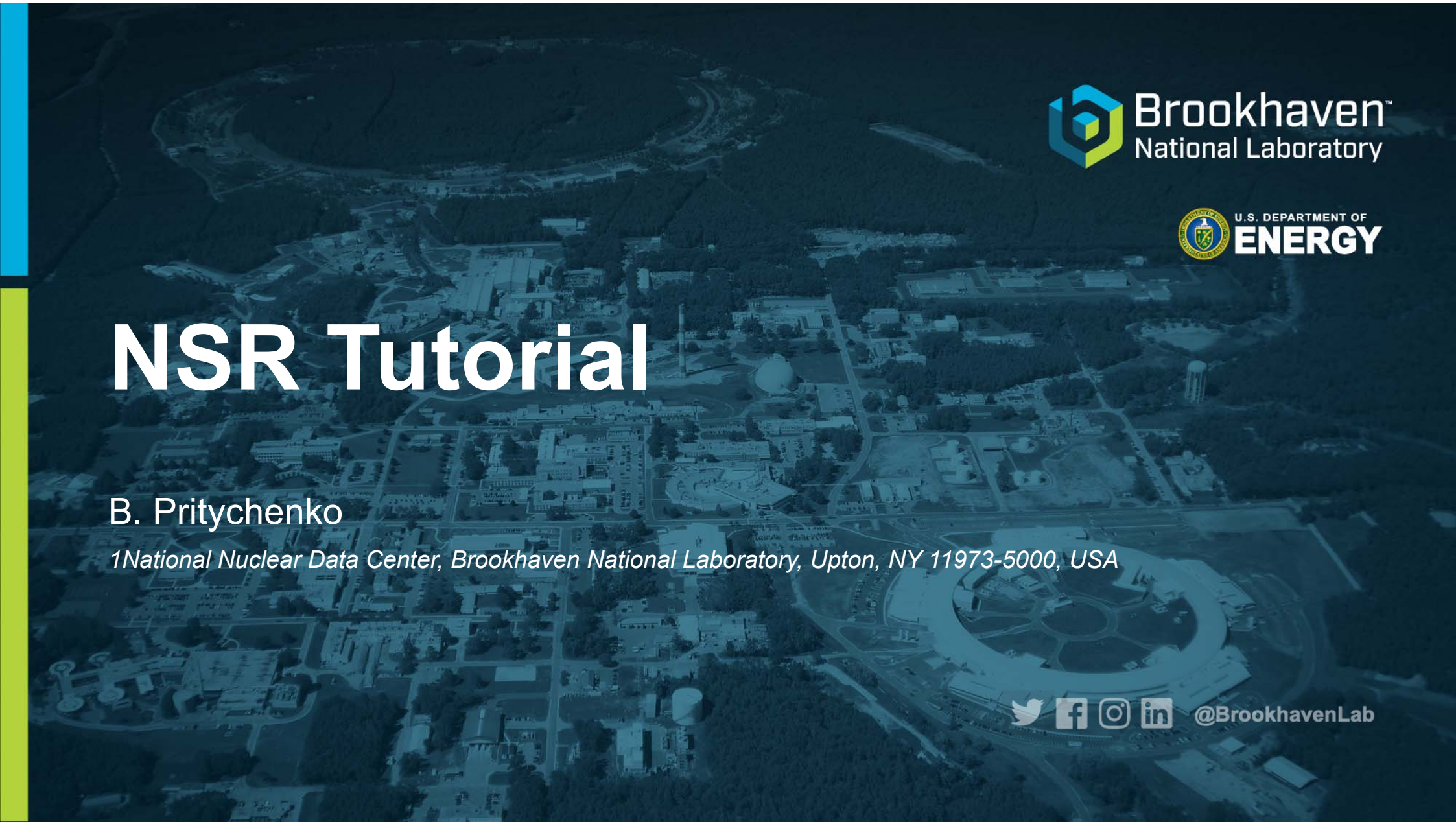

NSR Tutorial

B. Pritychenko

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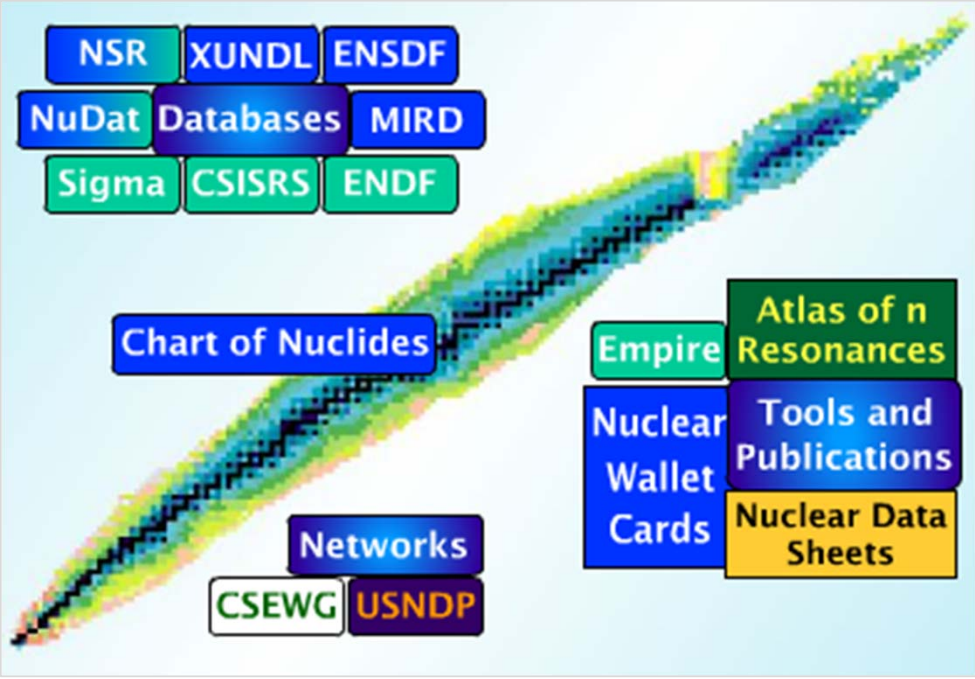
National Nuclear Data Center

The National Nuclear Data Center (NNDC) collects, evaluates, and disseminates nuclear physics data for basic nuclear research and for applied nuclear technologies. The NNDC is a worldwide resource for nuclear data.

Major Databases

- ENDF: Evaluated Nuclear (reaction) Data File
- EXFOR: Experimental Nuclear Reaction Data
- ENSDF: Evaluated Nuclear Structure Data File
- XUNDL: eXperimental Unevaluated Nuclear Data List
- NSR: Nuclear Science References



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Nuclear Science References (NSR): https://www.nndc.bnl.gov/nsr

- Katherine Way (formerly at Met Lab, Chicago) recognized the importance of nuclear bibliography database and keywords. She convinced several journals to include keywords (Nucl.Phys., Phys.Rev.).
- Oak Ridge NSR entry consisted of authors, journal and simple nuclear structure keywords; title was often missing.
- References were stored in the ORNL library.
- In 1980 NSR operation was transferred from Oak Ridge to Brookhaven.
- The database was improved at Brookhaven: keywords were expanded, digital object identifiers (doi) and database integration were implemented.

KATHARINE WAY

648 BURBIDGE, BURBIDGE,

Al57a L. H. Aller, Preprint for *Handbuch der Physik* (Springer-Verlag, Berlin, 1957).
Al57b L. H. Aller and J. L. Greenstein (private communication).
Al57c Aller, Elste, and Jugaku, Astrophys. J. Suppl. **3**, 1 (1957).
Al57d L. H. Aller, Astrophys. J. **125**, 84 (1957).
Al50 R. A. Alpher and R. C. Herman, Revs. Modern Phys. **22**, 153 (1950).
Al53 R. A. Alpher and R. C. Herman, Ann. Rev. Nuclear Sci. **2**, 1 (1953).
Ar53 Arp, Baum, and Sandage, Astron. J. **58**, 4 (1953).
Aw56 M. Awschalom, Phys. Rev. **101**, 1041 (1956).
Ba43 W. Baade, Astrophys. J. **97**, 119 (1943).
Ba45 W. Baade, Astrophys. J. **102**, 309 (1945).
Ba56 Baade, Burbidge, Hoyle, Burbidge, Christy, and Fowler, Publ. Astron. Soc. Pacific **68**, 296 (1956).
Ba57a W. Baade (private communication).
Ba57 H. W. Babcock, *Proceedings of the Stockholm Symposium on Electromagnetic Phenomena in Cosmical Physics* (to be published).
Ba50 C. L. Bailey and W. R. Stratton, Phys. Rev. **77**, 194 (1950).

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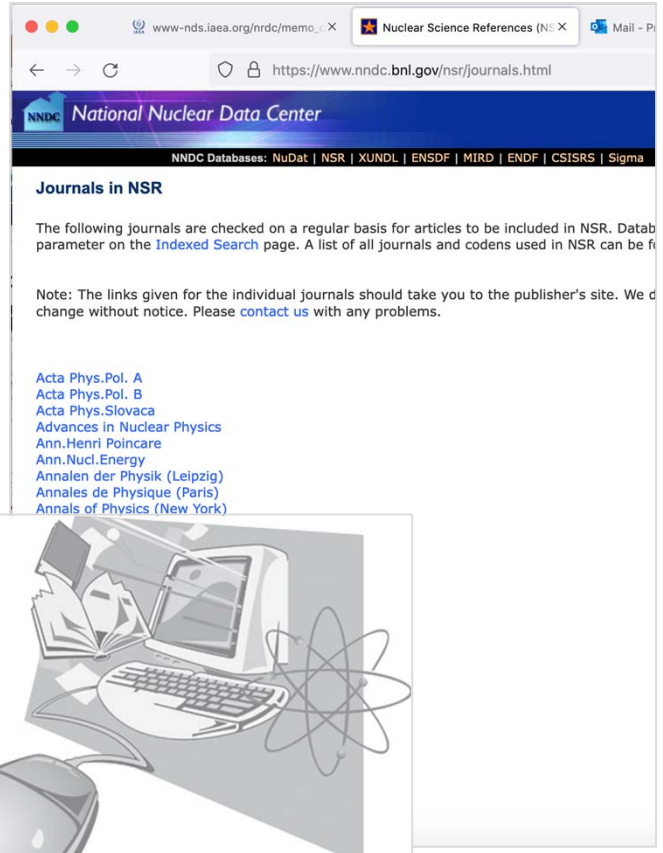
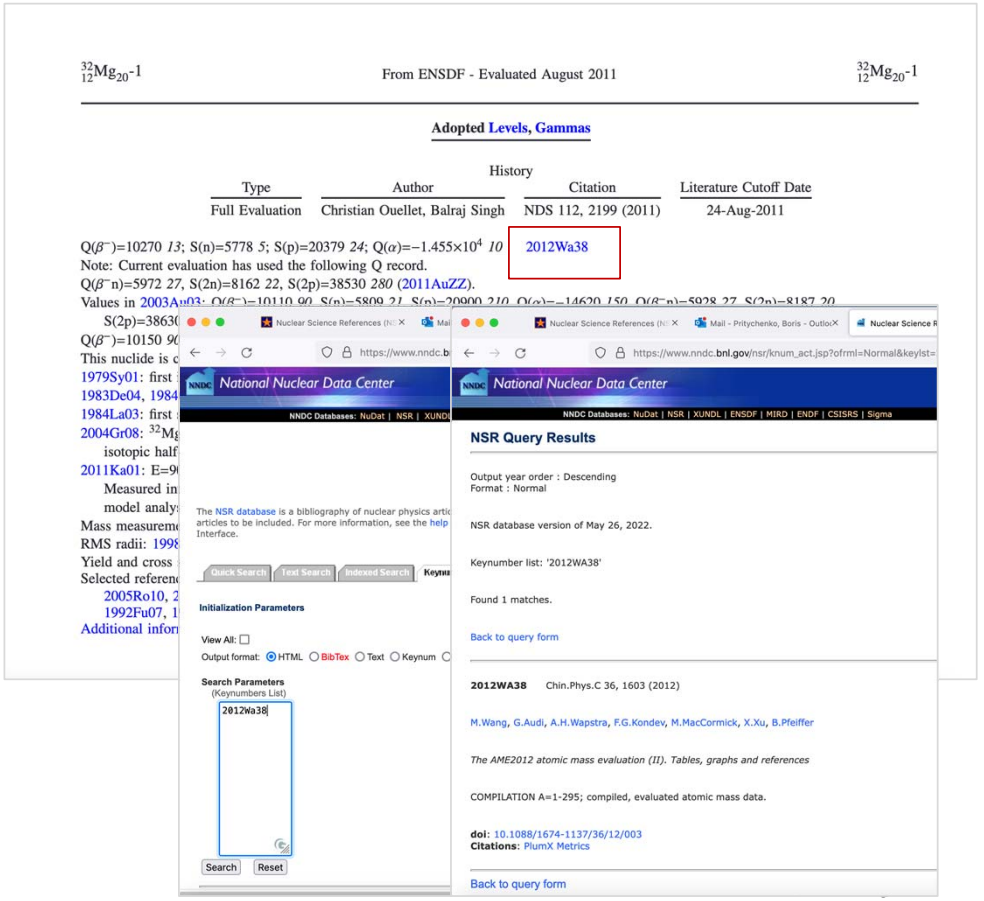
NSR Scope

- Low- and intermediate-energy nuclear physics and selected nuclear engineering publications.
- Journal articles, books, conference proceedings, laboratory reports, theses, private communications.
- Over 80 journals are checked on a regular basis for articles to be included.
- Bibliography of nuclear physics articles, indexed according to content and spanning more than 100 years of research: 242,616 as of May 31, 2022.



Why do weed NSR???

- NSR was created in support of Evaluated Nuclear Structure Data File (ENSDF) evaluations at Oak Ridge.
- NSR entries are uniquely identified using eight-character strings, NSR keynumbers (i.e. ***2012Wa38***, analog of Social Security numbers for nuclear publications).
- NSR preserves the unique set of publications behind each evaluated data set. It makes ENSDF evaluations well-documented and reproducible.
- Entries also include author, journal, title, keywords, doi, EXFOR and XUNDL links.



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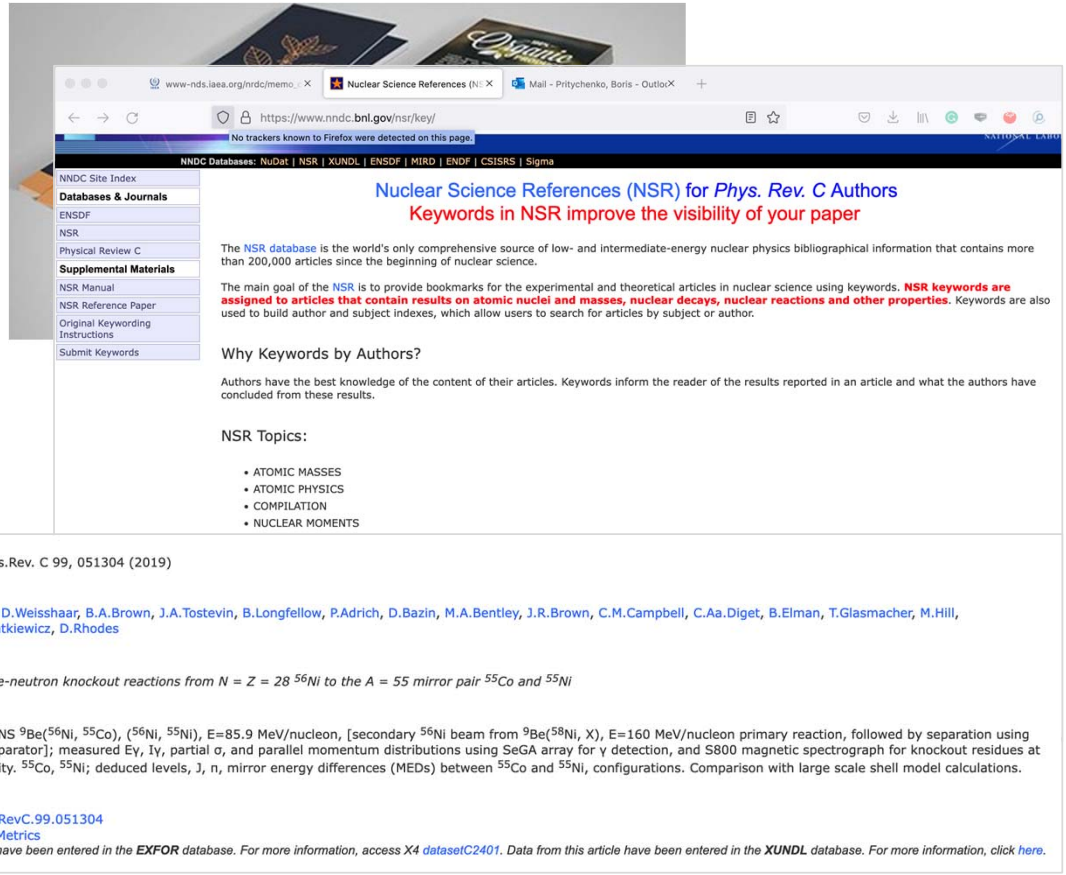
NSR Keywords

- NSR provides bookmarks for the experimental and theoretical articles in nuclear science using keywords.
- Articles are keyworded if new results for nuclear reactions, nuclear structure and radioactive decay are published.
- 197,098 NSR abstracts include keywords out of 242,616 NSR entries.



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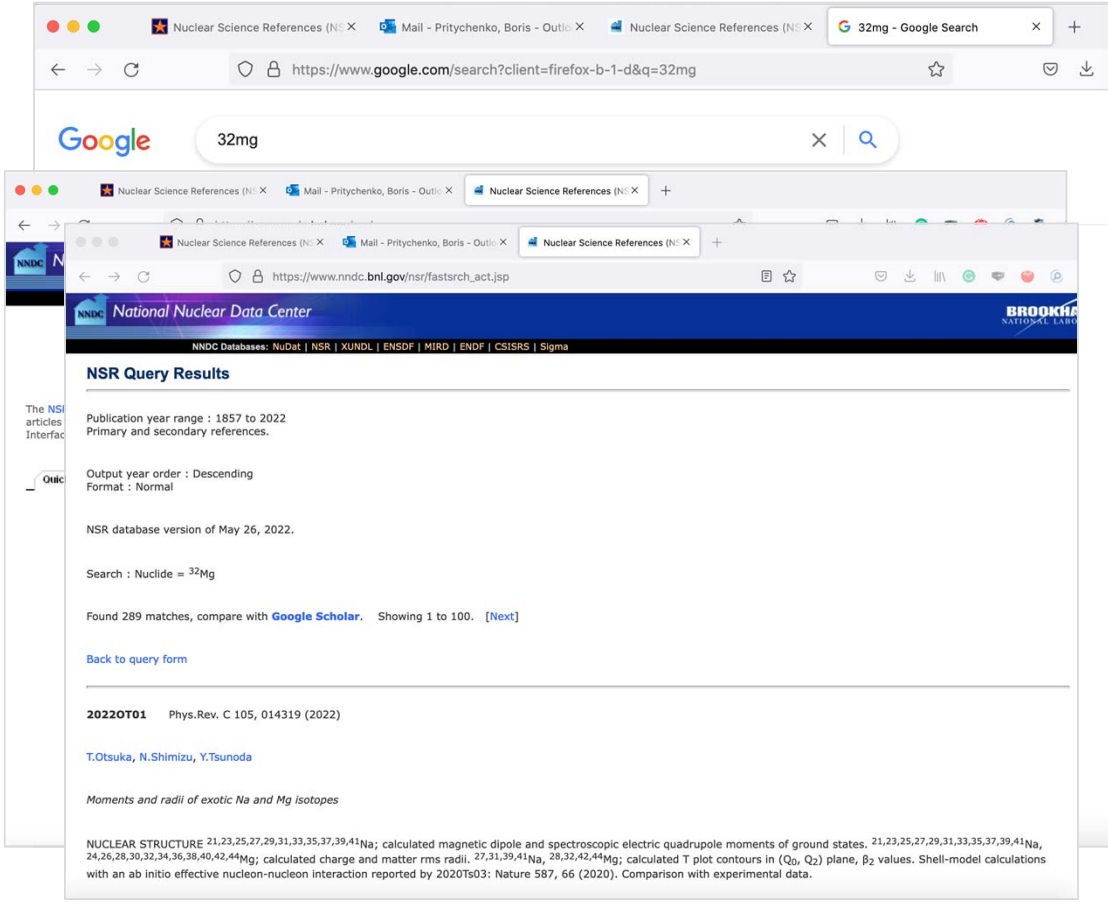
Why do we need keywords???

- Why do we need keywords in the age of Google???
  - Google is a commercial product that is looking for the most frequent (not necessarily nuclear) applications.
  - Google coverage is very good for the last 30 years and problematic with the older unique references.
- Search for ^{32}Mg nucleus with Google and NSR
  - Google: About 1,160,000 results (0.46 seconds). Impressive but not practical.
  - NSR: 289 articles, easy to deal.



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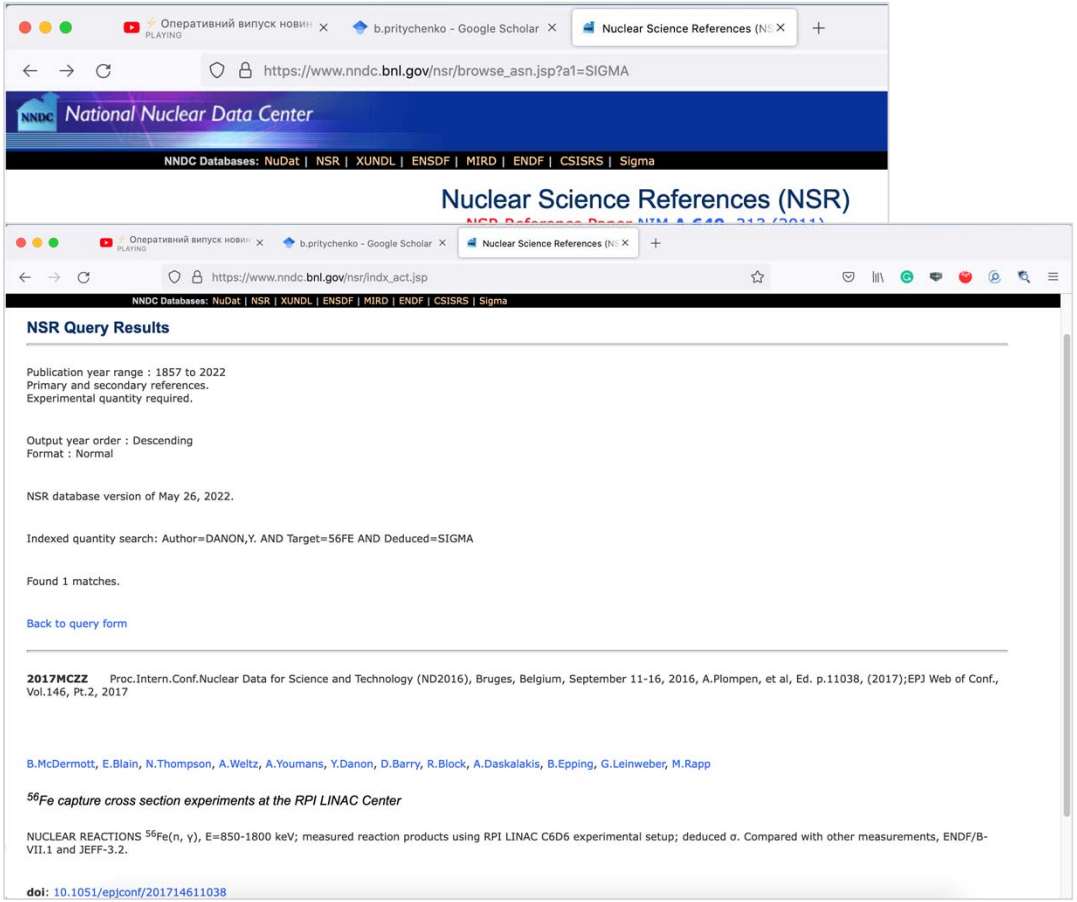
Example of NSR Indexed Search

- Indexed search is based on NSR keywords.
- NSR indexed search for author Y.Danon, target ^{56}Fe and deduced cross section value.
- NSR entry includes measured values and not available in the EXFOR database.
- Indeed, NSR contains advanced search options.



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NSR was based on NNDC ``Paper'' Library

- NNDC collects unique references, we acquired Oak Ridge library, Los Alamos, McMaster U. and many other collections.
- NNDC implemented new scanner, mirofiche reader, ...
- Joann Totans is leading this effort.
- Traditional ``paper'' library became a bottleneck due to large volume of requests, and change was needed.
- Electronic library was needed.

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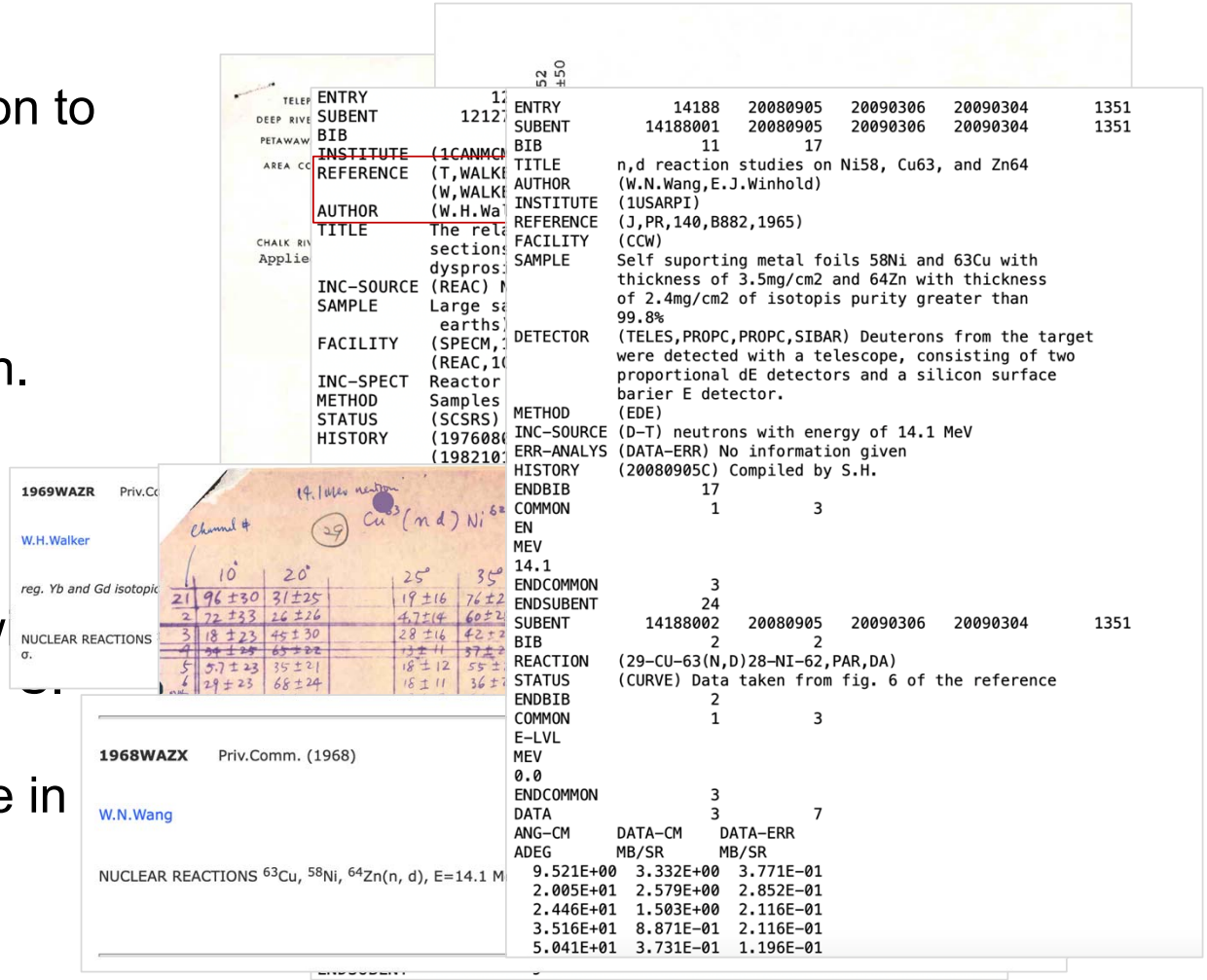
Recovery of NNDC Library Publications

- W.H. Walker private communication to Victoria May.
- EXFOR entry #12127.
- NSR DB entry 1968WEZZ.
- W.N. Wang private communication.
- NSR entry 1968WAZX.
- EXFOR entry 14188, STATUS=CURVE???
- Perhaps, we replace digitization w tabulated data in consultation with Hlavac.
- NNDC Library data processing are in progress.



```
ENTRY          14188   20080905   20090306   20090304       1351
SUBENT      14188001   20080905   20090306   20090304       1351
BIB               11         17
TITLE      n,d reaction studies on Ni58, Cu63, and Zn64
AUTHOR     (W.N.Wang,E.J.Winhold)
INSTITUTE  (1USARPI)
REFERENCE  (J,PR,140,B882,1965)
FACILITY   (CCW)
SAMPLE     Self suporting metal foils 58Ni and 63Cu with
           thickness of 3.5mg/cm2 and 64Zn with thickness
           of 2.4mg/cm2 of isotopis purity greater than
           99.8%
DETECTOR   (TELES,PROPC,PROPC,SIBAR) Deuterons from the target
           were detected with a telescope, consisting of two
           proportional dE detectors and a silicon surface
           barier E detector.
METHOD     (EDE)
INC-SOURCE (D-T) neutrons with energy of 14.1 MeV
ERR-ANALYS (DATA-ERR) No information given
HISTORY    (20080905C) Compiled by S.H.
ENDBIB             17
COMMON              1          3
EN
MEV
14.1
ENDCOMMON           3
ENDSUBENT          24
SUBENT      14188002   20080905   20090306   20090304       1351
BIB                 2          2
REACTION   (29-CU-63(N,D)28-NI-62,PAR,DA)
STATUS     (CURVE) Data taken from fig. 6 of the reference
ENDBIB              2
COMMON              1          3
E-LVL
MEV
0.0
ENDCOMMON           3
DATA                3          7
ANG-CM     DATA-CM    DATA-ERR
ADEG       MB/SR      MB/SR
  9.521E+00  3.332E+00  3.771E-01
  2.005E+01  2.579E+00  2.852E-01
  2.446E+01  1.503E+00  2.116E-01
  3.516E+01  8.871E-01  2.116E-01
  5.041E+01  3.731E-01  1.196E-01
```

1968WAZX Priv.Comm. (1968)

W.N.Wang

NUCLEAR REACTIONS ^{63}Cu, ^{58}Ni, ^{64}Zn(n, d), E=14.1 M

1969WAZR Priv.Co

W.H.Walker

reg. Yb and Gd isotopic

NUCLEAR REACTIONS

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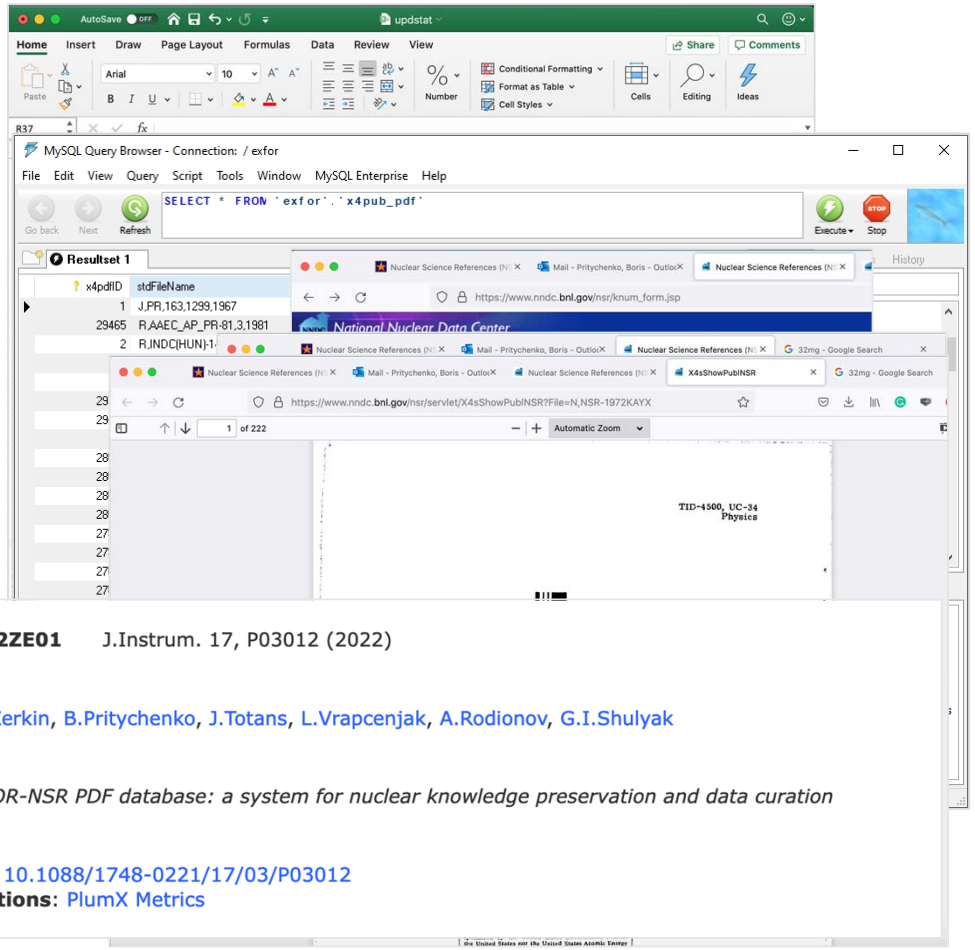
Complete, Documented Data Sets

- Viktor Zerkin (Nuclear Data Section, IAEA) in collaboration with NNDC started to store PDFs in the EXFOR relational database.
- Data tables are essentially no different than Excel tables: numbers, text, dates and BLOBs.
- Download of the PDF file for Ph.D. Thesis of J.L. Kammerdiener, NSR keynumber = 1972KAYX, works inside BNL or IAEA only.
- Results are described in the Journal of Instrumentation.



2022ZE01 J.Instrum. 17, P03012 (2022)

V.V.Zerkin, B.Pritychenko, J.Totans, L.Vrapcenjak, A.Rodionov, G.I.Shulyak

EXFOR-NSR PDF database: a system for nuclear knowledge preservation and data curation

doi: 10.1088/1748-0221/17/03/P03012
Citations: PlumX Metrics

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Portable Document File (PDF) Database

- Portable Document File (PDF) database operation.
- Regular updates of EXFOR and NSR databases extended to PDF files.
- Private collections for existing entries.
- PDF library coverage reflects publishing trends.
- Authorized Web access only due to major publishers restrictions.
- Continuing PDF scanning effort at NNDC.
- Future contributions from LBNL and other labs are more than welcome.

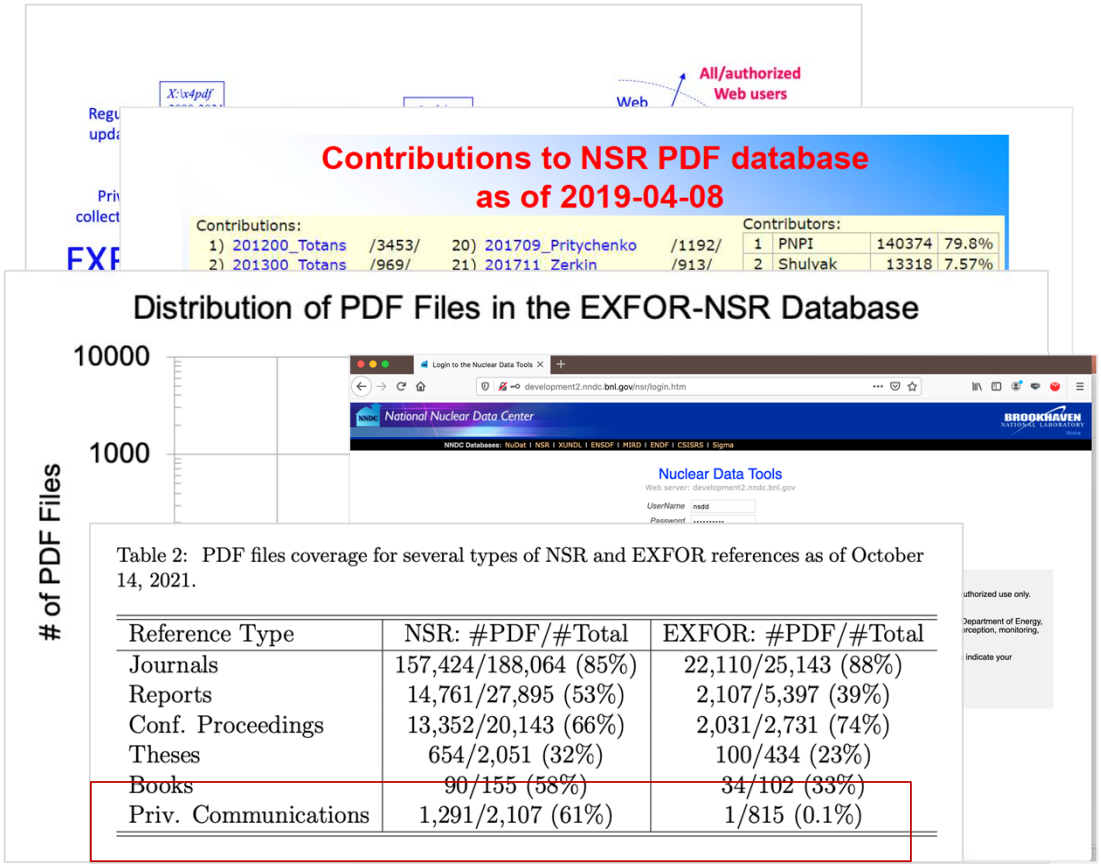

Table 2: PDF files coverage for several types of NSR and EXFOR references as of October 14, 2021.

Reference Type	NSR: #PDF/#Total	EXFOR: #PDF/#Total
Journals	157,424/188,064 (85%)	22,110/25,143 (88%)
Reports	14,761/27,895 (53%)	2,107/5,397 (39%)
Conf. Proceedings	13,352/20,143 (66%)	2,031/2,731 (74%)
Theses	654/2,051 (32%)	100/434 (23%)
Books	90/155 (58%)	34/102 (33%)
Priv. Communications	1,291/2,107 (61%)	1/815 (0.1%)

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Takeaways

- NSR is a unique collection of indexed nuclear physics publications that is updated on a weekly basis.
- NSR compilation efforts are complex and well-organized: B. Pritychenko, J. Totans (BNL), B. Singh, D. Symochko (Contractors), V. Zerkin (IAEA).
- NSR abstracts are uniquely identified using the eight-character long NSR keynumbers.
- NSR keywords are essential for indexed search.
- EXFOR-NSR Portable Document File (PDF) database includes 220 K+ files.

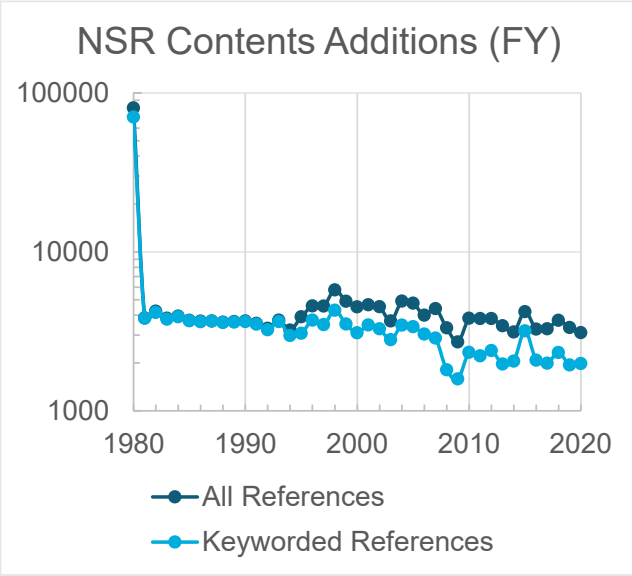

Table 1: PDF coverage for EXFOR and NSR references as of October 14, 2021. Reciprocal PDF contributions are shown as # of complementary files.

Database	# of References	# of PDF Files	# of Complementary Files
NSR	236,583	187,617	1,375
EXFOR	34,609	26,343	1,899
CINDA	39,817	14,154	
IBANDL	795	642	