The Present Status of the EXFOR Project: Area #1

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Nuclear Reaction Data Compilations in USA & Worldwide

- Experimental neutron reaction data compilations have been pioneered at the Metallurgical Laboratory, University of Chicago and Los Alamos National Laboratory in 1945-1947.
- Brookhaven National Laboratory hired many *Manhattan Project* alumni when it was founded in 1947, and the lab got involved in nuclear data.

75 Years of Experimental Nuclear Reaction Data Compilations

- (1952), it is a precursor of BNL-325 (Atlas of Neutron Resonances).
- SCISRS (Sigma Center Information and Retrieval System) at BNL (1964) was a precursor of EXFOR.
- Other data centers were created in Paris, France (NEA-Databank), Vienna, Austria (NDS-IAEA), and Obninsk, USSR (IPPE) in 1963-1964.
- Around 1970 four neutron data centers agreed on the data interchange format (EXFOR). The four centers could store data locally in its formats. The Nuclear Data Centres Reaction (NRDC) network was founded in 1979 under the auspices of the IAEA.

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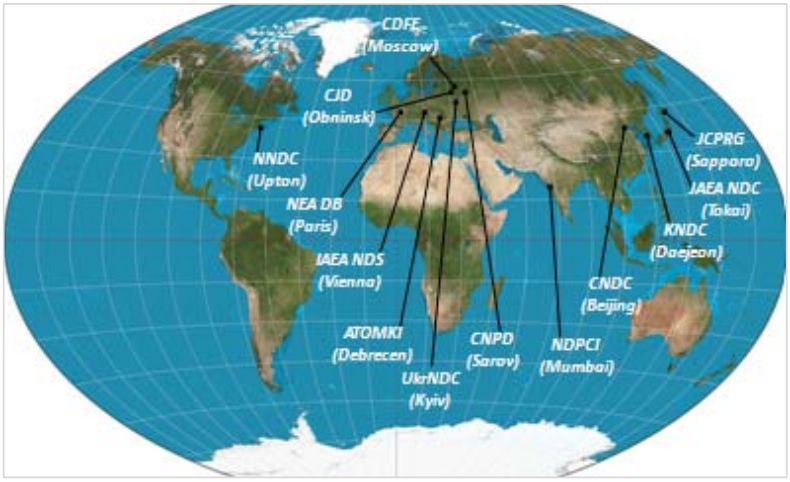
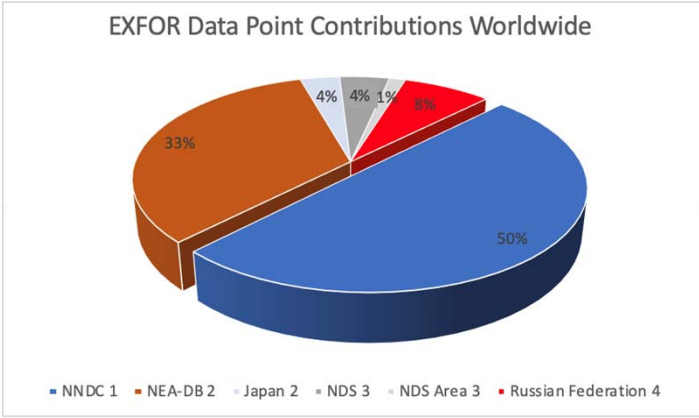
EXFOR - Experimental Nuclear Reaction Data

The largest experimental nuclear reaction database (*www.nndc.bnl.gov/exfor*)

- 24,225 experiments (multiple publications are grouped into a single measurement).
- 182,512 data sets as of May 31, 2022.
- Essential for Evaluated Nuclear Data File (ENDF) libraries worldwide.
- Presently run by the Nuclear Reaction Data Centres (NRDC), internationally. This is an IAEA network which is coordinated by the IAEA.
- Two largest contributors: NNDC & NEA-Databank.
- Every second, third and sixth data points in the library were contributed by the NNDC, NEA-Databank and the rest of NRDC network, respectively.

EXFOR philosophy is to compile data as they were published (in consultation with authors) unless obvious errors are found. Published nuclear reaction data contain outliers and discrepancies.





Area #1 FY 2021 Statistics

- FY 2021: October 1, 2020 - September 30, 2021.
- New compilations: 131
- Updated compilations: 303
- Finished compilations of missing fission yields, NRDC memos: CP/C-0464, CP/C-0465, CP/C-0466, and CP/D-979.
- Preliminary NRDC transmissions: 26
- Final NRDC transmissions: 17
- EXFOR DB Updates: 40
- EXFOR Web retrievals
  - CINDA: 1,479
  - ENDF: 101,045
  - EXFOR: 44,387

Nuclear Data Centers abbreviations

1	NNDC	US National Nuclear Data Center, Brookhaven, USA
2	NEA-DB	OECD/NEA Nuclear Data Bank, Boulogne-Billancourt, France
3	NDS	IAEA Nuclear Data Section, Vienna, Austria
4	CJD	Nuclear Data Centre, Obninsk, Russia
5	ATOMKI	ATOMKI Nuclear Reaction Data Group, Debrecen, Hungary
6	CDFE	Centre for Photonuclear Experiments Data, Moscow State University, Russia
7	CNDC	China Nuclear Data Center, Beijing, China
8	CNPD	Center of Nuclear Physics Data, Russian Federal Nuclear Center (VNIIEF), Sarov, Russia
9	JCPRG	Japan Charged Particle Nuclear Reaction Data Group, Hokkaido University, Sapporo, Japan
10	UkrNDC	Ukrainian Nuclear Data Center, Institute for Nuclear Research, Kyiv, Ukraine
11	NDPCI	Indian Compilation Group: BARC and others, India
12	KNDC	KAERI Nuclear Data Evaluation Group, Daejeon, Republic of Korea
13	KAZMON	Kazakhstan+Mongolia team
14	CAJaD	Russian Nuclear Structure and Reaction Data Centre, Kurchatov Institute, Moscow, Russia
15	KCPDG	Karlsruhe Charged Particle Data Group, Germany (extinct)
16	RIKEN	RIKEN Nuclear Data Group, Japan (extinct)

EXFOR Compilation Statistics based on N2 and EXFOR archive.
Information updated: 10-Jun-2022, 14:08:07

	NNDC	NEA-DB	NDS	CJD	ATOMKI	CDFE	CNDC	CNPD	JCPRG	UkrNDC	NDPCI	KNDC	KAZMON	CAJaD	KCPDG	RIKEN	Sum	
2022			16	2			4			2	15	2	2				43	
	5	107	71	51	9	20	2			6	6	1			14		292	▪▪
	344	580	15,112	106	-53		48			54	1,268	333	314				18,106	
	15	7	6	5	2	2	3			4	8	5	2		2		61	▪▪▪▪▪▪
2021	154	98	34	23	5	11	26	15	19	16	41	10	12				464	▪▪▪▪▪
	270	149	129	167	39	43	18	139		12	34	2	1	63	17		1083	▪▪▪▪▪▪▪▪▪▪▪
	92,050	130,955	12,683	3,235	-3,780	1,152	1,497	5,517	17,001	2,789	11,469	320	1,458	-243	-54		276,049	▪▪▪
	27	18	14	10	4	6	8	12	2	7	9	5	3	3	2		128	▪▪▪▪▪▪▪▪▪▪▪▪
2020	221	129	80	39	10	12	32	29	36	13	33	3	26				663	▪▪▪▪▪▪▪
	307	377	52	142	9	19	9	223	12	13	8	6		61			1238	▪▪▪▪▪▪▪▪▪▪▪▪
	27,119	314,005	51,704	5,348	1,276	350	5,642	3,809	7,505	1,484	2,638	733	27,399	-410			448,602	▪▪▪▪
	24	15	10	7	2	6	5	13	8	6	8	3	4	3		1	115	▪▪▪▪▪▪▪▪▪▪▪▪

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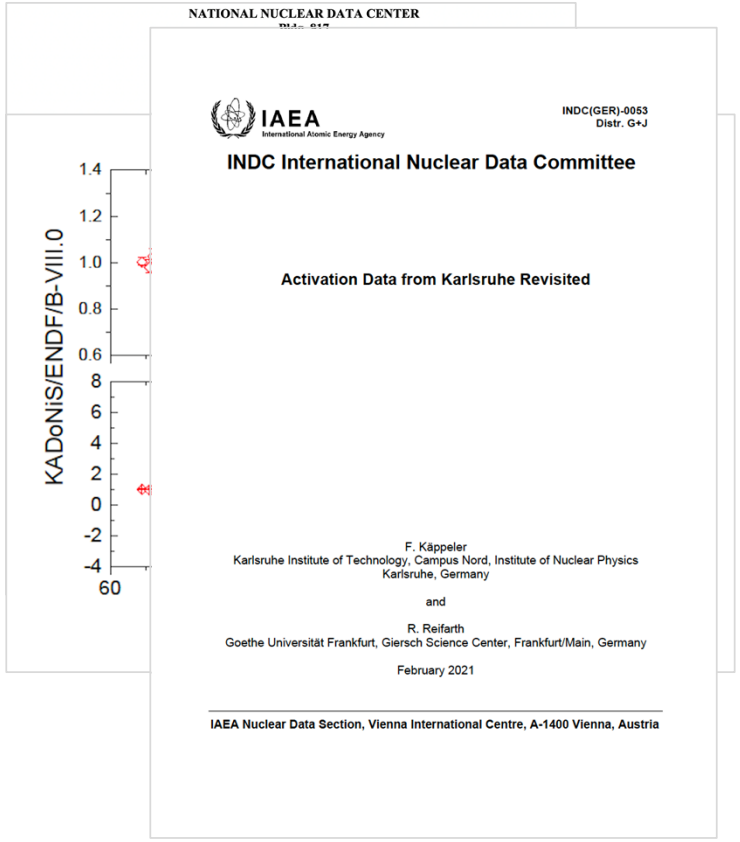
Work Distribution Within Area #1

- Stanislav Hlavac is responsible for new experimental data compilations.
- Olena Gritzay finished compilation of four NRDC memos: CP/C-0464, CP/C-0465, CP/C-0466, and CP/D-979 (*Experimental fission product yields missing in EXFOR*). Olena presently works on CP-D/937 (*Proton-induced reaction articles in NSR/CINDA but not in EXFOR*), CP-D/947 (*Alpha-induced reaction articles in NSR/CINDA but not in EXFOR*).
- Boris Pritychenko provides the overall project and database management, compilation of individual user requests, charged particle fission yields, historic Manhattan Project data, and the NNDC library data.
- Otto Shwerer provides quality assurance in the Area #1, preliminary and final transmission handling, fixes errors and bugs in the existing entries.
- Viktor Zerkin (IAEA) helps with Web dissemination and database management.
- Compartmentalization, the division of something into sections or categories.

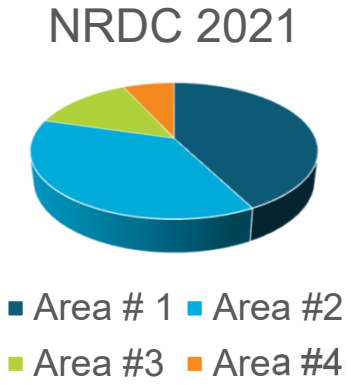
Karlsruhe Corrections

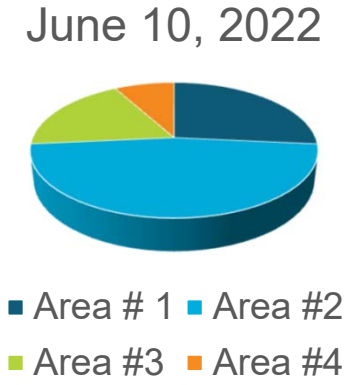
- Present status of Karlsruhe cross sections (CP-C/472).
- 5-7% deviations in ^{197}Au(n,γ) cross sections produce 20-30% deviations in *r*-process abundances: B. Pritychenko, J. Phys. (London) **G48**, 08LT01 (2021).
- C30 The activation cross sections measured by the Karlsruhe renormalized with a new gold standard cross section are published as INDC(GER)-053 and the relevant EXFOR entries must be updated. See also CP-C/472=WP2021-27.
- Area #1 corrections are finished.

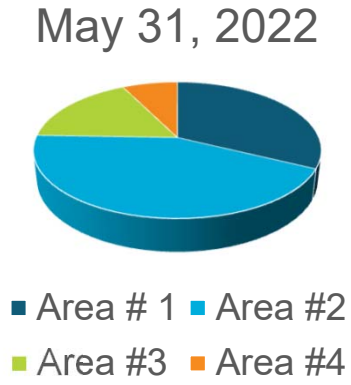


Unobtainable Data

- C32 The subentry coded with STATUS= UNOBT may be deleted if the dataset is not suitable for digitization or optical character recognition (OCR) data recovery, and the source article was published before 2000.
- NRDC 2021:
  - Area #1: 130
  - Area #2: 114
  - Area #3: 42
  - Area #4: 21
- May 31, 2022=>June 10, 2022:
  - Area #1: 87 => 66
  - Area #2: 117
  - Area #3: 46
  - Area #4: 20







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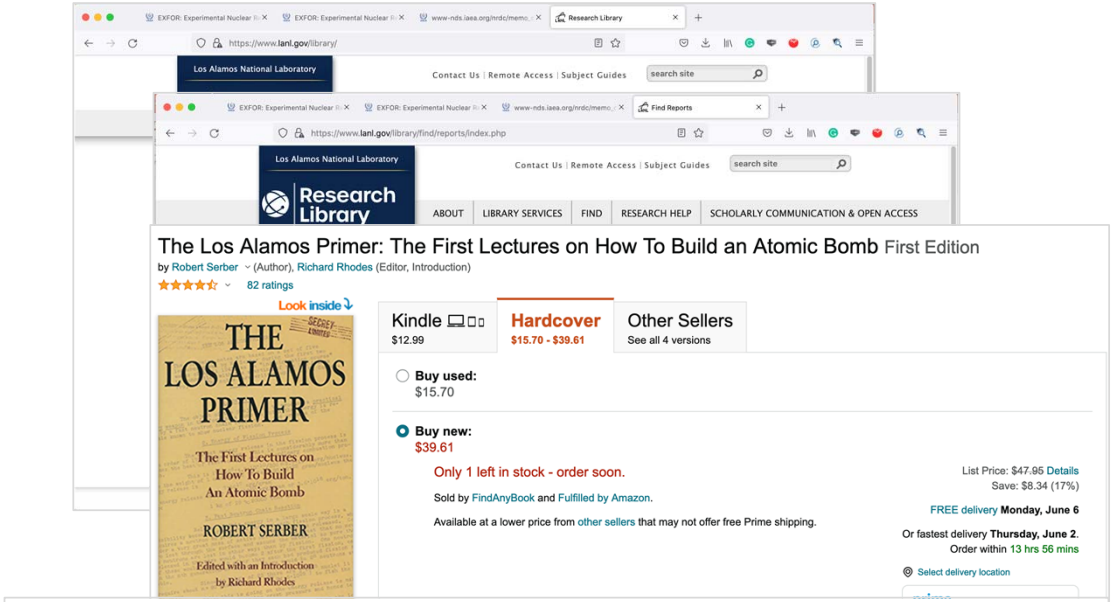
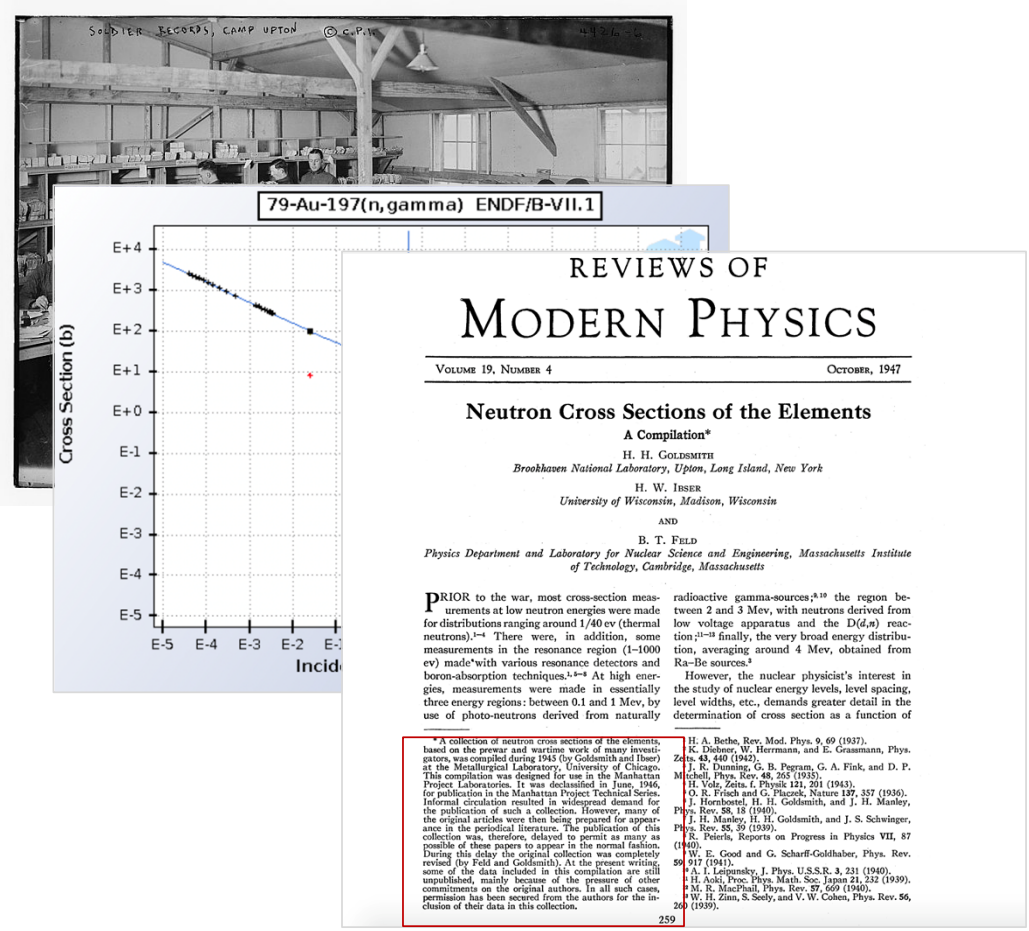
Los Alamos Reports

- Over 500 reports were added to NSR: 1943-1953.
- LA-1, Los Alamos Primer.
- All reports were checked for EXFOR related contents: 24 new entries, updated multiple existing entries.



Takeaways

- NNDC (or camp Upton) EXFOR compilation efforts are complex and well-organized: B. Pritychenko (BNL), O. Schwerer, S. Hlavac, O. Gritzay (Under contract with BNL), V. Zerkin (IAEA).
- FY 2021: 131 new and 303 updated compilations.
- ^{197}Au(n,γ) issue is fixed in EXFOR.
- 75th anniversary of nuclear reaction data compilations in 2021-2022.



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The International Atomic Energy Agency: (https://www.iaea.org/about/mission)

is an independent intergovernmental, science and technology-based organization, in the United Nations family, that serves as the global focal point for nuclear cooperation;

assists its Member States, in the context of social and economic goals, in planning for and using nuclear science and technology for various peaceful purposes, including the generation of electricity, and facilitates the transfer of such technology and knowledge in a sustainable manner to developing Member States;

develops nuclear safety standards and, based on these standards, promotes the achievement and maintenance of high levels of safety in applications of nuclear energy, as well as the protection of human health and the environment against ionizing radiation;

verifies through its inspection system that States comply with their commitments, under the Non-Proliferation Treaty and other non-proliferation agreements, to use nuclear material and facilities only for peaceful purposes.