NDS Evaluation –History and Introduction

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Evaluated Data

Nuclear Data Sheets

ENSDF

XUNDL

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Evaluation History

Katherine Way is the Matriarch of this activity. She as part of Manhattan Project working at Clinton Lab (later renamed ORNL) began collecting nuclear data.

In 1948 Way headed the Nuclear Data Project at US National Bureau of Standards (later renamed US National Inst of Standards and Technology)

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Evaluation History - cont

A “Nuclear Data” report was published in 1950.

In 1953, the Nuclear Data Project, moved under the US National Academy of Sciences-National Research Council in Washington, DC

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Evaluation History - cont

The data were published, as AEC reports,.
These were in form of loose leaf pages and were called the “Nuclear Data Sheets”

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Ground State

J	7/2	App. 1	Abundance	97.41%	App. 2
μ	+2.230 *11*	App. 1	σ_{nA}	23	App. 3
Q	+5.68 *6*	App. 1			

0.100-ns, 0.1138-MeV Level

J	9/2	Coulomb excitation	^{175}Lu–1
μ	+1.89 *14*	$\gamma\gamma(\theta,H)$	^{175}Yb–3
$T_{1/2}$	**0.110 ns** *10*	$\beta\gamma$-delay	^{175}Yb–2
	0.101 *7*	p(ce)-delay	^{175}Lu–1
	0.080	Coulomb excitation	^{175}Lu–1
	0.090 *10*	$\gamma\gamma$-delay	^{175}Hf–2
	[A] **0.100**		

Reaction Data

Coulomb Excitation

^{175}Lu(x,x'γ)

0.1138 level
$T_{1/2}$ = 0.080 ns if B(E2)↑ = 2.4, α = 2.49, δ^2 = 0.22
0.101 *7* p(ce)-delay 60Bl10
[A] 0.100

ϵB(E2)↑	E_γ	B(E2)↑[a]	x	E_x		
ce_L 0.36	**0.114**	2.8	p	1.75	sd ce_L	56H49
γ 0.8	**0.114**	2.8	α	6	scin	56H78
	0.11379 *4*		p	3.7	cryst	58C36
γ 0.72	**0.114**	2.5	p	4	scin	58M36
	0.114 *2*	2.34 *10*	p,d	4.5	sx'	59E42
ce_L 0.358	**0.114**	2.78	p	3.2	s ce_L	60Be16
	[A] **0.1138**				See ^{175}Yb-1	

For conversion-coefficient data for 0.1138γ, see ^{175}Yb–1

p(0.1138γ)(θ) A_2 = +0.007 *7* 58M36

[a] If α = 2.49 and α_L = 0.45 for 0.1138γ (δ^2 = 0.22)
[b] If α = 1.41, α_L = 0.23 for 0.1377γ, α = 0.133, α_K = 0.086 for 0.251γ, and crossover/cascade = 0.95
[c] If α_K(0.251γ) = 0.086
[d] If B(E2)↑ = 2.4 for 0.1138 level
[A] Adopted value

Reaction Data continued

Coulomb Excitation continued

^{175}Lu(x,x'γ)

0.2515 level
$T_{1/2}$ = 0.042 ns if B(E2)↑ = 0.55, α(0.1377γ) = 1.41, α(0.251γ) = 0.133, crossover/cascade = 0.95

ϵB(E2)↑	E_γ	B(E2)↑[b]	x	E_x		
γ	**0.136**		α	6	scin	56H78
γ 0.13	**0.140**	0.45	p	4	scin	58M36
ce_L 0.044	**0.137**	0.67	p	3.2	s ce_L	60Be16
	[A] **0.1377**				See ^{175}Yb–1	

K/L = 4.3 *4* α_L = 0.30[c] 60Be16
6.6 0.19 M1 Theory
1.1 0.43 E2 Theory
4.8 0.23 $|\delta|$ = 0.47

p(0.1377γ)(θ) A_2 = +0.107 *13* δ = +0.47 *4* 58M36

	0.248		α	3.4	scin	54T21
	0.240 *7*		p	2.6	scin	55M44
	0.250	0.53[d]	p	2.9	scin	56G47
γ 0.11	**0.250**	0.40	α	6	scin	56H78
γ 0.12	**0.254**	0.44	p	4	scin	58M36
	0.251	0.57 *8*	p,d	4.5	sx'	59E42
ce_K 0.012	**0.251**	0.51	p	3.2	s ce_K	60Be16
	[A] **0.251**				See ^{175}Yb–1	

K/L = 2.9 *4* 60Be16
K/L = 2.4 α_K = 0.086 E2 Theory

p(0.251γ)(θ) A_2 = +0.089 *6* δ^2 = ∞ 58M36

I_γ(0.251γ)/I_γ(0.1377γ) = 0.90 *15* scin 56G47
0.50 scin 56H78
0.95 scin 58M36
0.95 *6* scin $\gamma\gamma$ 62Go23
[A] 0.95

(ce_K 0.251γ)/(ce_L 0.1377γ) = 0.32 *3* 60Be16

$\gamma\gamma$ (0.1377γ)(0.1138γ) • 56G47, 56H78

Reaction Data continued

Coulomb Excitation continued

$^{175}Lu(x,x'\gamma)$

0.75 level

E_γ	B(E2)↑[e]	x	E_x	
0.258	0.040 *6*	p	3.5	s ce_K 60Be16

E(level) = 0.75 *10* 60Be16
from relative yields of 0.258γ for E_p = 3.2 and 3.5

Level $^{175}Lu(\gamma,\gamma)$

0.343 level
$T_{1/2}$ = 0.29 ns *3* if the 0.343 photon accounts for 88.3% of decays from this level resonance fluorescence 62De2

0.343γ(θ) $A_2 = -0.20$ *28* 62De2
consistent with { −30 ≤ δ ≤ −2 62De2; −0.3 ≤ δ ≤ 0.1 62De2

Q

$^{175}Lu(\gamma,n)$

g.s. Q = −7.77 *5* thresh 58K39[f]
−7.88 *8* thresh 60Ge1

[e] If 0.258γ is M1
[f] Natural element was used for target

Mass-Spectrometer Data

Mass-Doublet Measurements 60Bh2, 63De30
See Appendix 4

Added in Proof

Reaction γ's
$^{176}Yb(p,2n\gamma)$ E_p = 12, pulsed

E_γ	
0.345	$T_{1/2}$ = 1.3 *2* μs x_K/γ indicates E1 transition E_{x_K} shows transition is in Lu

S.Bjornholm, J.Borggreen, H.J.Frahm, M.J.Sigurd Hansen, priv.comm. Authors assign K = 1/2, J = 5/2 to the 0.345 level, suggest it is lowest member of 1/2[541] band.

Evaluation History - cont

In 1964, the Nuclear Data Project, under the leadership of Katherine Way moved back to Oak Ridge National Lab, where her effort had originally started in 1948.

The Nuclear Data Sheets were to be published in a book form by the Academic Press, rather than the single sheets of data.

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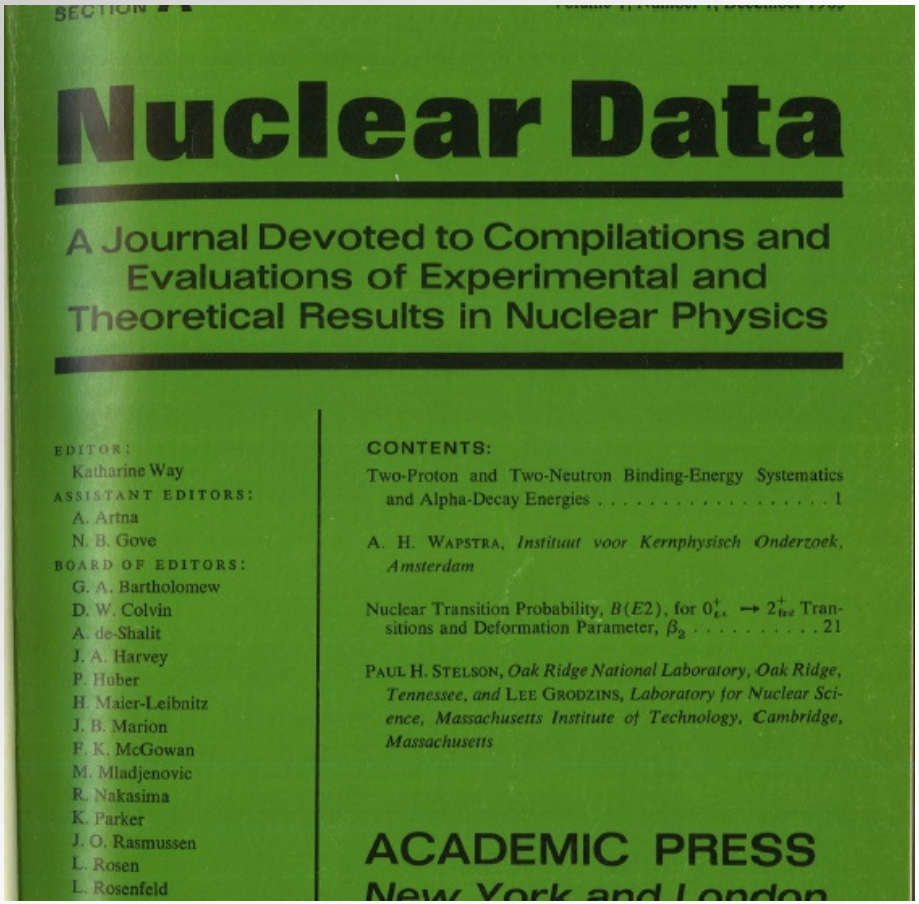

SECTION A

Nuclear Data

A Journal Devoted to Compilations and Evaluations of Experimental and Theoretical Results in Nuclear Physics

CONTENTS:

Two-Proton and Two-Neutron Binding-Energy Systematics and Alpha-Decay Energies 1

A. H. WAPSTRA, *Instituut voor Kernphysisch Onderzoek, Amsterdam*

Nuclear Transition Probability, $B(E2)$, for $0^+_{g.s.} \rightarrow 2^+_{first}$ Transitions and Deformation Parameter, β_2 21

PAUL H. STELSON, *Oak Ridge National Laboratory, Oak Ridge, Tennessee, and* LEE GRODZINS, *Laboratory for Nuclear Science, Massachusetts Institute of Technology, Cambridge, Massachusetts*

ACADEMIC PRESS
New York and London

Evaluation History - cont

Nuclear Data Sheets-Journal

In February 1966, Nuclear Data Sheets started as the section B of the journal Nuclear Data, and later as simply Nuclear Data Sheets published by the Academic Press

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SECTION A

Volume 1, Number 1, December 1965

Nuclear Data

A Journal Devoted to Compilations and Evaluations of Experimental and Theoretical Results in Nuclear Physics

CONTENTS:

Two-Proton and Two-Neutron Binding-Energy Systematics and Alpha-Decay Energies 1

A. H. WAPSTRA, *Instituut voor Kernphysisch Onderzoek, Amsterdam*

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PAUL H. STELSON, *Oak Ridge National Laboratory, Oak Ridge, Tennessee, and* LEE GRODZINS, *Laboratory for Nuclear Science, Massachusetts Institute of Technology, Cambridge, Massachusetts*

ACADEMIC PRESS
New York and London

SECTION B

Volume 1, Number 1, February 1966

Nuclear Data

A Journal Devoted to Compilations and Evaluations of Experimental and Theoretical Results in Nuclear Physics

CONTENTS:

Policies B1-1-iii
Bases for Spin and Parity Assignments B1-1-v
Cumulated Index to A-Chains B1-1-x

Revised A-Chains

A = 182 ..... K. Way B1-1-1
A = 183 ..... A. Artna B1-1-37
A = 184 ..... M. J. Martin B1-1-63
A = 185 ..... A. K. Sen Gupta B1-1-83

Adjusted Mass Differences

A = 182 to A = 185
W. B. Ewbank and N. B. Gove B1-1-105
References for all A-Chains B1-1-109
Conventions, Symbols, and Abbreviations B1-1-119

ACADEMIC PRESS

Evaluation History - cont

Nuclear Data Sheets-Journal

The section A of Nuclear Data was started in December 1965 as Atomic Data Tables.

In August 1973 Two journals Atomic Data and Atomic Data A merged as Atomic and Nuclear Data Tables with K. Way as the Editor for both

Evaluations Effort limited to NDP-ORNL

Volume 9, Number 1, January 1973

Nuclear Data Sheets

CONTENTS: RECENT REFERENCES
September 1972 through December 1972

D. C. West, W. B. Ewbank, F. W. Hurley, M. R. McGinnis

SPECIAL COMMENT i
Cumulated Index to A-Chains ii
Introduction: Coverage, Arrangement, Scope iii
Explanation of the KEY WORDS iv
Journal Abbreviations and CODEN v

KEY NUMBERS AND KEY WORDS 1
REACTION INDEX 59
REFERENCES 76
SAMPLE THEORETICAL ENTRIES..... 109
REFERENCES FOR THEORETICAL ENTRIES 117
Symbols and Abbreviations .....Inside Back Cover

IMPORTANT NOTE

This issue of Recent References has been produced from a computer list of the permanent indexed reference file now being assembled by the Nuclear Data Group. Since this is a permanent file which will be used repeatedly to retrieve experimental articles and to produce reference lists, it is very important that it be correct. We urge all users who find errors (either substantive or typographical) to report them

Volume 32, Number 1, January 1985

Atomic Data AND Nuclear Data Tables

A Journal Devoted to Compilations of Experimental and Theoretical Results

CONTENTS:

Atomic Subshell Photoionization Cross Sections and Asymmetry Parameters: $1 \leqslant Z \leqslant 103$
J. J. Yeh and *I. Lindau* 1

Symmetric and Antisymmetric Outer Plethysms of Schur Functions
Ö. Eğecioğlu and *J. B. Remmel* 157

Evaluation History - cont

Hand-written data sheets. Draftspersons drew drawings.

Bruce Ewbank at ORNL was instrumental in

Computerization of recent references (NSR)

Computerization of drawings

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Evaluation History - cont

Common input format for tables and drawing

Evaluated Nuclear Structure Data File

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Evaluation History - cont

Subsequent to the completion of NIRA program, it was proposed in 1975 that the evaluation activity be decentralized with international involvement under the auspice of IAEA, Nuclear Data Section.

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Evaluation History - cont

The evaluation responsibility was divided amongst various data centers within and outside the US.

The NNDC at BNL coordinated the national and the international effort for the US/ DOE. But the lead role in editing and processing of evaluation continued at the NDP/ORNL.

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Evaluation History - cont

- Change of production responsibility to NNDC, however, came about in 1980 when ORNL management support for the activity dropped considerably.
- The NNDC took over production of Nuclear Data sheets in 1981 and completely computerized the process.

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Evaluation History - cont

The ORNL and NNDC jointly edited the journal until June, 1998 when Murray Martin, who started evaluation work with Katherine Way and served as the Editor-in-Chief of the journal while working at the Nuclear Data Project at ORNL, retired. With Murray's retirement the editing responsibility completely shifted to the National Nuclear Data Center.

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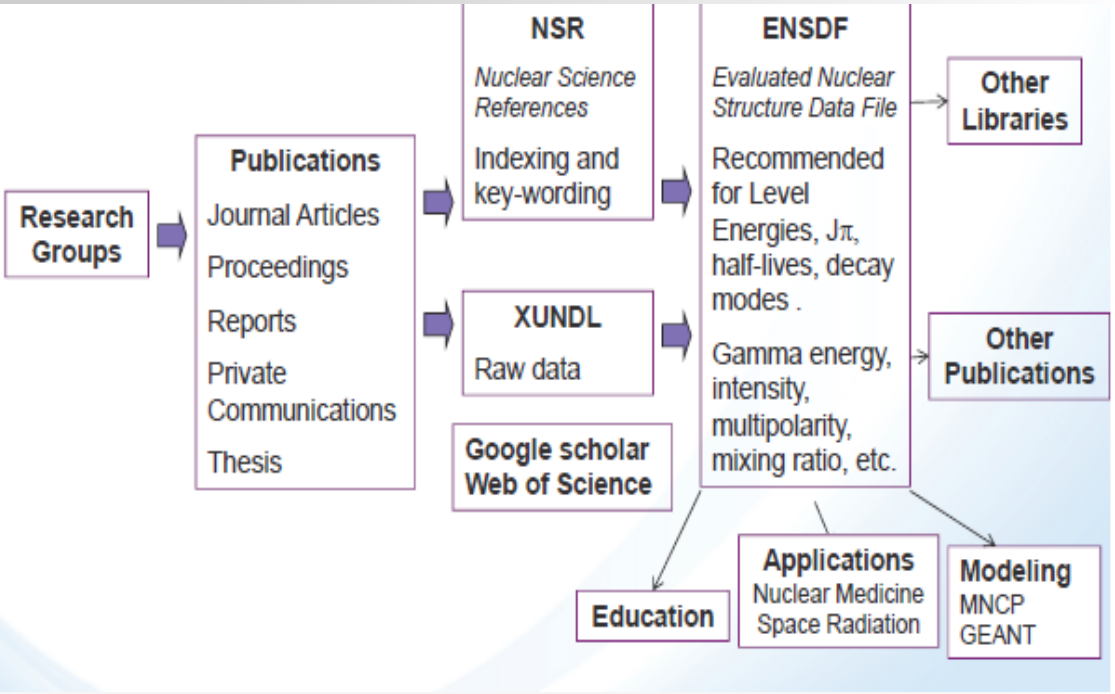
ENSDF Evaluation Process



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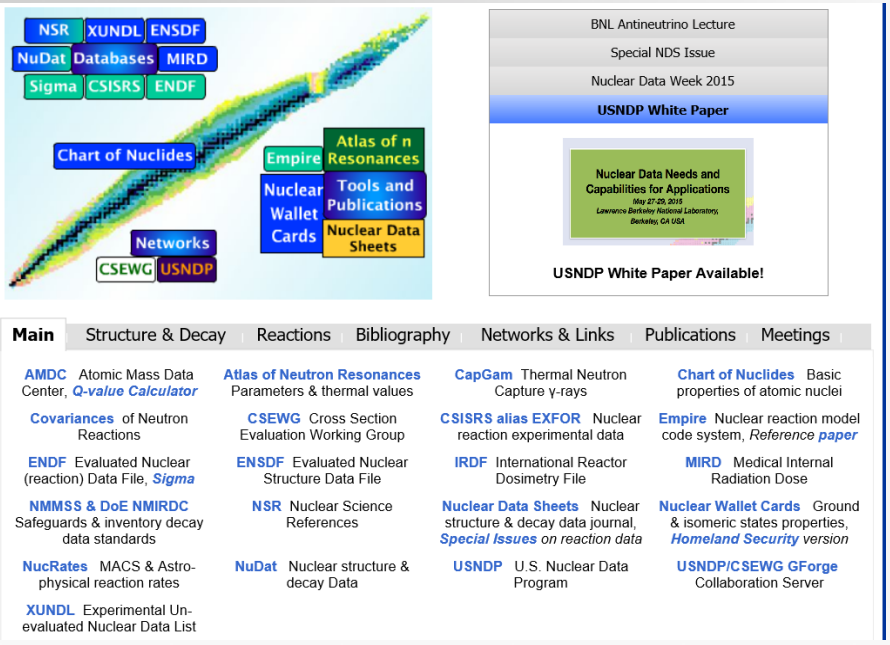
NNDC-Web



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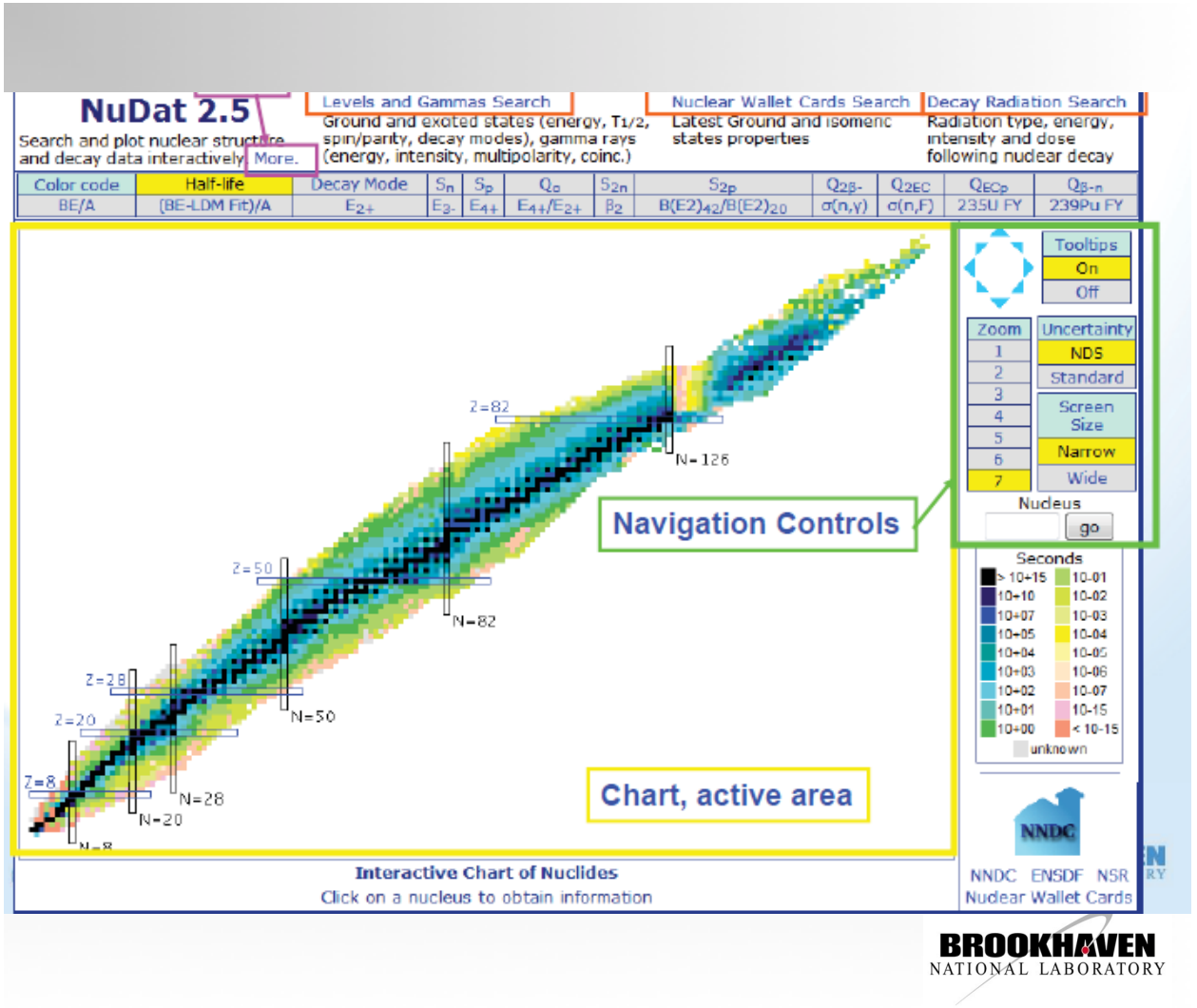

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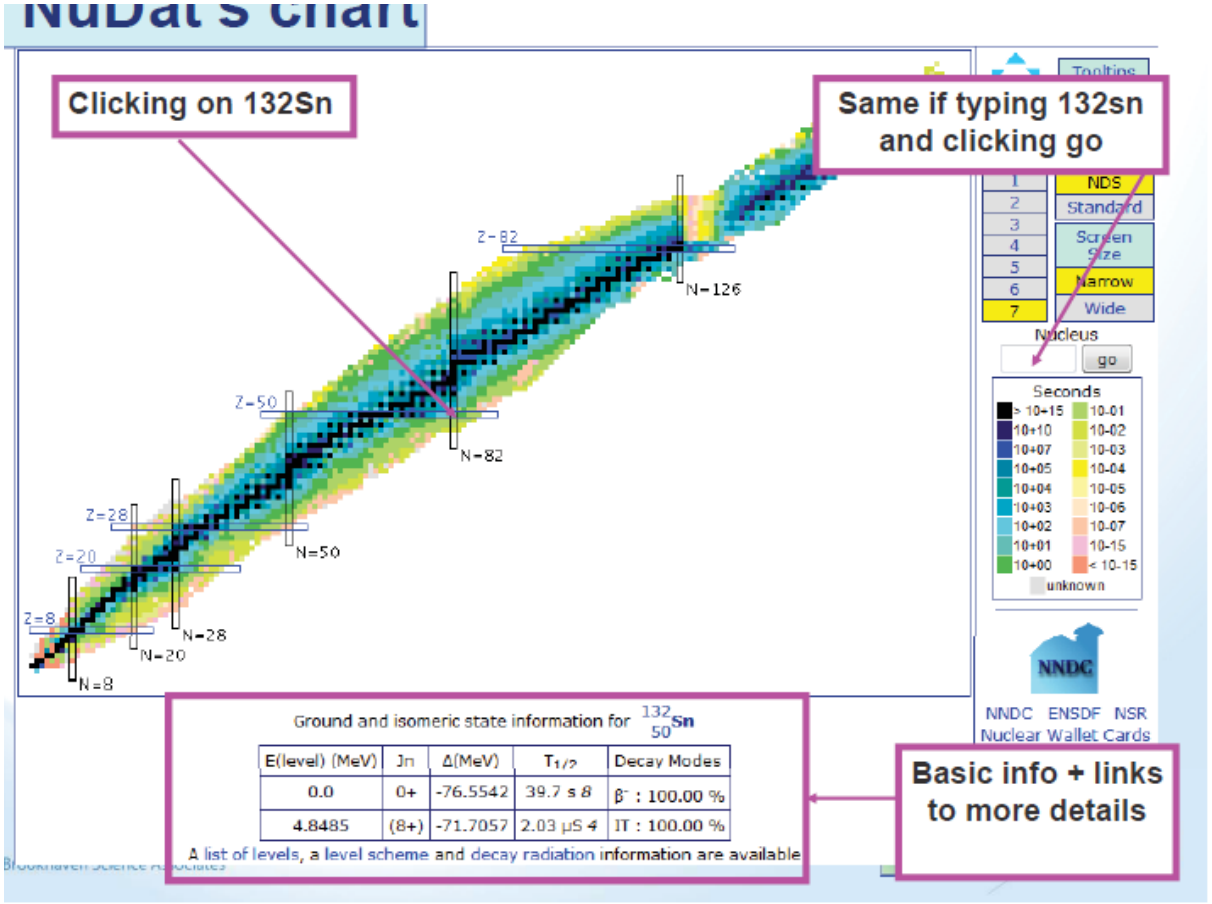

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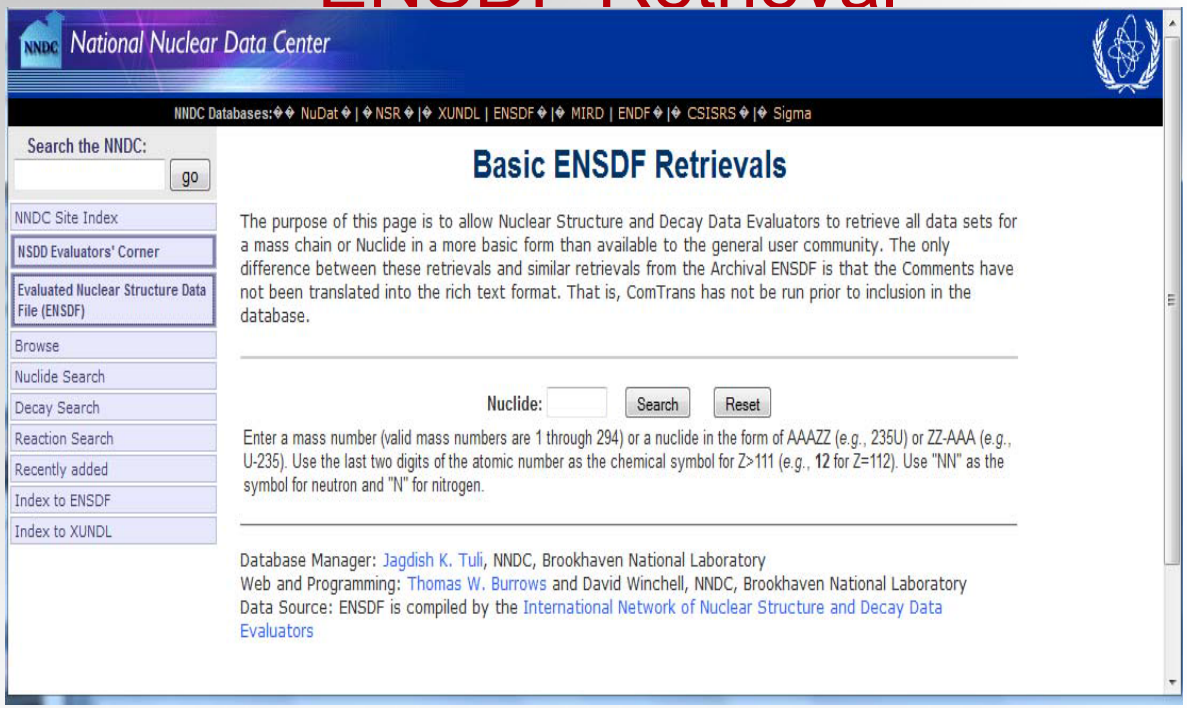
ENSDF Retrieval



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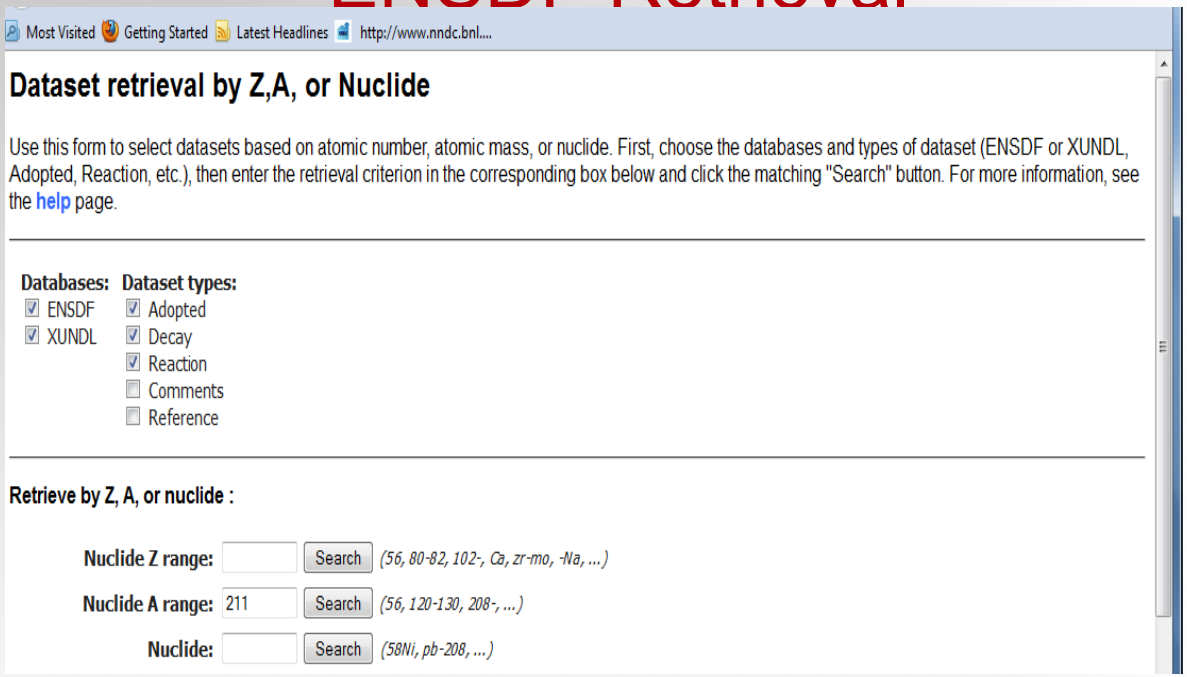
ENSDF Retrieval



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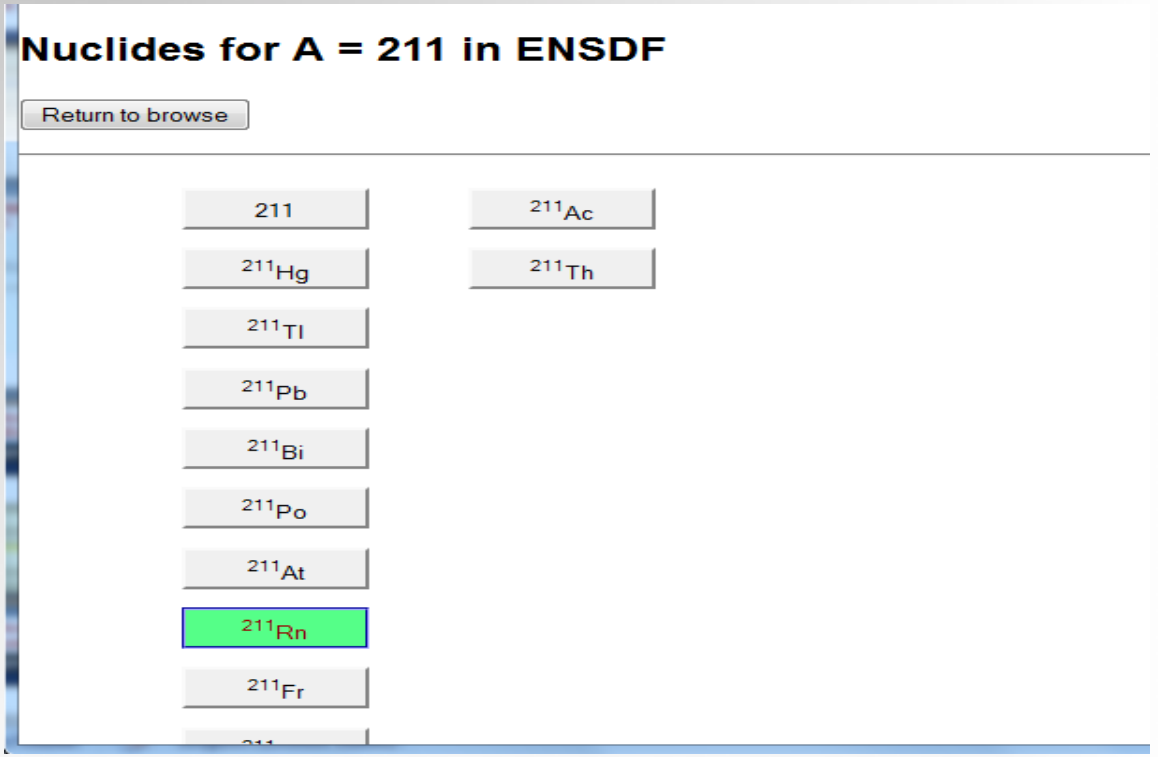

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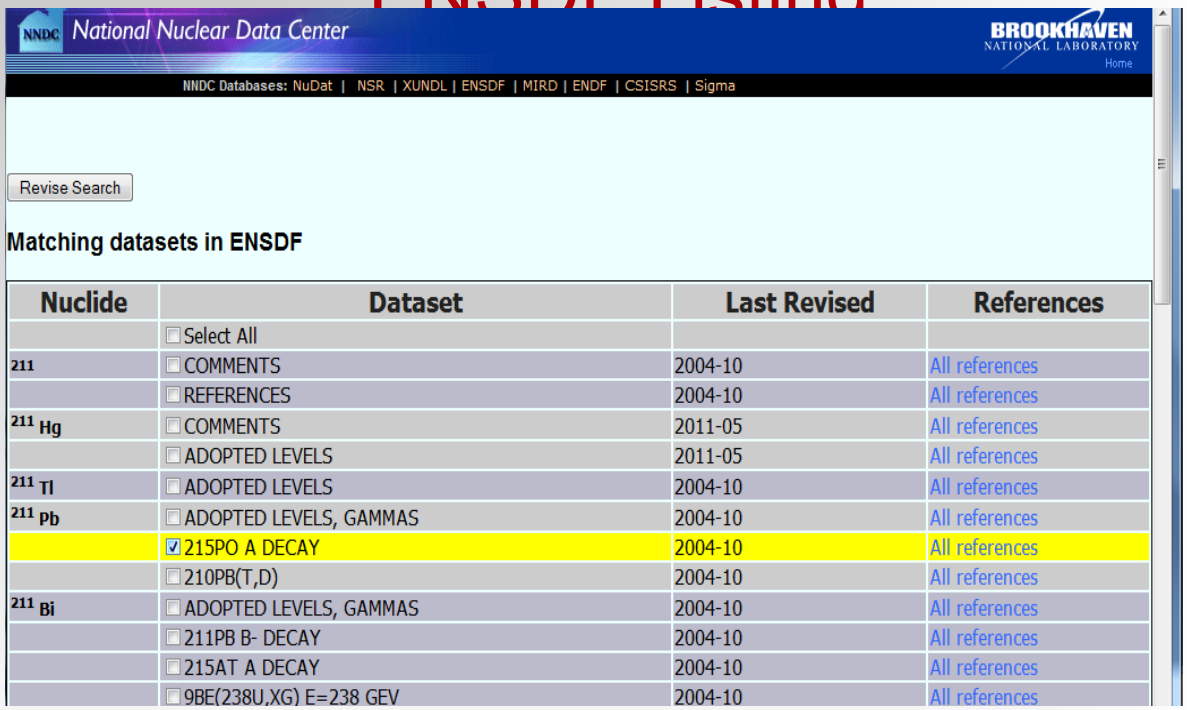
ENSDF Listing



Nuclide	Dataset	Last Revised	References
	☐ Select All		
^{211}	☐ COMMENTS	2004-10	All references
	☐ REFERENCES	2004-10	All references
^{211}Hg	☐ COMMENTS	2011-05	All references
	☐ ADOPTED LEVELS	2011-05	All references
^{211}Tl	☐ ADOPTED LEVELS	2004-10	All references
^{211}Pb	☐ ADOPTED LEVELS, GAMMAS	2004-10	All references
	☑ 215PO A DECAY	2004-10	All references
	☐ 210PB(T,D)	2004-10	All references
^{211}Bi	☐ ADOPTED LEVELS, GAMMAS	2004-10	All references
	☐ 211PB B- DECAY	2004-10	All references
	☐ 215AT A DECAY	2004-10	All references
	☐ 9BE(238U,XG) E=238 GEV	2004-10	All references

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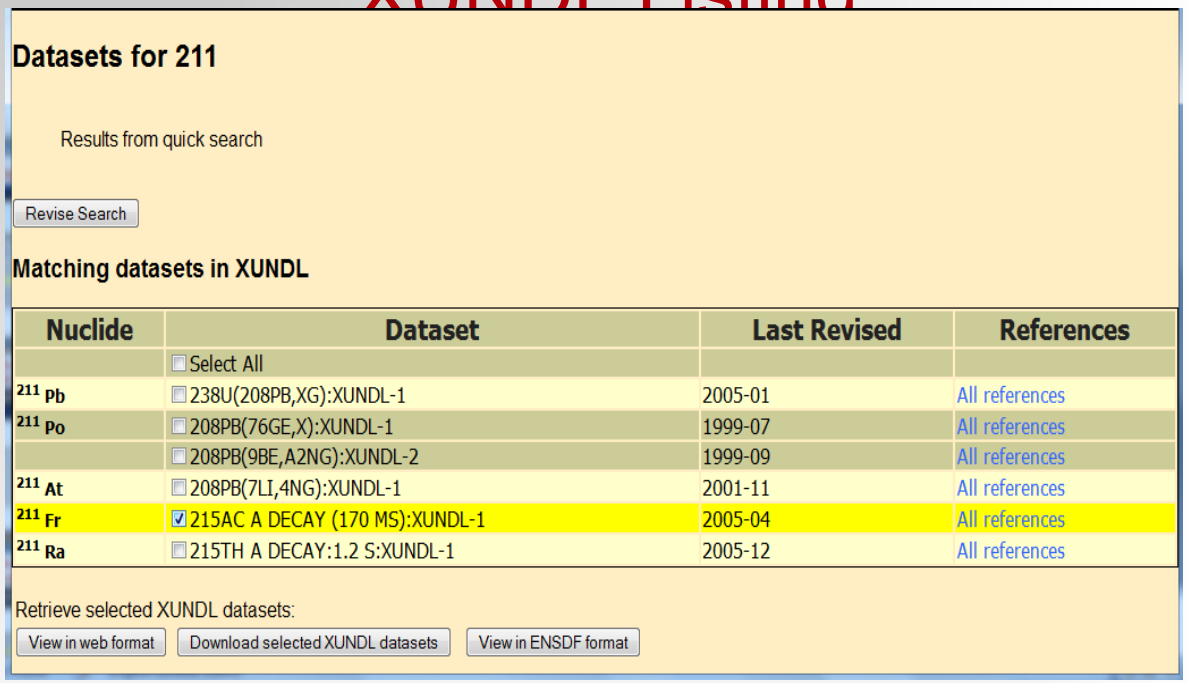
XUNDL Listing



Datasets for 211

Results from quick search

Revise Search

Matching datasets in XUNDL

Nuclide	Dataset	Last Revised	References
	☐ Select All		
^{211}Pb	☐ 238U(208PB,XG):XUNDL-1	2005-01	All references
^{211}Po	☐ 208PB(76GE,X):XUNDL-1	1999-07	All references
	☐ 208PB(9BE,A2NG):XUNDL-2	1999-09	All references
^{211}At	☐ 208PB(7LI,4NG):XUNDL-1	2001-11	All references
^{211}Fr	☑ 215AC A DECAY (170 MS):XUNDL-1	2005-04	All references
^{211}Ra	☐ 215TH A DECAY:1.2 S:XUNDL-1	2005-12	All references

Retrieve selected XUNDL datasets:

View in web format | Download selected XUNDL datasets | View in ENSDF format

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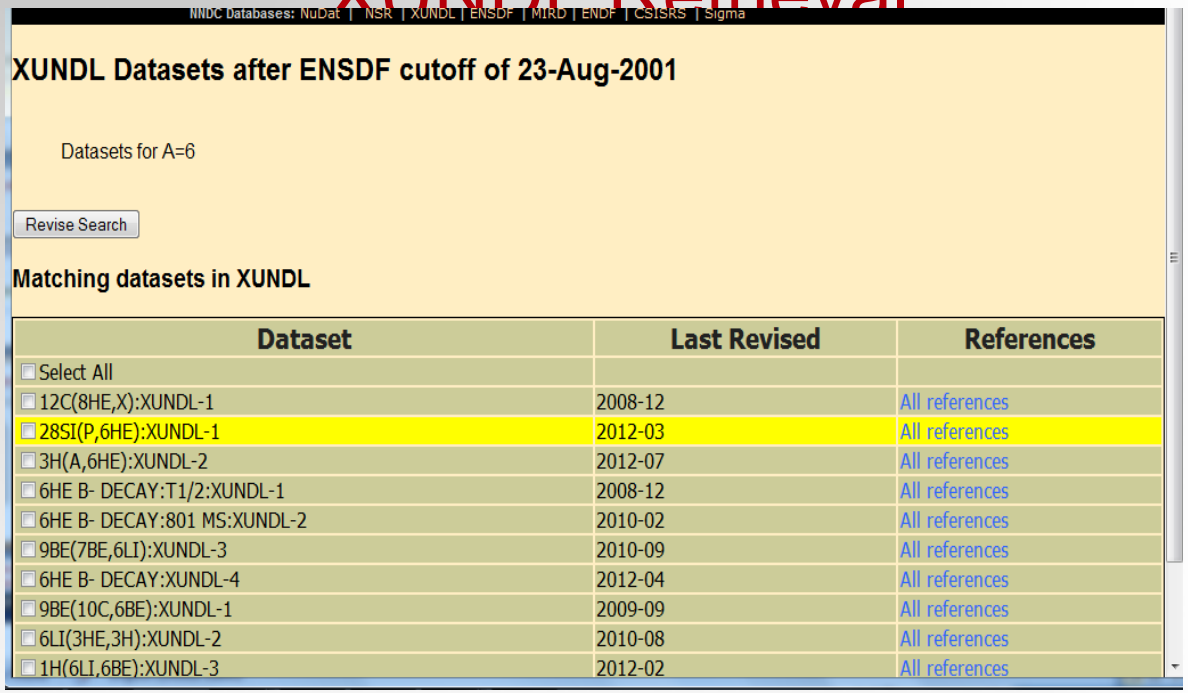
XUNDL Retrieval



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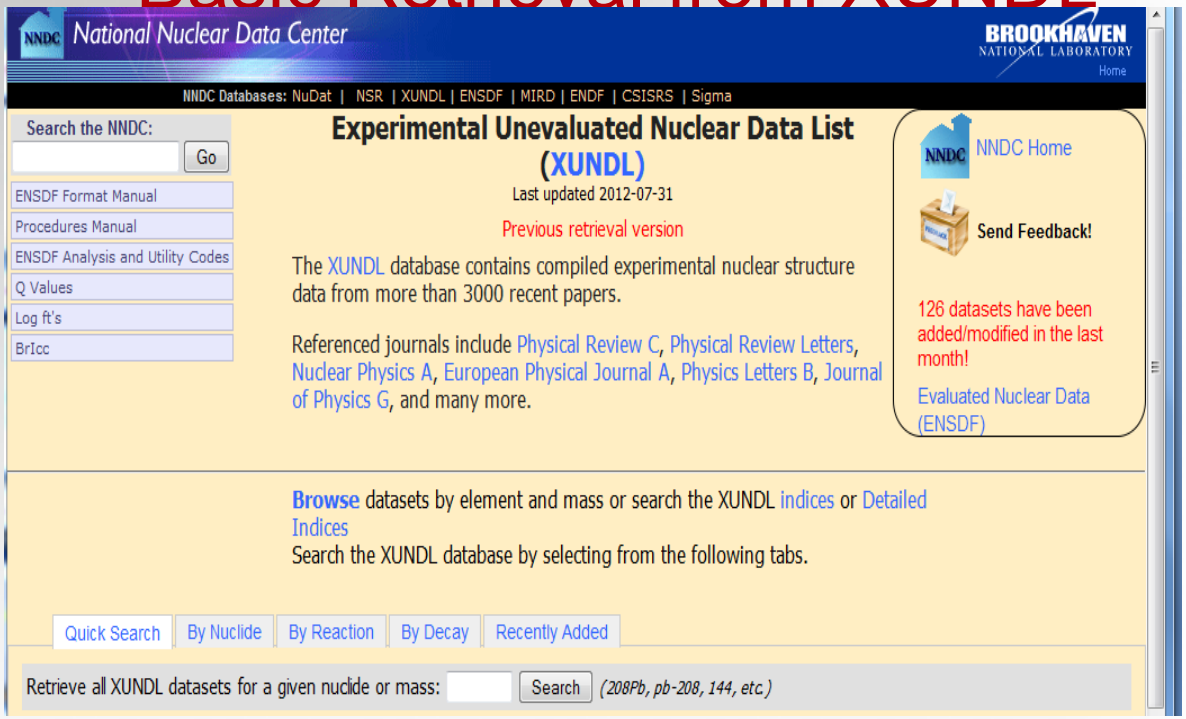
Basic Retrieval from XUNDL



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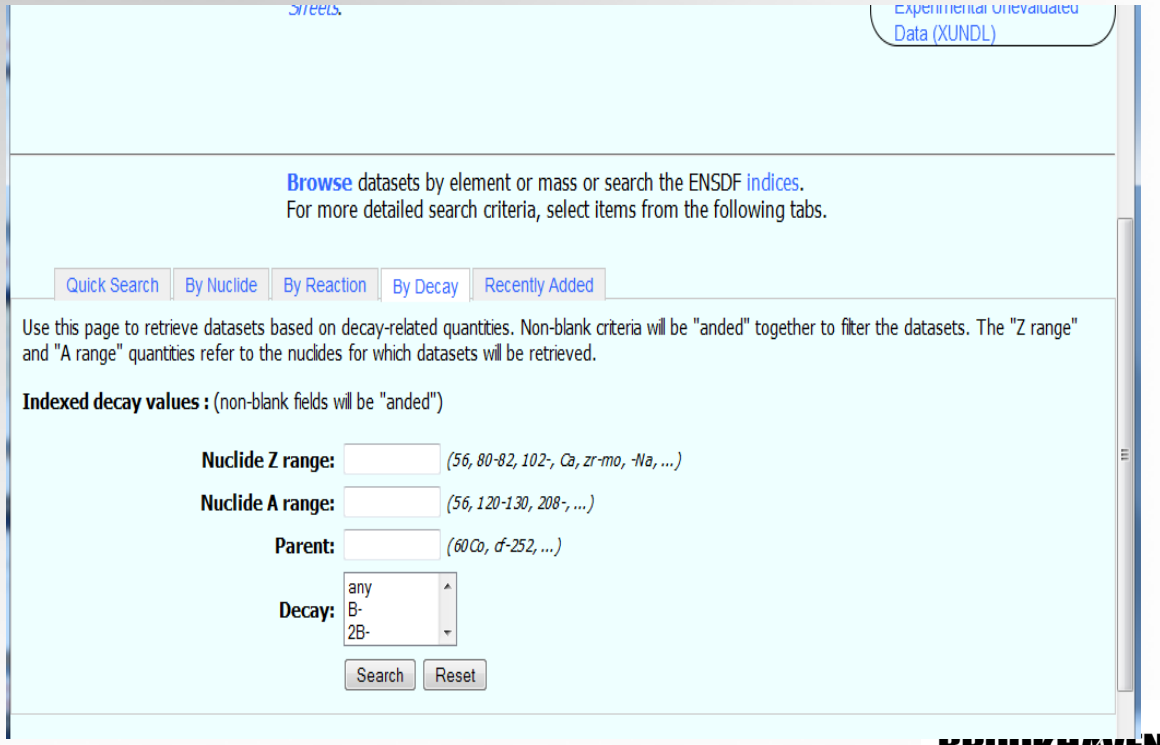
Specific Retrieval



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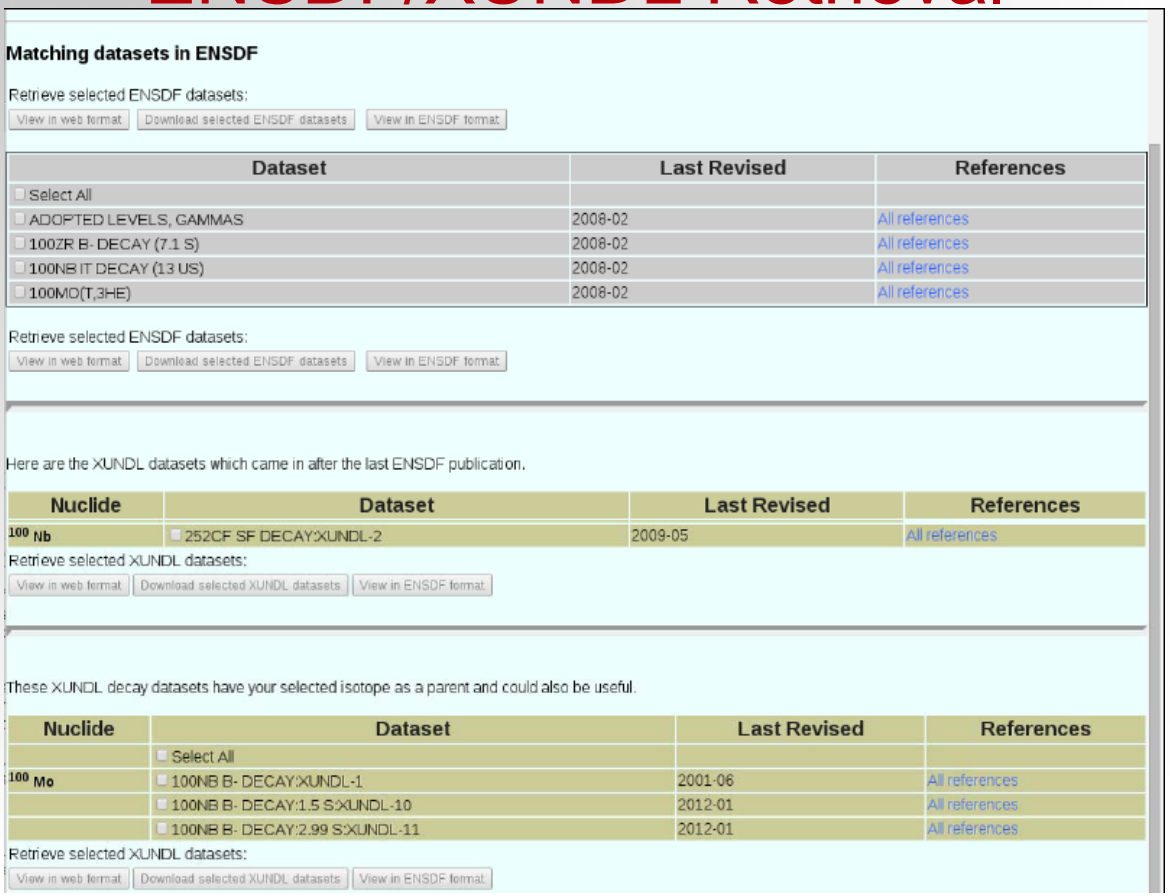
ENSDF/XUNDL Retrieval



Matching datasets in ENSDF

Retrieve selected ENSDF datasets:

View in web format | Download selected ENSDF datasets | View in ENSDF format

Dataset	Last Revised	References
Select All		
ADOPTED LEVELS, GAMMAS	2008-02	All references
100ZR B- DECAY (7.1 S)	2008-02	All references
100NB IT DECAY (13 US)	2008-02	All references
100MO(T,3HE)	2008-02	All references

Retrieve selected ENSDF datasets:

View in web format | Download selected ENSDF datasets | View in ENSDF format

Here are the XUNDL datasets which came in after the last ENSDF publication.

Nuclide	Dataset	Last Revised	References
^{100}Nb	252CF SF DECAY:XUNDL-2	2009-05	All references

Retrieve selected XUNDL datasets:

View in web format | Download selected XUNDL datasets | View in ENSDF format

These XUNDL decay datasets have your selected isotope as a parent and could also be useful.

Nuclide	Dataset	Last Revised	References
	Select All		
^{100}Mo	100NB B- DECAY:XUNDL-1	2001-06	All references
	100NB B- DECAY:1.5 S:XUNDL-10	2012-01	All references
	100NB B- DECAY:2.99 S:XUNDL-11	2012-01	All references

Retrieve selected XUNDL datasets:

View in web format | Download selected XUNDL datasets | View in ENSDF format

NSR

- NSR (Nuclear Science References) is a bibliographic database containing nearly 200,000 nuclear science articles, indexed according to content.About 4,000 are added each year covering 80 journals as well as conference proceedings, laboratory reports, thesis and private communications. Each article included in NSR is read and assigned a number of variables that succinctly described its content. These variables, also known as keywords, are then incorporated in a database.

NSR – Contd.

- One unique feature of NSR is the ability to selectively retrieve articles out of a vast number, satisfying a particular set of conditions. Articles can be retrieved according to: first author, author, nuclide, reaction, target, measured quantity, publication year, type of publication (primary or secondary), journal, topics, etc.

- NSR management resides at the NNDC,

NSR Retrieval

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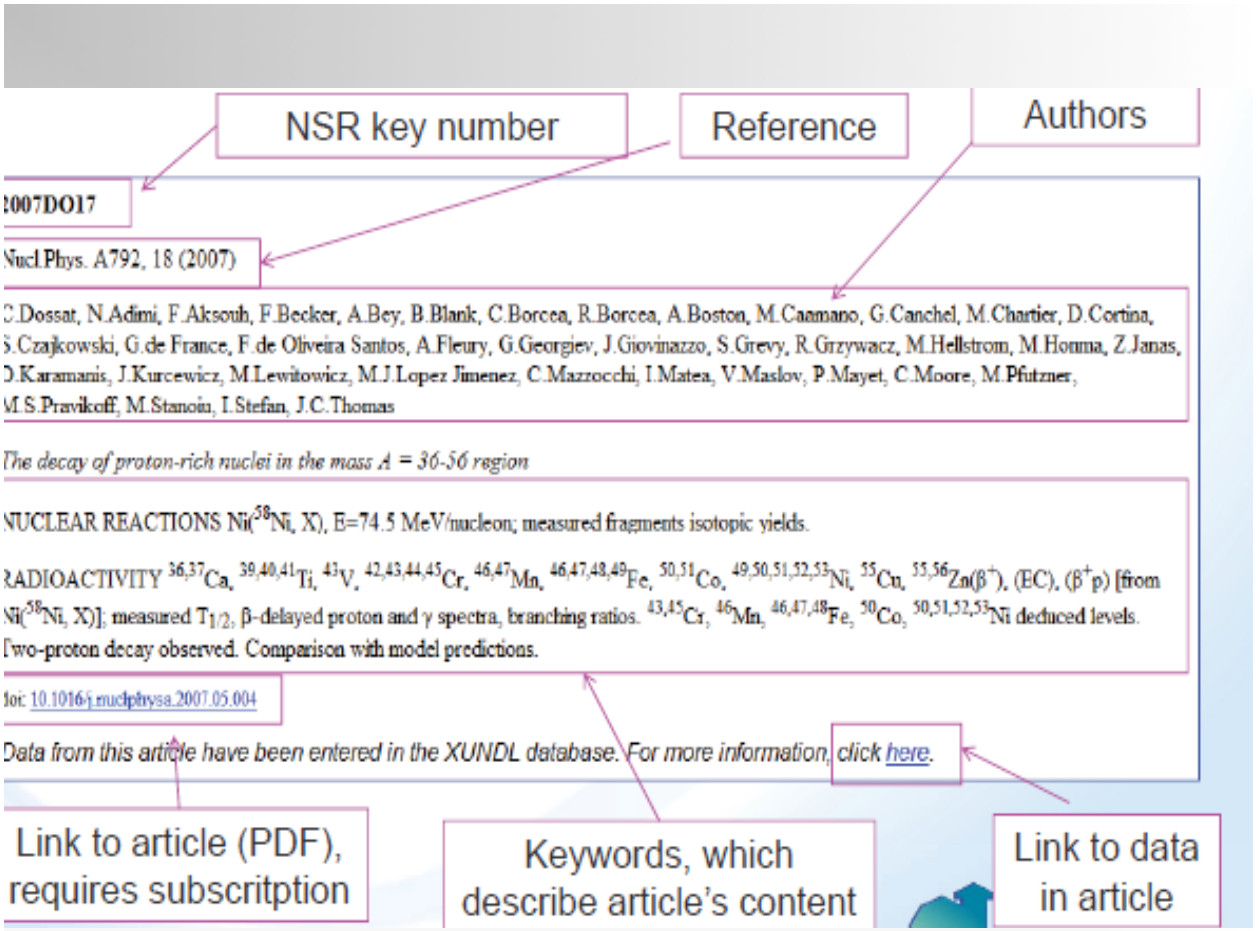

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NuDat
www.nndc.bnl.gov/nudat2

NuDat is a web application with two main goals, a) to present nuclear structure and decay information from ENSDF in a user-friendly way, and b) to allow users to execute complex search operations in the wealth of data contained in ENSDF. NuDat provides an interactive chart of nuclides for navigation and an output in the Table of Isotopes style. NuDat contents are updated regularly as new evaluations are entered into ENSDF.

NuDat 2 was developed by the National Nuclear Data Center (NNDC) in Brookhaven National Laboratory Using NuDat 2, it is possible to search for nuclear level properties (energy, half-life, spin-parity), gamma-ray information (energy, intensity, multipolarity, coincidences), radiation information following nuclear decay (energy, intensity, dose).

More on www.nndc.bnl.gov/nudat2/help

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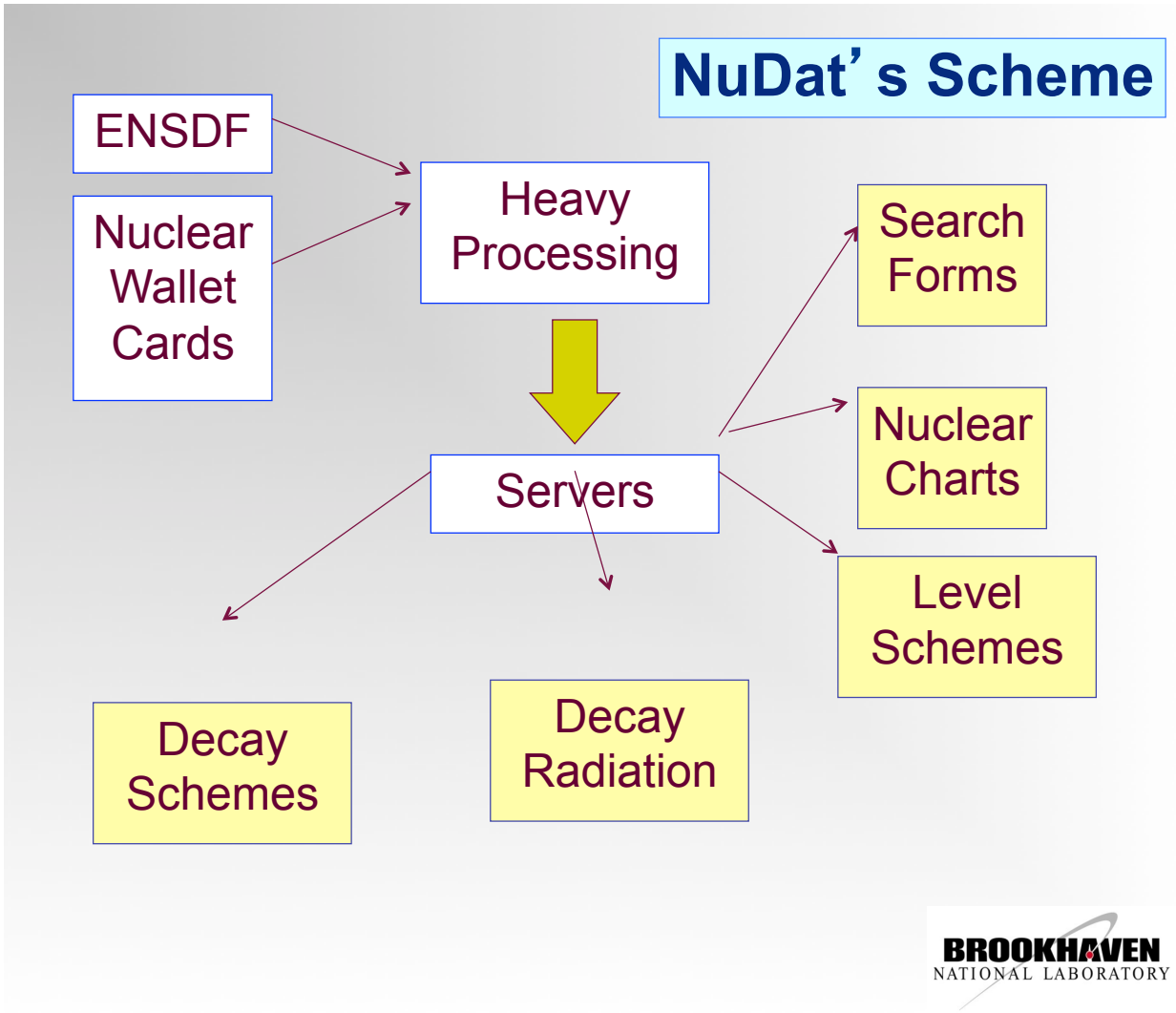
NuDat's Scheme
ENSDF
Nuclear Wallet Cards
Heavy Processing
Search Forms
Nuclear Charts
Servers
Level Schemes
Decay Schemes
Decay Radiation
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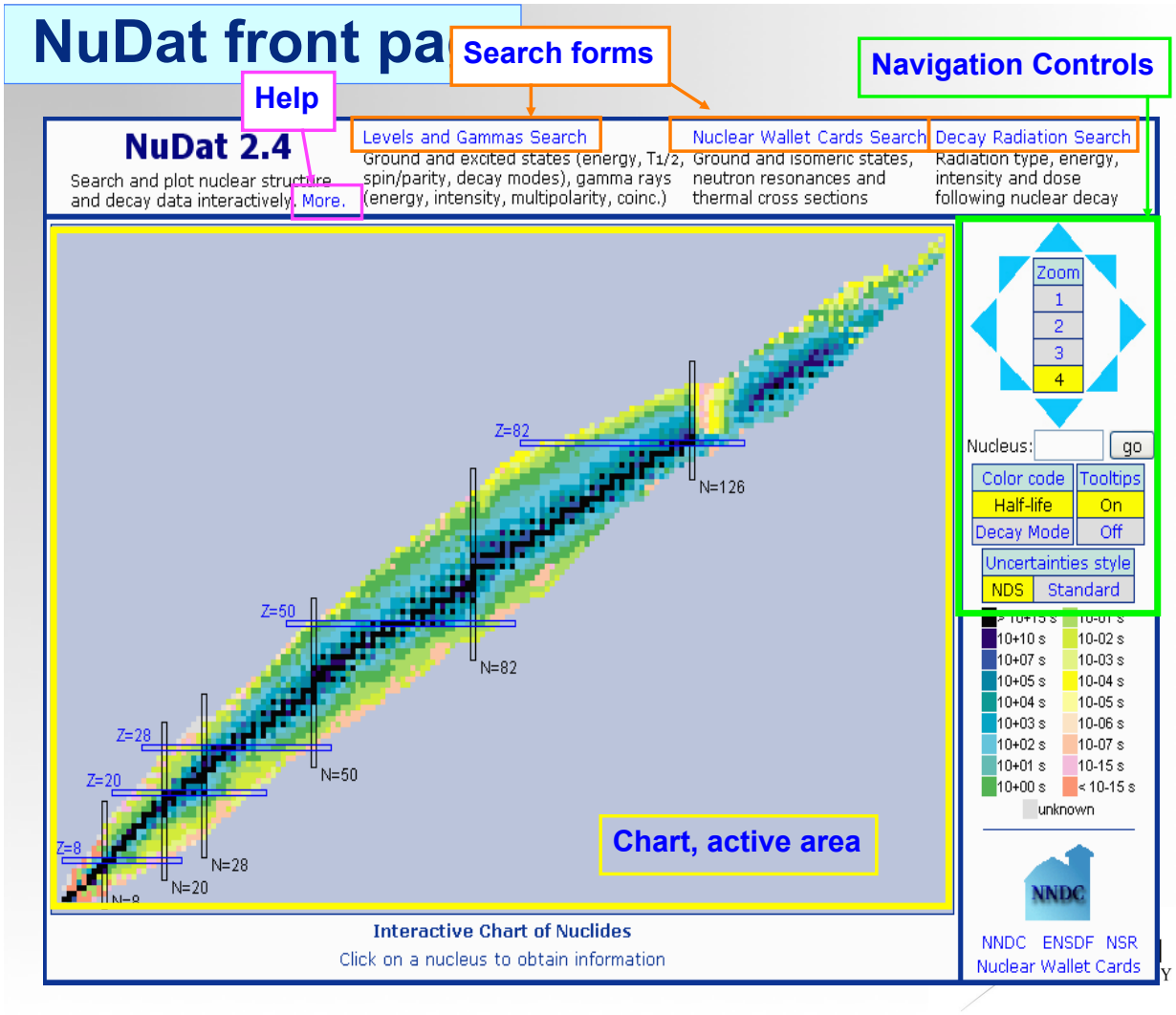
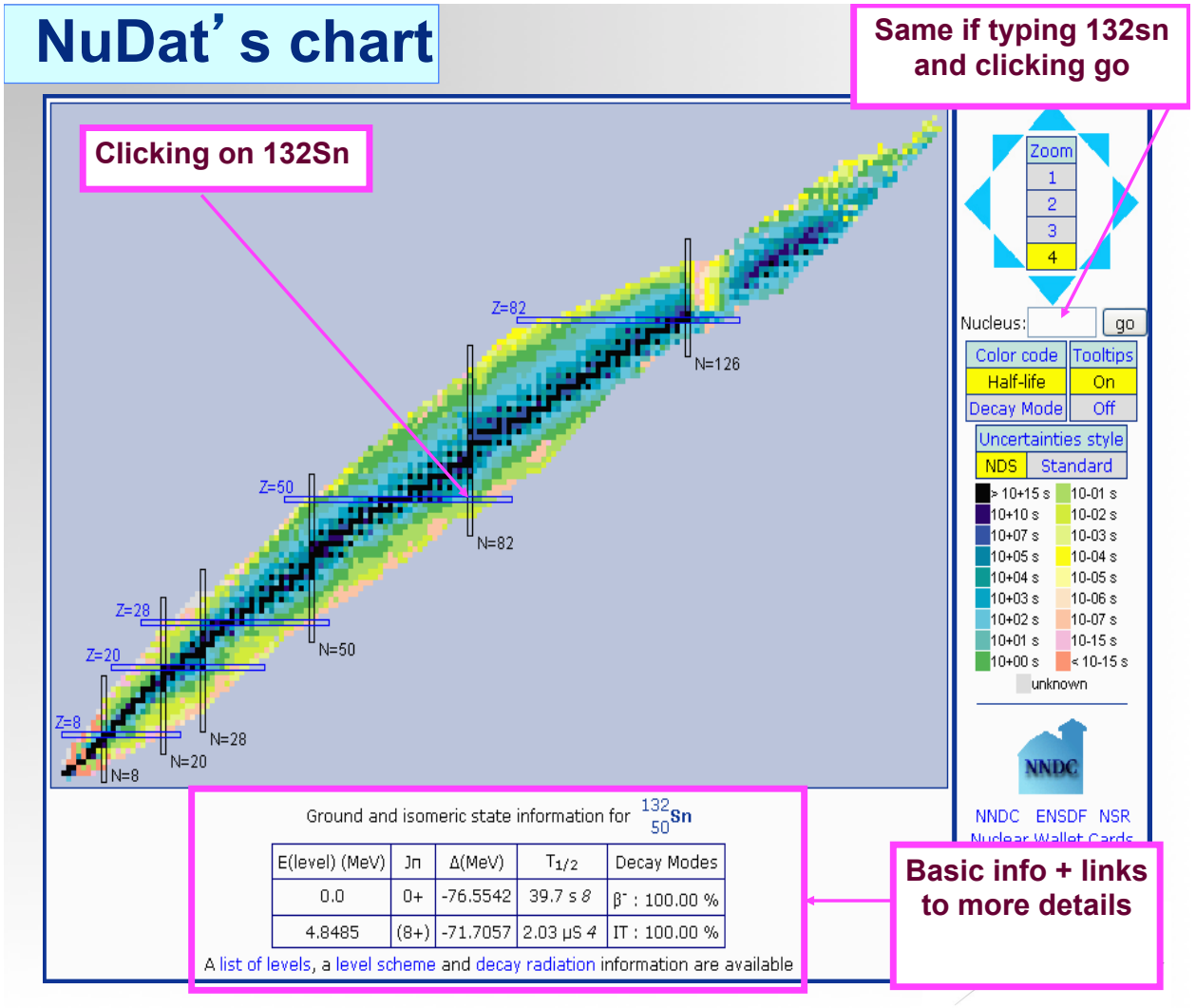
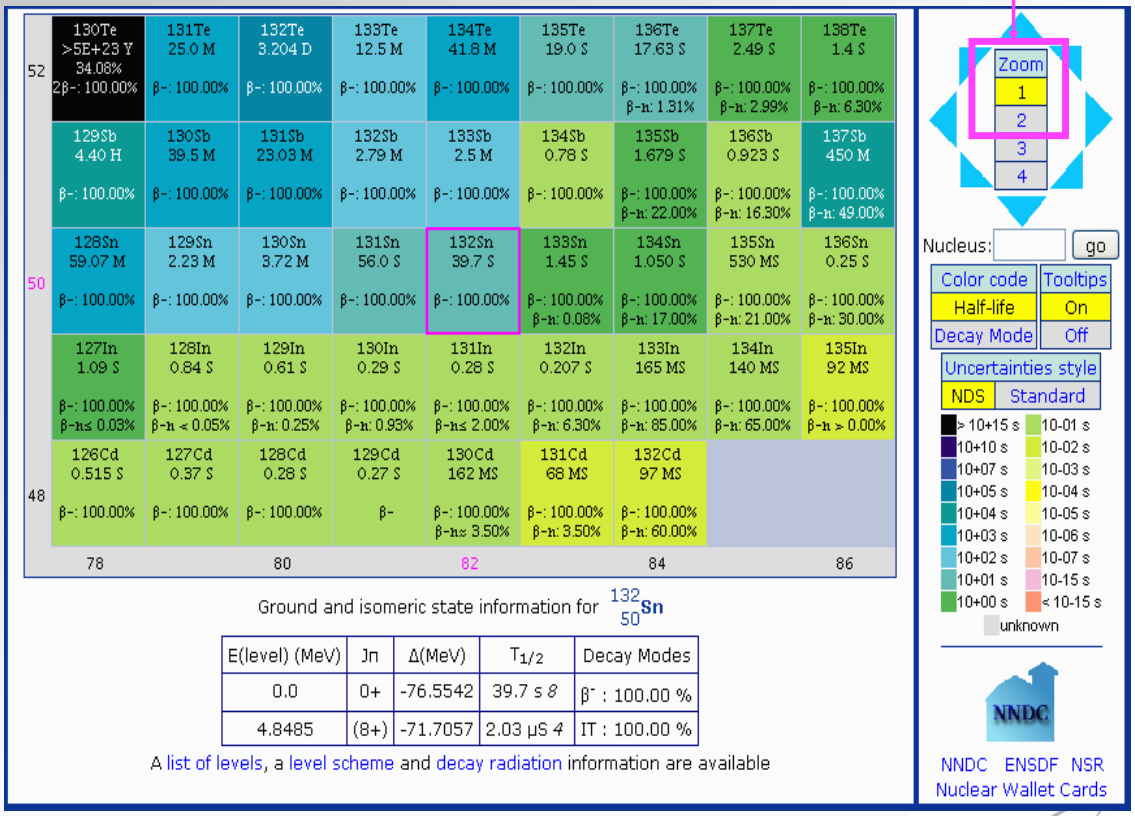

NuDat front pa
Search forms
Navigation Controls
Help
NuDat 2.4
Search and plot nuclear structure and decay data interactively. More.
Levels and Gammas Search
Ground and excited states (energy, T1/2, spin/parity, decay modes), gamma rays (energy, intensity, multipolarity, coinc.)
Nuclear Wallet Cards Search
Ground and isomeric states, neutron resonances and thermal cross sections
Decay Radiation Search
Radiation type, energy, intensity and dose following nuclear decay
Zoom
1
2
3
4
Nucleus:
go
Color code
Tooltips
Half-life
On
Decay Mode
Off
Uncertainties style
NDS
Standard
Z=82
N=126
Z=50
N=82
Z=28
N=50
Z=20
N=28
Z=8
N=20
Chart, active area
10+10 s
10+07 s
10+05 s
10+04 s
10+03 s
10+02 s
10+01 s
10+00 s
10-02 s
10-03 s
10-04 s
10-05 s
10-06 s
10-07 s
10-15 s
< 10-15 s
unknown
NNDC
NNDC ENSDF NSR
Nuclear Wallet Cards
Interactive Chart of Nuclides
Click on a nucleus to obtain information

NuDat's chart



NuDat's chart

Changing the zoom value



Ground and isomeric state information for $^{132}_{50}Sn$

E(level) (MeV)	Jπ	Δ(MeV)	$T_{1/2}$	Decay Modes
0.0	0+	-76.5542	39.7 s *8*	β^- : 100.00 %
4.8485	(8+)	-71.7057	2.03 μs *4*	IT : 100.00 %

A list of levels, a level scheme and decay radiation information are available

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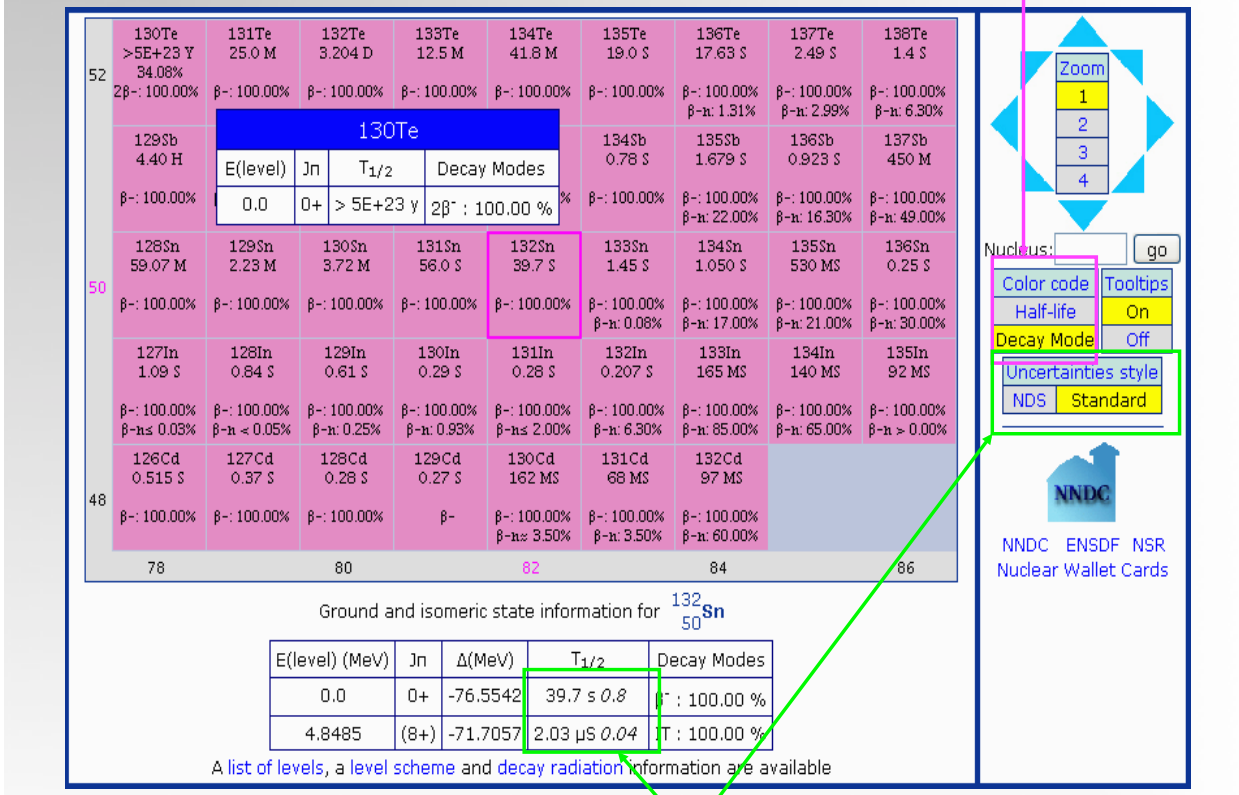
NuDat's chart



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Nuclear Decay

A process where the protons and neutrons in a given nucleus are rearranged into a lower energy state. The transition may involve states of the same nucleus (gamma emission, electron conversion) or levels of different nucleus. Each different process is known as a 'decay mode ‘:

* Gamma emission, electron conversion
* β- decay
* β+ decay
* Electron Capture (EC)
* β-delayed particle emission
* Double β decay
* Proton decay
* Alpha decay
* Cluster decay
* Spontaneous Fission (SF)

The probability of undergoing a given nuclear decay is often indicated using the percent sign followed by the decay mode name and the probability per 100 decays.

For instance, %β-=100 means 100% probability of β- decay.

The energy released during the decay is called 'Q-value'. For a given decay mode to have a probability larger than 0, the Q-value has to be positive.

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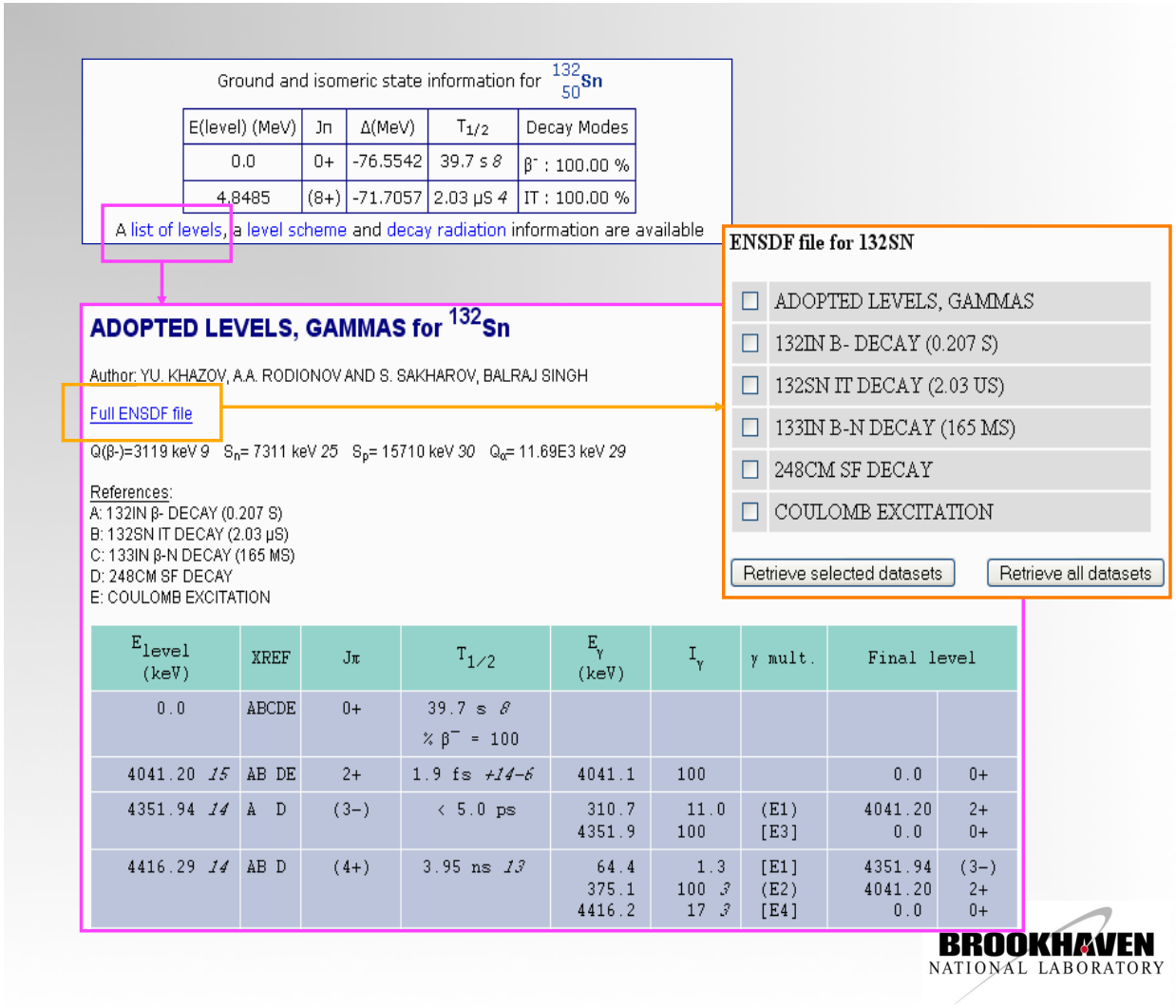
Uncertainties

The uncertainty associated with a given quantity can be expressed in the so-called Nuclear Data Sheets style, or in a standard style. The Nuclear Data Sheets style has been used for a long time since it facilitates data storage, which was crucial in the early days. A table with a brief explanation of the Nuclear Data Sheet style is given below:

NDS Style	Standard style and meaning
4.623 3	4.623 +- 0.003
4.6 h 12	4.6 +- 1.2 hours
5.4×10^{3} *2*	5400 + - 200
4.2 *+8-10*	4.2 + 0.8 - 1.0
9.22 *SY*	9.22 is a result of a systematic study
9.22 CA	9.22 value is not an experimental one, but


Ground and isomeric state information for $^{132}_{50}Sn$
E(level) (MeV) | Jπ | Δ(MeV) | $T_{1/2}$ | Decay Modes
0.0 | 0+ | -76.5542 | 39.7 s 8 | β⁻ : 100.00 %
4.8485 | (8+) | -71.7057 | 2.03 μS 4 | IT : 100.00 %
A list of levels, a level scheme and decay radiation information are available
ADOPTED LEVELS, GAMMAS for ^{132}Sn
Author: YU. KHAZOV, A.A. RODIONOV AND S. SAKHAROV, BALRAJ SINGH
Full ENSDF file
Q(β-)=3119 keV 9 Sn= 7311 keV 25 Sp= 15710 keV 30 Qα= 11.69E3 keV 29
References:
A: 132IN β- DECAY (0.207 S)
B: 132SN IT DECAY (2.03 μS)
C: 133IN β-N DECAY (165 MS)
D: 248CM SF DECAY
E: COULOMB EXCITATION
ENSDF file for 132SN
ADOPTED LEVELS, GAMMAS
132IN B- DECAY (0.207 S)
132SN IT DECAY (2.03 US)
133IN B-N DECAY (165 MS)
248CM SF DECAY
COULOMB EXCITATION
Retrieve selected datasets
Retrieve all datasets
E_{level} (keV) | XREF | Jπ | $T_{1/2}$ | E_γ (keV) | I_γ | γ mult. | Final level
0.0 | ABCDE | 0+ | 39.7 s 8 % β⁻ = 100
4041.20 15 | AB DE | 2+ | 1.9 fs +14-6 | 4041.1 | 100 | | 0.0 | 0+
4351.94 14 | A D | (3-) | < 5.0 ps | 310.7 4351.9 | 11.0 100 | (E1) [E3] | 4041.20 0.0 | 2+ 0+
4416.29 14 | AB D | (4+) | 3.95 ns 13 | 64.4 375.1 4416.2 | 1.3 100 3 17 3 | [E1] (E2) [E4] | 4351.94 4041.20 0.0 | (3-) 2+ 0+
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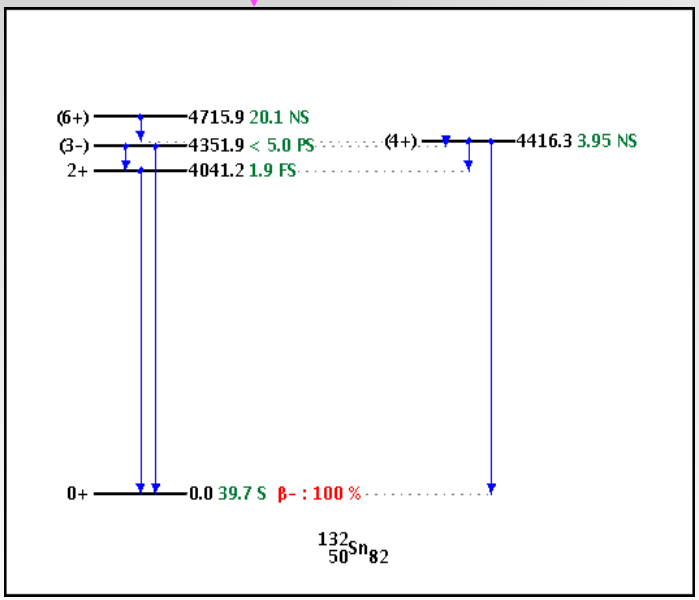
Ground and isomeric state information for $^{132}_{50}Sn$

E(level) (MeV)	Jπ	Δ(MeV)	$T_{1/2}$	Decay Modes
0.0	0+	-76.5542	39.7 s *8*	β^- : 100.00 %
4.8485	(8+)	-71.7057	2.03 μS *4*	IT : 100.00 %

A list of levels, a level scheme and decay radiation information are available

Interactive Level Scheme



132Sn is doubly magic, how does a level scheme of a nucleus at mid-shell?

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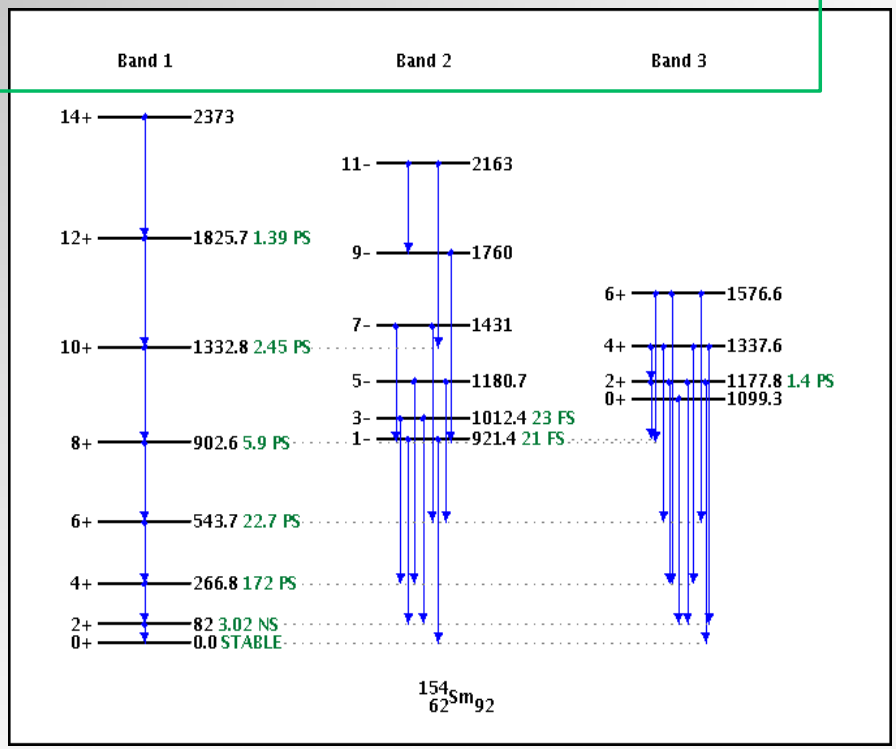
Rotational bands



Partial view of 154Sm level scheme

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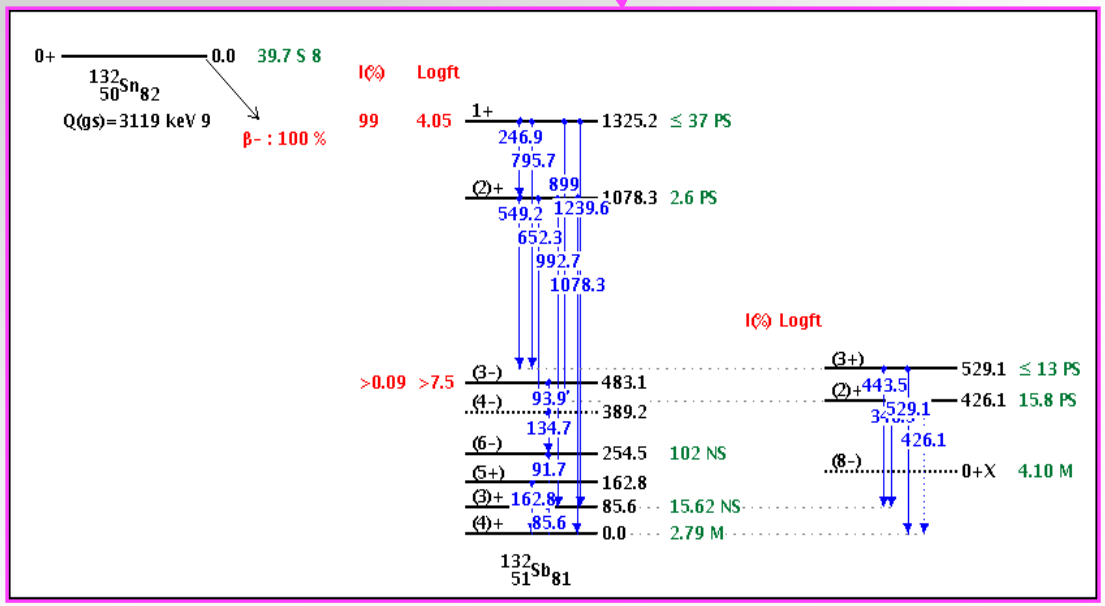
Ground and isomeric state information for $^{132}_{50}Sn$

E(level) (MeV)	Jπ	Δ(MeV)	$T_{1/2}$	Decay Modes
0.0	0+	-76.5542	39.7 s *8*	β^- : 100.00 %
4.8485	(8+)	-71.7057	2.03 uS *4*	IT : 100.00 %

A list of levels, a level scheme and decay radiation information are available



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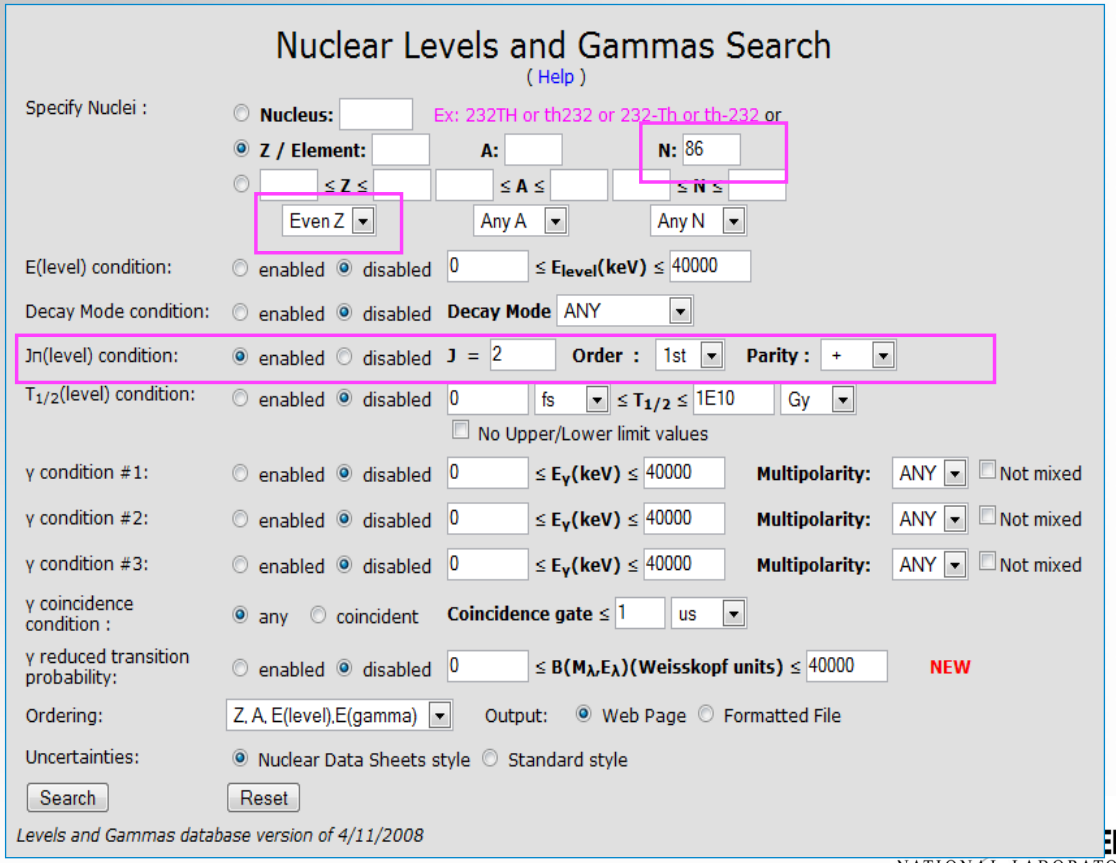
Levels Search

Search for first 2+ states in N=86 Nuclides



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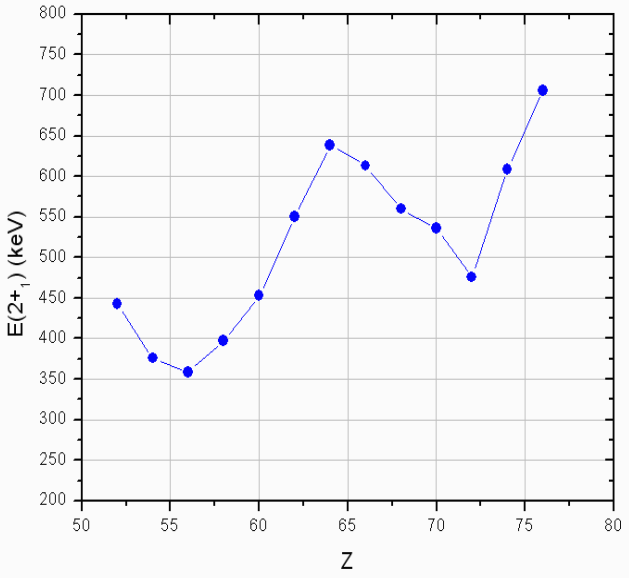
Results

Nucleus	E_{level}(keV)	Jπ	$T_{1/2}$
138TE	443.1 *10*	(2+)	
140XE	376.658 *15*	2+	70.5 ps *22*
142BA	359.597 *14*	2+	65 ps *2*
144CE	397.441 *9*	2+	35.4 ps *20*
146ND	453.77 *5*	2+	21.6 ps *13*
148SM	550.255 *8*	2+	7.72 ps *32*
150GD	638.045 *14*	2+	
152DY	613.82 *7*	2+	10 ps *5*
154ER	560.8 *1*	2+	
156YB	536.4 *1*	2+	
158HF	476.36 *11*	2+	
160W	609.9 *2*	2+	
162OS	706.7 *3*	(2+)	

For more search examples, see Help file

Tool for systematic studies



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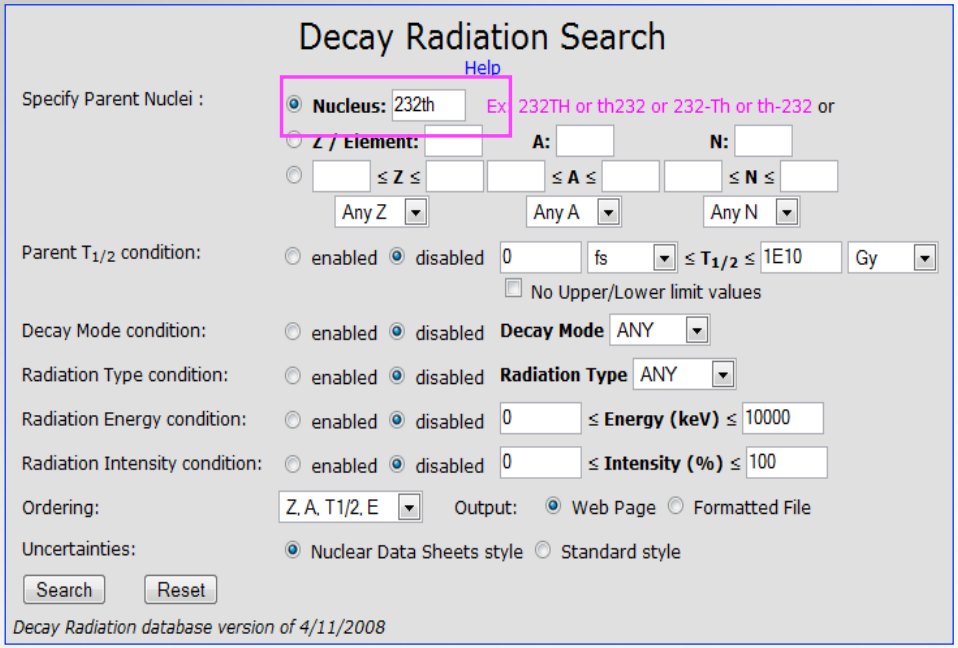
Decay Search



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Author: AGDA ARTNA-COHEN Citation: Nuclear Data Sheets 80, 723 (1997)

Parent Nucleus	Parent E(level)	Parent Jπ	Parent $T_{1/2}$	Decay Mode	GS-GS Q-value (keV)	Daughter Nucleus	Decay Scheme
$^{232}_{90}Th$	0	0+	14.05E+9 y *6*	α: 100 %	4082.8 *14*	$^{228}_{88}Ra$	

Results

Alphas:

Energy (keV)	Intensity (%)	Dose (MeV/Bq-s)
3811.1 *14*	0.069 % *13*	0.0026 *5*
3947.2 *20*	21.7 % *13*	0.86 *5*
4012.3 *14*	78.2 % *13*	3.14 *5*

Electrons:

	Energy (keV)	Intensity (%)	Dose (MeV/Bq-s)
Auger L	9.09	8.7 % *5*	7.9E-4 *4*
CE K	36.958 *13*	0.0060 % *11*	2.2E-6 *4*
CE L	44.573 *10*	15.8 % *8*	0.0070 *3*
CE M	58.988 *10*	4.27 % *21*	0.00252 *12*
CE NP	62.602 *10*	1.53 % *8*	9.6E-4 *5*
Auger K	65.9	1.9E-4 % *4*	1.3E-7 *3*
CE L	121.643 *10*	0.031 % *6*	3.8E-5 *7*
CE M	136.058 *10*	0.0084 % *16*	1.14E-5 *22*
CE NP	139.672 *10*	0.0030 % *6*	4.3E-6 *8*

Gamma and X-ray radiation:

Energy (keV)		Intensity (%)	Dose (MeV/Bq-s)
XR l	12.3	7.1 % *5*	8.8E-4 *6*
	63.81 *1*	0.263 % *13*	1.68E-4 *8*
XR kα2	85.431	0.0017 % *3*	1.4E-6 *3*
XR kα1	88.471	0.0028 % *5*	2.4E-6 *5*
XR kβ3	99.432	3.4E-4 % *6*	3.3E-7 *6*
XR kβ1	100.13	6.4E-4 % *12*	6.5E-7 *12*
XR kβ2	102.498	2.4E-4 % *5*	2.5E-7 *5*
	140.88 *1*	0.021 % *4*	3.0E-5 *6*

Where are the electrons coming from?

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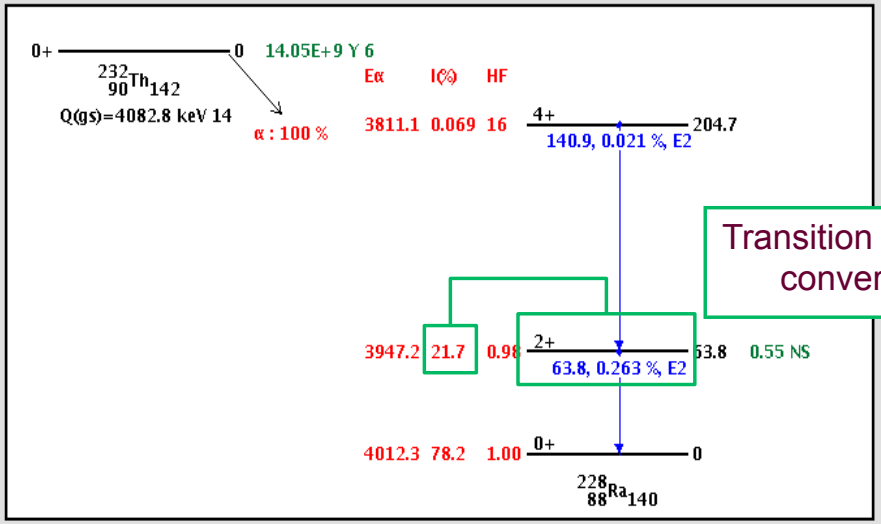
Interactive Decay Scheme

^{232}Th α decay

0.0 < E(level) < 225.0	☑ Level Energy	☑ Level T1/2	☑ Level Spin-parity	☑ Final Level
Highlight: Level	☑ Gamma Energy	☑ Gamma Intensity	☑ Gamma Multipolarity	☑ Decay Information
Image Height: 350	Level Width: 100	Band Spacing: 20	Plot	Clear



Transition heavily converted

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