ENSDF Format, Policies, Guidelines

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ENSDF

Source For

- Table of Isotopes
- Nuclear Data Sheets
- Nuclear Wallet Cards
- NUDAT

Update – continuous

Distributed – six monthly

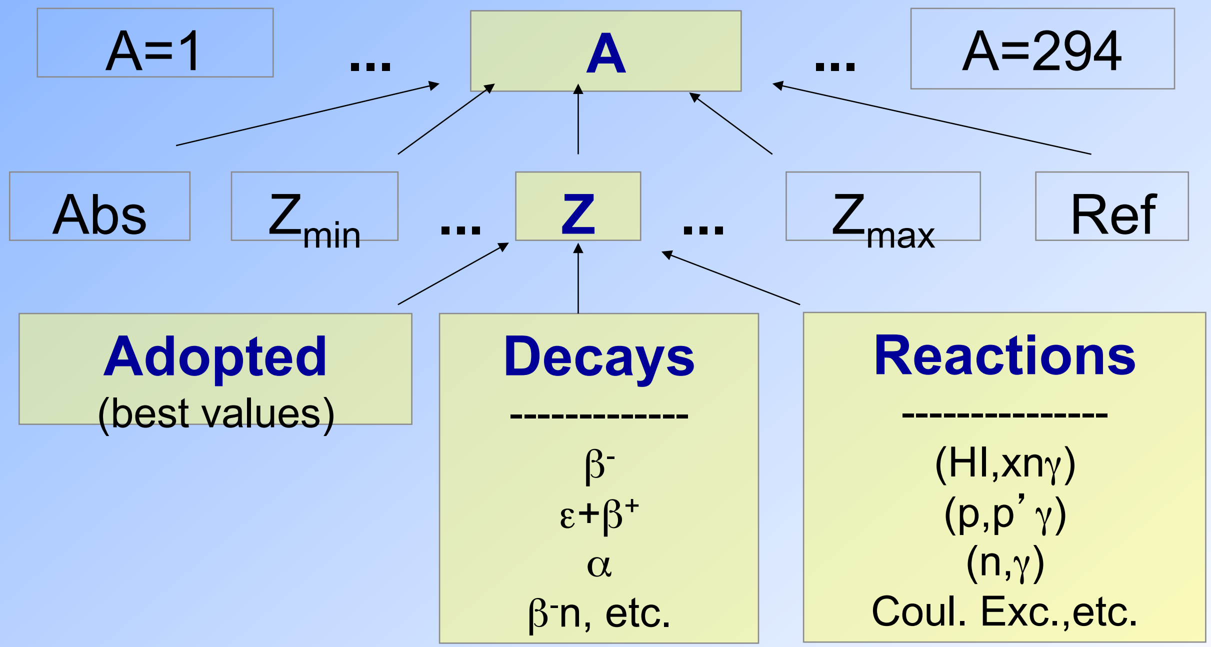
ENSDF Content

Collection of Data Sets by A and Z

Comments (Abstract)
References
Adopted Levels, Gammas

Experimental Data Sets
-Radiactive Decay
-Nuclear Reactions

ENSDF Schematic

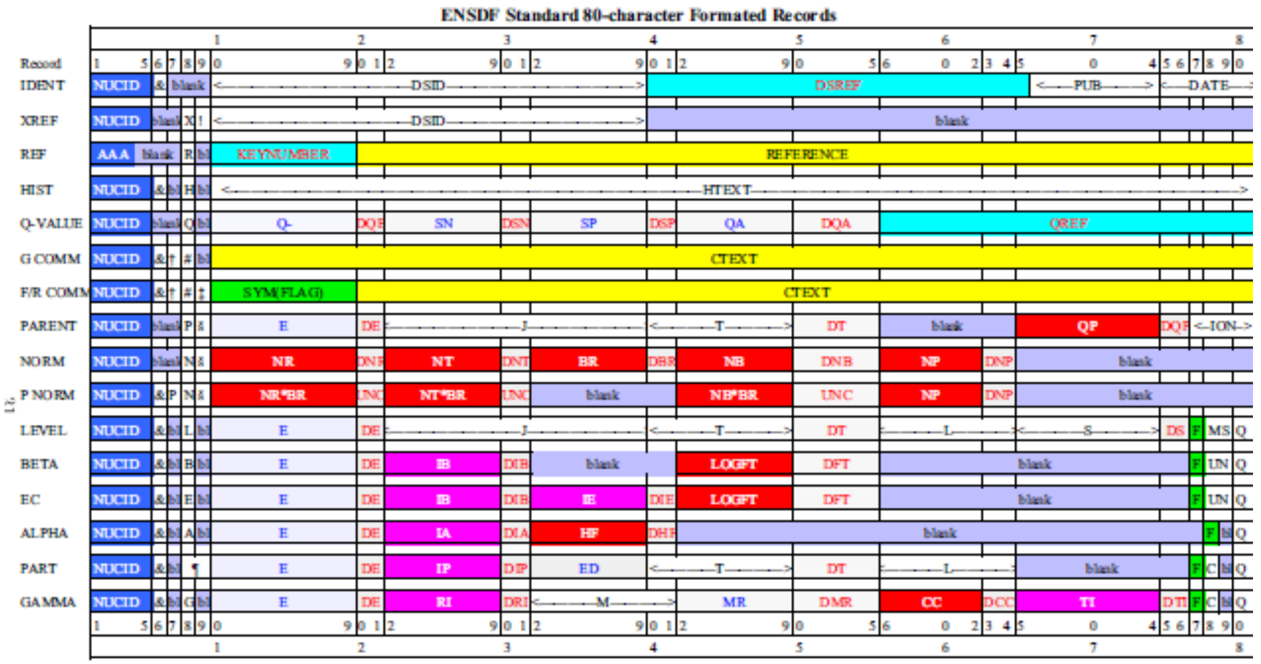


EVALUATED NUCLEAR STRUCTURE DATA FILE

A Manual for Preparation
of Data Sets

Jagdish K. Tuli

Format Summary



Purpose/Philosopy (ENSDF)

Present set of critically evaluated properties of nuclides based on best known experimental information to date

Present best data available for each type of experiment

Present best info for each nuclide

Concise, consistent, and well-documented

Purpose/Philosopy (XUNDL)

Present information given in a paper in ENSDF format.

Present it as concise, consistent, and well-documented.

General

Evaluated results of a single experiment or combined results of a number of experiments yielding basically the same kind of information, e.g., (HI,xng), or Coulomb Excitations. The collection is called a Data Set.

The adopted Properties of the nucleus.

Minimum Standards

A-Chain completeness – All nuclides

Nuclide Completeness – All data sets

Data Set Completeness – ID to END record

Decay Data Sets: Parent record, (Normalization)

Adopted sets: Q record, (XREF's)

etc.

Uncertainty, units, documentation

Physical Properties

Adopted Properties

General – Q, History, XREF, Comments

Levels-E,Jpi,T1/2,branching,static mom

Gammas-E,branching,mult,cc,BLW

Decay Properties

Nuclear Reaction Properties

GS Properties

Q(beta-)
N-Separation Energy
P-Separation Energy
Alpha-Decay Q value
Half-life
Spin-parity
Decay Modes
Static Moments

Level Properties

Spin-parity

Half-life

Angular Momentum transfer

Spectroscopic Factor

Decay braching

Static Moments

Configuration

Experiments in which level is seen

Level Properties –Special Cases

Configuration assignments

Band Assignments

Isomer Shifts, isotope shifts

Charge distribution of gs, often only a reference

Deformation parameters of gs (model dependent)

Excitation Probabilities (BEL, BML) when the T1/2 and gs branching are not known

Radiation Properties

Placement in level scheme

Energy

Intensity –Relative and Absolute through Normalization. Per 100 decay modes for Alphas.

Transition Intensity. EC, B+ decay (theory).

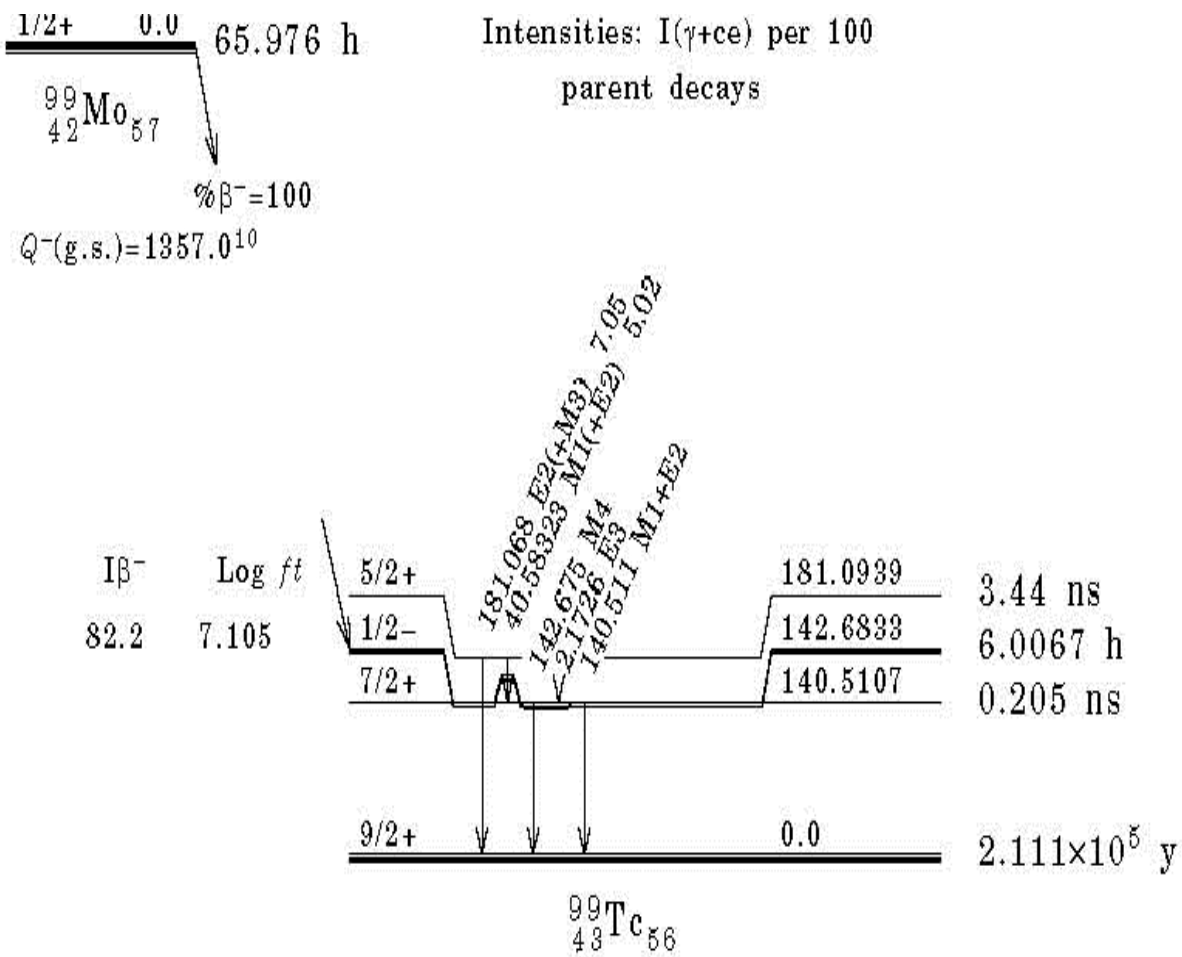
Partial EC probabilities.

Multipolarity and Mixing Ratios

Total internal Conversion Coefficients

Logft values/ Hindrance Factors

Reduced Transition Probability-down –W.u.



1/2+ 0.0 65.976 h
$^{99}_{42}Mo_{57}$
%β⁻=100
Q^-(g.s.)=1357.0 10
Intensities: I(γ+ce) per 100 parent decays
181.068 E2(+M3) 7.05
40.58323 M1(+E2) 5.02
142.675 M4
2.17726 E3
140.511 M1+E2
Iβ⁻ Log ft
82.2 7.105
5/2+ 181.0939 3.44 ns
1/2− 142.6833 6.0067 h
7/2+ 140.5107 0.205 ns
9/2+ 0.0 2.111×10^5 y
$^{99}_{43}Tc_{56}$

Decay Dataset

99TC   99MO B- DECAY   1992GO22   11NDS   2011
99TC c Measured: |g (1992Go22,1990Me15,1978MeZK); |g, |g|g, |g|g(|q)
99TC2c (1982Si16); |g, |g|g (1969Co18); |g, |g|g (1968Va14); |g (1980Di
99TC cG   The large discrepancies of the measurements of |g|g(|q)
99TC2cG involving the 181 level
99TC cG E   From 1990Me15 and 1978MeZK, if not indicated otherw
99TC cG RI   From 1992Go22, if not indicated otherwise
99TC cG RI(A)   From 1990Me15
99TC cG M   From |g|g(|q) and |a(K)exp, if not noted otherwise.
99TC cL J   Adopted values
99MO P 0   1/2+   65.976 H 24   1357.0   10
99TC N 0.1226   18   1.0   1.0
99TC G 89.4   2 0.025   17
99TC G 455.84   130.011   5   A
99TC G 490.53   150.009   3   A
99TC G   581.30 120.008   4

- 99TC G 509.6   5 0.017   8
- 99TC L   0   9/2+   2.111E+5 Y12

Record Types

ID	LEVEL
History	BETA
XREF	EC
Comments	ALPHA
Q-value	PARTICLE
Parent	GAMMA
Normalization	END

Identification Record

Required for all data sets.Must precede all other records.

Field (Col.)	**Name**
1-5	NUCID
10-39	DSID
40-65	DSREF
66-74	PUB
75-80	DATE (year/month)

The History Record

Field (Col.)	Name
1-5	NUCID
6	Blank
7	Blank
8	H
9	Blank
10-80	History

The Q-value Record

Field (Col.)	**Name**		
1-5	NUCID		
8	Q	Letter ‘Q’ is required	
10-19	Q^-	20-21	DQ^-
22-29	SN	30-31	DSN
32-39	SP	40-41	DSP
42-49	QA	50-55	DQA
56-80	QREF		

The Cross-Reference Record

Field (Col.)	**Name**	
1-5	NUCID	
8	X	Letter ‘X’ is required
9	DSSYM	Any ASCII character
10-39	DSID	*Must* exactly match one of ID’s

The Comment Record

Field (Col.)	Name	
1-5	NUCID	
7	Letter ‘C’, ‘D’, or ‘T’ is required	
8	RTYPE	Blank or record type
9	PSYM	Blank, or symbol
10-80	CTEXT	Text of the comment.

The Parent Record

Field	Name	
1-5	NUCID	
8	P (required)	
9	Blank or integer	
10-19	E Energy	20-21 DE
22-39	JPI	
40-49	T	50-55 DT
65-74	QP	75-76 DQP
77-80	Ionization State	

The Normalization Record

Field	Name	
8	N (required)	
10-19	NR	20-21 DNR
22-29	NT	30-31 DNT
32-39	BR	40-41 DBR
42-49	NB	50-55 DNB
56-62	NP	63-64 DNP

The Prod Normalization Record

Field	Name	
8	N (required)	
10-19	NR*BR	20-21 DNR
22-29	NT*BR	30-31 DNT
42-49	NB*BR	50-55 DNB
56-62	NP	63-64 DNP
77	Blank or C	78 Opt (1-7)

The Level Record

Field	Name	
1-5	NUCID	
8	L (required)	
10-19	E Energy	20-21 DE
22-39	JPI	
40-49	T	50-55 DT
56-64	L (angular momentum transfer)	
65-74	S	75-76 DS
77	Flag	78-79 MS
80	Q	

The Beta Record

Field	Name	
1-5	NUCID	
8	B (required)	
10-19	E Energy	20-21 DE
22-29	IB Intensity	30-31 DIB
42-49	Logft	50-55 DFT
77	Flag	
78-79	Forbiddenness 80	Q

The EC Record

Field	Name		
1-5	NUCID		
8	E (required)		
10-19	E Energy	20-21 DE	
22-29	IB Intensity	30-31 DIB	
32-39	IE Intensity	40-41 DIE	
42-49	Logft	50-55 DFT	
65-74	TI	75-76 DTI	77 Flag
78-79	Forbiddenness	80 Q	

The Alpha Record

Field	Name	
1-5	NUCID	
8	A (required)	
10-19	E Energy	20-21 DE
22-29	IA Intensity	30-31 DIA
32-39	HF	40-41 DHF
77	Flag	
80	Q	

The Gamma Record

Field	Name		
8	G (required)		
10-19	E Energy	20-21 DE	
22-29	RI rel Intensity	30-31 DRI	
32-41	M multipolarity		
42-49	MR mix ratio	50-55 DMR	
56-62	CC total CC	63-64 DCC	
65-74	TI	75-76 DTI	
77	Flag	78 COIN	80 Q

The (Delayed-) Particle Record

Field	Name		
8	D (for delayed)	9	particle (N,P,..)
10-19	E Energy	20-21 DE	
22-29	IP % Intensity	30-31 DIP	
32-39	EI lev en intermediate nucleus		
40-49	T Width	50-55 DT	
56-64	L angular momentum transfer		
77	Flag	78 COIN	80 Q

Guidelines-extraction of data

Quote authors' measured quantities

Document any deviations

Note authors' assumptions

Check for missed references

Check authors' quoted older values

Guidelines-presentation of data-1

Order of Comments

E= not needed for reaction

Target JPI should be given

Keyno: measured, etc.

Do not combine different kind of data sets

Specify source of data

Guidelines-presentation-2

Gammas order by increasing Eg

Significant digits

Uncertainty limited to 25

Multiplets

Xsection,Analyzing-power not given

BEL up for levels, down for gammas

Delayed gammas-give as IT decay

Guidelines-presentation-3

Normalization condition should be given

Parent record, all fields should be given

Replace `/’ by `:’ for multiple ratios

Unresolved discrepancies should be pointed out

Uncertainty not error

E(ec),E(b-) only when accurate, measured

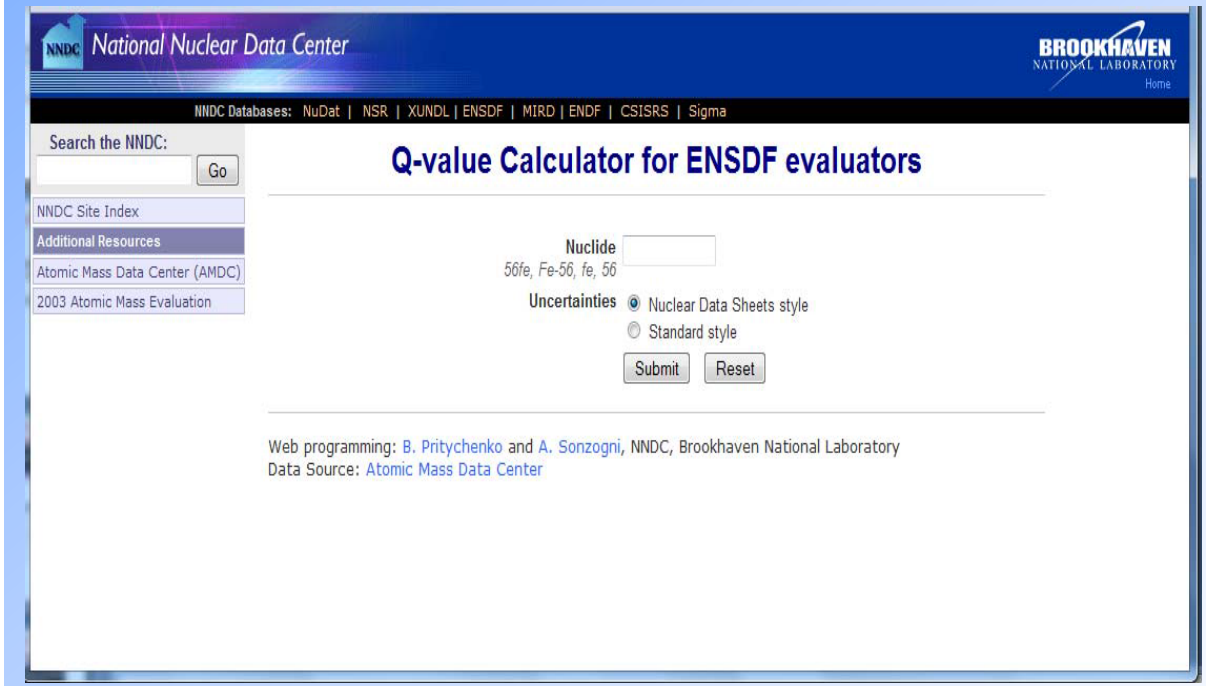
Guideline-presentation-4

APS style adopted

Accepted abbreviations

Key no. is plural. Space after `,'

QCalc



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Atomic Mass Data Center (AMDC)
2003 Atomic Mass Evaluation
Q-value Calculator for ENSDF evaluators
Nuclide
56fe, Fe-56, fe, 56
Uncertainties
Nuclear Data Sheets style
Standard style
Submit
Reset
Web programming: B. Pritychenko and A. Sonzogni, NNDC, Brookhaven National Laboratory
Data Source: Atomic Mass Data Center

QCalc

National Nuclear Data Center

NNDC Databases: NuDat | NSR | XUNDL | ENSDF | MIRD | ENDF | CSISRS | Sigma

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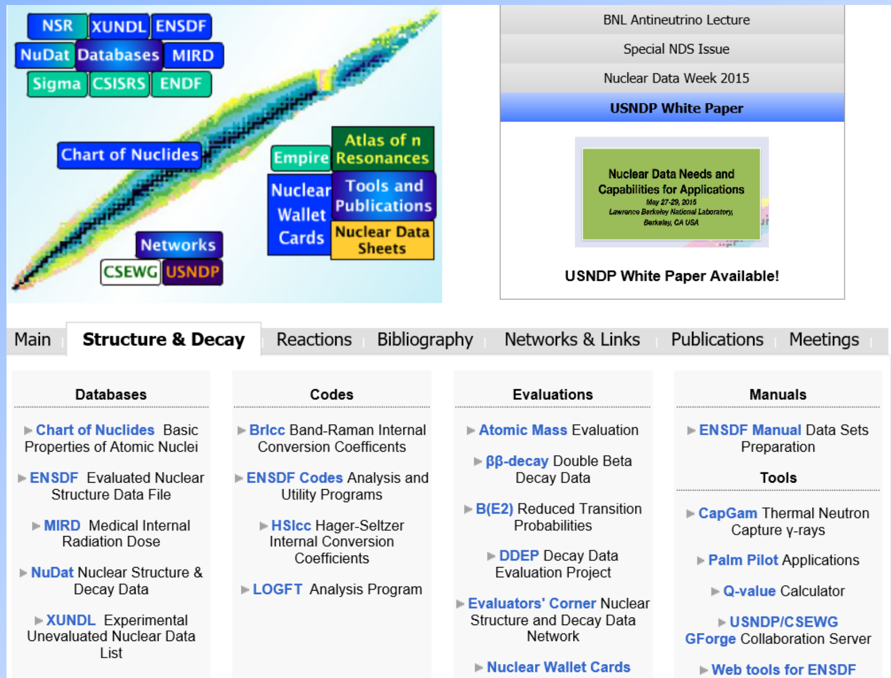
- Atomic Mass Data Center (AMDC)
- 2003 Atomic Mass Evaluation

Q-value Calculator (QCalc)

Nucleus	KeyNumber	$Q_{\beta-}$	SY	$\Delta Q_{\beta-}$	S_n	SY	ΔS_n	S_p	SY	ΔS_p	Q_α	SY	ΔQ_α	$Q_{\beta-n}$	SY	$\Delta Q_{\beta-n}$	Q_{ECp}	SY	ΔQ_{ECp}
^{211}Hg	2003AU03																		
	2011AUZZ	5.5E+3	SY	3	3.2E+3	SY	3	1.01E+4	SY	4				7.1E+2	SY	20			
^{211}Tl	2003AU03	4.42E+3	SY	20	4.90E+3	SY	20	8.3E+3	SY	4				5.8E+2	SY	20			
	2011AUZZ	4.55E+3	SY	20	4.77E+3	SY	20	7.9E+3	SY	3	2.4E+3	SY	4	7.1E+2	SY	20	-1.56E+4	SY	4
^{211}Pb	2003AU03	1367		6	3834		3	8534		12	3.30E+3		15	-3771		3	-1.27E+4		3
	2011AUZZ	1368		6	3833		3	8533		12	3.30E+3		15	-3770		3	-1.241E+4		20
^{211}Bi	2003AU03	574		5	5138		5	4419		6	6750.3		5	-3977		5	-9901		13
	2011AUZZ	575		5	5137		5	4419		6	6750.3		5	-3976		5	-9901		13
^{211}Po	2003AU03	-785		3	4550.8		5	4929.7		9	7594.5		5	-8532		8	-4993.2		10
	2011AUZZ	-785		3	4550.8		5	4929.6		9	7594.5		5	-8532		8	-4993.1		10
^{211}At	2003AU03	-2892		7	7747		8	2983.1		25	5982.4		13	-10121		9	-4144.3		24
	2011AUZZ	-2892		7	7747		8	2983.1		25	5982.4		13	-10118		5	-4144.3		24
^{211}Rn	2003AU03	-4598		22	7229		11	4073		10	5965.4		14	-13481		23	-91		7
	2011AUZZ	-4616		14	7226		8	4073		10	5965.4		14	-13495		17	-91		7

Structure & Decay



ENSDF Analysis and Utility Codes

Platforms

- Most of the programs are available for the following:
  - ANSI standard Fortran 95
  - LINUX and UNIX (Lahey/Fujitsu FORTRAN 95)
  - Windows -7
  - For LINUX, UNIX, and Windows, executables are also provided.

ENSDF Analysis and Utility Codes
Overview

- FMTCHK (Format Check)
- GTOL (Least-Squares fit, Intenisty Balance)
- JGAMUT (Combine datasets)
- Logft
- Pandora
- RadList (Radiation Listing) — Calculates atomic & nuclear radiations. Checks energy balance
- Ruler — Calculates reduced transition probabilities

ENSDF Analysis and Utility Codes
All Types of Datasets

- Applicable programs are FMTCHK, ENSDAT, PANDORA.
- FMTCHK should be run after any manual changes to the file.
- If you are considering combining several datasets (*e.g.*, from XUNDL), PANDORA may be useful.

ENSDF Analysis and Utility Codes

Adopted Levels, Gamma Datasets — 1

- Applicable programs are ADDGAM, GTOL, BrIcc, PANDORA, and RULER.
- ADDGAM and PANDORA are useful in constructing the dataset.
- PANDORA used iteratively to aid in physics decisions, checking assignments, and updating source datasets based on changes in the adopted data.
- GTOL useful only in obtaining the least-squares adjustment of the level energies.

ENSDF Analysis and Utility Codes

Adopted Levels, Gamma Datasets — 2

- RULER may be used in two modes:
  - Comparison mode to provide additional information in obtaining γ-multipolarity assignments.
  - Should also be run to provide the BEλW's and BMλW's.
  - BrIcc/HSICC should be run before RULER.
- BrIcc should be run to provide the internal conversion coefficients.

ENSDF Analysis and Utility Codes

Decay Datasets — 1

- Applicable programs are ALPHAD (for α decay), GABS, GTOL, BrIcc, LOGFT (for $\beta^{\pm}/\varepsilon$ decay), RadList, and RULER.
- ALPHAD should be used to obtain the hindrance factors and, for even-even ground-state nuclei, R_0. For other nuclei, an R_0 must be supplied.
- GABS may be used to combine the data from up to three sources to obtain I_γ-normalization (NR), the branching ratios (BR), and absolute I_γ's.
  - BrIcc should run on the input data or the α's from the adopted dataset should be used.

ENSDF Analysis and Utility Codes
Decay Datasets — 2

- GTOL may be used to:
  - Provide a least-squares adjustment of the level energies.
  - Check the uncertainties and placement of the γ' s.
  - Obtain the intensities of particles feeding the levels.
    - Should be done before ALPHAD and LOGFT are employed.
  - May be useful in deriving I_γ-normalization (NR).
- BrIcc may be used to:
  - Check experimentally measured α' s against theory.
  - If the adopted α' s are not used, to produce this information for the data set.

ENSDF Analysis and Utility Codes

Decay Datasets — 3

- LOGFT is required to obtain the log *ft'* s, $I_{\beta+}$ and I_{ε}, and partial electron-capture fractions.
  - Should be done before using RadList.
  - If one is not using measured intensities, GTOL should be used to obtain $I_{\beta-}$ and $I_{\varepsilon+\beta+}$.

ENSDF Analysis and Utility Codes
Decay Datasets — 4

- RadList should be used to:
  - Check the calculated energy deposited with that based the Q-value and branching ratio.
  - To compare to experimentally obtained X-ray intensities
  - Check results against integral measurements (*e.g.*, $<E_{\beta\pm}>$)
  - Unresolved discrepancies should be noted in the dataset.
  - BrIcc and LOGFT should have been used before doing these checks.

ENSDF Analysis and Utility Codes

Decay Datasets — 5

- RULER may be used to check or further limit multipolarities based on other methods (*e.g.*, from experimental conversion coefficients).

ENSDF Analysis and Utility Codes
Reaction Datasets — 1

- Applicable programs are GTOL, BrIcc, and RULER.
  - For (thermal n,γ) datasets, RadList may also prove of use.
- GTOL's primary use is to do a least-squares adjustment of the level energies and to check the uncertainties and placement of the γ's.
  - If ΔE_γ's are not given and a good estimate of these cannot be obtained, it may be better to use the authors' level energy values.
  - Also useful for checking for intensity imbalance problems if relative intensities are given.

ENSDF Analysis and Utility Codes
Reaction Datasets — 2

- BrIcc may be used to check experimentally measured α's against theory.
  - Very useful to include α's and partial α's for (thermal n,γ) datasets.
- RadList may be used to check the energy balance of (thermal n,γ) datasets