Experimental Nuclear Reaction Data Compilation and Other Needs of CIELO Project

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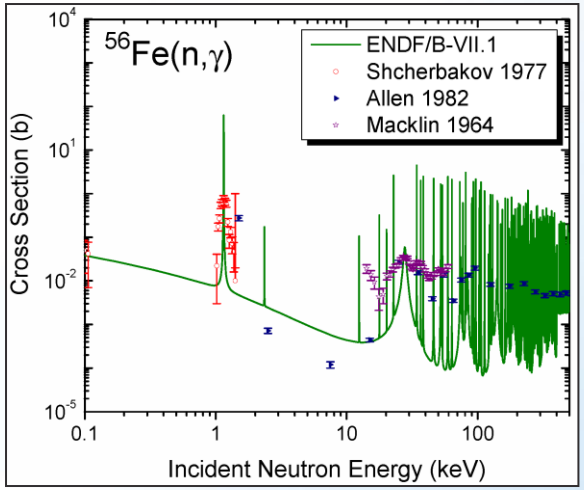
BROOKHAVEN NATIONAL LABORATORY

a passion for discovery

U.S. DEPARTMENT OF ENERGY | Office of Science

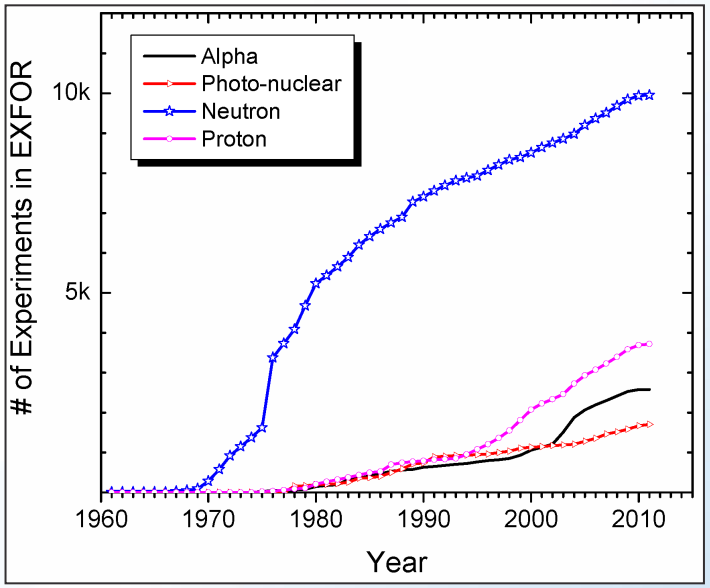
Evaluated Nuclear Data File (ENDF)

- First nuclear database in direct response to nuclear industry data needs: theory + experiment (resonance parameters)
- Core nuclear reaction database containing evaluated (recommended) cross sections, spectra, angular distributions, fission product yields, thermal neutron scattering, photo-atomic and other data, with emphasis on neutron-induced reactions. All data are stored in the internationally adopted format (ENDF-6) maintained by CSEWG.
- 423 neutron materials (isotopes) in ENDF/B-VII.1
- Other libraries in ENDF-6 format: JEFF (Europe), JENDL (Japan), CENDL (China), ROSFOND (Russian Federation)
- What all libraries have in common? Neutron cross sections, all other sublibraries are often missing.



EXFOR/CSISRS

- Compilation of experimental nuclear reaction data
  - Mostly Neutrons
  - Recently, charged particles and photonuclear
  - 20318 experiments
  - Monthly updated
- In support ENDF and research activities
- Truly international project: NNDC, NEA, IAEA, Obninsk



Area #1 Data Needs

- CIELO
  - Neutron Cross Sections
  - Neutron Cross Section Covariances
- XML
- Computer infrastructure for ENDF and Big Data

CIELO

- CIELO (Collaborative International Evaluated Library Organization) - towards a single neutron database
- The focus will initially be on a small number of the highest-priority isotopes, namely ^{1}H, ^{16}O, ^{56}Fe, $^{235,238}U$, and ^{239}Pu
- The evaluated data for these materials in the existing nuclear data libraries — ENDF/B-VII.1, JEFF-3.1, JENDL-4.0, CENDL-3.1, ROSFOND, IRDFF 1.0 — are reviewed, discrepancies are identified, and some integral properties are given, M.B. Chadwick et *al*., NDS **118**, 1 (2014)

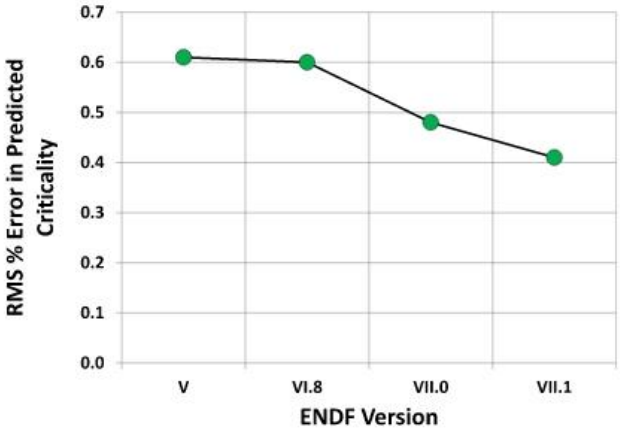


FIG. 1. Calculated/measured root mean square deviation (in %) from unity for nuclear criticality, k_{eff}, for a suite of 119 critical assemblies, as a function of ENDF library version number.

CIELO/EXFOR Cooperation

- What we can do for CIELO???
- Help with experimental data for six priority materials is the must
  - No more UNOBT for ^{1}H, ^{16}O, ^{56}Fe, ^{235,238}U, and ^{239}Pu
  - Check for missing data for these six materials
  - Direct contacts with evaluators
- Atlas of Neutron Resonances, Memo 4C/3-395.
- We should compile what is needed by our priority users instead of delivering just certain number of compilations.
- We should satisfy the needs of important user groups.
- CW 2014 Input

EXFOR Entry 13982

- Compilation of Data Corrected or Derived …., WP2014-46
- Pu-239(n,F) by P. Staples et al.
- Data was re-analyzed by T. Teaddeucci (LANL) using MCNP in cooperation with authors.
- Multiple neutron scattering uncertainties.
- A typo was discovered, and target mass was wrong.
- New update is in progress after

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HISTORY     (20050310C) DR
            (20100520R) On. Data received from P.Staples through
                        D.G.Madland and P.Talou
            (20100524A) On. Re-compiled from two references
            (20130323U) On. ERR-ANALYS corrected
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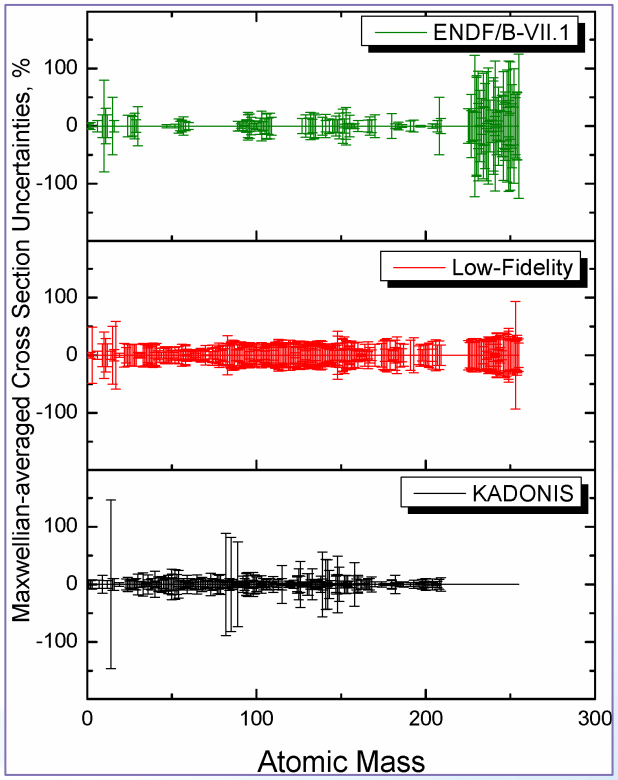
- #20576, Knitter also has multiple scattering issues, impossible to correct, one line in the paper.
- These problems were only discovered because of the present computer power.

Compilation of Covariances, Double Differential Cross Sections

- How many covariance data sets in EXFOR?
- How many Differential and Double-Differential cross sections?
- We need them for 423 ENDF/B-VII.1 materials.

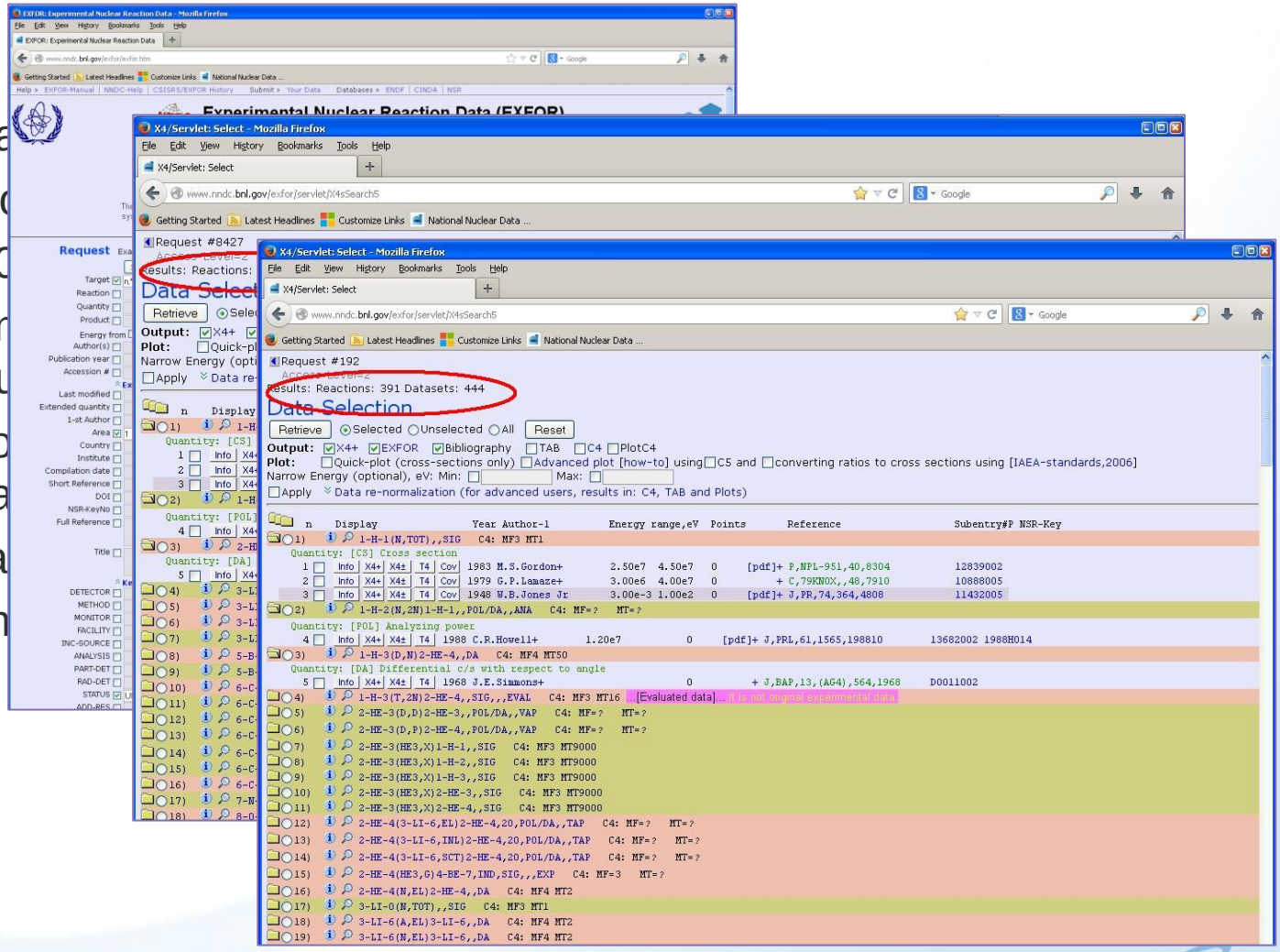


UNOBT & Missing Data

- UNOBT is not a bug in EXFOR. In practical terms, UNOBT status is a big problem.
- Missing Data: Unfortunately, the only way to find out that data are missing is to read the articles, or contact users (CIELO, Nuclear astrophysics, IBANDL, …)
- We have a serious research on missing data by Naohiko, now we need to track progress on these issues. Is anyone compiling these articles?

UNOBT Data, November 2013

- Data that a
- Not an erro
- About 5-10
- Digitization
  Herman su
- 192 neutro
  (US&Cana
- 391 all rea
- First 11 en



UNOBT Data, April 2014

- 178 neutron-induced reactions (199 datasets) in area #1 (US&Canada) only
- 372 all reactions (412 datasets) in area #1 (US&Canada) only
- Progress in Neutrons:
  - Reactions: 178/192
  - Datasets: 199/225
- Overall progress:
  - Reactions: 372/391
  - Datasets: 412/444

Open Access Developments

- **Public access**
  - America COMPETES Reauthorization Act of 2010 addresses public access to research results, particularly in the forms of scholarly publications and digital data
  - Charge from DOE Office of Science:"Identify and assess current practices, policies and procedures to research results with report by 1-jul-2011."
- **Report of the NSAC Sub-Committee on Public Access to Research Results**
  - The nuclear physics community often submits research results to freely accessible databases such as the National Nuclear Data Center (NNDC, http://www.nndc.bnl.gov/) …
  - Programs like the U.S. Nuclear Data Program also provide an important service through critical independent evaluation efforts.
- **APS News (http://www.aps.org/publications/apsnews/201310/access.cfm)**
  - Open Access Mandate will Include Raw Data

Big Data

- NNDC is investigating different options within the U.S. Nuclear Data Program.
- Future cooperation with George Washington University and Research Labs.
- Work is in progress, more details next year.

Conclusion & Outlook

- CIELO is #1 priority project for EXFOR community.
- Missing and UNOBT data are serious problems that we have to address.
- Luck of covariance and double differential data in EXFOR is very disturbing.
- Compilers should look after the needs of user communities instead of simply delivering the required number of compilations.
- Open Access developments in US may change the EXFOR operations as we know.