultimately, made available to ENSDF evaluators.

LBNL Planned Activities	Status
Continue to maintain and develop the EGAF database. Update EGAF prompt gamma-ray cross sections from new measurements. Add activation data to the EGAF file. Include improved nuclear stucture data for the RIPL library in EGAF datasets. Develop a Nuclear Data Sheet publication format for EGAF data.	Ongoing.
Collaborate with Charles University (Prague) to perform statistical-model calculations of quasi-continuum γ-ray cascade information and generate ENDF-format capture γ-ray datasets for use with MCNP and other transport-code calculations.	Ongoing.
Collaborate with the University of Oslo to measure low-energy photon strength functions and level densities.	Ongoing.
Unplanned activity:An updated version of the atlas is being prepared featuring up-to-date values for level and gamma-ray energies for fp-shell nuclei. The release is planned for early 2018. UC Berkeley students Amanda Lewis and Ian Kolaja are using the CoH, Talys and EMPIRE reaction codes to model the data in the Baghdad Atlas with an eye towards producing improved (n,n'γ) spectral data for incorporation into ENDF.	Ongoing.

H. Nuclear Structure Data Measurement

ANL, BNL, LANL and LBNL will devote a relatively small effort (a fraction of FTE each) to participate, through collaborative agreements, in nuclear physics research activities related to nuclear data needs. The emphasis will be on measurements aimed at providing answers to specific questions that arise from recent nuclear data evaluations and at improving quality of existing databases in the specific areas. These activities maintain important collaborative connections with local and national research communities.

ANL Planned Activities	Status
Participate in nuclear physics research activities at ANL, MSU and other nuclear physics user facilities with main emphasis on decay studies of neutron-rich nuclei, spectroscopy of heavy actinide nuclei and nuclei far from the line of stability	Participated in several experiments at ANL (ATLAS and CARIBU) and RIIKEN with emphasis on decay properties of neutron-rich nuclei. The analysis of decay data for neutron-rich nuclides in the light rare-earth region is continuing.

BNL Planned Activities	Status
Precisely determine decay schemes of relevant medical isotopes using state-of-the-art gamma-ray spectroscopy.	Completed. Analysis on 61Cu finalized by DOE SULI student.
Participate in beta-decay measurements at facilities such as Argonne's CARIBU with an emphasis on nuclei relevant to decay heat, antineutrino spectra and delayed nu-bar.	Analysis on 92Rb decay from CARIBU experiment, the top contributor to antineutrino spectra in 5-7 MeV region, was completed by SURP student.
Perform precision measurements of electromagnetic transition strengths in light nuclei as a guide for improved formulations of ab-initio theories.	Analysis on 12Be submitted for publication to PLB. Analysis on Li isotopes is ongoing.
Driven by deficiencies in nuclear data on the neutron-rich side of 208Pb, complete and analyze deep-inelastic reaction experiments performed at Argonne.	Paper on 209Tl was published in PRC. Two SULI students analyzed 198Ir, 203Tl and 202Hg.

LANL Planned Activities	Status
Analyze and publish the prompt gamma-ray data taken on fission products of mass range ~100, using the GEANIE array. experiments at Enriched Xenon Observatory (EXO). In addition we will study ^{186}Re and look for transitions that feed the long-lived isomer.	The prompt gamma-ray analysis on Mo-100 and Zr-99 are still ongoing.
Publish the gamma-ray production cross section on Xe-124, which was measured using the GEANIE array.	The work on Xe-124 is under review by Phys Rev C. The work on Xe-136 is being analyzed as a part of PhD thesis in Indian University.

LBNL Planned Activities	Status
Perform DICEBOX statistical model calculations to determine total radiative cross sections and elucidate nuclear level spins and parities.	Ongoing.
Measure gamma ray cross sections at the Garching FRM-II and Budapest Reactors and produce improved (n,g) decay schemes and total radiative capture cross sections.	Ongoing.
Investigate primary gamma ray photon strength functions and the contribution of the M1+E2 mixing ratio to nuclear statistical model calculations.	Ongoing.

(Unplanned Activity - LBNL): During 2016 and 2017 the LBNL/UCB nuclear data group collaborated with researchers from the nuclear structure groups at LBNL and ANL and the University of Washington analyzed data from an experiment using the GRETINA spectrometer coupled to a phoswich array of particle detectors to determine the properties of excited quasi-continuum (QC) states in 56Fe populated via the 56Fe(p,p'g) reaction. The data from this experiment showed significant radiative strength in the QC and validated the Brink-Axel hypothesis, which states that average gamma-decay rates depend only on the transition energy. It also involved the development of a new technique to obtain the radiative strength of the QC states from their lifetimes using a combination of experiment and modeling. This work will lead to three publications, and will form the basis of the doctoral dissertation of UC graduate student Leo Kirsch. In addition to these activities, members of the group continue to collaborate with researchers from the University of Oslo and iThemba Labs in South Africa to perform measurements of nuclear level densities and radiative strength function. These activities are coordinated with a newly-approved IAEA-CRP to produce an evaluated database of radiative strength.	Ongoing. Leo Kirsch completed his dissertation and submitted a manuscript to Physical Review C describing the new code he developed for this purpose, RAINIER. He is now working on a second manuscript on QC lifetimes in 56Fe measured at GRETINA.

TAMU Planned Activities	Status
(Unplanned activity) We continued the series of precision ICC measurements with the new αK study of 39.7-keV, E3 transition in 103mRh, from the β- decay of 103Ru. The result of this study is going to be used together with the previous α (total ICC) study of the same transition measured from 103Pd ε (that needs the αK value to determine α; otherwise a theoretical αK value should be used). Both values are in agreement with the series of previous measurement that the calculations considering the atomic vacancy are to be used in ENSDF. We also continued the series of high precision half-life values and branching ratio measurements (BR) for testing the unitarily of CKM matrix (Standard Model) with two measurement runs of 42Ti (T1/2) and one of 10C (BR). This type of measurements produce benchmark results in nuclear structure. We completed and published the two Phys. Rev. C papers on 125Te and 127Te ICC measurements.	Completed.

I. ENSDF Physics and Checking Codes

The NNDC maintains ENSDF checking and physics programs on behalf of the national and international evaluator networks

BNL Planned Activities	Status
Maintain and upgrade ENSDF checking and physics programs for format changes as required.	Several requested bug fixes and enhancements were made to fmtchk. Changes were made to alphad, and new changes are underway. Newly compiled code was made for gabs and radlist.
Move codes off the Lahey compiler and make compatible with gfortran.	Done for fmtchk, pandora, radlist, alphad, gabs.
Begin adding codes to ADVANCE for continuous testing.	To be done.

MSU Planned Activities	Status
Work on NDS java code.	Developed and maintained the Java program (JAVA-NDS) being used in generating publish-ready PDF file for the journal of Nuclear Data Sheets and for web-display of ENSDF and XUNDL databases; maintained the XLS2ENS python program used for converting an EXCEL file to an ENSDF file.

VI. Nuclear Reaction Physics

A. Experimental Data Compilation

The NNDC, as part of a larger international cooperation (NRDC), has responsibility for compiling experimental nuclear reaction data that have been produced in the U.S. and Canada. NNDC concentrates on new measurements, and continues compilations of earlier publications that have not been included in the EXFOR database. Since incident charged particle data have not been completely compiled in the past, NNDC is compiling new charged-particle measurements. In addition, because of emerging needs such as astrophysics, the NNDC is compiling older data.

BNL Planned Activities	Status
Compile experimental data for neutron, charged particle, and photon induced reactions from 120 publications.	98 new and 95 revised compilations were prepared in FY2017. The compilation activities include new and previously missing (recovered) data.

Explore possibilities of recovering previously unobtainable reaction data and proactively respond to users needs.	Continuing, work on recovering previously unobtainable reaction data and responses to users needs concentrated on documenting the missing publications and proper reaction coding of the recovered data.

B. ENDF Evaluations

Evaluated nuclear reaction data, for applications and for basic science needs, are stored under version control software on the GForge server, which is maintained by BNL. New evaluations funded primarily from other sources are commited by LANL, LLNL and ORNL, while BNL contribution is supported by the USNDP funding. LLNL is leading international collaboration developing a new XML based data structure intended as a modern replacement for the current ENDF-6 format.

BNL Planned Activities	Status
Respond to user needs for evaluated nuclear reaction data.	Continuing.
Collect and address users feedback related to the ENDF library.	Continuing. In Aug. 2017, held 3rd annual ENDF Hackathon to address ENDF library deficiencies. During the Hackathon, attendies from LLNL, LANL, ORNL, and BNL made 138 commits correcting problems throughout the ENDF library.
Complete evaluation of 56Fe in the frame of the CIELO project. Work with CSEWG on upgraded evaluations for future release of the ENDF/B library.	Evaluations for 54Fe, 56Fe, 57Fe and 58Fe were submitted for inclusion in ENDF/B-VIII.0. These evaluations address many shortcomings in older evaluations while preserving the overall good performance of the Fe evaluations in prior ENDF releases.
Improve methodology for providing covariance data in the resonance region and in the fast neutron region to the next release of ENDF.	Not performed due to manpower shortages.
In collaboration with LLNL, coordinate the development of the Generalized Nuclear Database Structure (GNDS) format as a proposed successor format for ENDF.	FUDGE 4.2.2 was released with support for GND-1.8 was released in March 2016. Drafting of the detailed GNDS specifications is scheduled to complete with the release of the ENDF/B-VIII.0 library.
Provide production cross sections for medical isotopes.	Not done since no funding was available.
Improve methodology for generating unresolved resonance region cross section probability distributions.	Status of this project was presented at ND2016.

LANL Planned Activities	Status
Upgrade the LANL ENDF evaluations for U and Pu isotopes that perform well in criticality benchmarks, including new theoretical development of statistical model for deformed systems. Close collaboration with international nuclear data library activities, CIELO coordinated under OECD/NEA.	New evaluations of Pu239 and Am241 performed in collaboration with international nuclear data activities. A series of neutron radiative capture calculations for even uranium isotopes were done, and the results were published in PRC.
Provide upgraded ENDF evaluated data files for light and medium mass elements, and perform criticality benchmarks.	New files of carbon and oxygen provided for ENDF/B-VIII, and benchmark calculations performed.
Provide new evaluations of the prompt fission neutron spectra for major actinides, based on the Monte Carlo technique as well as the deterministic method including pre-equilibrium emissions at high energies.	The Monte Carlo Hauser-Feshbach technique applied to the prompt fission neutron spectra. However, the actual evaluations were done by the deterministic method with the CoH3 code, which includes the pre-equilibrium emission.
Improve photon production data for neutron capture and inelastic scattering, which will be used in prompt gamma-ray spectroscopy.	Newly evaluated capture and inelastic scattering data files, such as Cu and Hf isotopes, include complete information of photon production. In the case of major actinides, we separated the photons by fission from the total photon production, and compiled into appropriate sections.

LLNL Planned Activities	Status
Perform new evaluations as per LLNL customer requests and submit these and other LLNL generated evaluations into ENDF.	Provision of 8 charged-particle evaluations to ENDF/B-VIII.0, with conversion from ENDL to ENDF formats via GNDS. Improved evaluations for neutron reactions on Be7 and U239
In collaboration with BNL, coordinate the development of the Generalized Nuclear Data (GND) format as a proposed successor format for ENDF.	Continuing.
Convert LLNL's 'Charged Particle Library' to ENDF format for targets up to A=7, to make candidates for inclusion in ENDF/B-VIII when/if they are improvements on existing evaluations there	Done, see above.
Perform R-matrix fits for proton and alpha particles incident on medium-mass nuclei (16 < A < 50), to accurately describe low-energy resonances. The resulting parameter sets will be converted to MF=2 format, to make candidates for future ENDF/B-VIII evaluations.	Management and support of international efforts for R-matrix resonance evaluations, focusing on charged-particle reactions. This coordinated work at LLNL, UND, JAEA, ORNL, Tsinghua and LANL to verify and validate all their R-matrix codes and fits of data.

C. ENDF Manuals and Documentation

The NNDC is responsible for maintaining the format and procedures manual for the ENDF system. We also produce the documentation supporting the contents of the ENDF/B library.

BNL Planned Activities	Status
Maintain GForge version of the ENDF-6 formats manual up-to-date with CSEWG endorsed format changes. Issue official release of the manual.	Continuing. The ENDF-6 formats manual is on track for simultaneous release with the ENDF/B-VIII.0 nuclear data library by the end of calendar year 2017.
Automate the generation and posting of the latest unofficial version of the ENDF-6 formats manual.	The manual production is completely automated by the ADVANCE QA system and published nightly on the NNDC website at http://www.nndc.bnl.gov/endf/format/endf-manual-latest.pdf

D. Nuclear Reaction Standards

Maintaining accurate current values for the standard cross sections is the primary objective of this task. It is efficiently accomplished through international cooperation under auspices of the IAEA.

LANL Planned Activities	Status
Participate in the international effort to reevaluate the light-element standard cross sections with LANL leadership, and investigate the nature of output covariance data from R-matrix analyses of systems containing the light-element standard cross sections.	One scientist participated in the light-element standard meeting, and another scientist participated in the R-matrix meeting at IAEA.
Incorporate the cross section standards into the new ENDF evaluations, and perform validation tests with integral measurements.	The IAEA new standards of fission cross sections were incorporated into the upgraded ENDF, and integral tests were performed.
Perform the precision measurements on 6Li(n,α)t and 6Li(n,α)dn using CLYC detectors, in order to improve uncertainties En > 1 MeV due to the triton breakup ambiguity shown in previous measurements.	The partial measurement was done and the collaborators at the Univ. of Massachusetts at Lowell are analyzing the data. The study on CLYC detector measurements on the Cf-252 source at LANSCE has been submitted to the NIM A journal.

NIST Planned Activities	Status
Initial values of the standards for use in the next version of a number of cross section libraries will have been determined at a July meeting. Additional data are expected that can be included in the evaluation shortly after the end of FY16. The final values will be obtained by the end of calendar year 2016 and will be made available for data testing and review. These data are largely a result of work on the IAEA data development project on maintenance of the neutron cross section standards. In addition to the traditional neutron cross section standards, this includes results for the capture cross section of gold at energies below 200 keV, as well as neutron spectrum results for the spontaneous fissioning of 252Cf and the fissioning of 235U with thermal neutrons.	Completed.
Drafts of the work done on the standards evaluation prepared through the IAEA data development project will be prepared in electronic form. This becomes the documentation for this new evaluation of the standards	Completed.
In an effort to continually improve the standards, we continue to recommend and encourage new measurements and perform examinations of the data from them for use in future evaluations of the standards.	Completed.
Diagnostic work will continue leading to measurements with the new deuterium gas target. This work is a step in the process of detecting neutrons to measure the H(n,n) angular distribution. The measurement will lead to improved determinations at small center-of-mass angles. This work is on an experiment at 10 MeV. Data will also be obtained at 14.9 MeV in the future. This work is done in collaboration with Ohio University, LANL and the U. of Guelma.	Completed.
Work will continue on an experiment based on 252Cf nu-bar leading to an improved calibration of NBS-I, the U.S. national primary standard neutron source and new determination of our manganese bath efficiency. Another approach is also underway in which the neutron fluence is based on alpha-gamma coincidences with the 10B(n,alpha) reaction. It will be done with a small bath and inter-compared with NBS-I indirectly.	Completed.
The measurement and initial analysis of the 6Li(n,t) standard cross section determination at ~ 4 meV neutron energy has been completed. It uses an improved fluence determination based on alpha-gamma coincidences with the 10B(n,alpha) reaction. A significant effort has gone into an investigation of the uncertainty of this result resulting mainly from uncertainty in the 6Li mass. The initial value obtained was in excellent agreement with the ENDF/B-VII standards evaluation. It was found that the mass reported by IRMM was in error. Using the new mass value produces a cross section value with an uncertainty of 0.3% lower by 1% compared with the ENDF/B-VII value. Publication of the result of this work is delayed due to interactions with IRMM on their new mass value. Work continues on a study of the stability of 10B deposits for	Completed.

10B(n,alpha)cross section measurements. If suitable targets can be made, cross section measurements will be initiated.	
Continue to acquire and monitor samples in the National Repository for Fissionable Isotope Mass Standards. Also make these samples available for loan in physics experiments. experiments.	Completed.

E. Nuclear Model Development

Nuclear reaction theory calculations have played a crucial role in the evaluation of nuclear data, and will continue to play an important part in future evaluations. USNDP develops advanced model codes to provide a state-of-the-art capability to predict reaction cross sections and to explore nuclear reaction physics in details. This task covers development and validation of nuclear reaction model codes, such as CoH and CGM (LANL), EMPIRE (BNL) and FREYA (LLNL) used for prediction of nuclear reaction observables. These codes, with parameters calibrated to reproduce available experimental data, are used to produce reaction evaluations by providing complete and consistent set of cross sections, spectra and angular distributions.

This also involves a close collaboration with experimentalists at LANSCE to interpret new measurements using the GEANIE, DANCE, and CHI-NU detectors. These data will result in advances in our understanding of nuclear reaction mechanisms, and improvements in our modeling codes.

BNL Planned Activities	Status
Continue to improve reaction modeling in the EMPIRE code, maintain code's numerical integrity and enhance user friendly GUI.	EMPIRE code was maintained including number of adjustments to the needs of iron and uranium evaluations.
Improve EMPIRE covariance capabilities for fast neutrons.	Covariance generation strategy has been developed that prevents too small uncertainties typically produced by the Kalman approach. The new strategy has been successfully applied to the iron evaluations.
Maintain GForge site with the current version of the EMPIRE code.	Continuing.
Maintain continuous integration system ADVANCE for checking and validation of new EMPIRE versions.	Continuing.

LANL Planned Activities	Status
Continue to develop a microscopic description of fission process in the fast energy range, which includes Class-I and Class-II coupling, as well as penetrability calculations through arbitrary fission barrier shapes. Implement the theory into the Hauser-Feshbach code to facilitate actinide evaluations.	This study continues. A technique to solve a Schroedinger equation for an arbitrary fission barrier shape developed, and implemented into the CoH3 code.
Continue to develop a coupled-channels Hauser-Feshbach method to neutron capture process for deformed targets including M1 scissors mode, in support of DANCE and GEANIE measurements, and fission cycle in r-process nucleo-synthesis studies.	A Phys. Rev. C paper on a global estimate of M1 scissors mode was published by linking the M1 strength with the nuclear deformation. The impact of the r-process nucleosynthesis was examined.
Study neutron inelastic scattering from deformed nuclei in the fast energy range, to which theoretical calculations are essential, in collaboration with CEA, France and IAEA.	A Phys. Rev. C paper published on this subject; the Engelbrecht-Weidenmueller transformation technique to calculate the S-matrix when strongly coupled channels exist. This is a join publication with CEA and IAEA.
Continue prompt fission neutron and gamma-ray spectrum calculations with the Monte Carlo method to 235U, 239Pu, and 252Cf, and compare available experimental information. Extend the neutron incident range to cover applications.	This work continued. The Monte Carlo Hauser-Feshbach code, CGMF, was applied to 235U and 239Pu and model parameters were extended in order to deal with wider neutron-incident energy range. This year, we paid a significant attention to the prompt gamma-ray emission.
Develop new width fluctuation correction calculation for the deformed systems, based on the Gaussian Orthogonal Ensemble and the Monte Carlo technique, which includes both the coupled and uncoupled channels in a consistent way.	This technique was developed, and some numerical studies were done. The method was implemented into the CoH3 code, as well as an in-house version of TALYS at CEA.
Continue to develop Monte-Carlo Hauser-Feshbach code, CGM, that can be used as an event generator in radiation transport codes.	The development of CGM continues, and a new deterministic code was also created in order to study the model parameters in more wider parameter space.
Develop a semi-microscopic level density model based on the Gaussian Orthogonal Ensemble.	The semi-microscopic level density model that include a delta-interaction developed, and presented at several conferences and meetings.

F. Nuclear Reaction Data Measurements

Experimental results are primary source of information in evaluation of nuclear data. They are also used to calibrate nuclear reaction theory calculations to interpolate or extrapolate to the regions for which no experimental data are available in order to provide complete nuclear data file. This activity is also essential to support and verify nuclear model development and application.

ANL is collaborating with INL on Measurement of Actinide Neutronic Transmutation Rates with Accelerator mass spectroscopy (MANTRA) aimed at obtaining valuable integral information about neutron cross sections on high mass actinides that are of importance to advanced nuclear fuel cycles. BNL is involved in a collaboration with BLIP to measure cross sections of relevance to the production of medical radioisotopes. LANL is traditionaly involved in extensive measurement campaigns carried out at several LANL facilities at WNR such as GEANIE, FIGARO, Chi-Nu, and DANCE. Most of these activities are funded from other sources. LBNL is collaborating with the Budapest Reactor Centre in the measurement, using isotopically-enriched targets, of selected thermal (n,γ) cross section data to supplement earlier elemental target measurements from which important information was either lacking (e.g., data from low-abundance isotopes) or discrepant.

ANL Planned Activities	Status
Continue participating at MANTRA research activities at ANL	Completed. Participated in an experimental program at ATLAS (ANL).

LANL Planned Activities	Status
Perform the precision measurement on the prompt fission-neutron spectrum for fission induced by neutrons of 0.5 to 200 MeV on 235U and 239Pu. With the high energy neutron detector array, the measurement will be extended to the outgoing neutrons up to 12 MeV.	Completed the data taking of the PFNS on U-235 and Pu-239 for the incoming neutron energy of 0.5 - 200 MeV at LANSCE. The high energy neutron detector array measurements were completed on both actinides up to 12 MeV and the preliminary result showed the PFNS of U-235 in the outgoing neutron energies from 10 keV to 10 MeV.
Analyze and publish radiative strength functions in neutron capture on 234,236,238U in collaboration with Theory Division at LANL.	The work has been completed and published in PRC this summer.
Transmission experiments on oxygen or neon isotopes at neutron energies from 1 MeV to 200 MeV for the interest of Dispersive Optical Model potential investigation and some level information near particle thresholds.	The measurements on oxygen isotopes were completed and the data analysis for a PhD thesis is on going.
Perform the measurements of the Pu-239 fission cross section relative to H(n,n), using the TPC.	The data analysis of the Pu-239 cross section has been progressed and the investigation of the relative measurement to H(n,n) is on going.
Perform the precision measurement on the 16O(n,α) reaction cross section at LANSCE	The precision measurement on the 16O(n,alpha) reaction cross section has been performed and the preliminary cross section is made. The systematic uncertainties are in the process of being estimated.

LBNL Planned activities	Status
Measure thermal (n,γ) cross sections using guided neutron beams in collaboration with the Budapest Research Centre and at the Munich Reactor.	Completed. No measurements are planned at this time.
Established and measure (n,n'g) measurement capabilities at the LBNL 88" cyclotron, and the UC Berkeley neutron generator laboratory. Measure gamma ray partial cross sections.	Ongoing. This work is in collaboration with Dr. Bethany Goldblum from the Bay Area Neutron Group.
(Unplanned Activity - LBNL): During 2016 and 2017 the LBNL/UC nuclear data group working with externally-supported graduate students from UC-Berkeley, Lahore Regional University in Pakistan and Karlsruhe Institute of Technology (Germany) performed a set of targeted activation-based cross section measurements to address uncertainties in the production of isotopes for medical and research applications, and to Three measurements were performed at the LBNL 88-Inch cyclotron: natFe(p,x)51,52g,52mMn, natZr(d,x)86,87Y and 139La(p,xn)139-xCe, and have formed part of the doctoral and masters theses for three graduate students. The group also participated in an activation-based measurement of the 64Zn(n,p) and 47Ti(n,p)47Sc cross sections using the compact DD High Flux Neutron Generator (HFNG) on campus. These results were published in Nuclear Instrumentation and Methods and will form a portion of the thesis data for the externally-supported UC graduate student Andrew Voyles. Lastly, the LBNL/UC group together with UC Berkeley graduate student Andrew Voyles collaborated with scientists from Los Alamos National Laboratory to develop the natNb(p,x)90Mo reactions as a new high-energy proton dosimetry standard. The need for new high-energy dosimetry standards was specifically called-out as the first nuclear data need in the NDNCA whitepaper (http://bang.berkeley.edu/events/ndnca/whitepaper).	Ongoing. The Y(d,xn) measurements formed a component of the thesis of Dr. Haleema Zaneb from Lahore Regional University. The Fe(p,x) measurements are being prepared for publication by Mr. Andrew Voyles as part of his thesis. A new measurement was performed in September 2017 of the La(p,xn) cross sections for x≤6 as part of a collaboration with the Isotopes Program. The focus is on the production of the positron-emitting 134Ce for use as a bio-uptake surrogate for the promising alpha-therapeutic radionuclide, 225Ac. The initial data analysis is complete, and this will form part of the Ph.D. project for UC Berkeley graduate student Jonathan Morrell.

G. Evaluation of Data Needed for Astrophysics

The objective of this activity is to support the nuclear data needs of the increasingly sophisticated simulations of astrophysical phenomena. ORNL chairs the Astrophysics Task Force of the USNDP, which serves to improve communication and coordination of nuclear data evaluation activities relevant for studies in astrophysics. ORNL also evaluates capture reactions on radioactive, proton-rich nuclei which are important for element synthesis and energy generation in stellar explosions. LANL participates in the USNDP effort by developing high-quality data for calculation of nucleosynthesis and makes these results available to astrophysics research community.

ANL Planned Activities	Status
Continue studying properties of levels above the long-lived isomer in 186Re relevant to chracterization of the production and destruction cross sections of this astrophysical relevant isotope	Completed. The results were published in Phys. Rev. C

BNL Planned Activities	Status
Work on neutron capture and fission integral values and their uncertainties in the energy region of interest for nuclear astrophysics.	Maxwellian-averaged cross sections for ENDF/B-VIII.beta4 library have been produced. The cross sections analysis indicates comparable with the KADoNiS library stellar nucleosynthesis parameters.

Evaluate nuclear astrophysics potential of EXFOR library.	Continuing, nuclear astrophysics potential of the EXFOR library is constantly enhanced and re-evaluated during the compilation process.

LANL Planned Activities	Status
Continue improvement of neutron capture modelling for calculating neutron capture rates off-stability to s and r-process hydro-dynamics simulations. Our focus is on a semi-microscopic level density modeling including spin and parity distributions, which is based on nuclear mean-fields theories.	The semi-microscopic level density model still under development, however some preliminary calculations were performed for the neutron capture reaction on iron. A large scale neutron capture calculation was performed for the r-process, which includes the M1 scissors mode.
Continue development of simultaneous beta-delayed neutron and fission calculations, and provide the reaction rates for the fission cycle study in the r-process nucleo-synthesis.	The beta-delayed neutron work was published in Phys. Rev. C. The beta-delayed fission paper is in preparation. We provided the calculated reaction rates for the r-process nucleosynthesis study that includes the fission cycle.
Perform measurements on (n,p) and (n,α) cross sections on the isotopes of interest for better understanding of p-process nucleosynthesis, in conjuction with the improvement on Hauser-Feshbach calculations	The Selenium target was attempted to be manufactured for the (n,p) reaction in the interest of p-process nucleosynthesis. The natural Ni was measured for the (n,p) reaction cross sections in the interest of nu-p process nucleosynthesis.

LLNL Activities	Status
The FIssion in R-process Elements (FIRE) collaboration was jointly funded in FY17. Its goal is to determine the astrophysical conditions of the rapid neutron capture process (r-process), which is responsible for the formation of heavy elements. This will be achieved by including in r-process simulations the most advanced models of fission (spontaneous, neutron-induced, β-delayed) that have been developed at LLNL and LANL. The collaboration is composed of LLNL (lead) and LANL for work on nuclear data (ground-state properties, fission, β-decay), BNL for nuclear data management, and the university of Notre Dame and North Carolina State University for r-process simulations. Under DOE/NNSA agreement, universities receive funds from the DOE Office of Science, while national laboratories receive funds directly from NA221.	The USNDP funds 0.5 PD at the University of Notre Dame (currently Nicole Vassh) and 1.0 graduate student at North Carolina State University (currently Yonglin Zhu). Vassh has begun extensions of the nuclear physics reverse-engineering work (see J. Phys. G 44, 034003 (2017)). The goal is to use the features of the rare-earth peak of the solar r-process abundance pattern to deduce the (still unknown) nuclear masses required to produce it, given a particular set of astrophysical conditions. Vashh validated her approach by comparing the predictions of nuclear masses from this reverse-engineer approach to standard mass evaluations and recent measurements at the CARIBU facility at ANL.In a second, related project, Vashh and ND graduate student Erika Holmbeck have incorporated various mass models as well as empirical and semi-empirical fission yield models to analyze the influence of fission yields on r-process abundance patterns. They identified nuclei that provide a robust fission flow.FIRE graduate student Yonglin Zhu has begun studying how the matter-neutrino resonance (MNR) effect affects the r-process in neutrino-driven winds occurring during a neutron-star merger. Due to the considerable number of neutrinos and electrons present during the merger, large numbers of neutrino-electron interactions can occur resulting in flavor oscillations of neutrinos, hence changes in electron fraction Ye. This, in turns, affect the abundance pattern in r-process simulations.

ORNL Planned Activities	Status
Continue assessments of capture reactions on p-rich unstable nuclides that are important for novae and X-ray bursts. The nuclei to be studied are those planned for measurements at radioactive beam facilities.	Levels in 21Na, 12N, and 35Cl were assessed for levels of astrophysical importance and included in three PRC publications.
Extract spectroscopic information (excitation energies, spectroscopic factors, spins, parities, ANCs) on nuclei near the N=82 closed shell – 81Ge, 127,129Sn, 135Te - from transfer reaction measurements on radioactive Ge, Sn, and Te nuclei. Use this information to calculate direct capture cross sections needed to model the r-process in supernovae. Develop techniques to quickly provide the nuclear structure information needed for these cross section calculations.	At ORNL, work continues on direct capture cross section calculations of exotic Sn isotopes based on radioactive beam measurements, with one paper submitted to PRL and another in progress.

H. Covariances Development

Quantification of uncertainties and their correlations, mathematically represented as covariance matrices, became recently a focal point of the ENDF evaluation effort world-wide. A strong motivation for this revival is the role of covariances in guiding adjustment of the evaluations to the integral experiments to improve reliability and performance of the new libraries. Work in this field includes improvement of the methodology as well as development of actual covariance data. Major covariance activities are carried out at BNL, LANL and ORNL (the latter in the resonance region).

BNL Planned Activities	Status
COMMARA-3, a library of covariance matrices including cross-reaction correlations will be produced for the iron evaluations (54,56,57,58Fe) developed within the international CIELO project.	Covariances for the isotopes of iron have been produced and submitted to the CIELO and ENDF/B-VIII.0 library.

I. Reactor antineutrino spectra and decay heat calculations

Decay heat and anti-neutrino spectra can be calculated using the fission yields and decay data sublibrary from the ENDF-6 formatted libraries.

BNL Planned Activities	Status
Improve our methods and databases to calculate anti-neutrino spectra for major actinides.	We studied the sensitivity of the 2016 Daya Bay data to experimental shape corrections, whose results were published in the following article: Dissecting Reactor Antineutrino Flux Calculations A.A. Sonzogni, E.A. McCutchan, and A.C. Hayes Phys. Rev. Letter **119**, 112501 (2017). We also collaborated with LANL on summation calculation of the Daya Bay evolution data.
Perform decay heat calculations in collaboration with experimental groups.	Continue working with groups in Valencia and ORNL on decay heat calculations.
Possibly participate in relevant experiments.	Not performed due to possible budget shortfalls.
Work on a review article.	Not performed due to a rapidly changing field.

J. Verification and Validation

Quality Assurance (QA) of a nuclear data library requires that all files are checked for integral consistency and conformance with the adopted format. This part of the QA is called verification and is one of the fundamental functions of the National Nuclear Data Center. Furthermore, checking performance of the library against the integral experiments, known as validation, is an important step ensuring usefulness of the library for the end-users. The most extensive validation is performed by LANL and other CSEWG contributors funded with non-DOE-SC sources. The USNDP supports the ultimate validation effort carried out at BNL.

BNL Planned Activities	Status
Establish automatic, real time verification and validation of new/modified ENDF evaluations submitted to the NNDC GForge server.	The ADVANCE QA system does this automatically. ADVANCE was updated to produce reports on the quality of the ENDF covariance data and produced ACE files using LANL's NJOY data processing system.

Detailed Status of the Work Plan
Fiscal Year 2017 Report

Appendix A
Fiscal Year 2017 Additional Funding Sources

BNL

Additional support for the nuclear data work at the National Nuclear Data Center comes from the following sources:

1. The US Nuclear Criticality Safety Program (NCSP), funded by DOE NNSA, supports the NNDC services in maintaining NCSP data submitted to ENDF/B-VII library as well as data development work on estimates/ evaluations of neutron cross section covariances for criticality safety applications.

2. The Fission in Rapid Process Elements (FIRE) collaboration.

LANL

Most of the nuclear data work is supported from funds other than the nuclear data program. The effort is in support of the ENDF-related work of nuclear model development, nuclear reaction evaluation and ENDF processing.

1. Advanced Simulation and Computing (ASC program). This work supports the development of more accurate ENDF cross section databases for actinide fission fuels, light-nucleus thermonuclear fuels, a nd for reactions on important materials used for diagnostics (radiochemical reactions). Nuclear model code development, for both statistical and preequilibrium models, and for light R-matrix codes, is supported by this program, as is the development of the NJOY data processing code for providing data usable by Monte Carlo and deterministic transport codes in applications. The funding also supports physics research developments in nuclear reaction and structure theory (with a recent emphasis on nuclei and isomers away from stability), and fission theory. Data testing using integral benchmarks such as fast critical assemblies is used to validate the ENDF data.

2. Nuclear criticality safety. This funding supports improved nuclear data important in criticality safety studies, such as uranium isotopes, as well as data on structural materials. Data testing using critical assemblies and NJOY processing code development is also funded by the program.

3. LANL LDRD. There is one LANL LDRD project to study the cosmogenic origins of 60Fe.

4. Nuclear Weapons supports LANSCE measurements of fission output (neutrons and gamma rays), neutron capture on actinides and radchem isotopes, and neutron reactions relevant to radchem.

5. DOE/NNSA Correlated Data in Fission Events (NA22), supports Monte Carlo Hauser-Feshbach modeling for fission neutron and gamma-ray emissions, and relevant code development.

6. DOE topical collaboration on Fission In R-Process Elements (FIRE) supports modeling of fission process and fission observables, such as fission product yields, with particular emphasis on the r-process nucleosynthesis.

LBNL

- UC-Berkeley Nuclear Engineering Department: During this year 25% of Dr. Jonathan Batchelder's support came from two different internal UC-Berkeley sources. His responsibilities during included serving as the facility manager of the High Flux Neutron Generator at UC-Berkeley and helping to lead targeted cross section measurements of interest to Isotope Production and basic science. Lee Bernstein also received support from UC-Berkeley to teach the upper level nuclear physics course at Cal. This accounted for about 8% of his salary support during this time period.
- The NNSA Office of Counter-proliferation Research and Development (NA-22): During this time Lee Bernstein received summer salary support and mentoring funds from the Nuclear Science and Security Consortium (NSSC) grant that he is a Co-PI on through the university. This accounting for approximately 15% of his support in FY17. The NSSC also provided approximately 40% of the salary support for Dr. Aaron Hurst to continue his analysis of gamma-ray spectral data and help mentor UC-Berkeley students.

LLNL

NNSA Defense Programs, the Department of Homeland Security, and branches of the Office of Science outside the USNDP support most of the nuclear efforts at LLNL. Funding from USNDP is used to coordinate these efforts and process data for use by the larger community. Much of the Livermore experimental work is made possible by beam time and collaborations at TUNL, TRIUMF, Texas A&M University Cyclotron Institute, LANSCE and LBNL. Sponsorship for different nuclear efforts includes:

1. NNSA/ASC funds data evaluation, validation and verification efforts, development of theory supporting the surrogate measurement campaign for unstable actinides, and optical potentials. Also funds part of the nuclear data formats and the processing of nuclear data.

2. NNSA/DP/SC funds experimental campaigns for unstable actinides, including development of the Time Projection Chamber at LLNL for new 239Pu fission cross section measurements.

3. NNSA/NA-22 funds the event by event fission modeling and the capture-gamma-ray evaluations.

4. OS/ARRA funds in part the generalized nuclear data efforts in tandem with ASC/IC.

5. NNSA/NA-22 is now funding full cross section evaluations

6. NNSA/NA-22 funds experimental efforts in surrogate measurements of nuclear cross sections

NIST

A variety of sources support nuclear data activities:

1. The NIST-DOE Neutron Cross Section and Fluence Standards program has funding through the Commerce Department. This provides about half of the total support for the program.

2.NIST provides 1 FTE for standard cross section work using ~4 meV neutrons and also for interferometry work, which has yielded coherent scattering lengths (which provide scattering data) needed for neutron cross-section evaluations.

4.NIST provided 1 FTE (75% experimental, 25% evaluation) for nuclear structure and decay data work. Much of this work also has applications in radioactivity standards and radiopharmaceutical studies.

ORNL

The nuclear data work is partly funded by the DOE-SC Low Energy Nuclear Physics program.

TAMU

Data and experimental activities supported by U.S. Department of Energy, Office of Science, Office of Nuclear Physics, under Grant No. DE-FG03-93ER40773.

TUNL

The nuclear data work is partly funded by the DOE-SC Low Energy Nuclear Physics program through a TUNL/NCSU grant.

Appendix B
Fiscal Year 2017 Selected Articles

1. **2017AL11** Eur.Phys.J. A 53, 62 (2017)
   J. M. Allmond, C. W. Beausang, T. J. Ross, P. Humby, M. S. Basunia, L. A. Bernstein, D. L. Bleuel, W. Brooks, N. Brown, J. T. Burke, B. K. Darakchieva, K. R. Dudziak, K. E. Evans, P. Fallon, H. B. Jeppesen, J. D. LeBlanc, S. R. Lesher, M. A. McMahan, D. A. Meyer, L. Phair, J. O. Rasmussen, N. D. Scielzo, S. R. Stroberg, M. Wiedeking
   Particle- γγ coincidence spectroscopy of the N = 90 nucleus 154Gd by (p,tγ)

2. **2016AL19** Phys.Rev. C 94, 034617 (2016)
   J.B.Albert, S.J.Daugherty, T.N.Johnson, T.O'Conner, L.J.Kaufman, A.Couture, J.L.Ullmann, M.Krticka
   Measurement of neutron capture on 136Xe

3. **2017AM01** Phys.Rev. C 95, 014330 (2017)
   B.M.S.Amro, C.J.Lister, E.A.McCutchan, W.Loveland, P.Chowdhury, S.Zhu, A.D.Ayangeakaa, J.S.Barrett, M.P.Carpenter, C.J.Chiara, J.P.Greene, J.L.Harker, R.V.F.Janssens, T.Lauritsen, A.A.Sonzogni, W.B.Walters, R.Yanez
   γ-ray spectroscopy of 209Tl

4. **2017AR04** Prog.Part.Nucl.Phys. 94, 1 (2017)
   A.Arcones, D.W.Bardayan, T.C.Beers, L.A.Bernstein, J.C.Blackmon, B.Messer, B.A.Brown, E.F.Brown, C.R.Brune, A.E.Champagne, A.Chieffi, A.J.Couture, P.Danielewicz, R.Diehl, M.El Eid, J.E.Escher, B.D.Fields, C.Frohlich, F.Herwig, W.R.Hix, C.Iliadis, W.G.Lynch, G.C.McLaughlin, B.S.Meyer, A.Mezzacappa, F.Nunes, B.W.O'Shea, M.Prakash, B.Pritychenko, S.Reddy, E.Rehm, G.Rogachev, R.E.Rutledge, H.Schatz, M.S.Smith, I.H.Stairs, A.W.Steiner, T.E.Strohmayer, F.X.Timmes, D.M.Townsley, M.Wiescher, R.G.T.Zegers, M.Zingale
   White paper on nuclear astrophysics and low energy nuclear physics Part 1: Nuclear astrophysics

5. **2017AU03** Chin.Phys.C 41, 030001 (2017)
   G.Audi, F.G.Kondev, M.Wang, W.J.Huang, S.Naimi
   The NUBASE2016 evaluation of nuclear properties

6. **2017BA21** Nuclear Data Sheets, 143, 1 (2017)
   M. S. Basunia
   Nuclear Data Sheets for A=193

7. **2017BA28** Phys.Rev. C 96, 024619 (2017)
   B.Baramsai, M.Jandel, T.A.Bredeweg, E.M.Bond, A.R.Roman, G.Rusev, C.L.Walker, A.Couture, S.Mosby, J.M.O'Donnell, J.L.Ullmann, T.Kawano
   Radiative neutron capture cross section from 236U

8. **2017BU04** Phys.Rev. C 95, 024610 (2017)
   M.Q.Buckner, C.Y.Wu, R.A.Henderson, B.Bucher, N.Wimer, A.Chyzh, T.A.Bredeweg, B.Baramsai, A.Couture, M.Jandel, S.Mosby, J.L.Ullmann
   Measurement of the 242mAm neutron-induced reaction cross sections

9. **2017CA06** Prog.Part.Nucl.Phys. 94, 68 (2017)
   J.Carlson, M.P.Carpenter, R.Casten, C.Elster, P.Fallon, A.Gade, C.Gross, G.Hagen, A.C.Hayes, D.W.Higinbotham, C.R.Howell, C.J.Horowitz, K.L.Jones, F.G.Kondev, S.Lapi, A.Macchiavelli, E.A.McCutchan, J.Natowitz, W.Nazarewicz, T.Papenbrock, S.Reddy, M.J.Savage, G.Savard, B.M.Sherrill, L.G.Sobotka, M.A.Stoyer, M.B.Tsang, K.Vetter, I.Wiedenhoever, A.H.Wuosmaa, S.Yennello
   White paper on nuclear astrophysics and low-energy nuclear physics, Part 2: Low-energy nuclear physics

10. **2017CH19** Phys.Rev. C 95, 044319 (2017)
    K.A.Chipps, S.D.Pain, U.Greife, R.L.Kozub, C.D.Nesaraja, M.S.Smith, D.W.Bardayan, A.Kontos, L.E.Linhardt, M.Matos, S.T.Pittman, P.Thompson
    Particle decay of proton-unbound levels in 12N

11. **2017CH22** Phys.Rev. C 95, 045808 (2017)
    K.A.Chipps, S.D.Pain, R.L.Kozub, D.W.Bardayan, J.A.Cizewski, K.Y.Chae, J.F.Liang, C.Matei, B.H.Moazen, C.D.Nesaraja, P.D.O'Malley, W.A.Peters, S.T.Pittman, K.T.Schmitt, M.S.Smith
    First spin-parity constraint of the 306 keV resonance in 35Cl for nova nucleosynthesis

12. **2017CH34** Phys.Rev. C 96, 025810 (2017)
    S.M.Cha, K.Y.Chae, S.Ahn, D.W.Bardayan, K.A.Chipps, J.A.Cizewski, M.E.Howard, R.L.Kozub, K.Kwak, B.Manning, M.Matos, P.D.O'Malley, S.D.Pain, W.A.Peters, S.T.Pittman, A.Ratkiewicz, M.S.Smith, S.Strauss
    Spectroscopic study of the radionuclide 21Na for the astrophysical 17F (α, p) 20Ne reaction rate

13. **2017CL01** Phys.Rev. C 95, 064612 (2017)
    S.D.Clarke, B.M.Wieger, A.Enqvist, R.Vogt, J.Randrup, R.C.Haight, H.Y.Lee, B.A.Perdue, E.Kwan, C.Y.Wu, R.A.Henderson, S.A.Pozzi
    M*easurement of the energy and multiplicity distributions of neutrons from the photofission of 235U*

14. **2017DA20** Phys. Rev. C 96, 024602 (2017).
    B. H. Daub, D. L. Bleuel, M. Wiedeking, L. A. Bernstein, N. M. Brickner, J. A. Brown, B. L. Goldblum, K. S. Holliday, J. Lundgren, and K. Moody.
    Neutron transfer in the 13C+197Au reaction from gold isotope residuals.

15. **2017DO01** Phys.Lett. B 766, 334 (2017)
    D.T. Doherty, J.M. Allmond, R.V.F. Janssens, W. Korten, S. Zhu, M. Zielinska, D.C. Radford, A.D. Ayangeakaa, B. Bucher, J.C. Batchelder, C.W. Beausang , C. Campbell, M.P. Carpenter, D. Cline, H.L. Crawford , H.M. David, J.P. Delaroche, C. Dickerson, P. Fallon, A. Galindo-Uribarri, F.G. Kondev, J.L. Harker, A.B. Hayes, M. Hendricks, P. Humby, M. Girod , C.J. Gross, M. Klintefjord, K. Kolos, G.J. Lane, T. Lauritsen,

J. Libert , A.O. Macchiavelli, P.J. Napiorkowski, E. Padilla-Rodal, R.C. Pardo, W. Reviol, D.G. Sarantites, G. Savard, D. Seweryniak, J. Srebrny, R. Varner, R. Vondrasek, A. Wiens, E. Wilson , J.L. Wood , C.Y. Wu
Triaxiality near the 110Ru ground state from Coulomb excitation

16. **2017FI03** Phys.Rev. C 95, 014328 (2017)
R.B.Firestone, T.Belgya, M.Krticka, F.Becvar, L.Szentmiklosi, I.Tomandl
Thermal neutron capture cross section for 56Fe(n,γ)

17. **2017GU07** Acta Phys.Pol. B48, 529 (2017)
V.Guadilla, A.Algora, J.L.Tain, J.Agramunt, J.Aysto, J.A.Briz, A.Cucoanes, T.Eronen, M.Estienne, M.Fallot, L.M.Fraile, E.Ganioglu, W.Gelletly, D.Gorelov, J.Hakala, A.Jokinen, D.Jordan, A.Kankainen, V.Kolhinen, J.Koponen, M.Lebois, T.Martinez, M.Monserrate, A.Montaner-Piza, I.Moore, E.Nacher, S.E.A.Orrigo, H.Penttila, I.Pohjalainen, A.Porta, J.Reinikainen, M.Reponen, S.Rinta-Antila, B.Rubio, K.Rytkonen, T.Shiba, V.Sonnenschein, A.A.Sonzogni, E.Valencia, V.Vedia, A.Voss, J.N.Wilson, A.-A.Zakari-Issoufou
Study of the β Decay of Fission Products with the DTAS Detector

18. **2017GU17** Phys.Rev. C 96, 014319 (2017)
V.Guadilla, A.Algora, J.L.Tain, J.Agramunt, D.Jordan, A.Montaner-Piza, S.E.A.Orrigo, B.Rubio, E.Valencia, J.Suhonen, O.Civitarese, J.Aysto, J.A.Briz, A.Cucoanes, T.Eronen, M.Estienne, M.Fallot, L.M.Fraile, E.Ganioglu, W.Gelletly, D.Gorelov, J.Hakala, A.Jokinen, A.Kankainen, V.Kolhinen, J.Koponen, M.Lebois, T.Martinez, M.Monserrate, I.Moore, E.Nacher, H.Penttila, I.Pohjalainen, A.Porta, J.Reinikainen, M.Reponen, S.Rinta-Antila, K.Rytkonen, T.Shiba, V.Sonnenschein, A.A.Sonzogni, V.Vedia, A.Voss, J.N.Wilson, A.-A.Zakari-Issoufou
Experimental study of 100Tc β decay with total absorption γ-ray spectroscopy

19. **2017HA03** Phys.Rev. C 95, 014321 (2017)
D.J.Hartley, L.L.Riedinger, R.V.F.Janssens, S.N.T.Majola, M.A.Riley, J.M.Allmond, C.W.Beausang, M.P.Carpenter, C.J.Chiara, N.Cooper, D.Curien, B.J.P.Gall, P.E.Garrett, F.G.Kondev, W.D.Kulp, T.Lauritsen, E.A.McCutchan, D.Miller, S.Miller, J.Piot, N.Redon, J.F.Sharpey-Schafer, J.Simpson, I.Stefanescu, X.Wang, V.Werner, J.L.Wood, C.-H.Yu, S.Zhu, J.Dudek
Investigation of negative-parity states in 156Dy: Search for evidence of tetrahedral symmetry

20. **2017JO05** Nucl.Data Sheets 142, 1 (2017)
T.D.Johnson, B.Singh
Nuclear Data Sheets for A=189

21. **2017KH08** Phys.Rev. C 95, 045805 (2017)
B.V.Kheswa, M.Wiedeking, J.A.Brown, A.C.Larsen, S.Goriely, M.Guttormsen, F.L.Bello Garrote, L.A.Bernstein, D.L.Bleuel, T.K.Eriksen, F.Giacoppo, A.Gorgen, B.L.Goldblum, T.W.Hagen, P.E.Koehler, M.Klintefjord, K.L.Malatji, J.E.Midtbo, H.T.Nyhus, P.Papka, T.Renstrom, S.J.Rose, E.Sahin, S.Siem, T.G.Tornyi.
137,138,139La (n,γ) cross sections constrained with statistical decay properties of 138,139,140La nuclei.

22. **2017MA39** Phys.Rev. C 96, 014318 (2017)
D.A. Matters, F.G. Kondev, N. Aoi, Y. Ayyad, A.P. Byrne, M.P. Carpenter, J.J. Carroll, C.J. Chiara, P.M. Davidson, G.D. Dracoulis, Y.D. Fang, C.R. Hoffman, R.O. Hughes, E. Ideguchi, R.V.F. Janssens, S. Kanaya, B.P. Kay, T. Kibédi, G.J. Lane, T. Lauritsen, J.W. McClory, P. Nieminen, S. Noji, A. Odahara, H.J. Ong, A.E. Stuchbery, D.T. Tran, H. Watanabe, A.N. Wilson, Y. Yamamoto, and S. Zhu
In-beam Gamma-ray spectroscopy studies of medium-spin states in the odd-odd nucleus 186Re

23. **2017MU04** Phys. Rev. C 95, 015805 (2017)
J.M.Munson, E.B.Norman, J.T.Burke, R.J.Casperson, L.W.Phair, E.McCleskey, M.McCleskey, D.Lee, R.O.Hues, S.Ota, A.Czeszumska, P.A.Chodash, A.J.Saastamoinen, R.A.E.Austin, A.E.Spiridon, M.Dag, R.Chyzh, M.S.Baunia,, J.J.Ressler, T.J.Ross
Decay branching ratios of excited 24Mg

24. **2017MU08** J.Phys.(London) G44, 034003 (2017)
M.R.Mumpower, G.C.McLaughlin, R.Surman, A.W.Steiner
Reverse engineering nuclear properties from rare earth abundances in the r process

25. **2017MU13** Phys.Rev. C 96, 024612 (2017)
M.R.Mumpower, T.Kawano, J.L.Ullmann, M.Krticka, T.M.Sprouse
Estimation of M1 scissors mode strength for deformed nuclei in the medium- to heavy-mass region by statistical Hauser-Feshbach model calculations

26. **2017NI03** Phys.Rev. C 95, 034325 (2017)
N.Nica, J.C.Hardy, V.E.Iacob, H.I.Park, K.Brandenburg, M.B.Trzhaskovskaya
Precise measurement of α_K for the 88.2-keV M4 transition in 127Te: Test of internal-conversion theory

27. **2017NI05** Nucl.Data Sheets 141, 1 (2017)
N.Nica
Nuclear Data Sheets for A=158

28. **2017NI10** Phys.Rev. C 95, 064301 (2017)
N.Nica, J.C.Hardy, V.E.Iacob, T.A.Werke, C.M.Folden, K.Ofodile, M.B.Trzhaskovskaya
Precise measurement of α_K and α_T for the 109.3-keV M4 transition in 125Te: Test of internal-conversion theory

29. **2017PR04** Nucl.Phys. A962, 73 (2017)
B.Pritychenko, M.Birch, B.Singh
Revisiting Grodzins systematics of B(E2) values

30. **2017RA06** Acta Phys.Pol. B48, 507 (2017)
B.C.Rasco, A.Fijalkowska, K.P.Rykaczewski, M.Wolinska-Cichocka, M.Karny, R.K.Grzywacz, K.C.Goetz, C.J.Gross, D.W.Stracener, E.F.Zganjar, J.C.Batchelder, J.C.Blackmon, N.T.Brewer, T.King, K.Miernik, S.V.Paulauskas, M.M.Rajabali, J.A.Winger

β Decays of 92Rb, 96gsY, and 142Cs Measured with the Modular Total Absorption Spectrometer and the Influence of γ Multiplicity on Total Absorption Spectrometry Measurements

31. **2017RI08** Phys.Rev. C 96, 014320 (2017)
S.Rice, A.Algora, J.L.Tain, E.Valencia, J.Agramunt, B.Rubio, W.Gelletly, P.H.Regan, A.-A.Zakari-Issoufou, M.Fallot, A.Porta, J.Rissanen, T.Eronen, J.Aysto, L.Batist, M.Bowry, V.M.Bui, R.Caballero-Folch, D.Cano-Ott, V.-V.Elomaa, E.Estevez, G.F.Farrelly, A.R.Garcia, B.Gomez-Hornillos, V.Gorlychev, J.Hakala, M.D.Jordan, A.Jokinen, V.S.Kolhinen, F.G.Kondev, T.Martinez, P.Mason, E.Mendoza, I.Moore, H.Penttila, Zs.Podolyak, M.Reponen, V.Sonnenschein, A.A.Sonzogni, P.Sarriguren
Total absorption spectroscopy study of the ß decay of 86Br and 91Rb

32. **2017RO16** Phys. Rev. C 96 (1), 014601 (2017).
S.J. Rose, F. Zeiser, J.N. Wilson, A. Oberstedt, S. Oberstedt, S. Siem, G.M. Tveten, L.A. Bernstein, D.L. Bleuel, J.A. Brown, L. Crespo Campo, F. Giacoppo, A. Görgen, M. Guttormsen, K. Hadynska, A. Hafreager, T.W. Hagen, M. Klintefjord, T.A. Laplace, A.C. Larsen, T. Renstrøm, E. Sahin, C. Schmitt, T.G. Tornyi, M. Wiedeking
Energy dependence of the prompt ?-ray emission from the (d,p)-induced fission of 234U and 240Pu.

33. **2017SI01** Nucl.Data Sheets 139, 138 (2017)
M.Sin, R.Capote, M.W.Herman, A.Trkov
Modelling Neutron-induced Reactions on 232-237U from 10 keV up to 30 MeV

34. **2017SI08** Nucl.Data Sheets 141, 327 (2017)
B.Singh *Nuclear Data Sheets for A=256*

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