Compilation/Evaluation of a source dataset for ENSDF

M. Shamsuzzoha Basunia

Lawrence Berkeley National Laboratory

Berkeley, CA 94720

Outline

- Source dataset
  - Data listing
  - Efficient and effective use of network members time as a whole
  - Archiving helpful notes/documents, prepared over the decades, at a single location
  - Notes/documents need to be prepared

Many data to compile - the knowledge of their need or use makes the work a little more rewarding

Source dataset:

- Building block for the Adopted dataset
  - Compilation of available data from all the articles
  - Many different types of data
  - 80-column limit (will go away soon)
  - Listing of all the data is useful for visibility and for the new codes (J. Chen)
  - Often it is an evaluation of all the available data – yet hard to justify sometimes
- The skill of data management develops with more and more evaluation work and by reviewing others work

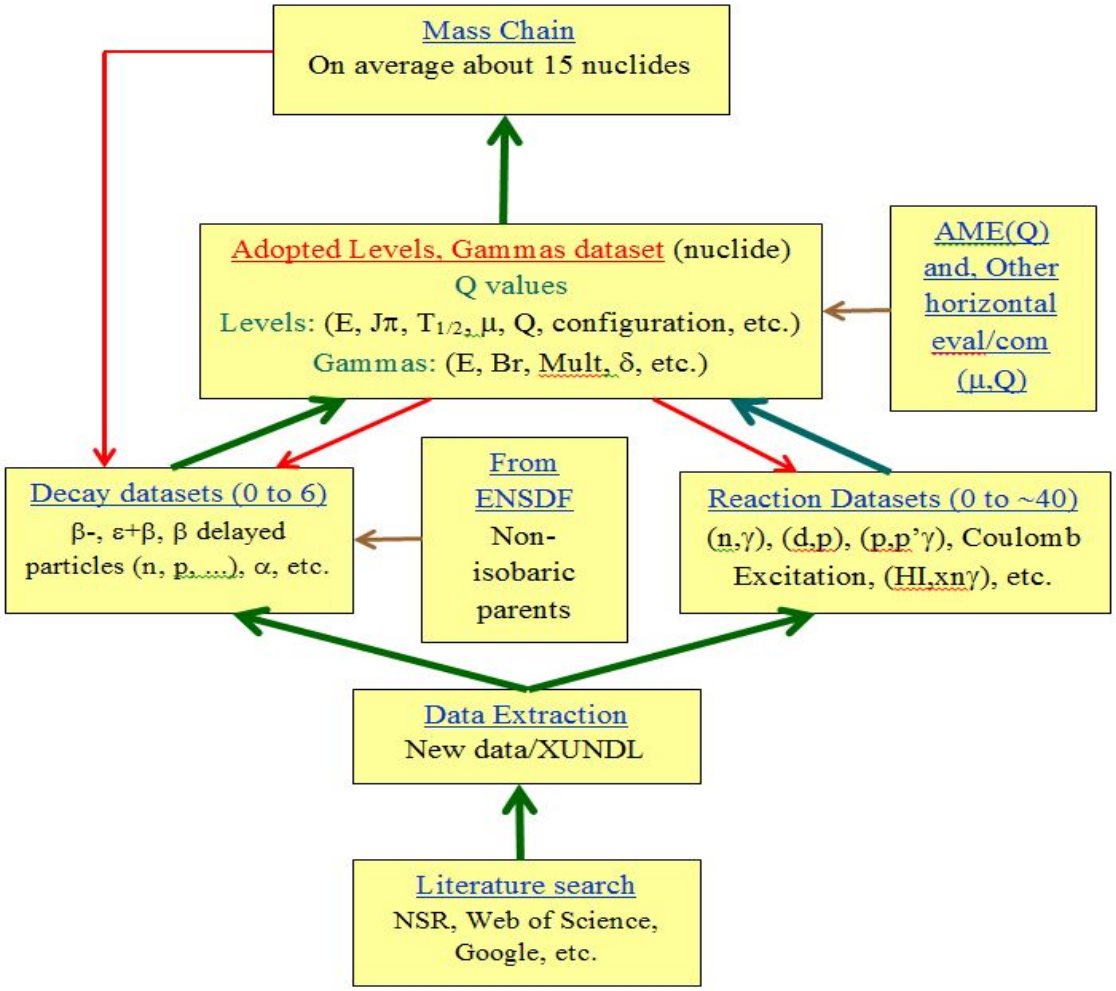


Fig: A general workflow of a mass evaluation

Challenges for consistency:

- Huge data from the past:
  - *Work of different evaluators from different institutes over the decades*
  - *Personal choice of an evaluator*
  - *Even the same evaluator changes with time*
  - *Adoption of new policies and procedures*
- Mass chain
  - ✔ In general, in a revision new data represent a fraction of ~25%
  - ✔ Update of the older data for changes in policy or style is ~75%

Indc-nds-0250, p9 (1990 NSDD)

1.4.4 Size of the A-chains in the NDS

The average length of an A-chain has increased gradually showing an increase of about 33% in 1989 compared to 1987. Since not many A-chains were ready for

ENSDF size ~76 MB in 1990 to 222 MB in 2018, about 3 times higher

Compilation/Evaluation of a source dataset:

- **Data listing**
  - ✔ Tedious work
  - ✔ Visibility and useful for averaging using the new codes (by J. Chen)
    - For example: in the previous version if something was like “weighted average of data in X, Y, Z (key #)
    - Now we list all the data in the comment and use the code for averaging
  - ✔ In recent years, I have started checking all articles from the NSR
    - *Rare articles from the IAEA pdf archive is a valuable resource*
    - *Keeping notes for articles if there is no data or primary article is available*
  - ✔ How we can make the notes available to the reviewer or to the future evaluators to save network members time
    - NSR references for a nuclide – but not related (calibration, target, ref, etc.)
    - Listing in a ‘d’ card (would this option be available in the new format?)
- **Deduced value vs. the data in the article:**
  - Listing of original data from the article: helpful to search, rounding inaccuracy for multiple data used in the averaging
  - Mean lifetime to half-live, Γ_0 to Γ, E_res (lab or c.m.) to level energy, etc.

Compilation/Evaluation of data in the source dataset:

- **Evaluator's summary notes:**
  - Observational notes in the comments
  - Helpful for decision making process and for users
- **Reference key number**
  - ✔ Description – what is measured, measuring instruments, and related notes – helps in decision making
    - listing the location of the research work (optional?) – the use?
- **Comments/footnotes:**
  - Cleaner presentation
  - Shorter vs. longer comments

Source dataset ⇔ Adopted dataset:

- **In the decay dataset:**
  - Some data from the adopted data set
  - Guideline (by Murray Martin) recommends to list the half-lives from the Adopted Levels
    - Is it applicable for all half-lives
    - I used to list the half-lives for the g.s. and isomeric states
    - Wish to know the use of listing very short half-life (ns, fs) in the decay dataset
- **For reaction dataset:**
  - If not needed, avoid taking data from the adopted dataset
  - Sometimes authors quote data from the literature for deducing quantities (spectroscopic factors, width, γ-branching, etc.). In those cases
    - Choice of footnote is important: "from adopted dataset" vs. ""by authors (key number) based on the literature"

Policy, Guidelines, Additional notes:

- **When can't follow:**
  - Explanation is useful - sometimes confusing
    - In weighted average when the uncertainty is the lowest input value
    - Level energies from a least-squares fit without Eγ uncertainty (Guideline vs. other opinion)
    - Calculated Eγ, when needed, with or without uncertainty
    - Beta intensity not from g-transition intensity balance

- **Gamma transition multipolarity:**
  - From A2, A4 or DCO – if authors give magnetic and/or electric
  - Keep authors value in the dataset and change in the adopted dataset?
    for example: M1+E2 vs. D+Q

Additional notes/documents for evaluators:

- **Keeping all compilation notes/documents at a single location:**
  - Assembling in categorized folders
    - Decay dataset related
    - Reaction dataset related
    - Adopted dataset related and
    - Working equations
- **The latest Guideline (by Murray Martin) 4/26/2021:**
  - Includes notes/documents as Appendix (A to G)
- **Missing notes/documents in the Guideline:**
  - Decay data normalization procedures (by J. Tuli)
  - Normalizing Decay Schemes and troubleshooting (by E. Browne)
  - Consistency for configuration listing (by F. Kondev)
  - To account for total decay branching (100%) for delayed particle decay data sets (by Balraj – no written document is available yet)
- **Nuclear Structure and Decay Data Evaluators' Corner**

  https://www.nndc.bnl.gov/ensdf/evalcorner/
  - Some useful documents are available

Additional notes: related to decay dataset

γ-ray Intensity Normalization for Radioactive Decays in

Nuclear Data Sheets

J. K. Tuli

National Nuclear Data Center
Brookhaven National Laboratory
Upton, NY 11973, U.S.A.

(September 1987)

1. Emission probability is measured
   for cases: a) P_{γ} , b) $P_{\beta-}$, c) $P_{\beta+}$, and d) P_{γ} in a decay chain (equilibrium)
2. Direct feeding to the g.s. is known
3. Annihilation radiation intensity is known
4. x-ray intensity is known
5. x-ray - γ-ray coincidence intensity is measured

Additional notes: related to decay dataset

A Procedure for Normalizing Decay Schemes.

E. Browne
Lawrence Berkeley Laboratory, University of California, Berkeley, California, USA.

April 1986

In this same document: a troubleshooting example

Action item 11
NSDD 2022

III. Recommended Procedure.

A single prescription to solve the problems described in section II may be hard (if not impossible) to find. However, the following procedure for calculating a normalizing factor, incorporates features which lead to more realistic values for N.

Table 1

	Experimental*		Solution 1		Solution 2	
Level Energy (keV)	Δ_i	ϵ(%)	Δ_i	ϵ(%)	Δ_i	ϵ(%)
168.3	-7.8	<1.0	0.0	0.0	0.0	0.0
236.2	0.13	<2.5	0.0	0.0	0.0	0.0
272.7	18.58	12.0	10.78	6.9	18.58	11.38
669.1	136.53	87.8	136.53	87.8	136.53	83.66
1161.8	8.09	5.2	8.09	5.2	8.09	4.96
	155.53	105.0	155.53	100.0	163.2	100.0

* From reference 2

[2]R.L. Haese, F.E. Bertrand, B. Harmatz, and M.J. Martin, *Nucl. Data. Sheets* **37**, 289 (1982).

Additional notes: related to decay dataset

A pseudo level range Sn+x and a beta record so that total %b- adds to 100 (by Balraj Singh)

^{40}P β^- decay (150 ms) 2001Wi21

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Jun Chen	NDS 140, 1 (2017)	30-Sep-2015

Parent: ^{40}P: E=0.0; $J^\pi=(2^-,3^-)$; $T_{1/2}$=150 ms *8*; Q(β^-)=14.76×10^3 *11*; %β^- decay=100.0

E(level)	J^π †	Comments
S(n)+x		S(n)(^{40}S)=7750 *50*, x<7010.

β^- radiations

E(decay)	E(level)	Iβ^- †#	Log *ft* ‡	Comments
(4×10^3 @ *4*)	S(n)+x	15.8 *21*		Iβ^-: %β^-n=15.8 *21* (from ^{40}P Adopted Levels).

^{40}P β^- decay (150 ms) 2001Wi21

Additional notes:

Consistency in assigning configurations in ENSDF

action item from the 2017 NSDD meeting

F.G. Kondev (ANL) & T.X. Kibedi (ANU)

2019 NSDD Meeting, April 8 - 12, 2019, IAEA Vienna

Spherical nuclei: shell-model notation

- ✓ use only the valence particles (holes)
- ✓ the spin & parity balance - caution with ranges …
- ✓ close relation between CONF and MOMM1 (g-factors, g_K-g_R …)

single-particle (hole)

$\pi(h_{9/2}^{+1})$	|p(h{-h/2}{++1}), e.g. $^{209}Bi_{83}$; Jπ=9/2-
$\nu(p_{1/2}^{-1})$	|n(p{-1/2}{+-1}), e.g. $^{207}Pb_{125}$; Jπ=1/2-
$\pi(h_{9/2}^{+1}) \otimes 2^+$	|p(h{-h/2}{++1})-#2{++}; Jπ=5/2- to 13/2-

two-particle (hole)

$\pi(h_{9/2}^{+1}) \otimes \nu(p_{1/2}^{-1})$	|p(h{-h/2}{++1})-#|n(p{-1/2}{+-1}); Jπ=4+ or 5+
$\pi(h_{9/2}^{+2})_{8+}$	|p(h{-h/2}{++1}){-{8{++}}}; Jπ=8+

many-particle (hole)

$\pi(h_{9/2}^{+1}) \otimes \nu(p_{1/2}^{-1}, f_{5/2}^{-1})_{4+}$	Jπ=1/2- το **17/2-**, odd-Z (N)
$\pi(h_{9/2}^{+2})_{8+} \otimes \nu(p_{1/2}^{-1}, f_{5/2}^{-1})_{4+}$	Jπ=12+, even-even (or odd-odd)

Deformed nuclei: Nilsson-level labeling

one-quasiparticle states

$K^\pi = 1/2^-, \pi 1/2^-[541]$

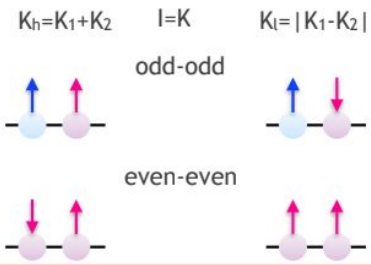
$K^\pi = 7/2^+, \nu 7/2^+[633]$

two-quasiparticle states

$K^\pi = 2^-, \pi 1/2^-[541] \otimes \nu 7/2^+[633]$

$K^\pi = 8^-, \pi^2(7/2^+[404], 9/2^-[514])$

Note the Gallagher-Moszkowski rule



multi-quasiparticle states

$K^\pi = 14^+, \pi^2(7/2^+[404], 9/2^-[514])_{8^-} \otimes \nu^2(5/2^-[512], 7/2^+[633])_{6^-}$

some time complicated band structures (very high spin) -> shell-model notation

Nuclear Structure and Decay Data Evaluators' Corner

https://www.nndc.bnl.gov/ensdf/evalcorner/

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- NNDC Site Index
- **Nuclear Data Resources**
- Evaluated Nuclear Structure Data File (ENSDF)
- Nuclear Science References (NSR)
- NSDD Website (IAEA)
- NSDD Data Centers
- US Nuclear Data Program
- **ENSDF Analysis & Utility Codes**
- **Calculational Tools**
- Band-Raman ICC's (ANU)
- Hager-Seltzer ICC's
- Log *ft*'s
- Q Values
- **ENSDF Manuals & Preprints**
- ENSDF Formats
- ENSDF Procedures
- Revised Guidelines for Evaluators, 2021
- ENSDF Pre-Submission Checklist
- NDS General Policies
- History of Elements
- **Horizontal Evaluations**
- Repository of Horizontal Evaluations

Revised Guidelines for Evaluators now available. Updated April 2021.

Please also consult the checklist before submitting your mass chain.

Guidelines for performing a review of a mass chain can be found here.

Zipped archived ENSDF files going back through 2004.

Find Q values needed for evaluations.

Listing of high-priority nuclides and current status of ENSDF evaluations ordered by XUNDL cut-off and by date of last evaluation.

ESNDF notes & documents

Decay dataset

Reaction dataset

Miscellaneous

Summary

Source dataset:

- *A well prepared source dataset is important and useful*
- *When reported data of the article is used to deduce any quantities – listing of the original data from the article is useful for tracking the pdf or identifying typos/mistakes*
- *Listing of NSR key #, if check and found irrelevant, in the "d" (document) record could be a time saving step for the network (reviewers, evaluators)*

Missing notes/documents in the Guideline (by *Murray Martin)*:

- *Archival of all the compilation/evaluation related documents preservation and use*
- *Some notes, documents, working equations, etc. are available in the Guideline Appendix (A to G), however, some are missing*
- *Evaluators Corner at the NNDC site may be used instead of appending those in the Guideline*
- A short document needs to be prepared for a new adopted format to account for the missing beta branching (for example if 100%) when delayed particle emission branch is present in the decay dataset (proposed by Balraj)

Many data to compile - the knowledge of their need or use makes the work a little rewarding

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Thank you