^{147}La β^- decay   **1989Ro20**

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	N. Nica and B. Singh	NDS 181, 1 (2022)	9-Mar-2022

Parent: ^{147}La: E=0.0; J^π=(5/2$^+$); $T_{1/2}$=4.06 s *4*; Q(β^-)=5336 *14*; %β^- decay=100.0

^{147}La-E,J^π,$T_{1/2}$: from ^{147}La Adopted Levels.

^{147}La-Q(β^-): From 2021Wa16.

1989Ro20: n$_{th}$-induced ^{235}U fission products analyzed with Tristan ISOL isotope separator at BNL with thermoionization source and moving tape collector. Used two Ge(Li) and two Ge. Measured γ, $\gamma\gamma$, $\gamma\gamma$t. Supersedes 1988RoZN, 1987RoZW, 1987RoZM.

1987ScZG, 1981ScZM: fission products analyzed with ISOL systems Lohengrin and Ostis (ILL Grenoble), and Josef (K.F.A Julich). Measured γ, $\gamma\gamma$, $\gamma\gamma$t, $\beta\gamma$t. Measured conversion electrons and mixing ratios (K/L ratio).

1981ShZH: n-induced ^{235}U fission products analyzed with Tristan ISOL isotope separator at BNL with thermoionization source and moving tape collector. Measured $T_{1/2}$ at SOLIS facility with γ-x HPGe detector and 2π plastic scintillator; measured $\gamma\gamma$ with two Ge(Li) detectors.

1984So18: measured ratio of count rates of a γ ray relative to a reference γ ray (with known %Iγ) relative to the β^- decay of the parent) using mass separators (Helios, Ostis) and Ge(Li) detectors at radioactive equilibrium.

Others: 1983Re11, 1982To16, 1979Bo26, 1976ScZR, 1975Pi03, 1974ClZX, 1974Ar25, 1973SeYW.

Level scheme is from 1989Ro20.

^{147}Ce Levels

Reduced χ^2=8.3 is greater than critical χ^2=1.7. This comes from the discrepancy between the γ's measured with curved crystal spectrometer, and the other γ's in this dataset.

E(level)[†]	J^π[‡]	$T_{1/2}$[‡]	Comments
0.0	(5/2$^-$)	56.4 s *10*	%β^-=100
			%β^-: from Adopted Levels.
117.711 *6*	(7/2$^-$)		
186.340 *7*	(5/2$^-$,7/2$^-$)	0.4 ns	
215.354 *16*	(3/2$^-$,5/2$^-$,7/2$^-$)		
273.72 *5*	(3/2$^-$,5/2$^-$,7/2$^-$)		
332.68 *6*	(5/2$^-$,7/2$^-$)		
353.215 *25*	(5/2$^-$,7/2$^-$)		
359.2?[#]			
401.110 *17*	(9/2$^+$)		
402.44 *5*			
432.83 *7*			
438.18 *3*	(5/2$^+$,7/2$^+$)		
495.08 *5*			
505.41 *4*			
517.02 *4*			
558.6?[#]			
597.82 *5*			
608.54 *7*			
625.34 *5*			
673.1?[#]			
676.94 *6*			
710.46 *4*			
769.75 *10*			
786.01 *5*			
831.44 *5*			
907.30 *8*			
921.11 *10*			
924.32 *11*			

^{147}La β^- decay   **1989Ro20** (continued)

^{147}Ce Levels (continued)

† From least-squares fit to Eγ's.
‡ From Adopted Levels.
# Level not observed by 1989Ro20.

β^- radiations

Q(β^-)$\approx$5.3 MeV and the highest level at $\approx$0.9 MeV indicate that the level scheme is incomplete. However based on the existing data, Σ%I$\beta\approx$100 *14*, which indicates that the level scheme is rather complete, although the value of unc makes this statement less certain. For both reasons although the calculated figures for Iβ and log *ft* look rather precise they can be considered higher and lower limits, respectively. Consequently these data should be used rather cautiously; new studies are needed for ^{147}La β^- decay.

E(decay)	E(level)	I$\beta^{-\dagger}$	Log *ft*	Comments
(4412 *14*)	924.32	0.11 *4*	7.75 *16*	av Eβ=1883.2 *66*
(4415 *14*)	921.11	0.20 *4*	7.49 *9*	av Eβ=1884.7 *66*
(4429 *14*)	907.30	0.11 *6*	7.76 *24*	av Eβ=1891.1 *66*
(4505 *14*)	831.44	1.46 *22*	6.66 *7*	av Eβ=1926.5 *66*
(4550 *14*)	786.01	3.8 *7*	6.27 *8*	av Eβ=1947.7 *66*
(4566 *14*)	769.75	0.60 *9*	7.08 *7*	av Eβ=1955.3 *66*
(4626 *14*)	710.46	2.1 *3*	6.56 *7*	av Eβ=1983.0 *66*
(4659 *14*)	676.94	0.49 *9*	7.20 *8*	av Eβ=1998.7 *66*
(4711 *14*)	625.34	2.0 *3*	6.61 *7*	av Eβ=2022.8 *66*
(4727 *14*)	608.54	0.68 *16*	7.09 *11*	av Eβ=2030.7 *66*
(4738 *14*)	597.82	2.5 *4*	6.53 *7*	av Eβ=2035.7 *66*
(4819 *14*)	517.02	6.3 *9*	6.16 *7*	av Eβ=2073.4 *66*
(4831 *14*)	505.41	2.3 *4*	6.60 *8*	av Eβ=2078.8 *66*
(4841 *14*)	495.08	1.9 *3*	6.68 *7*	av Eβ=2083.7 *66*
(4898 *14*)	438.18	7.4 *11*	6.12 *7*	av Eβ=2110.3 *66*
(4903 *14*)	432.83	1.15 *19*	6.93 *8*	av Eβ=2112.8 *66*
(4934 *14*)	402.44	3.0 *11*	6.52 *16*	av Eβ=2127.0 *66*
(4935 *14*)	401.110	4.2 *6*	6.38 *7*	av Eβ=2127.6 *66*
				log *ft* value from (5/2$^+$) of 147La parent is rather unfit for (9/2$^+$) adopted by the three high-spin datasets (^{252}Cf SF decay, ^{248}Cm SF decay, and ^{238}U(^{12}C,Fγ)).
(4977 *14*)	359.2?			
(4983 *14*)	353.215	6.1 *9*	6.23 *7*	av Eβ=2150.0 *66*
(5003 *14*)	332.68	4.1 *8*	6.41 *9*	av Eβ=2159.6 *66*
(5062 *14*)	273.72	2.8 *9*	6.60 *14*	av Eβ=2187.1 *66*
(5121 *14*)	215.354	0.6 *5*	7.3 *4*	av Eβ=2214.4 *66*
(5150 *14*)	186.340	8.3 *13*	6.16 *7*	av Eβ=2228.0 *66*
(5218 *14*)	117.711	11.2 *17*	6.06 *7*	av Eβ=2260.1 *66*
(5336 *14*)	0.0	27 *11*	5.72 *18*	av Eβ=2315.1 *66*

† Absolute intensity per 100 decays.

^{147}La β^- decay   **1989Ro20** (continued)

$\gamma(^{147}\text{Ce})$

Iγ normalization: absolute photon intensities were calculated from the absolute intensity %Iγ(117.7γ in ^{147}Ce)=18.3 *25*, based on %Iγ(315γ in ^{147}Pr β^-
   decay)=18.2 *18* (the value listed here for %Iγ(117.7γ) was recalculated by evaluator from %Iγ(117.7γ)=12.7 *12* from 1984So18 and %Iγ(315γ)=12.6 used by
   1984So18 – see ^{147}Pr β^- in ^{147}Nd datasets for discussion on %Iγ(315γ in ^{147}Pr β^- decay)).

E_γ[#]	I_γ[#@e]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[&]	δ[‡&]	α[†]	Comments
58.7[cf]	3	273.72	$(3/2^-,5/2^-,7/2^-)$	215.354	$(3/2^-,5/2^-,7/2^-)$	M1		5.51	%Iγ=0.54 α(K)=4.69 *7*; α(L)=0.647 *9*; α(M)=0.1354 *19* α(N)=0.0300 *5*; α(O)=0.00486 *7*; α(P)=0.000364 *5* γ not observed by 1989Ro20.
69.09[d] 8	3.8 *5*	186.340	$(5/2^-,7/2^-)$	117.711	$(7/2^-)$	(M1)		3.43	%Iγ=0.68 *14* α(K)=2.92 *5*; α(L)=0.402 *6*; α(M)=0.0842 *13* α(N)=0.0187 *3*; α(O)=0.00302 *5*; α(P)=0.000227 *4*
97.4[af] 3	5.0 *25*	215.354	$(3/2^-,5/2^-,7/2^-)$	117.711	$(7/2^-)$	[M1,E2]		1.8 *5*	%Iγ=0.9 *5* α(K)=1.20 *12*; α(L)=0.44 *30*; α(M)=0.098 *67* α(N)=0.021 *15*; α(O)=0.0030 *20*; α(P)=7.7×10^{-5} *8* γ not observed by 1989Ro20 (e.g. in coincidence with 118, while the weaker 69γ was observed).
117.718[b] 6	100	117.711	$(7/2^-)$	0.0	$(5/2^-)$	M1+E2	1.1	0.966	%Iγ=18 α(K)=0.694 *10*; α(L)=0.213 *3*; α(M)=0.0469 *7* α(N)=0.01014 *15*; α(O)=0.001479 *21*; α(P)=4.45×10^{-5} *7*
118[cf]		332.68	$(5/2^-,7/2^-)$	215.354	$(3/2^-,5/2^-,7/2^-)$	[M1,E2]		0.94 *20*	α(K)=0.68 *6*; α(L)=0.20 *12*; α(M)=0.044 *26* α(N)=0.0095 *56*; α(O)=0.00139 *75*; α(P)=4.5×10^{-5} *5* γ not observed by 1989Ro20.
141.8 2	1.2 *3*	495.08		353.215	$(5/2^-,7/2^-)$				%Iγ=0.22 *7*
152.3 1	0.9 *4*	505.41		353.215	$(5/2^-,7/2^-)$				%Iγ=0.16 *8*
155.86[cf]	1	558.6?		402.44					%Iγ=0.18 γ not observed by 1989Ro20.
156.10 7	5.1 *6*	273.72	$(3/2^-,5/2^-,7/2^-)$	117.711	$(7/2^-)$				%Iγ=0.92 *18*
[x]156.7 1	<1								%Iγ=0.09 *9*
159.2 2	5.3 *6*	597.82		438.18	$(5/2^+,7/2^+)$				%Iγ=0.95 *18*
170.2 2	<1	608.54		438.18	$(5/2^+,7/2^+)$				%Iγ=0.09 *9*
[x]175.1[a] 3									
184.4 1	4 *1*	517.02		332.68	$(5/2^-,7/2^-)$				%Iγ=0.72 *21*
186.320[b] 7	54 *1*	186.340	$(5/2^-,7/2^-)$	0.0	$(5/2^-)$	E2		0.234	%Iγ=9.7 *15* α(K)=0.1748 *25*; α(L)=0.0463 *7*; α(M)=0.01012 *15* α(N)=0.00219 *3*; α(O)=0.000322 *5*; α(P)=1.058×10^{-5} *15*
207.5 1	0.2 *5*	608.54		401.110	$(9/2^+)$				%Iγ=0.04 +*9*−*4*

^{147}La β^- decay   **1989Ro20 (continued)**

$\gamma(^{147}\text{Ce})$ (continued)

E_γ[#]	I_γ[#@e]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[&]	$\alpha^\dagger$	Comments
^{x}211.9^a 3								
215.0 1	23 2	332.68	(5/2$^-$,7/2$^-$)	117.711	(7/2$^-$)	M1+E2	0.142 3	%Iγ=4.1 8
								α(K)=0.115 5; α(L)=0.021 5; α(M)=0.0045 12
								α(N)=0.00099 25; α(O)=0.00015 4; α(P)=8.1×10^{-6} 12
215.3 3	4.4 8	402.44		186.340	(5/2$^-$,7/2$^-$)			%Iγ=0.79 19
215.418^{bd} 17	29 2	215.354	(3/2$^-$,5/2$^-$,7/2$^-$)	0.0	(5/2$^-$)	E2	0.1432	%Iγ=5.2 9
								α(K)=0.1101 16; α(L)=0.0261 4; α(M)=0.00567 8
								α(N)=0.001229 18; α(O)=0.000183 3; α(P)=6.86×10^{-6} 10
217.6 1	3.2 3	432.83		215.354	(3/2$^-$,5/2$^-$,7/2$^-$)			%Iγ=0.57 11
^{x}225.0 1	3.4 1							%Iγ=0.61 10
225.5^{cf}	2	558.6?		332.68	(5/2$^-$,7/2$^-$)			%Iγ=0.36
								γ not observed by 1989Ro20.
235.55 5	20.6 1	353.215	(5/2$^-$,7/2$^-$)	117.711	(7/2$^-$)	M1+E2	0.1080 22	%Iγ=3.7 6
								α(K)=0.088 6; α(L)=0.016 3; α(M)=0.0033 7
								α(N)=0.00073 15; α(O)=0.000112 18; α(P)=6.2×10^{-6} 10
246.39 9	3.1 5	432.83		186.340	(5/2$^-$,7/2$^-$)			%Iγ=0.56 13
^{x}254.3^a 3								
^{x}272.47 3	0.5 1							%Iγ=0.090 23
272.5^{cf}	1	673.1?		401.110	(9/2$^+$)			%Iγ=0.18
								γ not placed by 1989Ro20.
273.8 1	19 4	273.72	(3/2$^-$,5/2$^-$,7/2$^-$)	0.0	(5/2$^-$)			%Iγ=3.4 9
279.9 1	3.9 8	495.08		215.354	(3/2$^-$,5/2$^-$,7/2$^-$)			%Iγ=0.70 18
283.400^b 16	23 1	401.110	(9/2$^+$)	117.711	(7/2$^-$)	E1	0.01442	%Iγ=4.1 7
								α(K)=0.01238 18; α(L)=0.001620 23; α(M)=0.000337 5
								α(N)=7.42×10^{-5} 11; α(O)=1.185×10^{-5} 17;
								α(P)=8.36×10^{-7} 12
								Mult.: from Adopted Levels; 1981ScZM (this dataset)
								adopt M1+E2.
290.06 8	2.2 1	505.41		215.354	(3/2$^-$,5/2$^-$,7/2$^-$)			%Iγ=0.39 7
292.9 2	2.2 1	625.34		332.68	(5/2$^-$,7/2$^-$)			%Iγ=0.39 7
308.56 7	2.8 3	495.08		186.340	(5/2$^-$,7/2$^-$)			%Iγ=0.50 10
318.69^d 8	3.9 5	505.41		186.340	(5/2$^-$,7/2$^-$)			%Iγ=0.70 14
320.47 6	4.6 9	438.18	(5/2$^+$,7/2$^+$)	117.711	(7/2$^-$)			%Iγ=0.83 21
332.8 1	4.8 7	332.68	(5/2$^-$,7/2$^-$)	0.0	(5/2$^-$)			%Iγ=0.86 18
334.8 1	3.0 4	608.54		273.72	(3/2$^-$,5/2$^-$,7/2$^-$)			%Iγ=0.54 11
353.22 3	15 1	353.215	(5/2$^-$,7/2$^-$)	0.0	(5/2$^-$)			%Iγ=2.7 5
359.2^{cf}	4	359.2?		0.0	(5/2$^-$)			%Iγ=0.72
								γ not observed by 1989Ro20.
377.49 8	2.3 1	495.08		117.711	(7/2$^-$)			%Iγ=0.41 7
382.629^{bd} 47	1.8 2	597.82		215.354	(3/2$^-$,5/2$^-$,7/2$^-$)			%Iγ=0.32 6
387.94^d 7	4.8 2	505.41		117.711	(7/2$^-$)			%Iγ=0.86 14

¹⁴⁷**La** β[−] **decay** **1989Ro20 (continued)**

γ(¹⁴⁷Ce) (continued)

E$_\gamma$#	I$_\gamma$#@e	E$_i$(level)	J$_i^\pi$	E$_f$	J$_f^\pi$	Mult.&	α†	Comments
393.6^{af} 3	3.1 15	831.44		438.18	(5/2$^+$,7/2$^+$)			%Iγ=0.6 3
								γ not observed by 1989Ro20.
399.33 5	20.3 1	517.02		117.711	(7/2$^-$)			%Iγ=3.6 6
402.46 5	12 5	402.44		0.0	(5/2$^-$)			%Iγ=2.2 10
^{x}410.5^a 3								
410.9^d 1	5.7 5	597.82		186.340	(5/2$^-$,7/2$^-$)			%Iγ=1.02 18
416.5 1	0.6 1	769.75		353.215	(5/2$^-$,7/2$^-$)			%Iγ=0.108 25
432.95 9	1.2 3	786.01		353.215	(5/2$^-$,7/2$^-$)			%Iγ=0.22 7
437.2 2	2.7 1	769.75		332.68	(5/2$^-$,7/2$^-$)			%Iγ=0.48 8
438.17 3	42 2	438.18	(5/2$^+$,7/2$^+$)	0.0	(5/2$^-$)	E1	0.00488	%Iγ=7.5 12
								α(K)=0.00420 6; α(L)=0.000540 8; α(M)=0.0001121 16
								α(N)=2.48×10^{-5} 4; α(O)=3.98×10^{-6} 6; α(P)=2.91×10^{-7} 4
461.8 1	1.1 2	676.94		215.354	(3/2$^-$,5/2$^-$,7/2$^-$)			%Iγ=0.20 5
469.1 1	<1	907.30		438.18	(5/2$^+$,7/2$^+$)			%Iγ=0.09 9
^{x}474.5^a 3								
480.0 2	0.8 4	597.82		117.711	(7/2$^-$)			%Iγ=0.14 8
490.52 6	1.6 2	676.94		186.340	(5/2$^-$,7/2$^-$)			%Iγ=0.29 6
495.17 3	8.1 5	710.46		215.354	(3/2$^-$,5/2$^-$,7/2$^-$)			%Iγ=1.45 24
505.5^c	1	505.41		0.0	(5/2$^-$)			%Iγ=0.18
								γ not observed by 1989Ro20.
506.2 1	0.1 1	907.30		401.110	(9/2$^+$)			%Iγ=0.018 18
507.61 5	8.5 1	625.34		117.711	(7/2$^-$)			%Iγ=1.53 24
516.99 5	10.3 7	517.02		0.0	(5/2$^-$)			%Iγ=1.8 3
520.0 1	0.2 1	921.11		401.110	(9/2$^+$)			%Iγ=0.036 19
523.55^d 9	3.2 3	710.46		186.340	(5/2$^-$,7/2$^-$)			%Iγ=0.57 11
557.79 5	4.8 4	831.44		273.72	(3/2$^-$,5/2$^-$,7/2$^-$)			%Iγ=0.86 15
570.75 6	9.5 7	786.01		215.354	(3/2$^-$,5/2$^-$,7/2$^-$)			%Iγ=1.7 3
571.1 1	0.6 2	924.32		353.215	(5/2$^-$,7/2$^-$)			%Iγ=0.11 4
599.2^d 1	10 2	786.01		186.340	(5/2$^-$,7/2$^-$)			%Iγ=1.8 5
^{x}601.8 1	5 2							%Iγ=0.9 4
^{x}602.9^a 3								
644.99 6	3.2 3	831.44		186.340	(5/2$^-$,7/2$^-$)			%Iγ=0.57 11
647.4 3	0.9 1	921.11		273.72	(3/2$^-$,5/2$^-$,7/2$^-$)			%Iγ=0.16 3
^{x}649.1^a 3								
^{x}674.66 5	3.8 1							%Iγ=0.68 11
^{x}706.7^a 3								
709.8^{cf}	2	710.46		0.0	(5/2$^-$)			%Iγ=0.36
								γ not observed by 1989Ro20.
^{x}713.1 1	0.7 2							%Iγ=0.13 4

$\gamma(^{147}\text{Ce})$ (continued)

† Additional information 1.

‡ Additional information 2.

From 1989Ro20, except where noted.

@ Intensities are relative to 100 for I(118γ). For Iγ's given with no unc in the table no unc for %Iγ was adopted.

& From γ, ce and K/L measurements (1981ScZM − no data given), except where noted. These values are those adopted in the Adopted Levels, Gammas dataset.

a From 1987ScZG.

b From 1979Bo26 (measurements with curved crystal spectrometers).

c From 1981ScZM.

d Differ by 3 σ or more from calculated value.

e For absolute intensity per 100 decays, multiply by 0.183 *25*.

f Placement of transition in the level scheme is uncertain.

x γ ray not placed in level scheme.

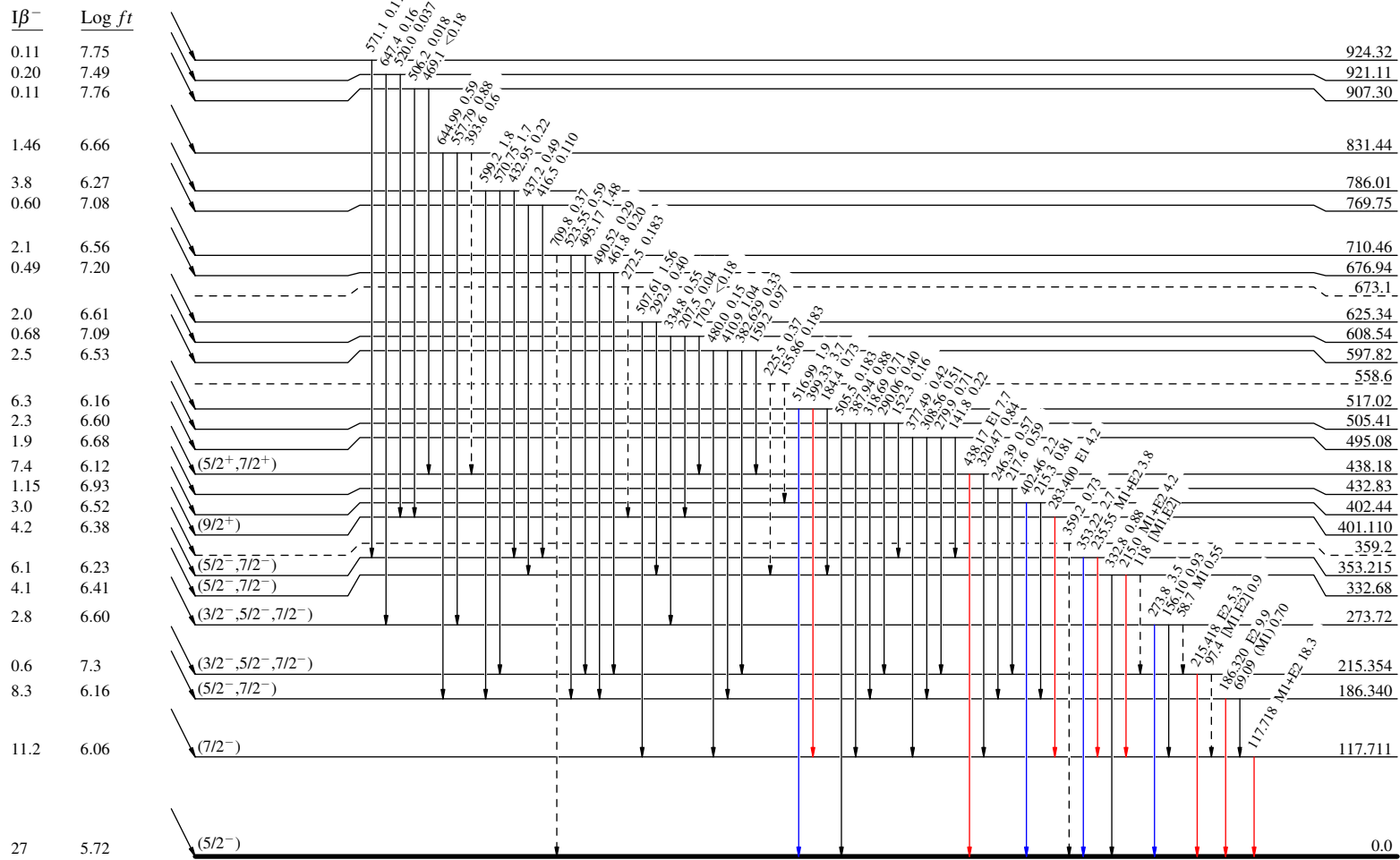## ^{147}La β^- decay   1989Ro20

Decay Scheme

Intensities: I_γ per 100 parent decays

Legend

→ $I_\gamma < 2\% \times I_\gamma^{max}$
→ $I_\gamma < 10\% \times I_\gamma^{max}$
→ $I_\gamma > 10\% \times I_\gamma^{max}$
→ γ Decay (Uncertain)

$(5/2^+)$ 0.0 4.06 s 4

Q_{β^-}=5336 14 $\%\beta^-$=100.0

$^{147}_{57}La_{90}$

From ENSDF

$I\beta^-$	Log ft		level
0.11	7.75		924.32
0.20	7.49		921.11
0.11	7.76		907.30
1.46	6.66		831.44
3.8	6.27		786.01
0.60	7.08		769.75
2.1	6.56		710.46
0.49	7.20		676.94
			673.1
2.0	6.61		625.34
0.68	7.09		608.54
2.5	6.53		597.82
			558.6
6.3	6.16		517.02
2.3	6.60		505.41
1.9	6.68		495.08
7.4	6.12	$(5/2^+,7/2^+)$	438.18
1.15	6.93		432.83
3.0	6.52		402.44
4.2	6.38	$(9/2^+)$	401.110
			359.2
6.1	6.23	$(5/2^-,7/2^-)$	353.215
4.1	6.41	$(5/2^-,7/2^-)$	332.68
2.8	6.60	$(3/2^-,5/2^-,7/2^-)$	273.72
0.6	7.3	$(3/2^-,5/2^-,7/2^-)$	215.354
8.3	6.16	$(5/2^-,7/2^-)$	186.340
11.2	6.06	$(7/2^-)$	117.711
27	5.72	$(5/2^-)$	0.0

186.340   0.4 ns

0.0   56.4 s 10

$^{147}_{58}Ce_{89}$

Gamma transitions (energy, intensity):
571.1 0.11; 647.4 0.16; 520.0 0.037; 506.2 0.018; 469.1 <0.18;
644.99 0.59; 557.79 0.88; 393.6 0.6;
599.2 1.8; 570.75 1.7; 432.95 0.22; 437.2 0.49; 416.5 0.110;
709.8 0.37; 523.55 0.59; 495.17 1.48; 490.52 0.29; 461.8 0.20; 272.5 0.183;
50.61 1.56; 292.9 0.40; 334.8 0.55; 207.5 0.04; 170.2 <0.18; 480.0 0.15; 410.9 1.04; 392.69 0.33; 139.2 0.97;
225.5 0.37; 155.86 0.183;
516.99 1.9; 399.33 3.7; 184.4 0.73; 505.5 0.183; 397.94 0.88; 318.69 0.71; 290.06 0.40; 152.3 0.16; 377.49 0.42; 308.56 0.51; 299.9 0.71; 141.8 0.22;
438.17 E1 7.7; 320.47 0.84; 246.39 0.57; 217.6 0.59; 402.46 2.2; 215.3 0.81; 283.400 E1 4.2;
359.2 0.73; 353.22 2.7; 235.55 M1+E2 1; 332.8 0.88; 215.0 M1+E2 1;
118 [M1,E2];
273.8 3.5; 136.10 0.93; 58.7 M1 0.55;
215.418 E2 5.3; 97.4 [M1,E2] 0.9;
186.330 E2 9.9; 69.09 [M1] 0.70;
117.718 M1+E2 18.3