

NDS Evaluation –History and Introduction

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Upton, NY 11973 USA



Evaluated Data

Nuclear Data Sheets

ENSDF

XUNDL



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)



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



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”

¹⁷⁵Lu
71 Lu 104

Ground State
0.100-ns, 0.1138-MeV Level
Reaction Data, Sheet 1

¹⁷⁵Lu
71 Lu 104

Ground State					
J	7/2	App. 1	Abundance	97.41%	App. 2
μ	+2.230	11 App. 1	σ _{HA}	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	γγ(β, H) ¹⁷⁵ Yb-3
T _{1/2}	0.110 ns	10	βγ-delay ¹⁷⁵ Yb-2
	0.101	7	p(ce)-delay ¹⁷⁵ Lu-1
	0.080		Coulomb excitation ¹⁷⁵ Lu-1
	0.090	10	γγ-delay ¹⁷⁵ Hf-2
	0.100		

Reaction Data

Coulomb Excitation

¹⁷⁵Lu(X, x'γ)

0.1138 level

T_{1/2} = 0.080 ns if B(E2) = 2.4, α = 2.49, δ² = 0.22
0.101 7 p(ce)-delay 60B110
0.100

eB(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
	0.1138			See ¹⁷⁵ Yb-1

For conversion-coefficient data for 0.1138γ,
see ¹⁷⁵Yb-1

p(0.1138γ) (β) A₂ = +0.007 7 58M36

^aif α = 2.49 and α_L = 0.45 for 0.1138γ (δ² = 0.22)
bif 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
AAdopted value

Reaction Data continued

Coulomb Excitation continued

¹⁷⁵Lu(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

eB(E2)†	E _γ	B(E2)† ^b	x	E _x
γ 0.13	0.136	0.45	p	4 scin 56H78
ce _L 0.044	0.140	0.67	p	3.2 s ce _L 58M36
	0.137			60Be16
	0.1377			See ¹⁷⁵ Yb-1

K/L = 4.3 4 α_L = 0.39^c 60Be16
6.6 0.19 M1 Theory
1.1 0.43 E2 Theory
4.8 0.23 |δ| = 0.47

p(0.1377γ) (β) A₂ = +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
	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) (β) A₂ = +0.089 6 δ² = ∞ 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 γγ 62G23
A0.95

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

γγ (0.1377γ) (0.1138γ) • 56G47, 56H78

6-6-24 (June 1965)

¹⁷⁵Lu-1

Replacement for 59-2-91

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$^{175}\text{Lu}_{71}^{104}$

Reaction Data, Sheet 2
Mass-Spectrometer Data

$^{175}\text{Lu}_{71}^{104}$

Reaction Data continued	Mass-Spectrometer Data
Coulomb Excitation continued	Mass-Doublet Measurements 60Bh2, 63De30 See Appendix 4
$^{175}\text{Lu}(x, x'\gamma)$	
0.75 level	
$\frac{E_{\gamma}}{0.258} \quad \frac{B(E2)^{16}}{0.040} \frac{x}{6} \quad \frac{E_x}{p} \quad 3.5 \text{ s ce}_K \quad 60\text{Be16}$	
$E(\text{level}) = 0.75 \text{ }^{10} \quad 60\text{Be16}$ from relative yields of 0.258 γ for $E_p = 3.2$ and 3.5	
Level $^{175}\text{Lu}(\gamma, \gamma)$	
0.343 level	
$T_{1/2} = 0.29 \text{ ns } 3$ if the 0.343 photon accounts for 88.3% of decays from this level resonance fluorescence 62De2	
$0.343\gamma(\beta) \quad A_{\beta} = -0.20 \text{ }^{28} \quad 62\text{De2}$ consistent with $\begin{cases} -30 \leq \delta \leq -2 \\ -0.3 \leq \delta \leq 0.1 \end{cases} \quad 62\text{De2}$	
Q $^{175}\text{Lu}(\gamma, n)$	
$Q = -7.77 \text{ }^{5} \quad \text{thresh } 58\text{K39}^{\text{f}}$ $-7.88 \text{ }^{5} \quad \text{thresh } 60\text{Ge1}$	
^a If 0.258 γ is M1	
^f Natural element was used for target	

Added in Proof

Reaction γ 's $^{176}\text{Yb}(p, 2n\gamma)$

$E_p = 12$, pulsed

$\frac{E_{\gamma}}{0.345}$

$T_{1/2} = 1.3 \text{ }^{2} \mu\text{s}$

x_K/γ indicates E1 transition

E_{xK} 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.

^{175}Lu completed

6-6-25 (June 1965)

^{175}Lu -2

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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.



SECTION 1

Nuclear Data

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

EDITOR:

Katharine Way

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CONTENTS:

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

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

Nuclear Transition Probability, $B(E2)$, for $0_{gs}^+ \rightarrow 2_{1st}^+$ Trans-
itions and Deformation Parameter, β_2 21

PAUL H. STELSON, *Oak Ridge National Laboratory, Oak Ridge,
Tennessee*, and LEE GRODZINS, *Laboratory for Nuclear Sci-
ence, 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

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

EDITOR:

Katharine Way

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J. A. Wheeler

CONTENTS:

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

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

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

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

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New York and London



VEN
ATORY

SECTION **B**

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MAY 31 1966

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Volume 1, Number 1, February 1966

2V02 6824-1

Nuclear Data

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

EDITOR:

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Revised A-Chains

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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

HAVER
BORATORY

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

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APR 1973

NNCSC

EDITORS: Nuclear Data Group

D. J. Horen, Director
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A. Sunyar

CONTENTS: RECENT REFERENCES

September 1972 through December 1972

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

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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

EDITOR:

Angela Li-Scholz

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P. M. Endt

Walter Gibson

V. I. Goldanskii

CONTENTS:

Atomic Subshell Photoionization Cross Sections and Asymmetry Parameters: $1 \leq Z \leq 103$

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

Evaluation History - cont

Common input format for tables and drawing

Evaluated Nuclear Structure Data File



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.

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.

Evaluation History - cont

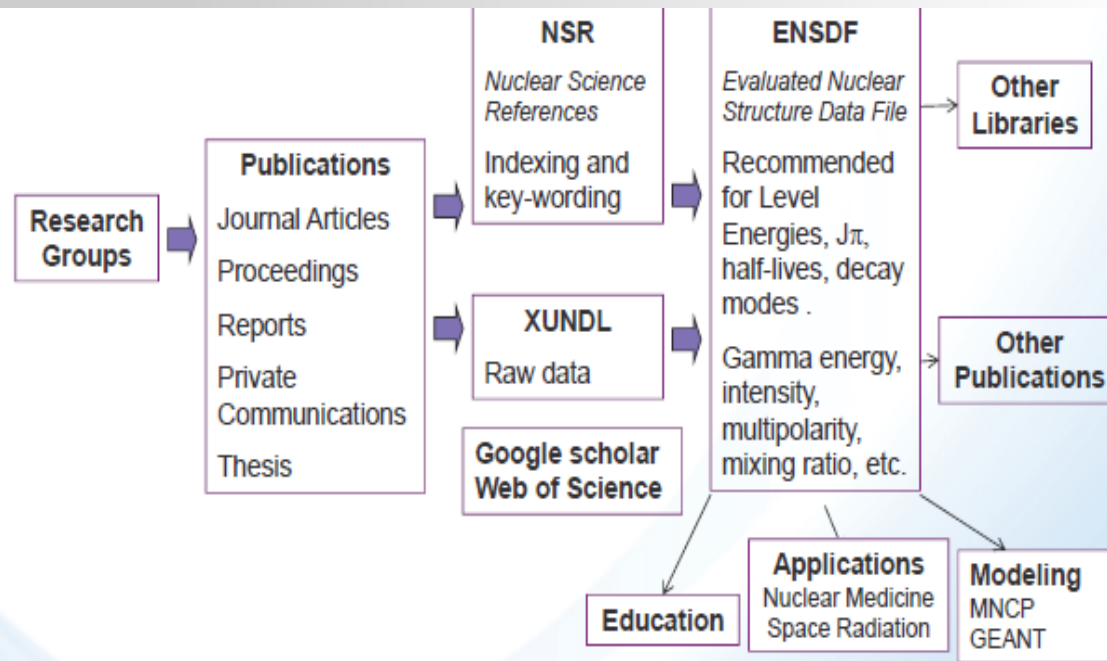
Change of production responsibility to NNDC, however, came about in 1980 when ORNL management support for the activity dropped considerably.

The NNDC took over production of Nuclear Data sheets in 1981 and completely computerized the process.

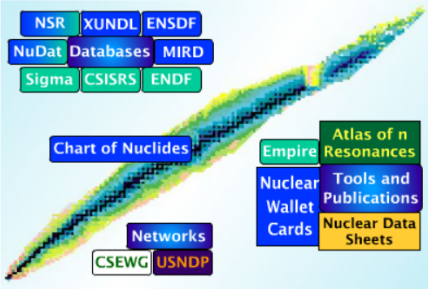
Evaluation History - cont

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.

ENSDF Evaluation Process



NNDC-Web




BNL Antineutrino Lecture

Special NDS Issue

Nuclear Data Week 2015

USNDP White Paper



USNDP White Paper Available!

Main

[Structure & Decay](#)

[Reactions](#)

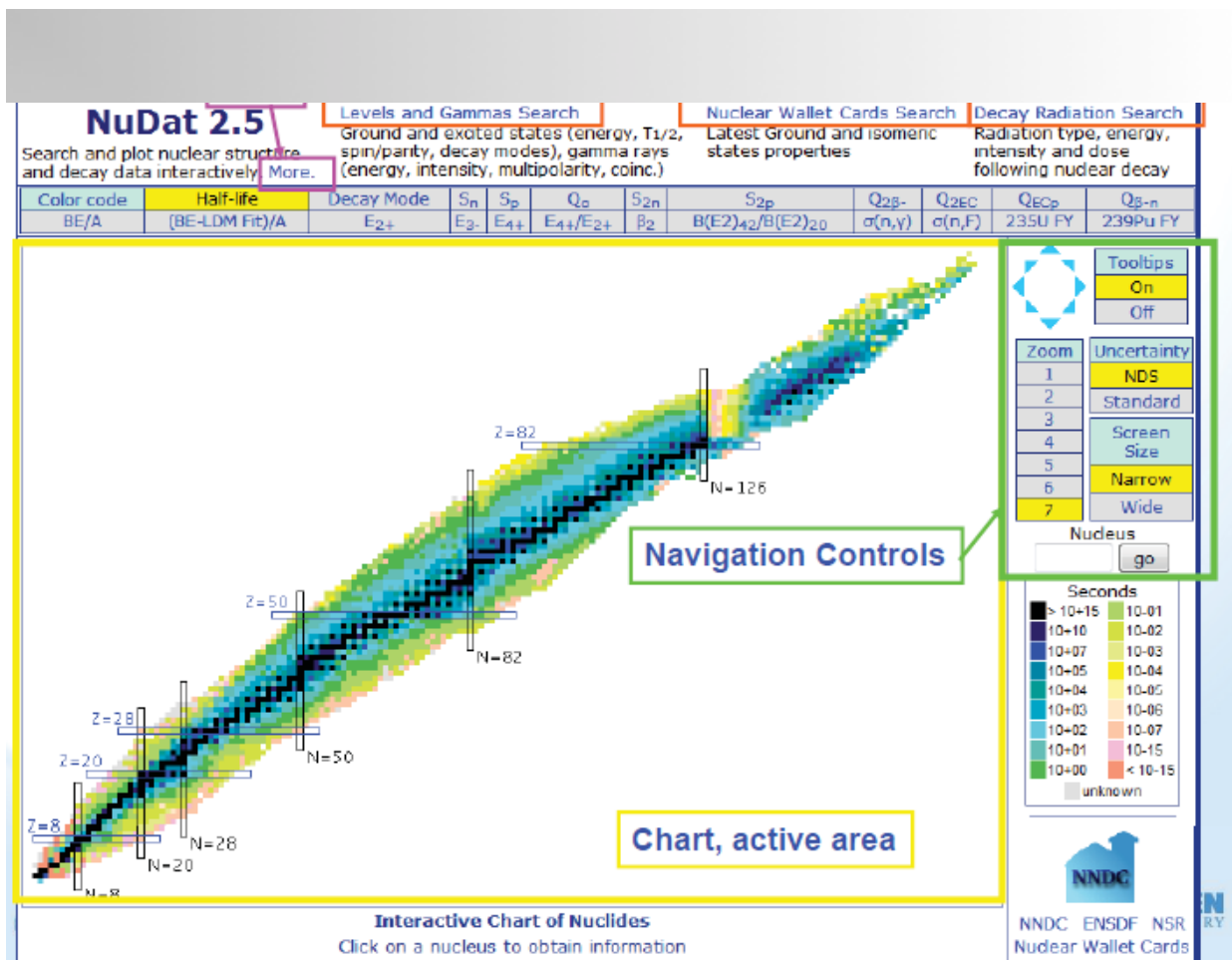
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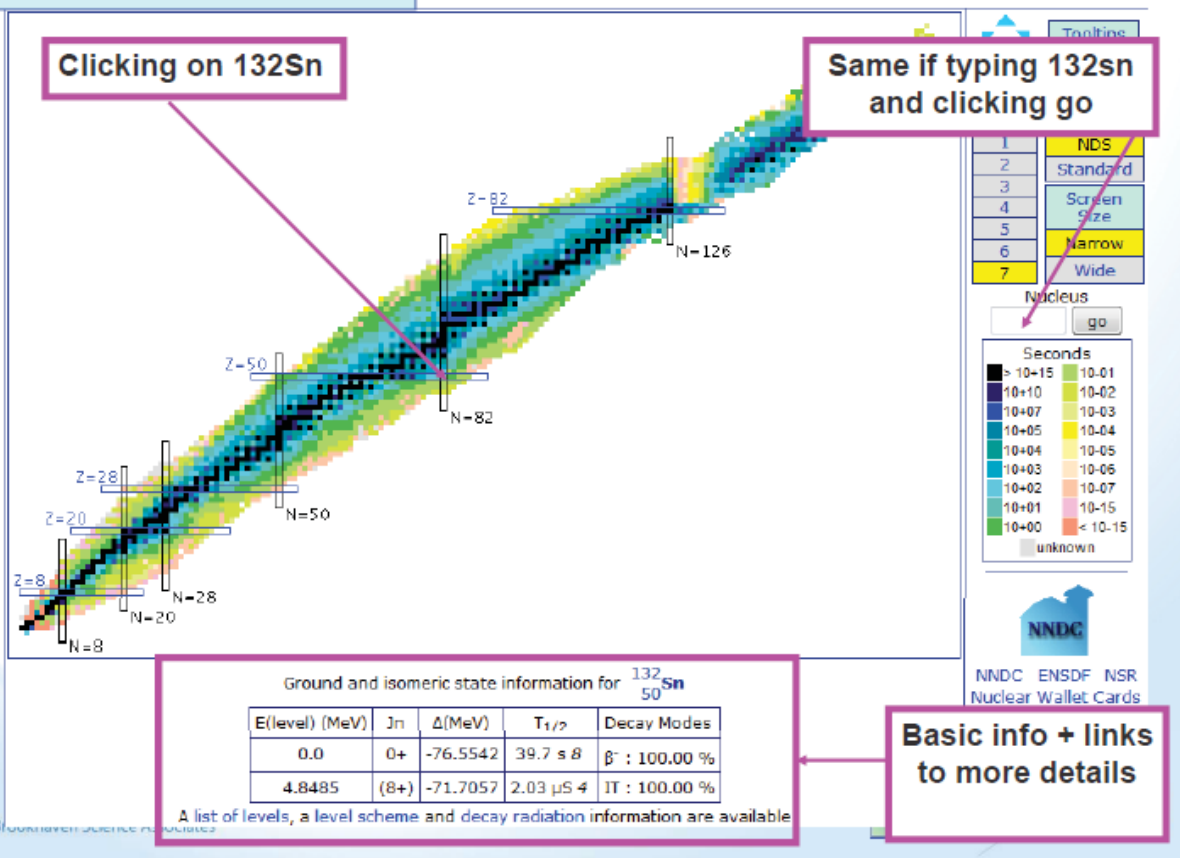
<p>AMDC Atomic Mass Data Center, Q-value Calculator</p> <p>Covariances of Neutron Reactions</p> <p>ENDF Evaluated Nuclear (reaction) Data File, Sigma</p> <p>NMMSS & DoE NMIRDC Safeguards & inventory decay data standards</p> <p>NucRates MACS & Astro-physical reaction rates</p> <p>XUNDL Experimental Un-evaluated Nuclear Data List</p>	<p>Atlas of Neutron Resonances Parameters & thermal values</p> <p>CSEWG Cross Section Evaluation Working Group</p> <p>ENSDF Evaluated Nuclear Structure Data File</p> <p>NSR Nuclear Science References</p> <p>NuDat Nuclear structure & decay Data</p>	<p>CapGam Thermal Neutron Capture γ-rays</p> <p>CSISRS alias EXFOR Nuclear reaction experimental data</p> <p>IRDF International Reactor Dosimetry File</p> <p>Nuclear Data Sheets Nuclear structure & decay data journal, Special Issues on reaction data</p> <p>USNDP U.S. Nuclear Data Program</p>	<p>Chart of Nuclides Basic properties of atomic nuclei</p> <p>Empire Nuclear reaction model code system, Reference paper</p> <p>MIRD Medical Internal Radiation Dose</p> <p>Nuclear Wallet Cards Ground & isomeric states properties, Homeland Security version</p> <p>USNDP/CSEWG GForge Collaboration Server</p>
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NUDat S Chart

Clicking on ^{132}Sn

Same if typing 132sn
and clicking go



ENSDF Retrieval

 **National Nuclear Data Center** 

INDC Databases: ♦ NuDat ♦ ♦ NSR ♦ ♦ XUNDL | ENSDF ♦ ♦ MIRL | ENDF ♦ ♦ CSISRS ♦ ♦ Sigma

Search the NNDC:

go

NNDC Site Index

NSDD Evaluators' Corner

Evaluated Nuclear Structure Data File (ENSDF)

Browse

Nuclide Search

Decay Search

Reaction Search

Recently added

Index to ENSDF

Index to XUNDL

Basic ENSDF Retrievals

The purpose of this page is to allow Nuclear Structure and Decay Data Evaluators to retrieve all data sets for a mass chain or Nuclide in a more basic form than available to the general user community. The only difference between these retrievals and similar retrievals from the Archival ENSDF is that the Comments have not been translated into the rich text format. That is, ComTrans has not been run prior to inclusion in the database.

Nuclide:

Search

Reset

Enter a mass number (valid mass numbers are 1 through 294) or a nuclide in the form of AAZZ (e.g., 235U) or ZZ-AAA (e.g., U-235). Use the last two digits of the atomic number as the chemical symbol for Z>111 (e.g., 12 for Z=112). Use "NN" as the symbol for neutron and "N" for nitrogen.

Database Manager: [Jagdish K. Tuli](#), NNDC, Brookhaven National Laboratory
Web and Programming: [Thomas W. Burrows](#) and David Winchell, NNDC, Brookhaven National Laboratory
Data Source: ENSDF is compiled by the [International Network of Nuclear Structure and Decay Data Evaluators](#)

ENSDF Retrieval

Most Visited Getting Started Latest Headlines <http://www.nndc.bnl...>

Dataset retrieval by Z,A, or Nuclide

Use this form to select datasets based on atomic number, atomic mass, or nuclide. First, choose the databases and types of dataset (ENSDF or XUNDL, Adopted, Reaction, etc.), then enter the retrieval criterion in the corresponding box below and click the matching "Search" button. For more information, see the [help](#) page.

Databases:	Dataset types:
<input checked="" type="checkbox"/> ENSDF	<input checked="" type="checkbox"/> Adopted
<input checked="" type="checkbox"/> XUNDL	<input checked="" type="checkbox"/> Decay
	<input checked="" type="checkbox"/> Reaction
	<input type="checkbox"/> Comments
	<input type="checkbox"/> Reference

Retrieve by Z, A, or nuclide :


Nuclide Z range:	<input type="text"/>	<input type="button" value="Search"/>	(56, 80-82, 102-, Ca, Zr-mo, -Na, ...)
Nuclide A range:	211 <input type="text"/>	<input type="button" value="Search"/>	(56, 120-130, 208-, ...)
Nuclide:	<input type="text"/>	<input type="button" value="Search"/>	(58Ni, pb-208, ...)


Nuclides for A = 211 in ENSDF

[Return to browse](#)

211	211Ac
211Hg	211Th
211Tl	
211Pb	
211Bi	
211Po	
211At	
211Rn	
211Fr	
211	

ENSDF Listing


National Nuclear Data Center


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Home

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

Revise Search

Matching datasets in ENSDF

Nuclide	Dataset	Last Revised	References
	<input type="checkbox"/> Select All		
²¹¹	<input type="checkbox"/> COMMENTS	2004-10	All references
	<input type="checkbox"/> REFERENCES	2004-10	All references
²¹¹ Hg	<input type="checkbox"/> COMMENTS	2011-05	All references
	<input type="checkbox"/> ADOPTED LEVELS	2011-05	All references
²¹¹ Tl	<input type="checkbox"/> ADOPTED LEVELS	2004-10	All references
²¹¹ Pb	<input type="checkbox"/> ADOPTED LEVELS, GAMMAS	2004-10	All references
	<input checked="" type="checkbox"/> 215PO A DECAY	2004-10	All references
	<input type="checkbox"/> 210PB(T,D)	2004-10	All references
²¹¹ Bi	<input type="checkbox"/> ADOPTED LEVELS, GAMMAS	2004-10	All references
	<input type="checkbox"/> 211PB B- DECAY	2004-10	All references
	<input type="checkbox"/> 215AT A DECAY	2004-10	All references
	<input type="checkbox"/> 9BE(238U,XG) E=238 GEV	2004-10	All references

XUNDL Listing

Datasets for 211

Results from quick search

[Revise Search](#)

Matching datasets in XUNDL

Nuclide	Dataset	Last Revised	References
	<input type="checkbox"/> Select All		
²¹¹ Pb	<input type="checkbox"/> 238U(208PB,XG):XUNDL-1	2005-01	All references
²¹¹ Po	<input type="checkbox"/> 208PB(76GE,X):XUNDL-1	1999-07	All references
	<input type="checkbox"/> 208PB(9BE,A2NG):XUNDL-2	1999-09	All references
²¹¹ At	<input type="checkbox"/> 208PB(7LI,4NG):XUNDL-1	2001-11	All references
²¹¹ Fr	<input checked="" type="checkbox"/> 215AC A DECAY (170 MS):XUNDL-1	2005-04	All references
²¹¹ Ra	<input type="checkbox"/> 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](#)

XUNDL Retrieval

NNDC Databases: NuDat NSR XUNDL ENSDF MIRDB ENDF CSISRS Sigma		
XUNDL Datasets after ENSDF cutoff of 23-Aug-2001		
Datasets for A=6		
<input type="button" value="Revise Search"/>		
Matching datasets in XUNDL		
Dataset	Last Revised	References
<input type="checkbox"/> Select All		
<input type="checkbox"/> 12C(8HE,X):XUNDL-1	2008-12	All references
<input checked="" type="checkbox"/> 28SI(P,6HE):XUNDL-1	2012-03	All references
<input type="checkbox"/> 3H(A,6HE):XUNDL-2	2012-07	All references
<input type="checkbox"/> 6HE B- DECAY:T1/2:XUNDL-1	2008-12	All references
<input type="checkbox"/> 6HE B- DECAY:801 MS:XUNDL-2	2010-02	All references
<input type="checkbox"/> 9BE(7BE,6LI):XUNDL-3	2010-09	All references
<input type="checkbox"/> 6HE B- DECAY:XUNDL-4	2012-04	All references
<input type="checkbox"/> 9BE(10C,6BE):XUNDL-1	2009-09	All references
<input type="checkbox"/> 6LI(3HE,3H):XUNDL-2	2010-08	All references
<input type="checkbox"/> 1H(6LI,6BE):XUNDL-3	2012-02	All references

Basic Retrieval from XUNDL

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[Home](#)

NNDc Databases: [NuDat](#) | [NSR](#) | [XUNDL](#) | [ENSDF](#) | [MIRD](#) | [ENDF](#) | [CSISRS](#) | [Sigma](#)

Search the NNDc:


[ENSDF Format Manual](#)
[Procedures Manual](#)
[ENSDF Analysis and Utility Codes](#)
[Q Values](#)
[Log ft's](#)
[BrIcc](#)


Experimental Unevaluated Nuclear Data List (XUNDL)

Last updated 2012-07-31
[Previous retrieval version](#)

The [XUNDL](#) database contains compiled experimental nuclear structure data from more than 3000 recent papers.

Referenced journals include [Physical Review C](#), [Physical Review Letters](#), [Nuclear Physics A](#), [European Physical Journal A](#), [Physics Letters B](#), [Journal of Physics G](#), and many more.

 [NNDc Home](#)

 [Send Feedback!](#)

126 datasets have been added/modified in the last month!

[Evaluated Nuclear Data \(ENSDF\)](#)

[Browse](#) datasets by element and mass or search the XUNDL [indices](#) or [Detailed Indices](#)

Search the XUNDL database by selecting from the following tabs.

Retrieve all XUNDL datasets for a given nuclide or mass: (208Pb, pb-208, 144, etc.)

Specific Retrieval

Experimental Unevaluated Data (XUNDL)

Browse datasets by element or mass or search the ENSDF indices.
For more detailed search criteria, select items from the following tabs.

Quick Search By Nuclide By Reaction By Decay Recently Added

Use this page to retrieve datasets based on decay-related quantities. Non-blank criteria will be "anded" together to filter the datasets. The "Z range" and "A range" quantities refer to the nuclides for which datasets will be retrieved.

Indexed decay values : (non-blank fields will be "anded")

Nuclide Z range: (56, 80-82, 102-, Ca, Zr-mo, -Nb, ...)

Nuclide A range: (56, 120-130, 208-, ...)

Parent: (60Co, d-252, ...)

Decay: any B- 2B-

Search Reset

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
<input type="checkbox"/> Select All		
<input type="checkbox"/> ADOPTED LEVELS, GAMMAS	2008-02	All references
<input type="checkbox"/> 100Zr B- DECAY (7.1 S)	2008-02	All references
<input type="checkbox"/> 100Nb IT DECAY (13 US)	2008-02	All references
<input type="checkbox"/> 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	<input type="checkbox"/> 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
	<input type="checkbox"/> Select All		
¹⁰⁰ Mo	<input type="checkbox"/> 100Nb B- DECAY:XUNDL-1	2001-06	All references
	<input type="checkbox"/> 100Nb B- DECAY:1.5 S:XUNDL-10	2012-01	All references
	<input type="checkbox"/> 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

Initialization Parameters

Publication year range: 1910 to 2010

Primary only: ☒ View All: ☐ Require measured quantity: ☐

Output year order: ☐ Ascending ☒ Descending

Output format: ☒ HTML ☐ BibTex ☐ Text ☐ Keynum ☐ Exchange

☒ Search all entries ☐ Search entries added since 10 / 5 / 2010 (month/day/year)

Search Parameters

Nuclide

AND

AND

As of today, 29 articles should appear.

NSR key number	Reference	Authors
1007DO17	Nucl.Phys. A792, 18 (2007)	<p>C.Dossat, N.Adimi, F.Aksouh, F.Becker, A.Bey, B.Blank, C.Borcea, R.Borcea, A.Boston, M.Caamano, G.Canchel, M.Chartier, D.Cortina, S.Czajkowski, G.de France, F.de Oliveira Santos, A.Fleury, G.Georgiev, J.Giovinazzo, S.Grevy, R.Grzywacz, M.Hellstrom, M.Homma, Z.Janas, J.Karamanis, J.Kurcewicz, M.Lewitowicz, M.J.Lopez Jimenez, C.Mazzocchi, I.Matea, V.Maslov, P.Mayet, C.Moore, M.Pfutzner, M.S.Pravikoff, M.Stanoiu, I.Stefan, J.C.Thomas</p>
The decay of proton-rich nuclei in the mass $A = 36$ -56 region		
NUCLEAR REACTIONS $\text{Ni}^{58}(\text{Ni}, \text{X})$, $E=74.5$ MeV/nucleon; measured fragments isotopic yields.		
<p>RADIOACTIVITY $^{36,37}\text{Ca}$, $^{39,40,41}\text{Ti}$, ^{43}V, $^{42,43,44,45}\text{Cr}$, $^{46,47}\text{Mn}$, $^{46,47,48,49}\text{Fe}$, $^{50,51}\text{Co}$, $^{49,50,51,52,53}\text{Ni}$, ^{55}Cu, $^{55,56}\text{Zn}(\beta^+)$, (EC), (β^+p) [from $\text{Ni}^{58}(\text{Ni}, \text{X})$]; measured $T_{1/2}$, β-delayed proton and γ spectra, branching ratios. $^{43,45}\text{Cr}$, ^{46}Mn, $^{46,47,48}\text{Fe}$, ^{50}Co, $^{50,51,52,53}\text{Ni}$ deduced levels. Two-proton decay observed. Comparison with model predictions.</p>		
for 10.1016/j.nucphysa.2007.05.004		
Data from this article have been entered in the XUNDL database. For more information, click here .		
Link to article (PDF), requires subscription	Keywords, which describe article's content	Link to data in article

NuDat

www.nndc.bnl.gov/nudat2

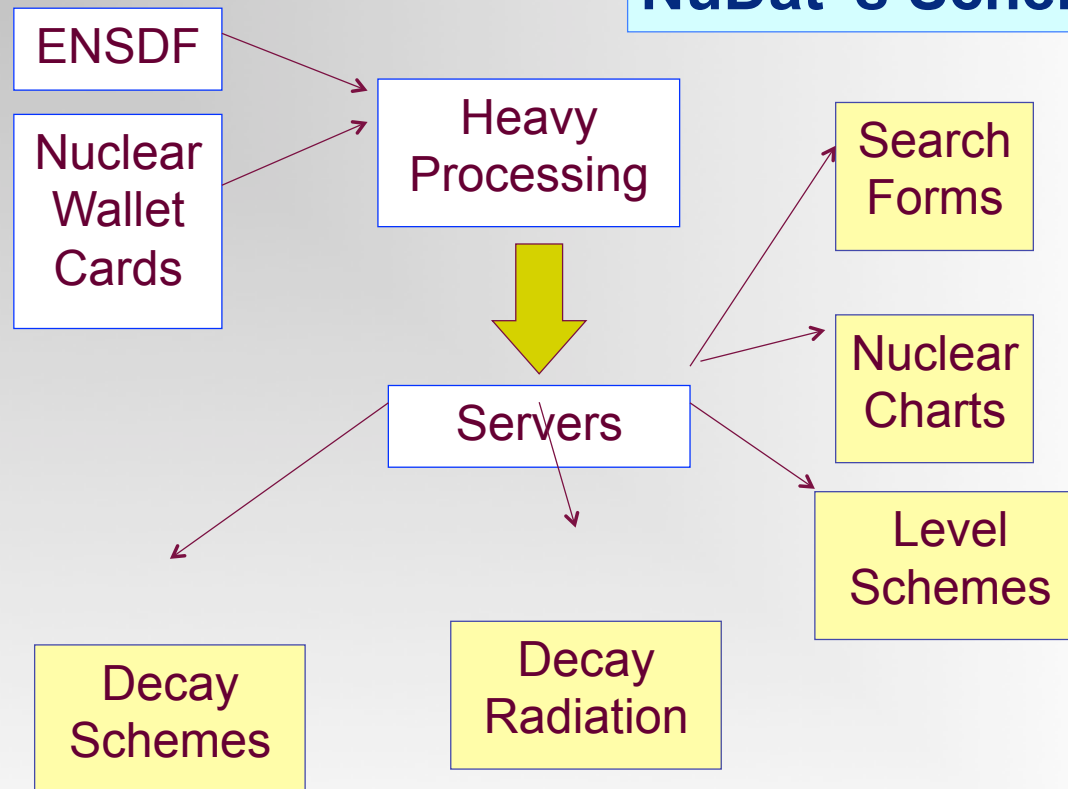
NuDat is a web application with two main goals, a) to present nuclear structure and decay information from ENSDF in a user-friendly way, and b) to allow users to execute complex search operations in the wealth of data contained in ENSDF. NuDat provides an interactive chart of nuclides for navigation 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



NuDat's Scheme



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

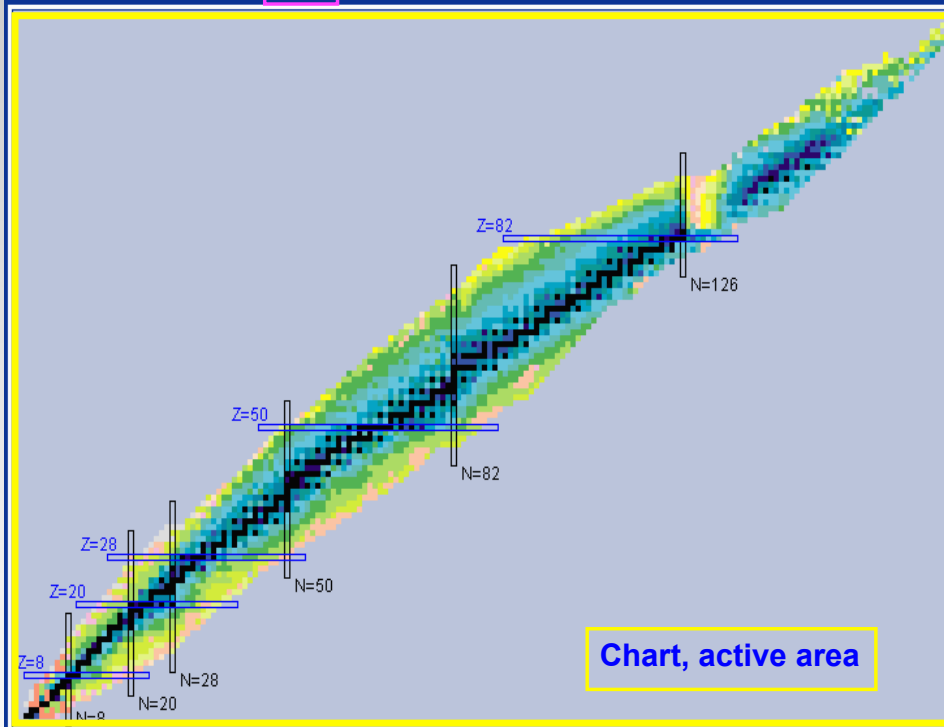
Ground and excited states (energy, $T_{1/2}$, spin/parity, decay modes), gamma rays (energy, intensity, multipolarity, coinc.)

Nuclear Wallet Cards Search

Ground and isomeric states, neutron resonances and thermal cross sections

Decay Radiation Search

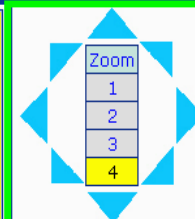
Radiation type, energy, intensity and dose following nuclear decay



Chart, active area

Interactive Chart of Nuclides

Click on a nucleus to obtain information



Nucleus: go

Color code Tooltips

Half-life On

Decay Mode Off

Uncertainties style

NDS Standard

Legend for half-life ranges (s):
10+13 s, 10+10 s, 10+07 s, 10+05 s, 10+04 s, 10+03 s, 10+02 s, 10+01 s, 10+00 s, 10-01 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

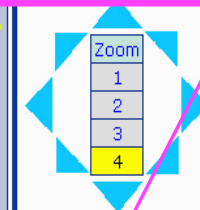
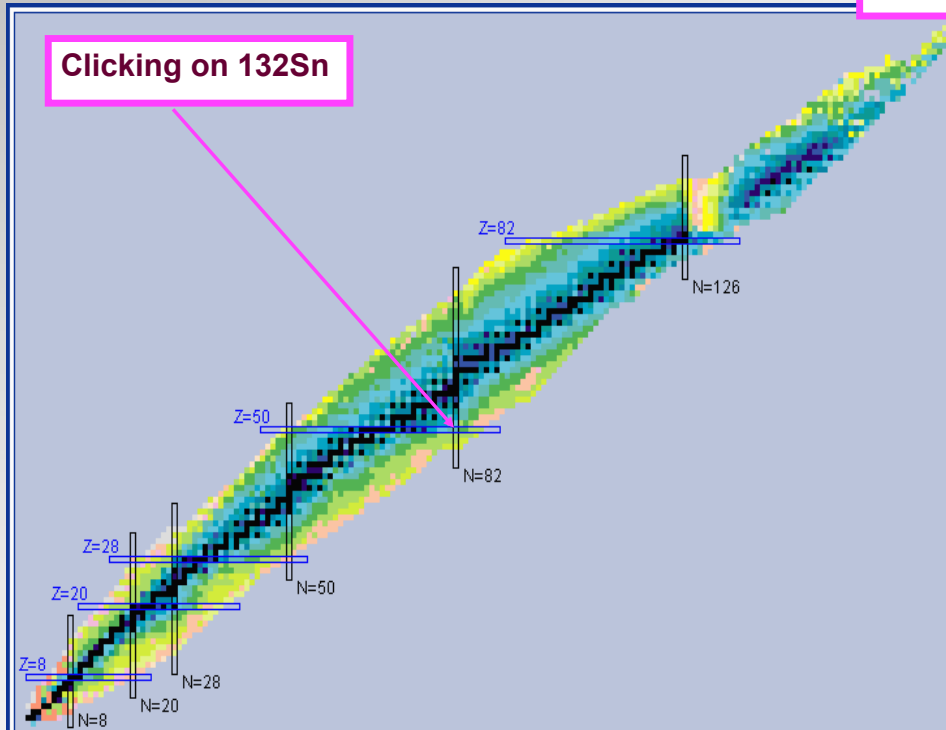


NNDC ENSDF NSR
Nuclear Wallet Cards

NuDat's chart

Same if typing 132sn and clicking go

Clicking on 132Sn



Nucleus: go

Color code

Half-life

Decay Mode

Uncertainties style

NDS

☐ > 10+15 s ☐ 10-01 s
☐ 10+10 s ☐ 10-02 s
☐ 10+07 s ☐ 10-03 s
☐ 10+05 s ☐ 10-04 s
☐ 10+04 s ☐ 10-05 s
☐ 10+03 s ☐ 10-06 s
☐ 10+02 s ☐ 10-07 s
☐ 10+01 s ☐ 10-15 s
☐ 10+00 s ☐ < 10-15 s
☐ unknown



[NNDC](#) [ENSDF](#) [NSR](#)
[Nuclear Wallet Cards](#)

Ground and isomeric state information for ¹³²₅₀Sn

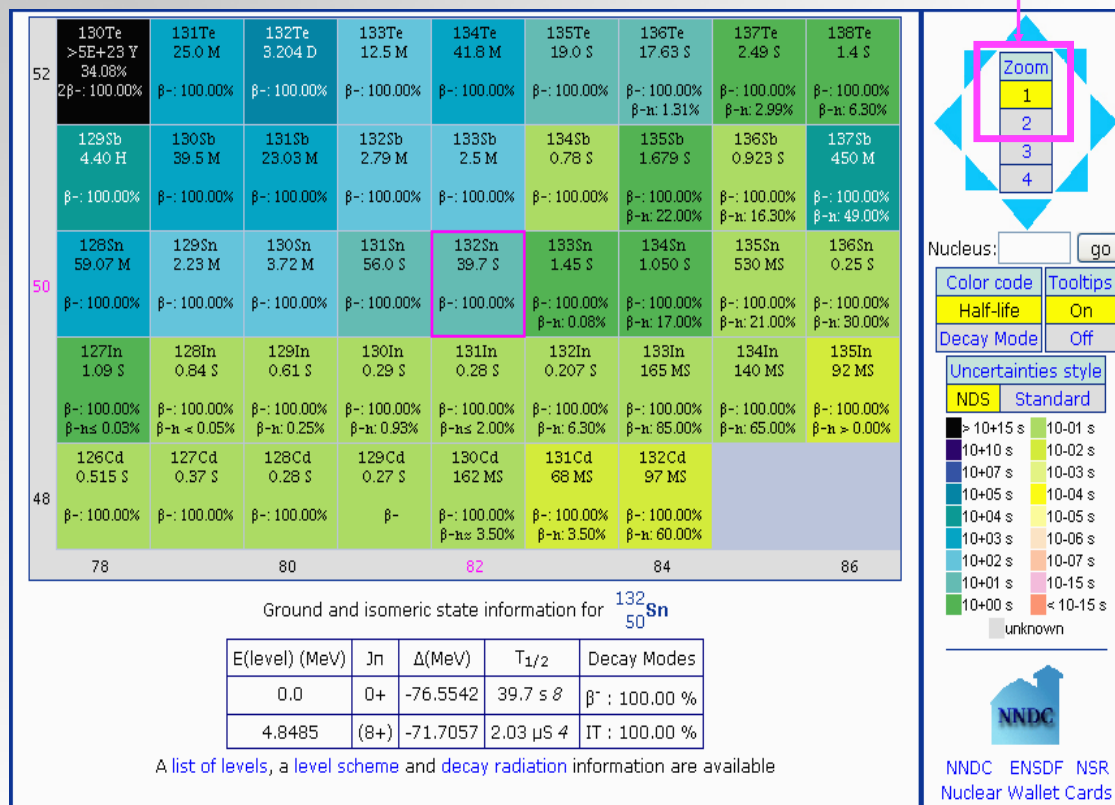
E(level) (MeV)	J π	Δ (MeV)	T _{1/2}	Decay Modes
0.0	0+	-76.5542	39.7 s 8	β^- : 100.00 %
4.8485	(8+)	-71.7057	2.03 μ s 4	IT : 100.00 %

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

Basic info + links to more details

NuDat's chart

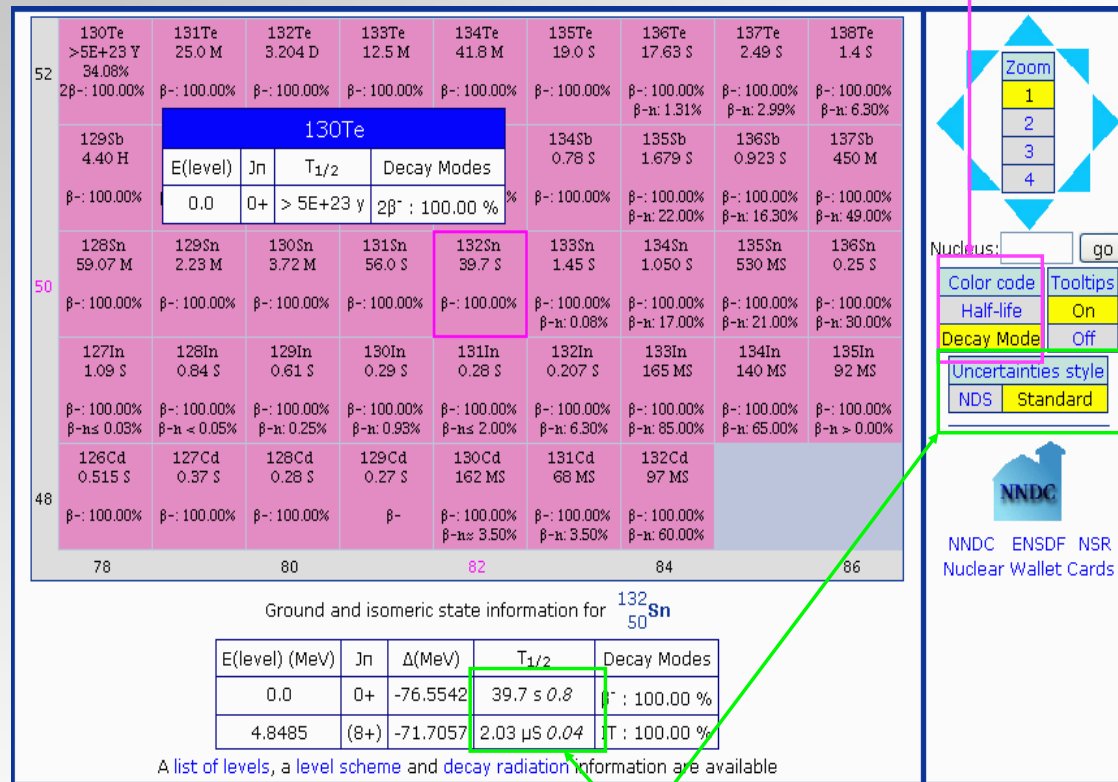
Changing the zoom value



BROOKHAVEN
NATIONAL LABORATORY

NuDat's chart

Decay Mode colors



Standard uncertainties style

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, $\% \beta^- = 100$ 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.

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 \pm 0.003
4.6 h 12	4.6 \pm 1.2 hours
5.4×10^3 2	5400 \pm 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 $^{132}_{50}\text{Sn}$

E(level) (MeV)	J π	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 μ s 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 S_n= 7311 keV 25 S_p= 15710 keV 30 Q _{α} = 11.69E3 keV 29

References:

- A: 132IN β^- DECAY (0.207 S)
 B: 132SN IT DECAY (2.03 μ S)
 C: 133IN β^- -N DECAY (165 MS)
 D: 248CM SF DECAY
 E: COULOMB EXCITATION

E _{level} (keV)	XREF	J π	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+

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

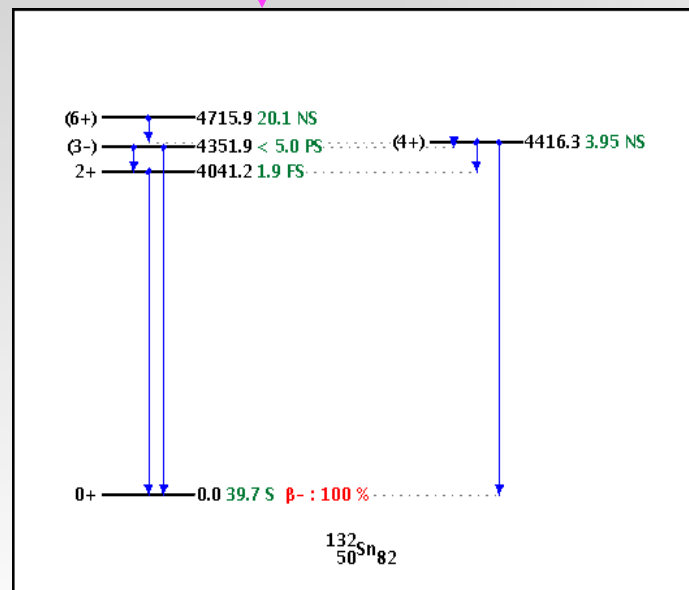
Retrieve all datasets

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

E(level) (MeV)	J π	Δ (MeV)	$T_{1/2}$	Decay Modes
0.0	0+	-76.5542	39.7 s	β^- : 100.00 %
4.6485	(8+)	-71.7057	2.03 μ s	IT : 100.00 %

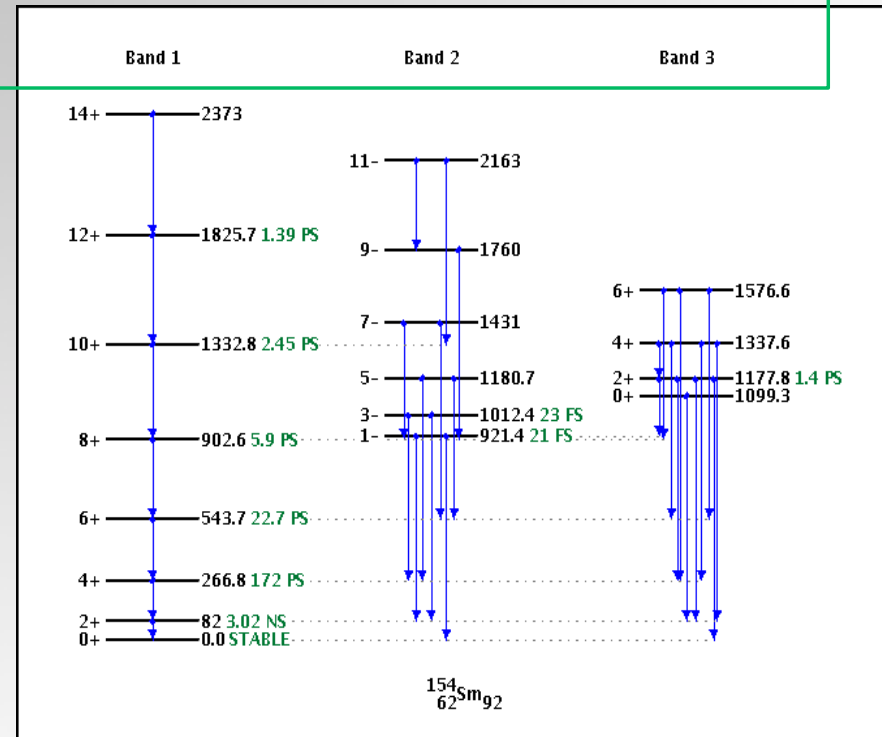
A list of levels, a level scheme and decay radiation information are available

Interactive Level Scheme



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

Rotational bands

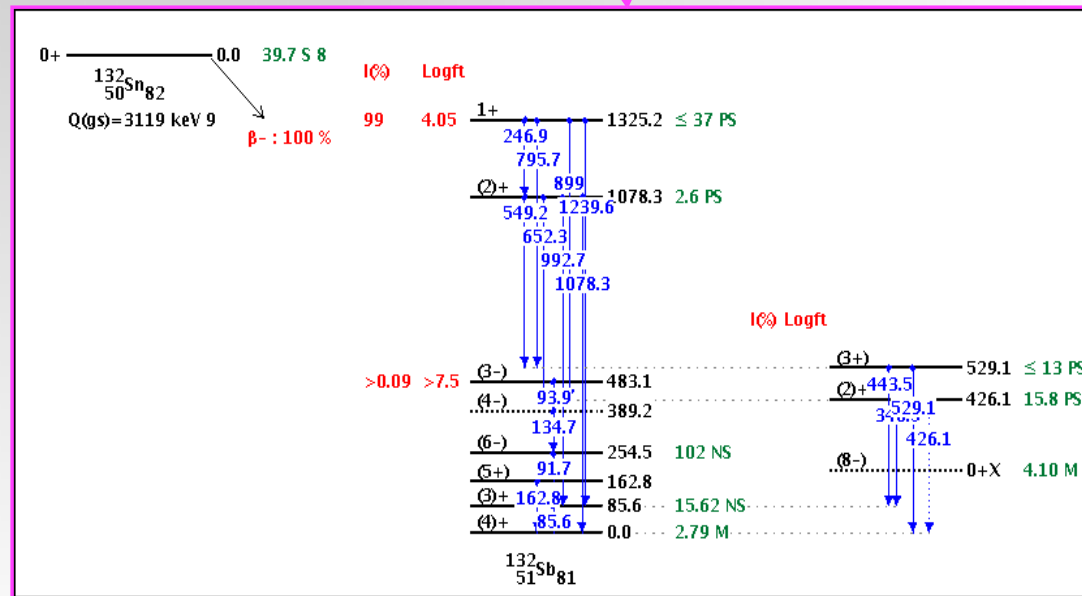


Partial view of ^{154}Sm level scheme

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

E(level) (MeV)	J π	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 μ s 4	IT : 100.00 %

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



Levels Search

Search for first 2+ states in N=86 Nuclides

Nuclear Levels and Gammas Search
([Help](#))

Specify Nuclei : ☐ Nucleus: Ex: 232TH or th232 or 232-Th or th-232 or
☒ Z / Element: A: N: 86
☐ ≤ Z ≤ ≤ A ≤ ≤ N ≤

E(level) condition: ☐ enabled ☒ disabled 0 ≤ E_{level}(keV) ≤ 40000

Decay Mode condition: ☐ enabled ☒ disabled Decay Mode ANY

Jn(level) condition: ☒ enabled ☐ disabled J = 2 Order : 1st Parity : +

T_{1/2}(level) condition: ☐ enabled ☒ disabled 0 ≤ T_{1/2} ≤ 1E10 fs Gy
☐ No Upper/Lower limit values

γ condition #1: ☐ enabled ☒ disabled 0 ≤ E_γ(keV) ≤ 40000 Multipolarity: ANY ☐ Not mixed

γ condition #2: ☐ enabled ☒ disabled 0 ≤ E_γ(keV) ≤ 40000 Multipolarity: ANY ☐ Not mixed

γ condition #3: ☐ enabled ☒ disabled 0 ≤ E_γ(keV) ≤ 40000 Multipolarity: ANY ☐ Not mixed

γ coincidence condition : ☒ any ☐ coincident Coincidence gate ≤ 1 us

γ reduced transition probability: ☐ enabled ☒ disabled 0 ≤ B(M_λ,E_λ)(Weisskopf units) ≤ 40000 **NEW**

Ordering: Z, A, E(level),E(gamma) Output: ☒ Web Page ☐ Formatted File

Uncertainties: ☒ Nuclear Data Sheets style ☐ Standard style

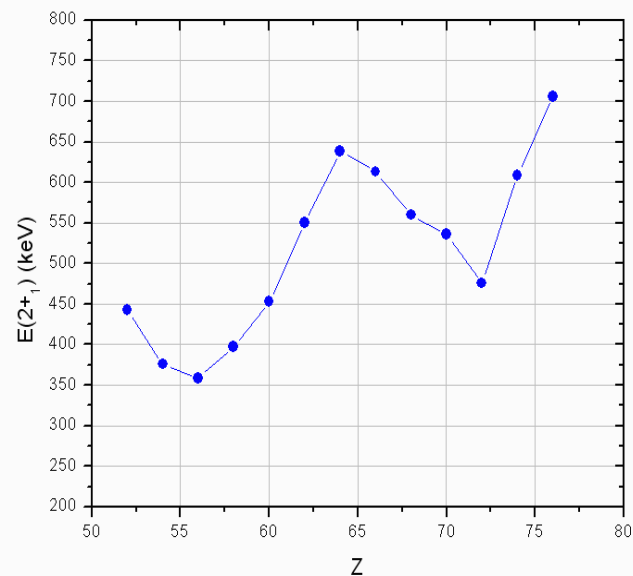
Levels and Gammas database version of 4/11/2008

Results

Nucleus	E _{level} (keV)	J π	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



Decay Search

Decay Radiation Search

[Help](#)

Specify Parent Nuclei : ☒ **Nucleus:** Ex 232TH or th232 or 232-Th or th-232 or

☐ **Z / Element:** **A:** **N:**

☐ ≤ **Z** ≤ ≤ **A** ≤ ≤ **N** ≤

Parent T_{1/2} condition: ☐ enabled ☒ disabled ≤ T_{1/2} ≤

☐ No Upper/Lower limit values

Decay Mode condition: ☐ enabled ☒ disabled **Decay Mode**

Radiation Type condition: ☐ enabled ☒ disabled **Radiation Type**

Radiation Energy condition: ☐ enabled ☒ disabled ≤ **Energy (keV)** ≤

Radiation Intensity condition: ☐ enabled ☒ disabled ≤ **Intensity (%)** ≤

Ordering: Output: ☒ Web Page ☐ Formatted File

Uncertainties: ☒ Nuclear Data Sheets style ☐ Standard style

Decay Radiation database version of 4/11/2008

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

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

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:

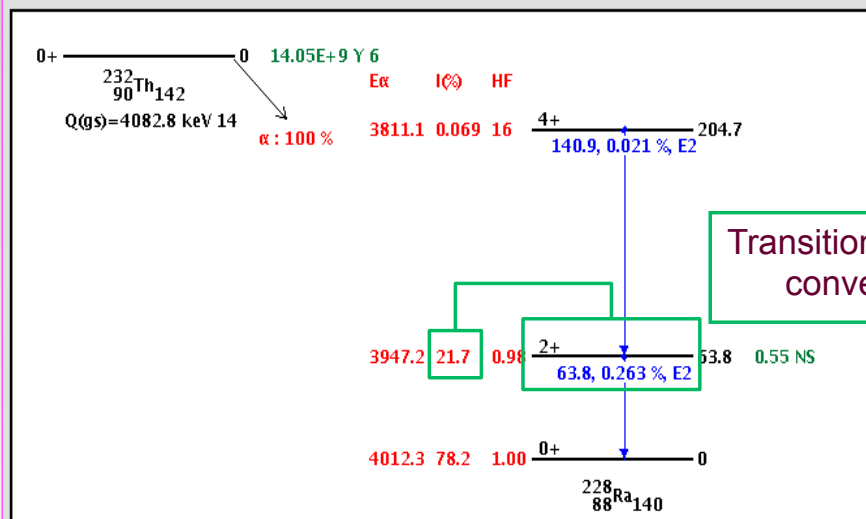
	Energy (keV)	Intensity (%)	Dose (MeV/Bq-s)
XR 1	12.3	7.1 % 5	8.8E-4 6
	63.81 1	0.263 % 13	1.68E-4 8
XR ka2	85.431	0.0017 % 3	1.4E-6 3
XR ka1	88.471	0.0028 % 5	2.4E-6 5
XR k β 3	99.432	3.4E-4 % 6	3.3E-7 6
XR k β 1	100.13	6.4E-4 % 12	6.5E-7 12
XR k β 2	102.498	2.4E-4 % 5	2.5E-7 5
	140.88 1	0.021 % 4	3.0E-5 6

Where are the electrons coming from?

Interactive Decay Scheme

^{232}Th α decay

0.0	< E(level) < 225.0	<input checked="" type="checkbox"/> Level Energy	<input checked="" type="checkbox"/> Level T1/2	<input checked="" type="checkbox"/> Level Spin-parity	<input checked="" type="checkbox"/> Final Level
Highlight:	Level	<input checked="" type="checkbox"/> Gamma Energy	<input checked="" type="checkbox"/> Gamma Intensity	<input checked="" type="checkbox"/> Gamma Multipolarity	<input checked="" type="checkbox"/> Decay Information
Image Height: 350	Level Width: 100	Band Spacing: 20	<input type="button" value="Plot"/> <input type="button" value="Clear"/>		



Transition heavily converted