^{91}Sr β^- decay 1977Ho12,1973Ha11,1969Kn01

History			
Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Coral M. Baglin	NDS 114, 1293 (2013)	1-Sep-2013

Parent: ^{91}Sr: E=0.0; $J^\pi=5/2^+$; $T_{1/2}$=9.65 h *6*; Q(β^-)=2699 *5*; %β^- decay=100.0

Others: 1953Am08, 1980De02, 1983Ia02, 2001Na43 (750γ and 1024γ only).

1977Ho12:Ge(Li), FWHM=2 to 3 keV at 1333; NaI(Tl); measured Eγ, Iγ, $\gamma\gamma$ coin, $\gamma\gamma(\theta)$, conversion electron spectra (Si(Li) detector).

973Ha11: measured β^- spectrum, conversion electrons with magnetic spectrometer.

^{91}Y Levels

The decay scheme is from 1977Ho12. A very doubtful level near 2379 keV, deexcited by tentative 2378.6γ, 1453γ and 1073.3γ, was suggested in 1977Ho12 but not included in their decay scheme, so it is not adopted here. Note that decay scheme appears to be incomplete, since Q × Branching=2699 *5* cf. total energy release of 2346 *47* based on decay scheme.

E(level)†	J^π‡	$T_{1/2}$‡	E(level)†	J^π‡
0	$1/2^-$	58.51 d *6*	1579.94 *7*	$5/2^+$,$7/2^+$
555.58 *5*	$9/2^+$	49.71 min *4*	1980.41 *7*	$(5/2)^-$
653.02 *7*	$3/2^-$		2066.62 *7*	$(5/2)^+$
925.74 *7*	$5/2^-$		2129.09 *12*	3/2,5/2,7/2
1186.88 *6*	$(7/2)^-$		2206.76 *9*	$5/2^-$
1305.39 *6*	$(5/2)^+$		2279.34 *10*	$(5/2^+,7/2^-)$
1473.69 *7*	$3/2^-$		2412.15 *12*	$(3/2^-)$
1545.90 *6*	$(5/2)^-$		2572.13? *12*	$(5/2^+,7/2,9/2^-)$

† From least-squares fit to Eγ.

‡ From Adopted Levels.

β^- radiations

E(decay)†	E(level)	Iβ^-‡	Log *ft*	Comments
(127 *5*)	2572.13?	≤0.047	≥6.1	av Eβ=33.9 *15* Additional information 1.
(287 *5*)	2412.15	0.016 *4*	7.70 *12*	av Eβ=83.0 *17*
(420 *5*)	2279.34	0.238 *11*	7.08 *3*	av Eβ=128.2 *18*
(492 *5*)	2206.76	1.48 *5*	6.519 *22*	av Eβ=154.2 *19*
(570 *5*)	2129.09	0.067 *4*	8.08 *3*	av Eβ=182.9 *19*
610 *20*	2066.62	2.08 *7*	6.751 *20*	av Eβ=206.7 *20* Other Iβ: 7.2% from Kurie plot analysis (1953Am08).
(719 *5*)	1980.41	0.372 *13*	7.696 *19*	av Eβ=240.2 *20*
1093 *10*	1579.94	34.8 *12*	6.437 *17*	av Eβ=405.3 *22* Other Iβ: 33.1% from Kurie plot analysis (1953Am08).
(1153 *5*)	1545.90	1.83 *7*	7.766 *19*	av Eβ=419.8 *22*
(1225 *5*)	1473.69	0.191 *10*	8.848 *24*	av Eβ=451.0 *22*
1359 *10*	1305.39	25.1 *9*	6.947 *17*	av Eβ=524.6 *22* Other Iβ: 29.2% from Kurie plot analysis (1953Am08).
(1512 *5*)	1186.88	0.65 *3*	8.673 *21*	av Eβ=577.2 *23*
2030 *20*	653.02	3.4 *4*	8.48 *6*	av Eβ=819.8 *23* Other Iβ: 4.1% from Kurie plot analysis (1953Am08).
(2143# *5*)	555.58			Iβ^-: the apparent intensity imbalance of 1.1% 4 is presumably due to statistical fluctuations and an underestimation of the uncertainty in Iγ(556γ).
2705 *8*	0	28.6 *22*	9.37[1u] *4*	av Eβ=1128.2 *24*

Continued on next page (footnotes at end of table)

^{91}Sr β^- decay 1977Ho12,1973Ha11,1969Kn01 (continued)

β^- radiations (continued)

E(decay)†	E(level)	Comments
		Spectrum shape is first-forbidden unique (1953Am08). E(decay): from 1980De02. Others: 2665 *10* (1953Am08), 2684 *4* (1973Ha11), 2709 *15* (1983Ia02). Iβ^-: unweighted average of 30.8% (1973Ha11) and 26.4% (1953Am08), from Kurie plot analyses; authors do not state uncertainty.

† From Kurie plot analysis of β^- spectrum (1953Am08), except as noted.
‡ Absolute intensity per 100 decays.
# Existence of this branch is questionable.

^{91}Sr β^- decay 1977Ho12,1973Ha11,1969Kn01 (continued)

$\gamma(^{91}Y)$

Iγ normalization: From Σ (I(γ+ce) to g.s.)=100−Iβ(g.s.) assuming Iβ(g.s.)=28.6 *22* (unweighted average of 30.8 (1973Ha11) and 26.4 (1953Am08), from Kurie plot analyses) and Iγ(556)=184 *1* (1977Ho12) in transient equilibrium.
E(α,β,D) From 1969Kn01. These values are used by 1977Ho12 as secondary standards.

E_γ[‡]	I_γ[#b]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[@]	δ	α[†]	Comments
118.5 *2*	0.22 *1*	1305.39	(5/2)$^+$	1186.88	(7/2)$^-$	[E1]		0.0653	α(K)=0.0577 *9*; α(L)=0.00642 *10*; α(M)=0.001089 *17*; α(N+..)=0.0001531 *23* α(N)=0.0001439 *22*; α(O)=9.23×10^{-6} *14*
261.2 *2*	1.34 *2*	1186.88	(7/2)$^-$	925.74	5/2$^-$				
272.6 *6*	0.78 *11*	925.74	5/2$^-$	653.02	3/2$^-$	[M1,E2]		0.021 *8*	α(K)=0.018 *7*; α(L)=0.0022 *9*; α(M)=0.00037 *16*; α(N+..)=5.2×10^{-5} *21* α(N)=4.9×10^{-5} *20*; α(O)=3.0×10^{-6} *11* α(K)exp=0.0126 *10* for the 272.6γ + 274.7γ doublet (weighted average of 0.015 *4* (1977Ho12) and 0.0125 *10* (1973Ha11)).
274.7 *2*	3.09 *8*	1579.94	5/2$^+$,7/2$^+$	1305.39	(5/2)$^+$	(M1)		0.01245	α(K)=0.01098 *16*; α(L)=0.001230 *18*; α(M)=0.000210 *3*; α(N+..)=3.02×10^{-5} *5* α(N)=2.83×10^{-5} *4*; α(O)=1.96×10^{-6} *3* α(K)exp=0.0126 *10* for the 272.6γ+274.7γ doublet dominated by this transition (weighted average of 0.015 *4* (1977Ho12) and 0.0125 *10* (1973Ha11)). Mult.: if 272.6γ is M1,E2 as deduced from level scheme.
359.1 *1*	0.15 *1*	1545.90	(5/2)$^-$	1186.88	(7/2)$^-$				
379.9 *1*	0.44 *1*	1305.39	(5/2)$^+$	925.74	5/2$^-$				
393.0 *1*	0.15 *1*	1579.94	5/2$^+$,7/2$^+$	1186.88	(7/2)$^-$				
486.5 *2*	0.24 *1*	2066.62	(5/2)$^+$	1579.94	5/2$^+$,7/2$^+$				
506.7 *1*	0.13 *1*	1980.41	(5/2)$^-$	1473.69	3/2$^-$				
520.8 *3*	0.10 *1*	2066.62	(5/2)$^+$	1545.90	(5/2)$^-$				
533.9 *1*	0.23 *1*	1186.88	(7/2)$^-$	653.02	3/2$^-$				
555.57 *5*		555.58	9/2$^+$	0	1/2$^-$	M4		0.0531	α(K)exp=0.0462 *23*; α(exp)=0.0534 *27* (1973Ha11) α(K)=0.0457 *7*; α(L)=0.00616 *9*; α(M)=0.001070 *15*; α(N+..)=0.0001506 *21* α(N)=0.0001416 *20*; α(O)=8.95×10^{-6} *13* Iγ: 184 *1* in transient equilibrium (1977Ho12). Other α(K)exp: 0.042 *3* (1977Ho12), 0.046 *2* (1953Am08). K/(L+M)=6.00 (1953Am08).
593.1 *1*	0.28 *1*	2066.62	(5/2)$^+$	1473.69	3/2$^-$				
620.1 *1*	5.3 *1*	1545.90	(5/2)$^-$	925.74	5/2$^-$	M1(+E2)[a]	≤2.1[a]	0.00190 *15*	α(K)exp=0.0030 *16* (1977Ho12) α=0.00190 *15*; α(K)=0.00168 *13*; α(L)=0.000187 *16*; α(M)=3.2×10^{-5} *3*; α(N+..)=4.6×10^{-6} *4* α(N)=4.3×10^{-6} *4*; α(O)=2.94×10^{-7} *19*
626.8 *1*	0.13 *1*	2206.76	5/2$^-$	1579.94	5/2$^+$,7/2$^+$				

$^{91}_{39}Y_{52}$-3

^{91}Sr β^- decay 1977Ho12,1973Ha11,1969Kn01 (continued)

$\gamma(^{91}Y)$ (continued)

E_γ‡	I_γ#b	E_i(level)	J_i^π	E_f	J_f^π	Mult.@	α†	Comments
631.3 *1*	1.66 *3*	1186.88	$(7/2)^-$	555.58	$9/2^+$			
652.3& *3*	8.9& *5*	1305.39	$(5/2)^+$	653.02	$3/2^-$			α(K)exp=0.00192 *15* for the triplet (1973Ha11).
652.9& *2*	24& *1*	653.02	$3/2^-$	0	$1/2^-$			α(K)exp=0.00192 *15* for the triplet (1973Ha11).
653& *2*	1.1& *4*	1579.94	$5/2^+,7/2^+$	925.74	$5/2^-$			α(K)exp=0.00192 *15* for the triplet (1973Ha11).
660.9 *1*	0.30 *1*	2206.76	$5/2^-$	1545.90	$(5/2)^-$			
749.8 *1*	70.7 *5*	1305.39	$(5/2)^+$	555.58	$9/2^+$	(E2)	0.001262 *18*	α(K)exp=0.00096 *10* α=0.001262 *18*; α(K)=0.001114 *16*; α(L)=0.0001245 *18*; α(M)=2.12×10^{-5} *3*; α(N+..)=3.04×10^{-6} α(N)=2.84×10^{-6} *4*; α(O)=1.93×10^{-7} *3* Mult.: M1,E2 from α(K)exp; not M1 from level scheme. α(K)exp: weighted average of 0.00088 *7* (1977Ho12) and 0.00108 *9* (1973Ha11).
761.4 *1*	1.72 *3*	2066.62	$(5/2)^+$	1305.39	$(5/2)^+$			
793.6 *1*	0.19 *1*	1980.41	$(5/2)^-$	1186.88	$(7/2)^-$			
820.8 *2*	0.48 *1*	1473.69	$3/2^-$	653.02	$3/2^-$			
823.7 *1*	0.20 *1*	2129.09	3/2,5/2,7/2	1305.39	$(5/2)^+$			
879.7 *1*	0.56 *1*	2066.62	$(5/2)^+$	1186.88	$(7/2)^-$			
892.9 *1*	0.21 *1*	1545.90	$(5/2)^-$	653.02	$3/2^-$			
901.3 *2*	0.28 *1*	2206.76	$5/2^-$	1305.39	$(5/2)^+$			
925.8 *2*	11.5 *1*	925.74	$5/2^-$	0	$1/2^-$	(E2)	0.000748 *11*	α(K)exp=0.00083 *18* α=0.000748 *11*; α(K)=0.000660 *10*; α(L)=7.29×10^{-5} *11*; α(M)=1.245×10^{-5} *18*; α(N+..)=1.78×10^{-6} α(N)=1.670×10^{-6} *24*; α(O)=1.149×10^{-7} *16* Mult.: α(K)exp implies mult=M1 or E2. M1 excluded by adopted ΔJ. α(K)exp: from 1977Ho12.
973.9 *1*	0.12 *1*	2279.34	$(5/2^+,7/2^-)$	1305.39	$(5/2)^+$			
992.2c *1*	0.13 *1*	2572.13?	$(5/2^+,7/2,9/2^-)$	1579.94	$5/2^+,7/2^+$			
1024.3 *1*	100	1579.94	$5/2^+,7/2^+$	555.58	$9/2^+$	M1,E2	0.000587 *9*	α(K)exp=0.000547 *21* α=0.000587 *9*; α(K)=0.000519 *8*; α(L)=5.67×10^{-5} *11*; α(M)=9.68×10^{-6} *18*; α(N+..)=1.394×10^{-6} *23* α(N)=1.303×10^{-6} *22*; α(O)=9.10×10^{-8} *13* α(K)exp: weighted average of 0.00052 *6* (1977Ho12) and 0.000551 *23* (1973Ha11).
1054.6 *1*	0.67 *1*	1980.41	$(5/2)^-$	925.74	$5/2^-$			
1140.8 *1*	0.38 *1*	2066.62	$(5/2)^+$	925.74	$5/2^-$			
1280.9 *5*	2.79 *3*	2206.76	$5/2^-$	925.74	$5/2^-$			
1305.3 *1*	0.05 *1*	1305.39	$(5/2)^+$	0	$1/2^-$			
1327.4 *1*	0.12 *1*	1980.41	$(5/2)^-$	653.02	$3/2^-$			
1353.5 *2*	0.07 *1*	2279.34	$(5/2^+,7/2^-)$	925.74	$5/2^-$			
1413.4 *1*	2.93 *4*	2066.62	$(5/2)^+$	653.02	$3/2^-$			
1473.8 *1*	0.50 *1*	1473.69	$3/2^-$	0	$1/2^-$			

$^{91}_{39}Y_{52}$-4

^{91}Sr β^- decay 1977Ho12,1973Ha11,1969Kn01 (continued)

$\gamma(^{91}Y)$ (continued)

E_γ ‡	I_γ #b	E_i(level)	J_i^π	E_f	J_f^π	E_γ ‡	I_γ #b	E_i(level)	J_i^π	E_f	J_f^π
1486.4 *1*	0.04 *1*	2412.15	$(3/2^-)$	925.74	$5/2^-$	1651.4 *5*	0.87 *1*	2206.76	$5/2^-$	555.58	$9/2^+$
1545.9 *1*	0.20 *1*	1545.90	$(5/2)^-$	0	$1/2^-$	1724.0 *5*	0.48 *1*	2279.34	$(5/2^+,7/2^-)$	555.58	$9/2^+$
1553.6 *3*	0.05 *1*	2206.76	$5/2^-$	653.02	$3/2^-$	2016[c] *1*	0.012 *3*	2572.13?	$(5/2^+,7/2,9/2^-)$	555.58	$9/2^+$
1626.8 *3*	0.04 *1*	2279.34	$(5/2^+,7/2^-)$	653.02	$3/2^-$	2412.3[c] *2*	0.013 *3*	2412.15	$(3/2^-)$	0	$1/2^-$
1646[c] *1*	0.009 *1*	2572.13?	$(5/2^+,7/2,9/2^-)$	925.74	$5/2^-$						

† Additional information 2.
‡ From 1977Ho12, if not indicated otherwise.
# From 1977Ho12.
@ From α(K)exp, if not indicated otherwise.
& Singles spectrum shows only one peak with Iγ=33 *2*. Data for the components of this multiplet are derived from coincidence measurements.
[a] A_2=+0.20 *2*, A_4=+0.10 *5* for 620γ-926$\gamma(\theta)$ (1977Ho12). This allows δ=+0.05 *7* and −1.81 *+23−27* for 5/2-5/2-1/2 cascade; α(K)exp is consistent with both of these solutions.
[b] For absolute intensity per 100 decays, multiply by 0.335 *11*.
[c] Placement of transition in the level scheme is uncertain.

$^{91}_{39}Y_{52}$-5

^{91}Sr β^- decay 1977Ho12,1973Ha11,1969Kn01

Decay Scheme

Intensities: $I_{(\gamma+ce)}$ 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)
- Coincidence

$^{91}_{38}Sr_{53}$

5/2+ 0.0 9.65 h 6

Q_{β^-}=2699 5 $\%\beta^-$=100

Iβ−	Log *ft*		
≤0.047	≥6.1	(5/2+,7/2,9/2−)	2572.13
0.016	7.70	(3/2−)	2412.15
0.238	7.08	(5/2+,7/2−)	2279.34
1.48	6.519	5/2−	2206.76
0.067	8.08	3/2,5/2,7/2	2129.09
2.08	6.751	(5/2)+	2066.62
0.372	7.696	(5/2)−	1980.41
34.8	6.437	5/2+,7/2+	1579.94
1.83	7.766	(5/2)−	1545.90
0.191	8.848	3/2−	1473.69
25.1	6.947	(5/2)+	1305.39
0.65	8.673	(7/2)−	1186.88
		5/2−	925.74
3.4	8.48	3/2−	653.02
		9/2+	555.58 49.71 min 4
28.6	9.37[1u]	1/2−	0 58.51 d 6

2016 0.0040; 1646 0.0034; 992.2 0.047; 2412.3 0.0044; 1486.4 0.017; 1724.0 0.164; 1626.8 0.017; 1353.5 0.027; 973.9 0.044; 1651.4 0.295; 1553.6 0.020; 1280.9 0.93; 901.3 0.097; 660.9 0.104; 626.8 0.047; 823.7 0.070; 1413.4 0.98; 1140.8 0.131; 879.7 0.191; 761.4 0.576; 593.1 0.097; 520.8 0.037; 486.5 0.084; 1327.4 0.044; 1054.6 0.228; 793.6 0.067; 506.7 0.047; 1024.3 M1,E2 33.5; 653 0.37; 393.0 0.054; 274.7 (M1) 1.05; 1545.9 0.070; 892.9 0.074; 620.1 M1(+E2) 1.78; 359.1 0.054; 1473.8 0.171; 820.8 0.164; 1305.3 0.020; 749.8 (E2) 23.7; 652.3 2.98; 379.9 0.151; 118.5 [E1] 0.079; 631.3 0.556; 533.9 0.080; 261.2 0.452; 925.8 (E2) 3.86; 272.6 [M1,E2] 0.27; 652.9 8.4; 555.57 M4

$^{91}_{39}Y_{52}$-6