^{81}Y ε decay 1985Li12

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Coral M. Baglin	NDS 109, 2257 (2008)	15-Aug-2008

Parent: ^{81}Y: E=0; J^π=(5/2$^+$); $T_{1/2}$=70.4 s *10*; Q(ε)=5819 *9*; %ε+%β^+ decay=100.0

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^π‡	$T_{1/2}$	Comments
0	1/2$^-$	22.3 min *4*	$T_{1/2}$: from Adopted Levels.
79.23 *4*	(5/2)$^-$	0.34 μs *5*	$T_{1/2}$: weighted average of 326 ns *55* (1982De36) and 370 ns *85* (1985Li12).
89.05 *7*	(7/2$^+$)		
119.76 *4*	(1/2$^+$)		
132.3	(9/2$^+$)		Reported in 1993Mi11 only.
155.20 *10*	(3/2$^-$)		
203.39 *5*	(3/2$^+$,5/2$^+$,7/2$^+$)	<3.5 ns	$T_{1/2}$: from 1982De36; other: <7 ns (1981Li12).
220.81 *7*	(3/2$^+$)		
336.20 *9*	(5/2$^+$)		
611.57 *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 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 α=81 β-recoil nuclei. They attribute this to g.s. feeding, but ΔE is too great to preclude attribution to excited states up to ≈ 200 keV. it was, presumably, feeding to the 203 level that was observed.

E(decay)	E(level)	Iβ^+ #	Iε#	Log *ft*†	I(ε+β^+)#	Comments
4.72×10^3 *14*	611.57	15.0 *7*	0.366 *17*	5.693 *22*	15.4 *7*	av Eβ=1920.5 *44*; εK=0.02083 *13*; εL=0.002432 *16*; εM+=0.000530 *4* E(decay): from Eβ(max)=3701 *135* (408γ-β^+ coin, 1981Li12).
(5483 *9*)	336.20	2.7 *4*	0.055 *8*	6.56 *7*	2.8 *4*	av Eβ=2053.0 *44*; εK=0.01731 *11*; εL=0.002020 *12*; εM+=0.000440 *3*
(5598 *9*)	220.81	4.5 *20*	0.08 *4*	6.39 *19*	4.6 *20*	av Eβ=2108.6 *44*; εK=0.01608 *10*; εL=0.001876 *11*; εM+=0.0004087 *2*
5358 *74*	203.39	32.1 *12*	0.594 *23*	5.550 *18*	32.7 *12*	av Eβ=2117.0 *44*; εK=0.01590 *9*; εL=0.001855 *11*; εM+=0.0004042 *2* E(decay): from weighted average of Eβ(max)=4235 *112* (1981Li12) and 4479 *128*, 4320 *146* (1982De36); from 124γ-β^+ coin.

Continued on next page (footnotes at end of table)

^{81}Y ε decay 1985Li12 (continued)

ϵ,β^+ radiations (continued)

E(decay)	E(level)	$I\beta^+$ [#]	$I\varepsilon$ [#]	Log *ft* [†]	$I(\varepsilon+\beta^+)$ [#]	Comments
(5664 *9*)	155.20	3.2 *4*	0.058 *7*	6.57 *6*	3.3 *4*	av Eβ=2140.3 *44*; εK=0.01542 *9*; εL=0.001799 *11*; εM+=0.0003921 *2*
(5699 *9*)	119.76	4.3 *8*	0.076 *14*	6.46 *8*	4.4 *8*	av Eβ=2157.4 *44*; εK=0.01508 *9*; εL=0.001760 *10*; εM+=0.0003835 *2* Log *ft*: far too low for a ΔJ=2, Δπ=No transition.
(5730 *9*)	89.05	≤35	≤0.61	≥5.6	≤36 [‡]	av Eβ=2172.2 *44*; εK=0.01480 *9*; εL=0.001727 *10*; εM+=0.0003762 *2*
(5740 *9*)	79.23	≤35	≤0.60	≥5.6	≤36 [‡]	av Eβ=2177.0 *44*; εK=0.01471 *9*; εL=0.001716 *10*; εM+=0.0003740 *2*
(5819 [@] *9*)	0	≤2.5	≤0.091	≥8.5 [1u]	≤2.6	av Eβ=2217.1 *43*; εK=0.03079 *18*; εL=0.003611 *21*; εM+=0.000787 *5*

† Calculated using Q=5819 *9* from mass measurement by 2006Ka48. note that this value is significantly higher than Q=5510 *60* (2003Au03) based on earlier β endpoint data.

‡ Because the 89 level to 79 level transition is unobserved, only $\varepsilon+\beta^+$ branching (=35.6% 12) 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 either level would be allowed (log *ft*≤5.9) if $I(\varepsilon+\beta^+)\geq16.5\%$, so the evaluator suggests $I(\varepsilon+\beta^+)$=8% 8 feeds the 79 level leaving $I(\varepsilon+\beta^+)$=28% 8 (log *ft*=5.67 *13*) to feed the 89 level.

\# 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$^\pi$ for ^{81}Y g.s.).

E_γ †	I_γ †@	E_i(level)	J^π_i	E_f	J^π_f	Mult. ‡	δ ‡	α &	$I_{(\gamma+ce)}$ @	Comments
(9.82)		89.05	(7/2$^+$)	79.23	(5/2)$^-$	(E1)		10.24	62 *50*	ce(L)/(γ+ce)=0.772 *6*; ce(M)/(γ+ce)=0.1254 *22*; ce(N+)/(γ+ce)=0.0138 *3* ce(N)/(γ+ce)=0.0133 *3*; ce(O)/(γ+ce)=0.000456 *9* $I_{(\gamma+ce)}$: from intensity imbalance at 79 and 89 levels, respectively, I(γ+ce)≤109.5 *17* and≥12.7 *4* (assuming mult(114γ)=M1 and Ti(43γ) negligible). E_γ: 9.82 *8* from level energy difference; transition not observed.
43.2		132.3	(9/2$^+$)	89.05	(7/2$^+$)	M1+E2	−0.08 *3*	1.89 *12*		α(K)=1.64 *8*; α(L)=0.21 *3*; α(M)=0.036 *5*; α(N+..)=0.0046 *6* α(N)=0.0043 *5*; α(O)=0.000246 *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.
79.23 *4*	66.5 *4*	79.23	(5/2)$^-$	0	1/2$^-$	(E2)		2.38		α(K)=1.95 *3*; α(L)=0.364 *6*; α(M)=0.0614 *9*; α(N+..)=0.00720 *11* α(N)=0.00696 *10*; α(O)=0.000241 *4* Mult.: from α(K)exp=2.3 *6* ((K x ray)-γ coin, 1982De36) which implies δ(E2,M1)>2.4. Eγ=79.17 *4*, Iγ=90.8 *11* in 1982De36.
101.05 *5*	7.4 *4*	220.81	(3/2$^+$)	119.76	(1/2$^+$)	M1+E2	−0.5 *+2−0*	0.32 *10*		α(K)=0.28 *8*; α(L)=0.039 *14*; α(M)=0.0066 *24*; α(N+..)=0.0008 *3* α(N)=0.0008 *3*; α(O)=3.8×10^{-5} *10*
114.34 *4*	11.4 *3*	203.39	(3/2$^+$,5/2$^+$,7/2$^+$)	89.05	(7/2$^+$)	[M1]		0.1122		α(K)=0.0988 *14*; α(L)=0.01125 *16*; α(M)=0.00190 *3*; α(N+..)=0.000252 *4* α(N)=0.000237 *4*; α(O)=1.509×10^{-5} *22*
115.39 *6*	5.7 *5*	336.20	(5/2$^+$)	220.81	(3/2$^+$)	(M1+E2)	−0.2 *1*	0.128 *22*		α(K)=0.112 *19*; α(L)=0.014 *3*; α(M)=0.0023 *5*; α(N+..)=0.00030 *6* 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		α(K)=0.0528 *8*; α(L)=0.00582 *9*;

From ENSDF

$^{81}_{38}$Sr$_{43}$-3

$\gamma(^{81}$Sr) (continued)

E_γ[†]	I_γ[†@]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[‡]	δ[‡]	α[&]	Comments
									α(M)=0.000970 *14*; α(N+..)=0.0001268 *18* α(N)=0.0001195 *17*; α(O)=7.22×10^{-6} *11*
124.16 *3*	110.7 *9*	203.39	(3/2$^+$,5/2$^+$,7/2$^+$)	79.23	(5/2)$^-$	(E1)		0.0537	α(K)=0.0475 *7*; α(L)=0.00523 *8*; α(M)=0.000872 *13*; α(N+..)=0.0001140 *16* α(N)=0.0001075 *15*; α(O)=6.51×10^{-6} *10* Other Eγ: 124.17 *4* (1982De36).
155.20 *10*	8.5 *10*	155.20	(3/2$^-$)	0	1/2$^-$	(M1+E2)	+0.1 *1*	0.051 *5*	α(K)=0.045 *4*; α(L)=0.0051 *6*; α(M)=0.00086 *10*; α(N+..)=0.000114 *12* 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	α(K)=0.0527 *8*; α(L)=0.00663 *10*; α(M)=0.001114 *16*; α(N+..)=0.0001419 *20* α(N)=0.0001346 *19*; α(O)=7.29×10^{-6} *11* E_γ,I_γ: 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	α(K)=0.00887 *13*; α(L)=0.000967 *14*; α(M)=0.0001617 *23*; α(N+..)=2.14×10^{-5} *3* α(N)=2.01×10^{-5} *3*; α(O)=1.260×10^{-6} *18*
408.18 *6*	41.2 *10*	611.57	(7/2$^+$)	203.39	(3/2$^+$,5/2$^+$,7/2$^+$)	(M1)		0.00424	α(K)=0.00375 *6*; α(L)=0.000412 *6*; α(M)=6.92×10^{-5} *10*; α(N+..)=9.26×10^{-6} *13* α(N)=8.70×10^{-6} *13*; α(O)=5.67×10^{-7} *8* Eγ from 1982De36; 408.36 *11* in 1985Li12. Iγ=39 *7* (1982De36).
479.3		611.57	(7/2$^+$)	132.3	(9/2$^+$)				E_γ: from level energy difference in 1993Mi11. Weak transition.

† From 1985Li12, except as noted. Data for the 3 gammas in 1982De36 agree closely with these, 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 intensity comes from the α=83 chain (1985Li12).
@ For absolute intensity per 100 decays, multiply by 0.372 *12*.
& Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

$^{81}_{38}$Sr$_{43}$-4

^{81}Y ε decay 1985Li12