^{153}Pm β^- decay 1988WiZY,1983MaYP,1995Gr19

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	N. Nica	NDS 170, 1 (2020)	16-Aug-2020

Parent: ^{153}Pm: E=0.0; J$^\pi$=5/2$^-$; T$_{1/2}$=5.25 min *2*; Q(β^-)=1912 *9*; %β^- decay=100.0

The decay scheme is from 1988WiZY with $\gamma\gamma$ coincidences data from 1983MaYP and added β branch intensities from 1995Gr19 and 1997Gr09.

1962Ko10: produced by ^{154}Sm(γ,p); report T$_{1/2}$ and 4 γ's.

1968Na21: level half-lives from $\gamma\gamma$(t).

1970SeZY: report 9 γ's.

1978PiZQ, 1979PiZP: produced from ^{235}U fission; report 20 γ's and scheme with 13 excited levels.

1983MaYP: produced from ^{252}Cf fission and chemical separation; report 32 γ's and $\gamma\gamma$ coincidences.

1988GrZY: produced by ^{252}Cf fission and isotope separation; report T$_{1/2}$.

1988WiZY: produced by ^{252}Cf fission and isotope separation; private communication, report 50 γ's.

1990An31: produced by ^{252}Cf fission and isotope separation; report T$_{1/2}$ (same group as 1988GrZY and 1988WiZY).

1990Ba57: produced from ^{252}Cf fission and chemical separation; show decay scheme (same group as 1988GrZY, 1988WiZY, and 1990An31).

1993Gr17: produced by ^{252}Cf fission and isotope separation; report Q value from β spectrum measured with Ge detector in coincidence with γ rays.

1995Gr19: produced by ^{252}Cf fission and isotope separation; measured I$_{\beta-}$ to levels below 70 keV from total absorption γ spectra.

1997Gr09: produced by ^{252}Cf fission and isotope separation; measured I$_{\beta-}$ to all levels from total absorption γ spectra.

^{153}Sm Levels

From total absorption γ (TAGS) spectra, the β- decay intensity as a function of the excitation energy has been deduced (1997Gr09) independent of the γ-ray intensity balances. These data imply β- decay to additional levels, especially above the highest level with γ decay at 630 keV.

E(level)[†]	J$^\pi$	T$_{1/2}$[‡]	Comments
0.0[@]	3/2$^+$	46.284 h *4*	J$^\pi$,T$_{1/2}$: adopted values.
7.534[@] *4*	5/2$^+$		
35.845[&] *5*	3/2$^-$	<0.1 ns	
53.538[@] *7*	7/2$^+$		
65.477[@] *21*	9/2$^+$		
90.872[&] *4*	5/2$^-$	0.52 ns *16*	
127.299[a] *4*	3/2$^-$		
174.180[&] *10*	7/2$^-$		
182.903[a] *6*	5/2$^-$	17 ns *7*	
194.6 *3*	(5/2$^+$)		
262.322 *15*	(7/2)$^+$		
265.73[a] *5*	(7/2)$^-$		
276.701 *10*	(3/2)$^+$		
321.13[b] *3*	(3/2)$^+$		
356.49[b] *6*	(5/2$^+$)		
362.21 *8*	(5/2)$^+$		
450.062 *11*	(5/2)$^-$		E(level): 2005Bu21 assigned a dominant configuration of 5/2[523] from results of their (t,p) study. The same assignment is given in 'Adopted Levels'. The earlier assignment (1998He06) as member of the 1/2[530] band is rejected.
510[#]			
630.24 *6*			
820[#]			

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^{153}Pm β^- decay 1988WiZY,1983MaYP,1995Gr19 (continued)

^{153}Sm Levels (continued)

E(level)[†]
1000[#]
1100[#]
1250[#]
1430[#]
1530[#]

[†] From least-squares fit to γ energies.

[‡] For excited levels, from $\gamma\gamma$(t) (1968Na21).

[#] Pseudolevel from TAGS data analysis.

[@] Band(A): K^π=3/2$^+$ band, 3/2[651]+3/2[402] states.

[&] Band(B): K^π=3/2$^-$ band, 3/2[521] state.

[a] Band(C): K^π=3/2$^-$ band, 3/2[532] state.

[b] Band(D): K^π=3/2$^+$ band, 3/2[402]+3/2[651] states.

β^- radiations

For the levels above 80 keV with depopulating γ's, the Iβ^- are from γ-ray intensity balances, but if the TAGS results differ significantly, they are noted in a comment. Below 80 keV, from total absorption γ (TAGS) measurement (1995Gr19, 1997Gr09), Iβ^-(0+7+35+53+65)=40% *6*, which combined with Iβ^-(35+53+65) from γ-ray intensity balances produces Iβ^-(0+7) ≈ 10% *5*; finally Iβ^-(7) is chosen to be approximately equal to Iβ^-(0), which gives total Iγ ≈ 95% *5* to g.s.

E(decay)	E(level)	Iβ^-[†]	Log *ft*	Comments
(382 *9*)	1530	0.10		av Eβ=111.6 *30*
(482 *9*)	1430	0.35		av Eβ=145.4 *32*
(662 *9*)	1250	0.54		av Eβ=209.8 *34*
(812 *9*)	1100	0.27		av Eβ=266.4 *35*
(912 *9*)	1000	0.14		av Eβ=305.4 *36*
(1092 *9*)	820	0.09		av Eβ=377.5 *37*
(1282 *9*)	630.24	0.51 *5*	6.9	av Eβ=455.9 *38* Iβ^-: The TAGS data gives 0.76%.
(1402 *9*)	510	0.33		av Eβ=506.6 *39*
(1462 *9*)	450.062	0.87 *9*	6.9	av Eβ=532.0 *39* Iβ^-: The TAGS data gives 1.2%.
(1550 *9*)	362.21	0.070 *9*	8.1	av Eβ=569.7 *39*
(1556 *9*)	356.49	0.103 *12*	7.9	av Eβ=572.1 *39* Iβ^-: The TAGS data gives 0.20%, or 0.27 for I$_{\beta-}$(356+362).
(1591 *9*)	321.13	0.122 *14*	7.9	av Eβ=587.4 *39* Iβ^-: The TAGS data gives 0.14%.
(1635 *9*)	276.701	0.45 *3*	7.3	av Eβ=606.6 *39* Iβ^-: The TAGS data gives 0.72%, or 1.67% for I$_{\beta-}$(262+265+276).
(1646 *9*)	265.73	0.05 *1*	8.3	av Eβ=611.4 *39*
(1650 *9*)	262.322	0.61 *6*	7.2	av Eβ=612.8 *39* Iβ^-: The TAGS data gives 0.95%, or 1.67% for I$_{\beta-}$(262+265+276).
(1729 *9*)	182.903	7.7 *8*	6.2	av Eβ=647.4 *40* Iβ^-: The TAGS data give 8.4%, or 9.4% for I$_{\beta-}$(174+183).
(1738 *9*)	174.180	0.8 *1*	7.2	av Eβ=651.2 *40*
(1785 *9*)	127.299	42 *6*	5.5	av Eβ=671.7 *40*
(1821 *9*)	90.872	6 *5*	6.5	av Eβ=687.7 *40*

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^{153}Pm β^- decay **1988WiZY,1983MaYP,1995Gr19 (continued)**

β^- radiations (continued)

E(decay)	E(level)	I$\beta^{-\dagger}$	Log *ft*	Comments
				Iβ^-: The TAGS data gives 6.3%.
(1858 *9*)	53.538	5 *4*	6.5	av Eβ=704.1 *40*
(1876 *9*)	35.845	24 *5*	5.8	av Eβ=711.9 *40*
(1904 *9*)	7.534	6	6.5	av Eβ=724.4 *40*
(1912 *9*)	0.0	5	6.5	av Eβ=727.7 *40*

† Absolute intensity per 100 decays.

γ(^{153}Sm)

Iγ normalization: From total Iγ ≈ 95% *5* to g.s. (see header comment on β^- radiations table).

There are a number of other γ rays reported in ^{152}Sm(n,γ) from the levels reported here, but which have not been observed in the ^{153}Pm β- decay. These γ's are generally weak and have not been included here.

$\gamma\gamma$ coincidences are from 1983MaYP.

E_γ[†]	I_γ[‡a]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ[#&]	α[@]	Comments
7.535 *5*	1.82 *27*	7.534	5/2$^+$	0.0	3/2$^+$	M1		114.6	E_γ: Calculated from γ energy differences in ^{152}Sm(n,γ). This transition was not observed directly, but its existence was inferred (1969Sm04) from L x ray intensities. I_γ: Chosen to give approximately equal β- feeding of levels at 0 and 7.5 keV.
28.321 *12*	19 *3*	35.845	3/2$^-$	7.534	5/2$^+$	E1		1.515	α(L)=1.194 *17*; α(M)=0.258 *4* α(N)=0.0560 *8*; α(O)=0.00709 *10*; α(P)=0.000240 *4*
35.853 *10*	82 *10*	35.845	3/2$^-$	0.0	3/2$^+$	E1		0.782	α(L)=0.616 *9*; α(M)=0.1328 *19* α(N)=0.0290 *4*; α(O)=0.00378 *6*; α(P)=0.0001397 *20*
36.74 *6*	1.0 *3*	127.299	3/2$^-$	90.872	5/2$^-$	M1(+E2)	≤0.73	28 *23*	α(L)=22 *18*; α(M)=5.0 *42* α(N)=1.09 *91*; α(O)=0.14 *11*; α(P)=0.00146 *23* α: α(M1)=5.0 and α(E2)=140, and intensity balance at 90-keV level suggests α < 55.
37.335 *10*	3.6 *9*	90.872	5/2$^-$	53.538	7/2$^+$	E1		0.698	α(L)=0.550 *8*; α(M)=0.1185 *17* α(N)=0.0259 *4*; α(O)=0.00339 *5*; α(P)=0.0001271 *18*
45.99 *6*	1.4 *3*	53.538	7/2$^+$	7.534	5/2$^+$	M1+E2	1.0 *+10−5*	24 *13*	α(L)=19 *10*; α(M)=4.3 *24* α(N)=0.94 *51*; α(O)=0.117 *62*; α(P)=5.7×10^{-4} *19*
53.55 *4*	0.30 *3*	53.538	7/2$^+$	0.0	3/2$^+$	E2		25.7	α(K)=3.96 *6*; α(L)=16.83 *25*; α(M)=3.93 *6* α(N)=0.857 *13*; α(O)=0.1052 *16*; α(P)=0.000207 *3*
55.031 *8*	1.27 *7*	90.872	5/2$^-$	35.845	3/2$^-$	M1(+E2)	<0.6	11.3 *18*	α(K)=7.5 *6*; α(L)=3.0 *18*; α(M)=0.67 *43* α(N)=0.148 *92*; α(O)=0.019 *12*; α(P)=0.00047 *5*
57.97 *23*	0.23 *4*	65.477	9/2$^+$	7.534	5/2$^+$	(E2)		18.6 *4*	α(K)=3.78 *6*; α(L)=11.5 *3*; α(M)=2.68 *7* α(N)=0.585 *14*; α(O)=0.0720 *17*; α(P)=0.000178 *3*
^{x}68.47 *3*	0.23 *3*								
^{x}75.29 *3*	0.30 *4*								
^{x}75.940 *17*	0.54 *4*								
83.339 *5*	11.5 *6*	90.872	5/2$^-$	7.534	5/2$^+$	E1		0.451	α(K)=0.379 *6*; α(L)=0.0571 *8*; α(M)=0.01222 *18* α(N)=0.00271 *4*; α(O)=0.000380 *6*; α(P)=1.79×10^{-5} *3*
90.870 *5*	18.2 *9*	90.872	5/2$^-$	0.0	3/2$^+$	E1		0.357	α(K)=0.301 *5*; α(L)=0.0447 *7*; α(M)=0.00957 *14* α(N)=0.00213 *3*; α(O)=0.000299 *5*; α(P)=1.436×10^{-5} *21*
91.455 *5*	10.8 *6*	127.299	3/2$^-$	35.845	3/2$^-$	M1(+E2+E0)		2.7 *6*	α(K)=1.68 *18*; α(L)=0.80 *55*; α(M)=0.18 *13* α(N)=0.041 *28*; α(O)=0.0052 *34*; α(P)=9.1×10^{-5} *28*
91.99 *5*	0.71 *12*	182.903	5/2$^-$	90.872	5/2$^-$	[M1,E2]		2.7 *6*	α(K)=1.65 *17*; α(L)=0.78 *53*; α(M)=0.18 *13* α(N)=0.040 *27*; α(O)=0.0051 *33*; α(P)=8.9×10^{-5} *27*
108.700 *19*	0.78 *5*	174.180	7/2$^-$	65.477	9/2$^+$	[E1]		0.220	α(K)=0.185 *3*; α(L)=0.0270 *4*; α(M)=0.00577 *8* α(N)=0.001288 *18*; α(O)=0.000183 *3*; α(P)=9.09×10^{-6} *13*

γ(^{153}Sm) (continued)

E$_\gamma$[†]	I$_\gamma$[‡a]	E$_i$(level)	J$^\pi_i$	E$_f$	J$^\pi_f$	Mult.[#]	α[@]	Comments
119.763 *5*	44.1 *22*	127.299	$3/2^-$	7.534	$5/2^+$	E1	0.1688	α(K)=0.1427 *20*; α(L)=0.0206 *3*; α(M)=0.00440 *7* α(N)=0.000982 *14*; α(O)=0.0001400 *20*; α(P)=7.09×10^{-6} *10*
120.74 *6*	0.29 *5*	174.180	$7/2^-$	53.538	$7/2^+$	[E1]	0.1651	α(K)=0.1396 *20*; α(L)=0.0201 *3*; α(M)=0.00430 *6* α(N)=0.000960 *14*; α(O)=0.0001369 *20*; α(P)=6.94×10^{-6} *10*
127.298 *5*	100 *5*	127.299	$3/2^-$	0.0	$3/2^+$	E1	0.1430	α(K)=0.1210 *17*; α(L)=0.01733 *25*; α(M)=0.00371 *6* α(N)=0.000828 *12*; α(O)=0.0001184 *17*; α(P)=6.06×10^{-6} *9*
129.369 *9*	6.2 *3*	182.903	$5/2^-$	53.538	$7/2^+$	E1	0.1369	α(K)=0.1158 *17*; α(L)=0.01657 *24*; α(M)=0.00354 *5* α(N)=0.000792 *11*; α(O)=0.0001132 *16*; α(P)=5.81×10^{-6} *9*
[x]133.51 *3*	0.44 *5*							
138.43[b] *5*	0.27[b] *5*	174.180	$7/2^-$	35.845	$3/2^-$	[E2]	0.736	α(K)=0.463 *7*; α(L)=0.212 *3*; α(M)=0.0486 *7* α(N)=0.01069 *15*; α(O)=0.001377 *20*; α(P)=2.11×10^{-5} *3*
138.43[b] *5*	0.27[b] *5*	265.73	$(7/2)^-$	127.299	$3/2^-$			
147.060 *9*	2.52 *14*	182.903	$5/2^-$	35.845	$3/2^-$	M1,E2	0.581 *17*	α(K)=0.43 *5*; α(L)=0.115 *48*; α(M)=0.026 *12* α(N)=0.0058 *25*; α(O)=7.8×10^{-4} *29*; α(P)=2.42×10^{-5} *64*
166.641 *10*	2.50 *14*	174.180	$7/2^-$	7.534	$5/2^+$	E1	0.0689	α(K)=0.0585 *9*; α(L)=0.00821 *12*; α(M)=0.001753 *25* α(N)=0.000393 *6*; α(O)=5.67×10^{-5} *8*; α(P)=3.03×10^{-6} *5*
171.41 *6*	0.29 *4*	262.322	$(7/2)^+$	90.872	$5/2^-$	[E1]	0.0639	α(K)=0.0542 *8*; α(L)=0.00759 *11*; α(M)=0.001622 *23* α(N)=0.000364 *6*; α(O)=5.26×10^{-5} *8*; α(P)=2.82×10^{-6} *4*
173.403 *24*	0.67 *5*	450.062	$(5/2)^-$	276.701	$(3/2)^+$	E1	0.0619	α(K)=0.0526 *8*; α(L)=0.00736 *11*; α(M)=0.001572 *22* α(N)=0.000352 *5*; α(O)=5.09×10^{-5} *8*; α(P)=2.74×10^{-6} *4*
175.370 *11*	12.3 *7*	182.903	$5/2^-$	7.534	$5/2^+$	E1	0.0601	α(K)=0.0510 *8*; α(L)=0.00713 *10*; α(M)=0.001524 *22* α(N)=0.000342 *5*; α(O)=4.94×10^{-5} *7*; α(P)=2.66×10^{-6} *4*
182.900 *8*	15.2 *8*	182.903	$5/2^-$	0.0	$3/2^+$	E1	0.0537	α(K)=0.0456 *7*; α(L)=0.00636 *9*; α(M)=0.001358 *19* α(N)=0.000304 *5*; α(O)=4.41×10^{-5} *7*; α(P)=2.39×10^{-6} *4*
194.61 *27*	0.12 *8*	194.6	$(5/2^+)$	0.0	$3/2^+$	[M1,E2]	0.244 *17*	α(K)=0.19 *3*; α(L)=0.041 *10*; α(M)=0.0091 *25* α(N)=0.00203 *53*; α(O)=0.00028 *6*; α(P)=1.10×10^{-5} *30*
196.86 *6*	0.68 *7*	262.322	$(7/2)^+$	65.477	$9/2^+$	[M1,E2]	0.236 *17*	α(K)=0.19 *3*; α(L)=0.039 *10*; α(M)=0.0087 *23* α(N)=0.00195 *49*; α(O)=0.00027 *6*; α(P)=1.07×10^{-5} *30*
208.71 *6*	0.38 *3*	262.322	$(7/2)^+$	53.538	$7/2^+$	[M1,E2]	0.198 *18*	α(K)=0.16 *3*; α(L)=0.032 *7*; α(M)=0.0071 *17* α(N)=0.0016 *4*; α(O)=0.00022 *4*; α(P)=9.1×10^{-6} *25*
223.13 *4*	0.37 *3*	276.701	$(3/2)^+$	53.538	$7/2^+$	(E2)	0.1451	α(K)=0.1072 *15*; α(L)=0.0296 *5*; α(M)=0.00667 *10* α(N)=0.001477 *21*; α(O)=0.000198 *3*; α(P)=5.44×10^{-6} *8*
254.794 *15*	1.58 *9*	262.322	$(7/2)^+$	7.534	$5/2^+$	M1,E2	0.110 *16*	α(K)=0.089 *18*; α(L)=0.0163 *15*; α(M)=0.0036 *4* α(N)=0.00080 *9*; α(O)=0.000114 *7*; α(P)=5.2×10^{-6} *15*
269.177 *11*	1.12 *7*	276.701	$(3/2)^+$	7.534	$5/2^+$	[M1,E2]	0.093 *15*	α(K)=0.076 *16*; α(L)=0.0136 *9*; α(M)=0.0030 *3* α(N)=0.00067 *5*; α(O)=9.6×10^{-5} *3*; α(P)=4.5×10^{-6} *13*
276.72 *4*	1.44 *8*	276.701	$(3/2)^+$	0.0	$3/2^+$	M1(+E2+E0)	0.086 *14*	α(K)=0.070 *15*; α(L)=0.0124 *7*; α(M)=0.00273 *20* α(N)=0.00061 *4*; α(O)=8.75×10^{-5} *17*; α(P)=4.2×10^{-6} *13*
291.11 *12*	0.12 *2*	356.49	$(5/2^+)$	65.477	$9/2^+$			
302.85 *8*	0.30 *3*	356.49	$(5/2^+)$	53.538	$7/2^+$			
321.13 *3*	0.63 *4*	321.13	$(3/2)^+$	0.0	$3/2^+$	M1	0.0675	α(K)=0.0575 *8*; α(L)=0.00794 *12*; α(M)=0.001702 *24* α(N)=0.000386 *6*; α(O)=5.80×10^{-5} *9*; α(P)=3.63×10^{-6} *5*

^{153}Pm β^- decay 1988WiZY,1983MaYP,1995Gr19 (continued)

γ(^{153}Sm) (continued)

E_γ[†]	I_γ[‡a]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[#]	α[@]	Comments
349.12 *13*	0.15 *2*	356.49	(5/2$^+$)	7.534	5/2$^+$			
354.69 *10*	0.21 *2*	362.21	(5/2)$^+$	7.534	5/2$^+$	M1	0.0520	α(K)=0.0443 *7*; α(L)=0.00610 *9*; α(M)=0.001307 *19* α(N)=0.000296 *5*; α(O)=4.45×10^{-5} *7*; α(P)=2.79×10^{-6} *4*
359.6 *4*	0.07 *3*	450.062	(5/2)$^-$	90.872	5/2$^-$			
362.20 *12*	0.16 *2*	362.21	(5/2)$^+$	0.0	3/2$^+$	M1(+E2)	0.041 *9*	α(K)=0.034 *9*; α(L)=0.0054 *4*; α(M)=0.00118 *7* α(N)=0.000265 *17*; α(O)=3.8×10^{-5} *4*; α(P)=2.02×10^{-6} *62*
396.517 *16*	1.55 *9*	450.062	(5/2)$^-$	53.538	7/2$^+$			
[x]414.26 *13*	0.40 *3*							
442.515 *16*	2.50 *13*	450.062	(5/2)$^-$	7.534	5/2$^+$			
[x]482.44 *10*	0.48 *4*							
[x]494.32 *17*	0.26 *3*							
622.71 *8*	1.13 *7*	630.24		7.534	5/2$^+$			
[x]627.84 *10*	0.44 *4*							
630.24 *8*	1.68 *9*	630.24		0.0	3/2$^+$			
[x]681.52 *15*	0.31 *4*							
[x]902.16 *15*	0.54 *4*							

[†] From 1988WiZY who made use of the precise energies from ^{152}Sm(n,γ) (1969Sm04).

[‡] From unweighted average of values of 1978PiZQ, 1983MaYP, and 1988WiZY with typical uncertainties assigned. Below 50 keV, the intensity balance at the 35-keV level and the $I_{\beta-}$ data of 1995Gr19 and 1997Gr09 were used to determine that the values of 1983MaYP were preferred.

[#] From ^{153}Sm Adopted Gammas and comments here.

[@] Additional information 1.

[&] Additional information 2.

[a] For absolute intensity per 100 decays, multiply by 0.181 *16*.

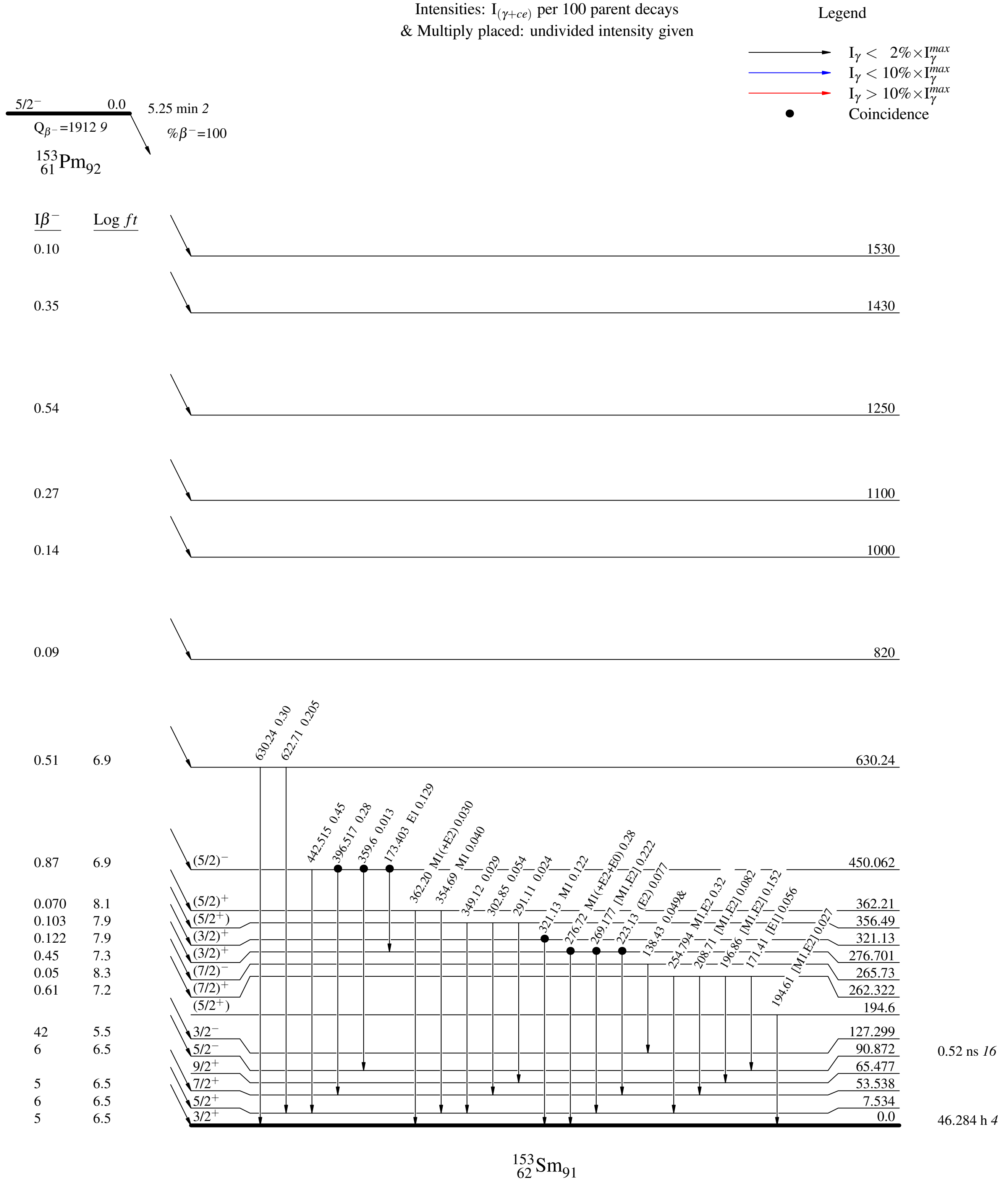
[b] Multiply placed with undivided intensity.

[x] γ ray not placed in level scheme.

^{153}Pm β^- decay 1988WiZY,1983MaYP,1995Gr19

Decay Scheme

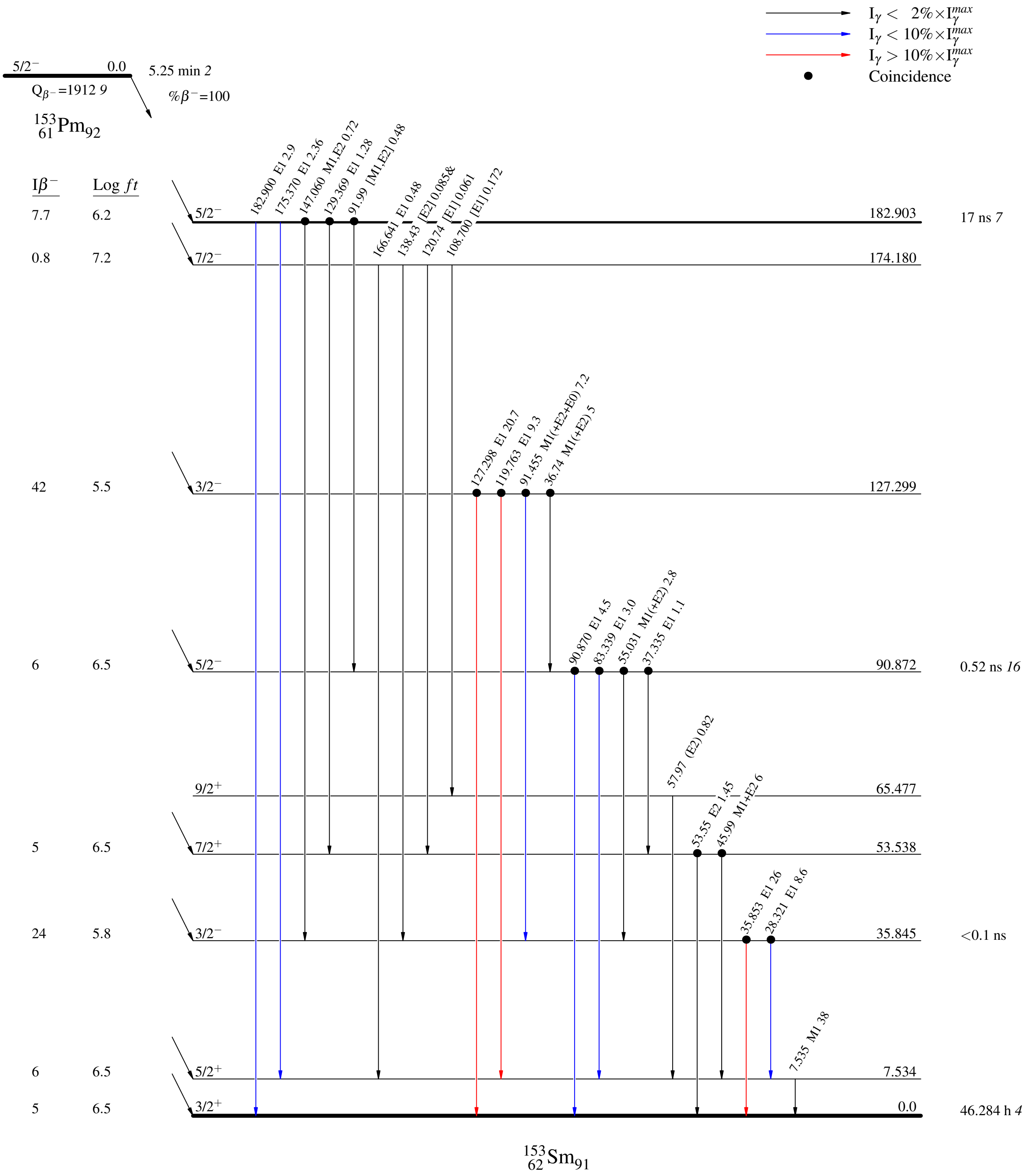
Intensities: $I_{(\gamma+ce)}$ per 100 parent decays
& Multiply placed: undivided intensity given



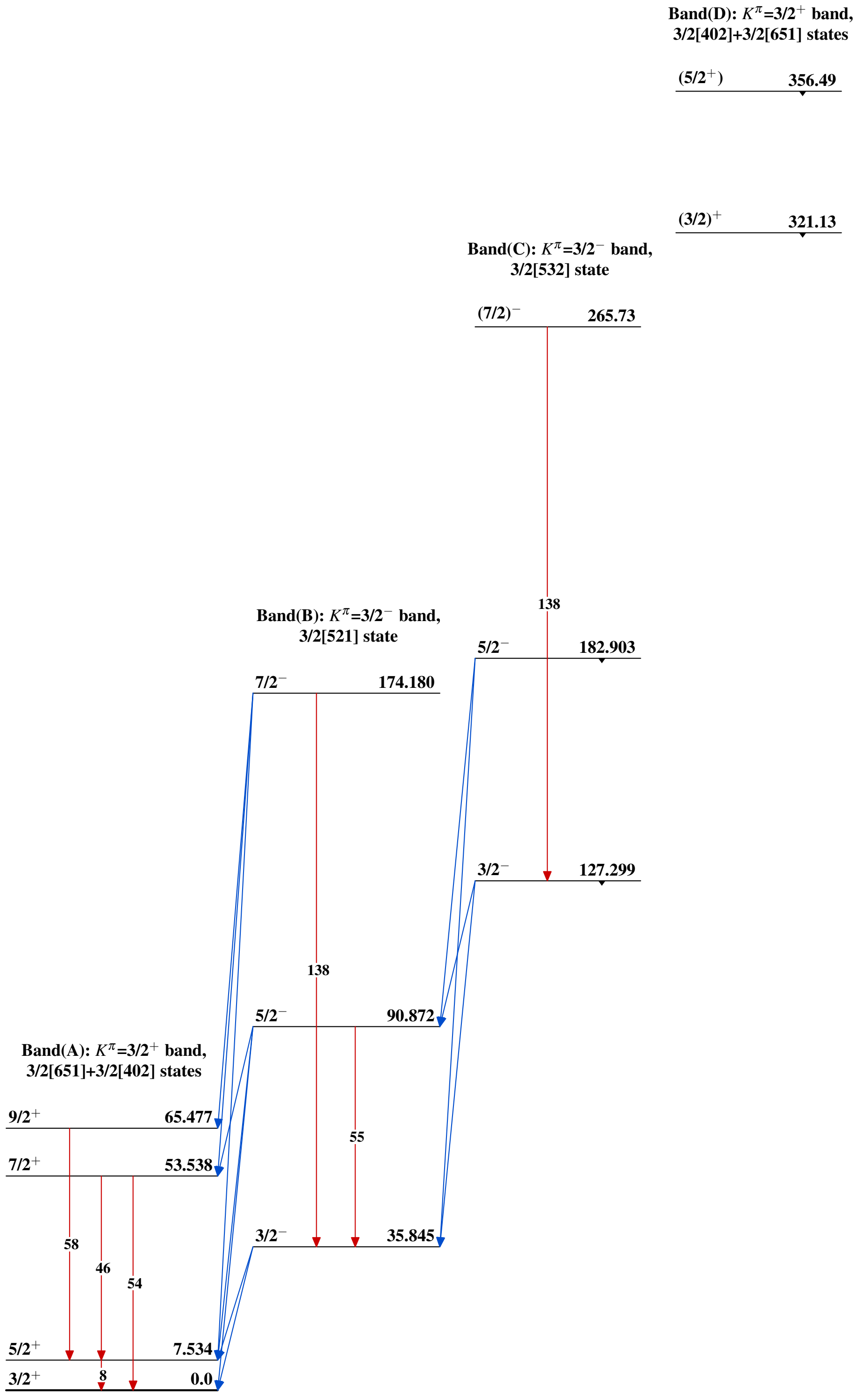
^{153}Pm β^- decay 1988WiZY,1983MaYP,1995Gr19

Decay Scheme (continued)

Intensities: $I_{(\gamma+ce)}$ per 100 parent decays
& Multiply placed: undivided intensity given



^{153}Pm β^- decay 1988WiZY,1983MaYP,1995Gr19



$^{153}_{62}$Sm$_{91}$