

Software support for Structure & Decay

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CRPs -TMs contributions



- β⁻ delayed neutron emission
 Database maintenance and Web application
- **RIPL discrete levels** Update with new ENSDF release Match with AME 2016, fix unknown energies
- NSDD Analysis & Utility software Web site to collect and disseminate

β⁻ delayed neutron emission



Database maintenance and Web application

Individual precursors



TEST PAGE

Compilations Commen	Completions Comments Occine		Systematics Miernik 14								
	s Qvalues	Theory Moel	ler et al. 03	Marketin et a	l. 16	Moeller et al.	19				
	Recommended val	ues									
	Nuclide	Isomer	Τ _{1/2}	%P(1n)	%P(2n)	%P(3n)	# of neutrons per decay	Reference	Spectra		
	2 He 6		119.4(15) ms	16 (1)			0.16	2015B105	1		
	3 Li* 6		178.2(4) ms	50.5 (10) ^a			0.505	20158105	2		
	11 Li a		8.58(32) ms	86.6 (13)	4.2 (4)	1.9 (2)	1.007	20158105	5		
	11 Be .		13740(80) ms					20158105			

Group parameters

Time dependence of delayed neutron activity Group Parameters

Search Nuclide : All V Energy : All V	Downloads 산 ⁵⁹⁹ Numerical data	🕼 Original
Show Evaluated Libraries		

229TH

Energy: Thermal Spectrum

5-Groups

Original Model - A. N. GUDKOV, A. B. KOLDOBSKII, S. V. KRIVASHEEV, N. A. LEBEDEV, and V. A. PCHELIN, Yields of Delayed-Neutron Groups in Thermal-Neutron Fission of 229Th, Sov. J. Nucl. Phys., 49, No. 6, 960 (1989).

#	Half-life [s]	Relative abundance a(i)
---	---------------	-------------------------

- 1 55.7 ± 1.300 0.114 ± 0.009
- 2 22.7 ± 0.710 0.341 ± 0.026
- 3 6.22 ± 0.230 0.237 ± 0.018 4 2.30 ± 0.090 0.248 ± 0.020
- 4 2.30 ± 0.090 0.248 ± 0.020 5 0.610 ± 0.083 0.059 ± 0.014
- Average Half-life : 16.20 ± .84 s

Spectra

Aggregated Delayed Neutron Spectra

Detailed information about experiment is presented in Annals of Atomic Energy Short discription of the data base:

- 1. Source of primary neutron: accelerator based reaction T(p,n) in polyethylene block
- 2. Detector of delayed neutron spectra: He-3 spectrometer
- 3. Time of sample irradiation: short irradiation (tir=20 s) and long irradiation (tir=120 s)
- Method of measurements: cyclic irradiation of sample and measurements of delayed neutron spectra in time windows (indicated in tables)
 Processing of the data (see the reference paper)
- The database can be used as a benchmark for validation of both delayed neutron spectra from individual precursors and for delayed neutron spectra for group data.

Short Irradiation dEn = 4 keV		Short Irradiation dEn = 10 keV			Long Irradiation dEn = 4 keV			ation keV	
Time window: 012-1 s Energy bins: 4 keV Neutron energy En, keV	tir=20 s dN/dEn, neutron/keV	Time window: 1-2 s Energy bins: 4 keV Neutron energy En, keV	tir=20 s dN/dEn, neutron/keV	Time window: 2-3 s Energy bins: 4 keV Neutron energy En, keV	tir=20 s dN/dEn, neutron/keV	Time window: 3-4 s Energy bins: 4 keV Neutron energy En, keV	tir=20 s dN/dEn, neutron/keV	Time window: 4-44 s Energy bins: 4 keV Neutron energy En, keV	tir=20 s dN/dEn, neutron/keV
4	0.11906	4	0.23715	4	0.22148	4	0.06304	4	0.07058
8	0.2859	8	0.38691	8	0.47003	8	0.15835	8	0.06391
12	1.04531	12	1.32995	12	1.46022	12	1.2709	12	0.45388
16	1.70032	16	2.13926	16	2.39803	16	2.13405	16	2.29236
20	2.35932	20	2.87943	20	3.23654	20	3.0512	20	7.29833
24	2.92908	24	3.53172	24	3.90931	24	3.78473	24	5.37028
28	3.17235	28	3.90669	28	4.1696	28	4.14668	28	4.77128
32	3.04082	32	3.7371	32	3.95256	32	3.92245	32	4.41363
36	3.06924	36	3.67164	36	3.82806	36	3,80703	36	4.10597
40	3.06549	40	3.66162	40	3.78838	40	3.76163	40	4.0211
4.4	2 07700		2 66065	4.4	2 03431	4.4	2 76502	4.4	4 00057

Total yields

		Total	Delayed Neutron Y	ields
Search Targe All Only recommence Evaluated Librari	All V led values	Reaction inducing fission	Recommended FSCSW = Fission TDN yield = tota β = delayed neut	lation by V. Piksaikin, A.S. Ego d experimental values spectrum. cross section weigh I delayed neutron yield (v _d) = ron fraction. I delayed neutron yield from fa
Downloads	ita 🖪	Original	Y15(X) = total d of = fission cross <v> = average n</v>	delayed neutron yield from the elayed neutron yield from fissi section. umber of prompt neutrons. utrons per atom/100 incident r
# Target	Energy [MeV]	Total delayed r	eutron yield	Adjustr

#	Target	Energy	Total delayed	Adjustm	
	[MeV		Reported	Adjusted	
	209-Bi	Charged - Partie	cle induced fission		
	209-Bi	29.1 (He-3)	0.0009 ± .0001mb		
	209-Bi	33.7 (He-3)	0.0172 ± .0024mb		
	231-Pa	Neutron induce	d fission		

RIPL discrete levels





Reference Input Parameter Library (RIPL-3)

R. Capote, M. Herman, P. Oblozinsky, P.G. Young, S. Goriely, T. Belgya, A.V. Ignatyuk, A.J. Koning, S. Hilaire, V.A. Plujko, M. Avrigeanu, O. Bersillon, M.B. Chadwick, T. Fukahori, Zhigang Ge, Yinlu Han, S. Kailas, J. Kopecky, V.M. Maslov, G. Reffo, M. Sin, E.Sh. Soukhovitskii and P. Talou



Nuclear Data Sheets - Volume 110, Issue 12, December 2009, Pages 3107-3214

RIPL discrete levels database updated in September 2020 - it contains the correction for +X,.. levels

Update with new ENSDF release

Match with AME 2016 to assign unknown level energies

MASSES [LEVELS] RESONANCES [OPTICAL] DENSITIES [GAMMA] FISSION [CODES] Contacts Introduction Nuclear Levels Segment Retrieval of Discrete Levels Discrete Levels and Decay Data (Updated on September 2020) Atomic number (Z) **Cumulative Plot** Compilation of nuclear level schemes extracted from the Mass number (A) ENSDF including additional information retrieved from retrieve reset Atomic number (Z) NUBASE. Missing spins were inferred uniquely from spin distributions constructed using the available spins up to Mass number (A) the highest known level. Missing Internal Conversion Discrete Levels Coefficients (ICC) were calculated using inferred or Max Excitation Energy auto MeV available spins. Decays other than electromagnetic are in the GNASH Format given if available. plot README File (2020) README File (2015) README Atomic number (Z) reset File (2002) Mass number (A) Click here to download all LEVELS files retrieve reset Level Parameters (analysis of level schemes) Retrieval of Level Parameters Cut-off energies (Umax) for completeness of level schemes and completeness of spins (U_c) for a Atomic number (Z) given level scheme as determined from the constant temperature fit of nuclear levels. Parameters

for colculation of nuclear lovel densities (nuclear temperature "back shift" and onin out off) and Mass num

NSDD Analysis & Utility software



ENSDF Analysis and Utility Programs

The Brookhaven National Nuclear Data Center maintains and distributes various programs in support of the International Atomic Energy Agency sponsored Nuclear Structure and Decay Data Network. These programs generally use as input files in the Evaluated Nuclear Structur Data File (ENSDF) format.^[1]

The tab '**Test and Validation**' contains new codes which are in beta versions or still under development and require further testing by the users. Bugs or other problems should be sent to the code developers at the email address indicated.

List of modifications:

Please address any issue regarding this page to nds.contact-point@iaea.org Last updating: 3 February 2021.

Disseminate

Collect

Analysis Utility Testing/Validation PNPI Codes NSDFLIB SETMDC

ENSDF Analysis Programs

When present, documentation is included in the compressed files

#	Program	Version/Last Change	Notes	ANSI	Linux	Windows	MacOS
1	ALPHAD Calculates alpha HF's and theoretical half-lives.	12 Nov 2020	r ₀ paper		compressed file with makefile	compressed file with executable	compressed file with makefile
2	ALPHAD-RadD ALPHAD extension, calculates radius parameter	12 Nov 2020	r ₀ paper		Compressed file with source, NSDFLIB95, and makefile	Compressed file with executable, source, NSDFLIB95, and makefile	Compressed file with source, NSDFLIB95, and makefile
3	BrIcc Calculates the conversion electron, electron-positron pair conversion coeffcients and the E0 electronic factors		2020-08-17		Compressed file	Self-extracting archive	Compressed file

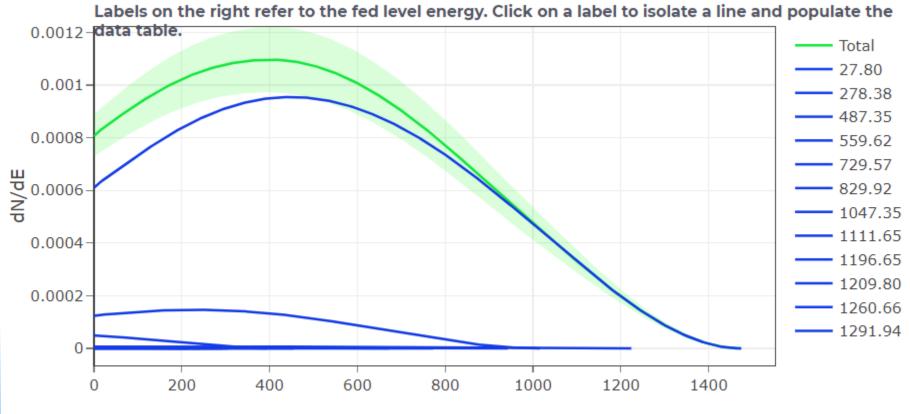
Livechart development



- Users' requests mainly related to decay data
- β^+ and β^- spectra
- B+/EC : splitting γ intensities
- X-ray intensities from each $\boldsymbol{\gamma}$
- High Maintenance task
- Code for atomic radiations calculation

β^+ and β^- spectra





Energy [keV]

X-ray intensities from each y



Λ	X-rays fro	om each γ trans	sition		
#	E [keV]	l(abs) [%]	Line	γ Energy [keV]	α _{shell}
1	6.960	0.214 6	L3-M1	105.3589	
2	7.844	0.479 14	L3-M4	105.3589	
3	7.899	0.479 14	L3-M5	105.3589	
4	8.138	0.097 3	L2-M1	105.3589	
5	6.960 - 9.557	5.84 16	L3	105.3589	0.072 5
6	8.906	0.307 10	L1-M2	105.3589	
7	9.022	3.54 11	L2-M4	105.3589	
8	9.022	4.22 12	L3-N1	105.3589	
9	6.960 - 11.268	11.8 <i>5</i>	L	105.3589	0.555 11
10	9.162	0.399 73	L1-M3	105.3589	
11	9.335 - 9.347	0.0514 15	L3-N45	105.3589	
12	8.138 - 10.735	4.35 12	L ₂	105.3589	0.108 6
13	9.496	0.87 <i>3</i>	L3-01	105.3589	

B+/EC disentanglement of γ intensities medical radioisotopes scouting



Evaluation: J.H. KELLEY, C.G.SHEU AND J.L. GODWIN, ET AL. Publication cut-off: 31-Mar-

Parent	T _{1/2}	E _x [keV]	Jp order	Decay	Q _{decay} note on Q value	Daughter	¢
¹⁰ ₆	19.290 s <i>12</i>	0.0	0+	ec β+ 100 %	3648.06 7	10 5 5	

C	Gamma	⊥Csv					
#	E _γ [keV]	l _y (abs) [%]	l _γ (abs) β ⁺ [%]	Initial level [keV]	Jπ	Final level [keV]	Jπ
1	718.353 <i>19</i>	100 <i>0</i>	99.967 <i>3</i>	718.380 77]+	0.0	3+
2	1021.646 14	1.4615 <i>19</i>	1.4571 <i>19</i>	1740.05 4	0+	718.380]+



replacing RADLST, no more maintained

Calculates intensities of

Code for atomic radiation

- X rays
- Conversion electrons
- Auger electrons (K and L shells)



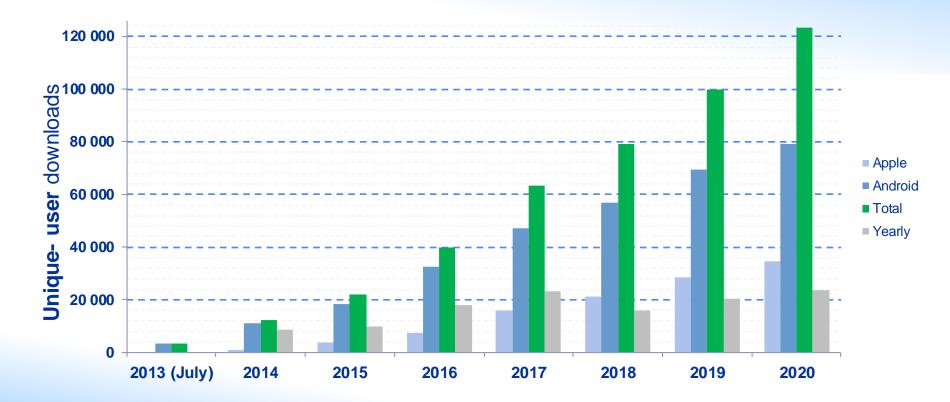


• Parts of the GUI need redesign

Need to keep up with the evolving Web technologies

Isotope Browser statistics





13 releases in 2019



~ 30% my initiative~ 70% users' requests & bugs

REVIEWS

Review policy and info







- Produces more feedback & requests than I can consume
- Technology is changing very fast
- The work has to be done for 2 Operating Systems

Other support to users' needs



- Place & maintain various datasets on the Web
 e.g. Nuclear Moments, Thermal n CS, Atomic Masses
- Extract and filter data with ad hoc criteria e.g. Logft review project, Atomic masses with covariance error matrix

Plans for the future

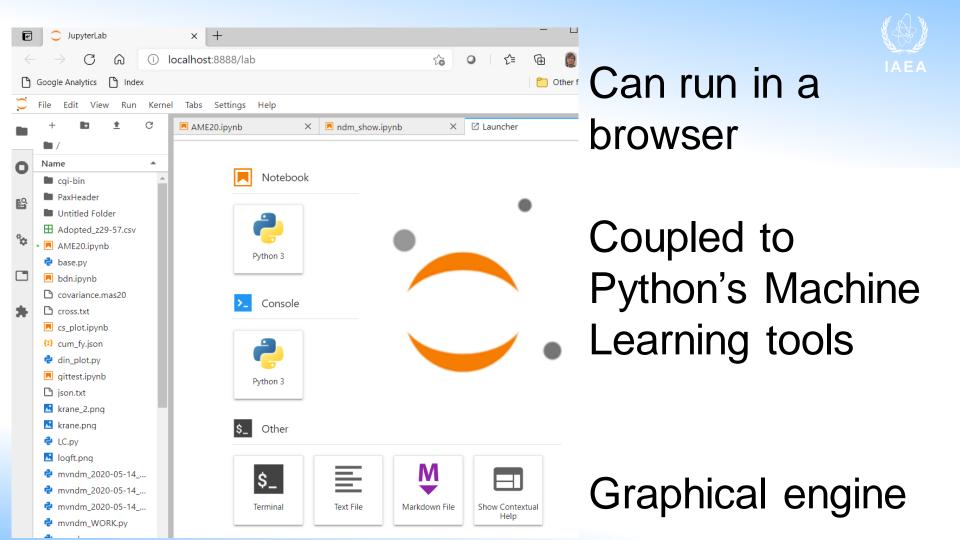
As before:

- CRPs support
- Livechart, Isotope Browser, ...
- Structure & Decay data needs

(e.g covariance matrix for AME2020)



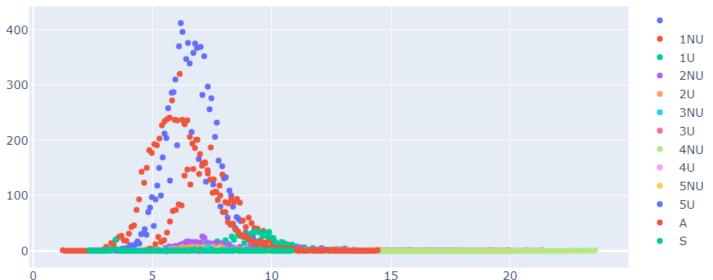
A bit more ambitious : from Visualization to Interaction (started with β spectra, Medical Isotope Browser) **Pocket Nuclear Database:** Data structure Tool for extraction & manipulation Visualization & Interaction



Logft vs Transition type

[]: # THIS EXTRACTS THE DATA
fields = "DECAY_RADIATION.B_TRANS_TYPE, DECAY_RADIATION.B_LOGFT_NUM"
ans = [pd.DataFrame(y) for x, y in build_df(fields), as_index=False)]

#THIS IS JUST PLOTTING fig = go.Figure() for a in ans: ct = pd.cut(a[a.columns[1]], bins=125) tst = ct.apply(lambda x: x.mid).value_counts(sort=False) fig.add_trace(go.Scatter(x=tst.index.values, y = tst) fig.show()





Thank you!

