^{81}Y ε+β^+ decay (70.4 s) 1985Li12

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	M. Shamsuzzoha Basunia	NDS 199,271 (2025)	1-Sep-2024

Parent: ^{81}Y: E=0; J$^\pi$=(5/2$^+$); T$_{1/2}$=70.4 s *11*; Q(ε)=5815 *6*; %ε+%β^+ decay=100

^{81}Y-Q(ε): from 2021Wa16.

Others: 1981Li12, 1982De36, 1993Mi11, 2005Ka39.

1985Li12: source from ^{58}Ni(^{28}Si,αp) at E(^{28}Si)=95 MeV, alternating 120-s bombardment and 180-s counting cycles, Ge(Li); measured Eγ, Iγ(t). Data from 1981Li12 reappraised.

1982De36: ^{81}Y from ^{32}S induced reactions on ^{54}Fe, ^{58}Ni and ^{50}Cr, E=100-160 MeV, β recoil tof of mass spectrometer, plastic scin, Ge(Li), x-ray detector.

1981Li12: heavy ion reactions, measured with Ge(Li), intrinsic germanium, plastic detectors.

The adopted decay scheme is essentially that of 1985Li12 and differs fundamentally from that of 1982De36. It relies heavily on tentative J^π assignments to Sr excited states deduced from (α,xnγ) data.

^{81}Sr Levels

E(level)†	J$^\pi$‡	T$_{1/2}$‡	Comments
0	1/2$^-$	22.3 min *4*	T$_{1/2}$: from Adopted Levels.
79.20 *4*	(5/2)$^-$	0.39 μs *6*	T$_{1/2}$: weighted average of 0.326 μs *55* (1982De36 − from τ=470 ns *80*) and 0.370 μs *85* (1985Li12,1981Li12).
89.02 *7*	(7/2$^+$)	6.4 μs *5*	
119.76 *4*	(1/2$^+$)	24 ns *4*	
132.3	(9/2$^+$)	<9 ns	Reported in 1993Mi11 only.
155.20 *10*	3/2$^-$	74 ps *20*	
203.36 *5*	(5/2$^+$)	1.1 ns *3*	T$_{1/2}$: from τ <5 ns (1982De36); Other: <7 ns (1981Li12).
220.81 *7*	3/2$^{(+)}$	0.63 ns *20*	
336.20 *9*	(5/2$^+$)	0.16 ns *5*	
611.58 *8*	(7/2$^+$)	<7 ns	T$_{1/2}$: from 1981Li12. Based on electronic time resolution (408γ and 511γ observed to be in prompt coincidence).

† From a least-squares fit to Eγ.
‡ From Adopted Levels.

ε,β^+ radiations

1982De36 report endpoint energy of 4520 *227* for T$_{1/2}$=70 s β^+ from A=81 β-recoil nuclei. They attribute this to g.s. feeding, but ΔE is too big to preclude attribution to excited states up to ≈200 keV. It was, presumably, feeding the 203 level that was observed.

εK, εL, εM, εN: Additional information 1.
av Eβ: Additional information 2.

E(decay)	E(level)	Iβ^+ #	Iε#	Log *ft*	I($\varepsilon+\beta^+$)†#	Comments
(5203 *6*)	611.58	≈15.0	≈0.4	≈5.7	≈15.4	av Eβ=1908.0 *29*; εK=0.02165 *45*; εL=0.00257 *5*; εM+=5.81×10^{-4} *10* E(decay): other: 4723 *135* from Eβ(max)=3701 *135* (408γ-β^+ coin, 1981Li12).
(5479 *6*)	336.20	≈2.7	≈0.1	≈6.6	≈2.8	av Eβ=2039.6 *29*; εK=0.01804 *37*; εL=0.002140 *44*; εM+=4.84×10^{-4} *9*
(5594 *6*)	220.81	≈4.5	≈0.1	≈6.4	≈4.6	av Eβ=2094.6 *29*; εK=0.01676 *34*; εL=0.001988 *41*; εM+=4.49×10^{-4} *8*
(5612 *6*)	203.36	≈32.1	≈0.6	≈5.6	≈32.7	av Eβ=2103.2 *29*; εK=0.01658 *34*; εL=0.001967 *40*;

Continued on next page (footnotes at end of table)

^{81}Y $\varepsilon+\beta^+$ decay (70.4 s) 1985Li12 (continued)

ϵ,β^+ radiations (continued)

E(decay)	E(level)	Iβ^+ [#]	Iε [#]	Log *ft*	I($\varepsilon+\beta^+$) [†#]	Comments
						εM+=4.45×10^{-4} *8* E(decay): other: 5358 *74* from Eβ(max)=4336 *74*: weighted average of Eβ(max)=4235 *112* (1981Li12) and 4479 *128*, 4320 *146* (1982De36); from 124γ-β^+ coin.
(5660 *6*)	155.20	≈3.2	≈0.1	≈6.6	≈3.3	av Eβ=2126.2 *29*; εK=0.01609 *33*; εL=0.001909 *39*; εM+=4.32×10^{-4} *8*
(5695 *6*)	119.76	≈4.2	≈0.2	≈8.2	≈4.4	av Eβ=2142.1 *28*; εK=0.0348 *7*; εL=0.00415 *8*; εM+=9.39×10^{-4} *16*
(5726 *6*)	89.02	≤36.3	≤0.7	≥5.6	≤37[‡]	av Eβ=2157.8 *29*; εK=0.01545 *31*; εL=0.001833 *37*; εM+=4.15×10^{-4} *7* I($\varepsilon+\beta^+$): upper limit from transition intensity balance of 18 *19*.
(5736 *6*)	79.20	≤35.4	≤0.6	≥5.6	≤36[‡]	av Eβ=2162.5 *29*; εK=0.01536 *31*; εL=0.001822 *37*; εM+=4.13×10^{-4} *7* I($\varepsilon+\beta^+$): upper limit from transition intensity balance of 17 *19*.
(5815[@] *6*)	0	≤2.5	≤0.1	≥8.5^{1u}	≤2.6	av Eβ=2198.6 *28*; εK=0.0322 *6*; εL=0.00384 *8*; εM+=8.70×10^{-4} *15*

† From transition intensity balance at each level, except where otherwise noted.

‡ Because the 89 level to 79 level transition is unobserved, only $\varepsilon+\beta^+$ branching (≈36.5%) to this pair of levels can be deduced. However, if J^π(^{81}Y g.s.)=5/2$^+$, most of the feeding would be expected to go to the (7/2$^+$) 89 level. Decay to a level would be allowed (log *ft*≤5.9) if I($\varepsilon+\beta^+$)≥16.5%, so an expected I($\varepsilon+\beta^+$) would be ≤16.5% to the 79 level and rest expected to feed the 89 level. In the dataset the upper-limits are listed for these two levels.

Absolute intensity per 100 decays.

@ Existence of this branch is questionable.

γ(^{81}Sr)

Iγ normalization: if Σ(I(γ+ce) to g.s.)=98.7% *13* (i.e., assuming g.s. branch <2.6%, which follows if log $f^{1u}t$>8.5). Note: absolute Iγ determined by 1982De36 from (total Iγ/total β^+ recoils) implies Iγ normalization=0.011 *1* (97% g.s. branch); the reason for this major discrepancy is not understood. The decay scheme normalization is consequently tentative (see also comments on adopted J^π for ^{81}Y g.s.) and approximate.

E_γ[†]	I_γ[†&]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[‡]	δ[‡]	α[@]	$I_{(\gamma+ce)}$[&]	Comments
(9.82)		89.02	(7/2$^+$)	79.20	(5/2)$^-$	[E1]		10.24 *14*	62 *50*	ce(L)/(γ+ce)=0.772 *6*; ce(M)/(γ+ce)=0.1254 *22* ce(N)/(γ+ce)=0.01332 *25*; ce(O)/(γ+ce)=0.000456 *9* α(L)=8.68 *12*; α(M)=1.410 *20* α(N)=0.1498 *21*; α(O)=0.00513 *7* E_γ: 9.82 *8* from level energy difference; transition not observed. $I_{(\gamma+ce)}$: from intensity imbalance at 79 and 89 levels, respectively, I(γ+ce)≤109 *3* and ≥12.7 *4* (assuming mult(114γ)=M1 and I(γ+ce)(43γ) negligible). Note that α(k)(exp)(43γ)=1.5 *3* (2005Ka39) implies I(γ+ce)(43γ) is not negligible. An estimated value I(γ+ce)(43γ)=228 does not yield a satisfactory intensity balance to resolve the beta feeding as of the footnote. Measurement of Iγ(43) is needed.
43.3		132.3	(9/2$^+$)	89.02	(7/2$^+$)	M1+E2	−0.08 *3*	1.87 *11*		α(K)exp=1.5 *3* (2005Ka39) α(K)=1.62 *8*; α(L)=0.210 *28*; α(M)=0.035 *5* α(N)=0.0043 *5*; α(O)=0.000245 *9* E_γ: from level energy difference in 1993Mi11. Mult.,δ: from Adopted Gammas. α(K)exp=1.5 *3* (2005Ka39; measured relative to α(K)exp(79.2γ)). This implies mult=M1(+E2) with δ≤0.14, consistent with adopted value. Additional information 3.
79.20 *4*	66.5 *4*	79.20	(5/2)$^-$	0	1/2$^-$	E2		2.386 *34*		%Iγ≈24.7 α(K)=1.953 *28*; α(L)=0.364 *5*; α(M)=0.0615 *9* α(N)=0.00697 *10*; α(O)=0.0002410 *34* E_γ: weighted average of 79.23 *4* (1985Li12) and 79.17 *4* (1982De36). I_γ: other: 82 *1* (relative to Iγ(124)=100) and 0.91% *25* (1982De36 – %Iγ appears to be erroneous). Mult.: from α(K)exp=2.3 *6* ((K x ray)-γ coin, 1982De36) which implies δ(E2,M1)>2.4.
101.05 *5*	7.4 *4*	220.81	3/2$^{(+)}$	119.76	(1/2$^+$)	M1+E2	−0.5 *2*	0.32 *10*		%Iγ≈2.75 α(K)=0.28 *8*; α(L)=0.039 *14*; α(M)=0.0066 *23* α(N)=7.8×10^{-4} *26*; α(O)=3.8×10^{-5} *10*

γ(^{81}Sr) (continued)

E$_\gamma$ †	I$_\gamma$ †&	E$_i$(level)	J$^\pi_i$	E$_f$	J$^\pi_f$	Mult.‡	δ‡	α@	Comments
114.34 *4*	11.4 *3*	203.36	(5/2$^+$)	89.02	(7/2$^+$)	[M1]		0.1122 *16*	%Iγ≈4.23 α(K)=0.0988 *14*; α(L)=0.01125 *16*; α(M)=0.001895 *27* α(N)=0.0002369 *33*; α(O)=1.509×10^{-5} *21*
115.39 *6*	5.7 *5*	336.20	(5/2$^+$)	220.81	3/2$^{(+)}$	(M1+E2)	−0.2 *1*	0.128 *22*	%Iγ≈2.12 α(K)=0.112 *18*; α(L)=0.0135 *29*; α(M)=0.0023 *5* α(N)=0.00028 *6*; α(O)=1.67×10^{-5} *23*
119.76 *4*	21.5 *17*	119.76	(1/2$^+$)	0	1/2$^-$	(E1)		0.0597 *8*	%Iγ≈8.0 α(K)=0.0528 *7*; α(L)=0.00582 *8*; α(M)=0.000970 *14* α(N)=0.0001195 *17*; α(O)=7.22×10^{-6} *10*
124.16 *3*	110.7 *9*	203.36	(5/2$^+$)	79.20	(5/2)$^-$	(E1)		0.0537 *8*	%Iγ≈41.1 α(K)=0.0475 *7*; α(L)=0.00523 *7*; α(M)=0.000872 *12* α(N)=0.0001075 *15*; α(O)=6.51×10^{-6} *9* E$_\gamma$: other: 124.17 *4* (1982De36). I$_\gamma$: other: 100 (relative) and 1.1% *1* (1982De36 – %Iγ appears to be erroneous).
155.20 *10*	8.5 *10*	155.20	3/2$^-$	0	1/2$^-$	(M1+E2)	+0.1 *1*	0.051 *4*	%Iγ≈3.2 α(K)=0.045 *4*; α(L)=0.0051 *5*; α(M)=0.00086 *9* α(N)=0.000107 *11*; α(O)=6.8×10^{-6} *5*
216.6	<2.2	336.20	(5/2$^+$)	119.76	(1/2$^+$)	(E2)		0.0606 *8*	%Iγ<0.816 α(K)=0.0527 *7*; α(L)=0.00663 *9*; α(M)=0.001114 *16* α(N)=0.0001346 *19*; α(O)=7.29×10^{-6} *10* E$_\gamma$,I$_\gamma$: γ not observed by 1985Li12; Eγ is from level energy difference in 1993Mi11, Iγ is limit from 1985Li12.
221#	9 *5*	220.81	3/2$^{(+)}$	0	1/2$^-$	(E1)		0.01002 *14*	%Iγ≈3.3 α(K)=0.00887 *12*; α(L)=0.000967 *14*; α(M)=0.0001617 *23* α(N)=2.011×10^{-5} *28*; α(O)=1.260×10^{-6} *18*
408.22 *8*	41.2 *10*	611.58	(7/2$^+$)	203.36	(5/2$^+$)	(M1)		0.00424 *6*	%Iγ≈15.3 α(K)=0.00375 *5*; α(L)=0.000412 *6*; α(M)=6.92×10^{-5} *10* α(N)=8.69×10^{-6} *12*; α(O)=5.66×10^{-7} *8* E$_\gamma$: weighted average of 408.18 *6* (1982De36) and 408.36 *11* (1985Li12). I$_\gamma$: other: 35 *6* (relative to Iγ(124)=100) and 0.4% *1* (1982De36 – %Iγ appears to be erroneous).
479.3		611.58	(7/2$^+$)	132.3	(9/2$^+$)				E$_\gamma$: from level energy difference in 1993Mi11. Weak transition.

† From 1985Li12, except as noted. Data for the 3 gammas in 1982De36, listed in comments, are in agreement, except for Iγ(79).

‡ From Adopted Gammas, except as noted.

Unresolved from much stronger 221γ from ^{83}Zr ε decay. Decay time of multiplet indicates that most of the intensity comes from the A=83 chain (1985Li12).

@ Additional information 4.

& For absolute intensity per 100 decays, multiply by ≈0.371.

^{81}Y ε decay (70.4 s) 1985Li12