^{157}Sm β^- decay 1994WiZZ,1997Gr09,1996Gr20

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	N. Nica	NDS 132, 1 (2016)	4-Dec-2015

Parent: ^{157}Sm: E=0.0; J^π=(3/2$^-$); $T_{1/2}$=8.03 min *7*; Q(β^-)=2781 *6*; %β^- decay=100.0

For these decay scheme studies, ^{157}Sm has been produced by the ^{160}Gd(n,α) reaction, n fission of ^{235}U with isotope separation, and spontaneous fission of ^{252}Cf with chemical separation. Measurements have included γ singles and $\gamma\gamma$-coincidence spectra with Ge detectors, β- spectra with plastic and anthracene detectors, and $\gamma\beta$- coincidences.

Experimental methods:

1960Wi10: Produced by ^{160}Gd(n,α), but $T_{1/2}$ reported as 0.5 min *1*, so isotope probably misassigned.

1972Mo28: Produced by ^{160}Gd(n,α) with E_n=14.7 MeV on enriched (96.5%) target. Report γ of 121 keV and $E_{\beta-}$ of 2.83 MeV *10*, but report $T_{1/2}$=83 s *1*, so isotope probably misassigned.

1973Da05: Produced by ^{160}Gd(n,α) reaction with E_n=14.8 MeV on natural target. γ measured with Ge detector, β- with anthracene detector, and $\gamma\beta$- coincidences. Report 7 γ's, but report isotope assignment is not certain.

1973Ka23: Produced by ^{160}Gd(n,α) reaction with fast n on enriched (95.2%) target. γ measured with Ge detectors, $\gamma\gamma$ coincidences with Ge detectors, and β- with plastic detectors. Report 14 γ's.

1980Ba51: Produced from ^{252}Cf spontaneous fission with chemical separation. γ measured with Ge detector. Report 23 γ's, but no decay scheme.

1986Ma12: Produced by n fission of ^{235}U with isotope separation. γ singles and $\gamma\gamma$ coincidences measured with Ge detectors. $T_{1/2}$ measured.

1994WiZZ: Produced from ^{252}Cf spontaneous fission with chemical separation. γ measured with Ge detector. Same authors as 1980Ba51.

1993Gr17: Produced from ^{252}Cf spontaneous fission with isotope separation. Measured β- end-point energy with Ge detector.

1996Gr20: Produced from ^{252}Cf spontaneous fission with isotope separation. Measured β- intensity for "ground-state" branch with total absorption γ-ray spectrometer.

1997Gr09: Produced from ^{252}Cf spontaneous fission with isotope separation. Measured β- branch intensity as a function of the excited level energy with total absorption γ-ray spectrometer.

^{157}Eu Levels

E(level)[†]	J^π[‡]	E(level)[†]	J^π[‡]	E(level)[†]	E(level)[†]
0.0[@]	5/2$^+$	850.[#]		1377.32 *12*	1950[#]
76.709[@] *6*	7/2$^+$	971.99[b] *9*	3/2$^+$	1382.94 *8*	2050[#]
197.863[&] *6*	5/2$^-$	988.38 *10*		1418.47 *18*	2150[#]
263.228[&] *14*	7/2$^-$	1021.27 *10*		1463.12 *7*	2250[#]
394.334[a] *9*	3/2$^+$	1050[#]		1550[#]	2350[#]
453.500[a] *12*	5/2$^+$	1150[#]		1650[#]	2450[#]
670.419 *25*		1250[#]		1750[#]	2550[#]
716.31 *5*		1360.92 *13*		1850[#]	

† From least-squares fit to γ energies.

‡ From ^{157}Eu Adopted Levels and in agreement with J^π and band assignments of 1994WiZZ and those in the ^{158}Gd(pol t,α) study (1979Bu05). See 1990Ja11 for review of band assignments.

Pseudo levels, which are artificially introduced, the placement and number of which is quite arbitrary and merely indicates that in those energy regions a certain amount of β-feeding is required to fit the measured spectrum.

@ Band(A): 5/2[413] band.

& Band(B): 5/2[532] band.

a Band(C): 3/2[411] band.

b Band(D): 1/2[411] band.

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β^- radiations

E(decay)	E(level)	$I\beta^{-\dagger\ddagger\#}$	Log $ft^{\ddagger}$	Comments
(231 *6*)	2550	0.2		av Eβ=63.9 *19*
(331 *6*)	2450	0.2		av Eβ=94.9 *20*
(431 *6*)	2350	0.3		av Eβ=127.8 *21*
(531 *6*)	2250	0.4		av Eβ=162.3 *22*
(631 *6*)	2150	0.3		av Eβ=198.1 *22*
(731 *6*)	2050	0.5		av Eβ=235.2 *23*
(831 *6*)	1950	1.2		av Eβ=273.3 *24*
(931 *6*)	1850	1.2		av Eβ=312.3 *24*
(1031 *6*)	1750	0.7		av Eβ=352.2 *25*
(1131 *6*)	1650	0.6		av Eβ=392.8 *25*
(1231 *6*)	1550	0.4		av Eβ=433.9 *25*
(1318 *6*)	1463.12	3.8 *7*	6.2 *3*	av Eβ=470.2 *26*
(1363 *6*)	1418.47	0.7 *2*	6.9 *3*	av Eβ=489.0 *26*
(1398 *6*)	1382.94	1.2 *4*	6.7 *3*	av Eβ=504.0 *26*
(1404 *6*)	1377.32	1.0 *2*	6.8 *3*	av Eβ=506.3 *26*
(1420 *6*)	1360.92	1.2 *2*	6.8 *3*	av Eβ=513.3 *26*
(1531 *6*)	1250	1.0		av Eβ=560.5 *26*
(1631 *6*)	1150	0.7		av Eβ=603.6 *26*
(1731 *6*)	1050	1.6		av Eβ=647.0 *27*
(1760 *6*)	1021.27	0.8 *2*	7.3 *2*	av Eβ=659.5 *27*
(1793 *6*)	988.38	1.9 *5*	7.0 *3*	av Eβ=673.9 *27*
(1809 *6*)	971.99	0.7 *2*	7.4 *3*	av Eβ=681.0 *27*
(1931 *6*)	850.	0.2		av Eβ=734.6 *27*
(2065 *6*)	716.31	1.7 *4*	7.3 *2*	av Eβ=793.8 *27*
(2111 *6*)	670.419	2.6 *5*	7.2 *2*	av Eβ=814.2 *27*
(2328 *6*)	453.500	17 *7*	6.5 *3*	av Eβ=911.1 *27*
(2387 *6*)	394.334	13 *7*	6.7 *3*	av Eβ=937.7 *27*
(2583 *6*)	197.863	43 *8*	6.3 *2*	av Eβ=1026.3 *28* E(decay): From γβ- coincidences $E_{\beta-}$(197)=2400 *200* which implies Q_{β^-}=2600 *200* (1973Da05,1973Ka23) compared singles measurement of Q_{β^-}=2734 *50* (1993Gr17).
(2704 *6*)	76.709	2.5 *25*	≥8.5^{1u}	av Eβ=1065.1 *27* Iβ⁻: From log $f_{1u}t \geq 8.5$ from systematics (1998Si17) as well as from $I_{\beta-}$(0+77)=0.3 *+29−3* (1996Gr20).
(2781 *6*)	0.0	≤3	≥7.1	av Eβ=1116.0 *28* Iβ⁻: From 4πγβ coincidence data (1996Gr20), $I_{\beta-}$(0+77)= 0.3 *+29−3*.

† Relative values are from γ-ray intensity balances for levels with deexciting γ′s, except for the 76 level. These values are converted to absolute values by including the values from the total absorption γ spectra, TAGS, for the ground state (1996Gr20) and the pseudolevels (1997Gr09). The values from the intensity balances and TAGS data are in good agreement. The β-intensity distribution from the total absorption γ spectra (TAGS) (1997Gr09) indicate that ≈ 9.4% of the decays are to levels that are not in the γ-ray decay scheme, namely, ≈ 850, 1050 − 1250, and above 1500 keV. These decays are represented here by pseudolevels which do not have any depopulating γ′s. These pseudolevels represent the sum of the β- feeding to all the actual levels in an energy range. Where the pseudolevels are adjacent, this range is half of the distance between the adjacent levels; and where a pseudolevel is between discrete levels, the range is between these levels. No uncertainties are included for the $I_{\beta-}$ to the pseudolevels, and no log *ft*′s are given since this intensity is expected to be distributed over several actual levels.

‡ The inability to include the unknown γ decays from the upper levels will, in principle, cause the $I_{\beta-}$ values deduced from the γ intensity balances to be incorrect; however, since most of these unknown γ′s are expected to populate the strongly fed levels below 460 keV, the changes in the log *ft* values are probably small. The uncertainties in the $I_{\beta-}$ and log *ft*′s do not include any contributions from the incompleteness of the decay scheme.

\# Absolute intensity per 100 decays.

^{157}Sm β^- decay 1994WiZZ,1997Gr09,1996Gr20 (continued)

$\gamma(^{157}Eu)$

Iγ normalization: computed to give 100% β- decay; the uncertainty does not include any contribution due to the incompleteness of the γ-ray portion of the decay scheme.
The γγ coincidences noted in the decay-scheme drawing are those of 1973Ka23.
The unplaced γ's are those of 1994WiZZ.

E_γ[†]	I_γ[†@]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[‡]	α[#]	Comments
^{x}31.07 *7*	0.29 *7*							
^{x}31.78 *5*	0.39 *7*							
^{x}37.30 *8*	0.85 *6*							
59.168 *10*	2.00 *5*	453.500	5/2$^+$	394.334	3/2$^+$	[M1,E2]	13 *5*	α(K)=5.3 *19*; α(L)=6 *6*; α(M)=1.4 *13* α(N)=0.3 *3*; α(O)=0.04 *4*; α(P)=0.0005 *3*
^{x}60.58 *9*	0.15 *6*							
^{x}61.40 *11*	<1.2							
^{x}62.62 *5*	0.24 *5*							
65.44 *10*	0.13 *4*	263.228	7/2$^-$	197.863	5/2$^-$	[M1,E2]	9 *3*	α(K)=4.2 *12*; α(L)=4 *4*; α(M)=0.9 *8* α(N)=0.20 *17*; α(O)=0.027 *22*; α(P)=0.00041 *18*
^{x}74.88 *15*	0.08 *4*							
76.701 *7*	3.35 *12*	76.709	7/2$^+$	0.0	5/2$^+$	[M1+E2]	5.2 *13*	α(K)=2.8 *6*; α(L)=1.9 *14*; α(M)=0.4 *4* α(N)=0.10 *8*; α(O)=0.013 *10*; α(P)=0.00027 *11*
^{x}77.94 *5*	0.17 *3*							
^{x}81.11 *5*	0.19 *3*							
^{x}88.38 *6*	0.15 *3*							
121.147 *7*	8.50 *16*	197.863	5/2$^-$	76.709	7/2$^+$	[E1]	0.1689	α(K)=0.1425 *20*; α(L)=0.0208 *3*; α(M)=0.00447 *7* α(N)=0.001007 *15*; α(O)=0.0001526 *22*; α(P)=1.221×10^{-5} *17*
^{x}186.00 *16*	0.44 *17*							
186.55 *3*	1.45 *7*	263.228	7/2$^-$	76.709	7/2$^+$	[E1]	0.0527	α(K)=0.0447 *7*; α(L)=0.00630 *9*; α(M)=0.001353 *19* α(N)=0.000307 *5*; α(O)=4.71×10^{-5} *7*; α(P)=4.05×10^{-6} *6*
190.273 *17*	2.01 *7*	453.500	5/2$^+$	263.228	7/2$^-$	[E1]	0.0500	α(K)=0.0424 *6*; α(L)=0.00597 *9*; α(M)=0.001282 *18* α(N)=0.000291 *4*; α(O)=4.47×10^{-5} *7*; α(P)=3.85×10^{-6} *6*
^{x}193.4 *3*	1.9 *5*							
196.461 *9*	29.7 *4*	394.334	3/2$^+$	197.863	5/2$^-$	[E1]	0.0459	α(K)=0.0390 *6*; α(L)=0.00547 *8*; α(M)=0.001176 *17* α(N)=0.000266 *4*; α(O)=4.10×10^{-5} *6*; α(P)=3.55×10^{-6} *5*
197.870 *8*	100.0 *3*	197.863	5/2$^-$	0.0	5/2$^+$	[E1]	0.0451	α(K)=0.0383 *6*; α(L)=0.00537 *8*; α(M)=0.001153 *17* α(N)=0.000261 *4*; α(O)=4.03×10^{-5} *6*; α(P)=3.49×10^{-6} *5*
216.95 *6*	0.57 *7*	670.419		453.500	5/2$^+$			
263.207 *22*	2.40 *12*	263.228	7/2$^-$	0.0	5/2$^+$	[E1]	0.0214	α(K)=0.0182 *3*; α(L)=0.00251 *4*; α(M)=0.000539 *8* α(N)=0.0001224 *18*; α(O)=1.90×10^{-5} *3*; α(P)=1.705×10^{-6} *24*
276.05 *3*	1.76 *6*	670.419		394.334	3/2$^+$			
^{x}315.2 *4*	0.42 *6*							
317.46 *7*	2.32 *14*	394.334	3/2$^+$	76.709	7/2$^+$	[E2]	0.0489	α(K)=0.0381 *6*; α(L)=0.00846 *12*;

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^{157}Sm β^- decay 1994WiZZ,1997Gr09,1996Gr20 (continued)

γ(^{157}Eu) (continued)

E_γ [†]	I_γ [†@]	E_i(level)	J_i^π	E_f	J_f^π	Mult. [‡]	α [#]	Comments
								α(M)=0.00190 *3*; α(N)=0.000427 *6*; α(O)=6.29×10^{-5} *9*; α(P)=3.58×10^{-6} *5*
321.78 *10*	0.46 *5*	716.31		394.334	3/2$^+$			
376.70 *11*	0.52 *6*	453.500	5/2$^+$	76.709	7/2$^+$	[M1,E2]	0.039 *10*	α(K)=0.032 *9*; α(L)=0.0052 *5*; α(M)=0.00114 *10*; α(N)=0.000259 *23*; α(O)=4.0×10^{-5} *5*; α(P)=3.4×10^{-6} *12*
394.351 *16*	21.3 *3*	394.334	3/2$^+$	0.0	5/2$^+$	[M1,E2]	0.034 *9*	α(K)=0.029 *8*; α(L)=0.0045 *6*; α(M)=0.00099 *10*; α(N)=0.000226 *24*; α(O)=3.5×10^{-5} *5*; α(P)=3.0×10^{-6} *10*
453.1 *4*	0.54 *14*	716.31		263.228	7/2$^-$			
453.47 *6*	0.72 *20*	453.500	5/2$^+$	0.0	5/2$^+$	[M1,E2]	0.024 *7*	α(K)=0.020 *6*; α(L)=0.0030 *5*; α(M)=0.00066 *10*; α(N)=0.000151 *23*; α(O)=2.4×10^{-5} *4*; α(P)=2.1×10^{-6} *7*
472.65 *6*	1.37 *8*	670.419		197.863	5/2$^-$			
518.46[&] *11*	0.57[&] *6*	716.31		197.863	5/2$^-$			
518.46[&] *11*	0.57[&] *6*	971.99	3/2$^+$	453.500	5/2$^+$	[M1,E2]	0.017 *5*	α(K)=0.014 *4*; α(L)=0.0021 *4*; α(M)=0.00046 *8*; α(N)=0.000104 *19*; α(O)=1.6×10^{-5} *4*; α(P)=1.5×10^{-6} *5*
534.60 *20*	0.34 *7*	988.38		453.500	5/2$^+$			
[x]557.54 *10*	0.75 *7*							
577.69 *12*	0.62 *9*	971.99	3/2$^+$	394.334	3/2$^+$	[M1,E2]	0.013 *4*	α(K)=0.011 *4*; α(L)=0.0016 *4*; α(M)=0.00034 *7*; α(N)=7.8×10^{-5} *16*; α(O)=1.2×10^{-5} *3*; α(P)=1.1×10^{-6} *4*
594.24 *17*	0.51 *8*	988.38		394.334	3/2$^+$			
[x]641.46 *16*	0.40 *6*							
670.46 *11*	0.90 *7*	670.419		0.0	5/2$^+$			
716.40 *7*	1.39 *8*	716.31		0.0	5/2$^+$			
[x]724.19 *19*	0.45 *8*							
758.2 *3*	0.37 *9*	1021.27		263.228	7/2$^-$			
[x]797.36 *24*	0.48 *13*							
823.39 *10*	1.00 *8*	1021.27		197.863	5/2$^-$			
[x]844.0 *3*	0.45 *12*							
[x]846.0 *3*	0.58 *12*							
[x]868.52 *14*	0.58 *13*							
[x]909.3 *3*	0.51 *13*							
[x]911.7 *3*	0.61 *3*							
966.2 *3*	0.54 *10*	1360.92		394.334	3/2$^+$			
988.2 *1*	0.9 *4*	1382.94		394.334	3/2$^+$			
988.38 *13*	2.6 *4*	988.38		0.0	5/2$^+$			
[x]1028.16 *11*	1.02 *9*							
1155.04 *24*	0.64 *12*	1418.47		263.228	7/2$^-$			
1163.14 *14*	1.52 *12*	1360.92		197.863	5/2$^-$			
1185.65 *12*	1.24 *11*	1382.94		197.863	5/2$^-$			
1220.82 *25*	0.57 *11*	1418.47		197.863	5/2$^-$			
1300.1 *3*	0.57 *13*	1377.32		76.709	7/2$^+$			
[x]1354.67 *23*	0.63 *11*							
1377.40 *12*	1.25 *10*	1377.32		0.0	5/2$^+$			
1386.35 *10*	1.76 *11*	1463.12		76.709	7/2$^+$			

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$^{157}Sm\ \beta^-$ decay 1994WiZZ,1997Gr09,1996Gr20 (continued)

$\gamma(^{157}Eu)$ (continued)

E_γ †	I_γ †@	E_i(level)	E_f	J^π_f
x1407.65 *18*	0.61 *8*			
1463.16 *9*	5.1 *3*	1463.12	0.0	$5/2^+$

† From 1994WiZZ. Others: 1973Da05 and 1973Ka23.
‡ All assignments are deduced from the assigned J^π values. The intensity balance at 77 level supports the multipolarity of the 77 γ.
# Additional information 1.
@ For absolute intensity per 100 decays, multiply by 0.56 *10*.
& Multiply placed with undivided intensity.
x γ ray not placed in level scheme.

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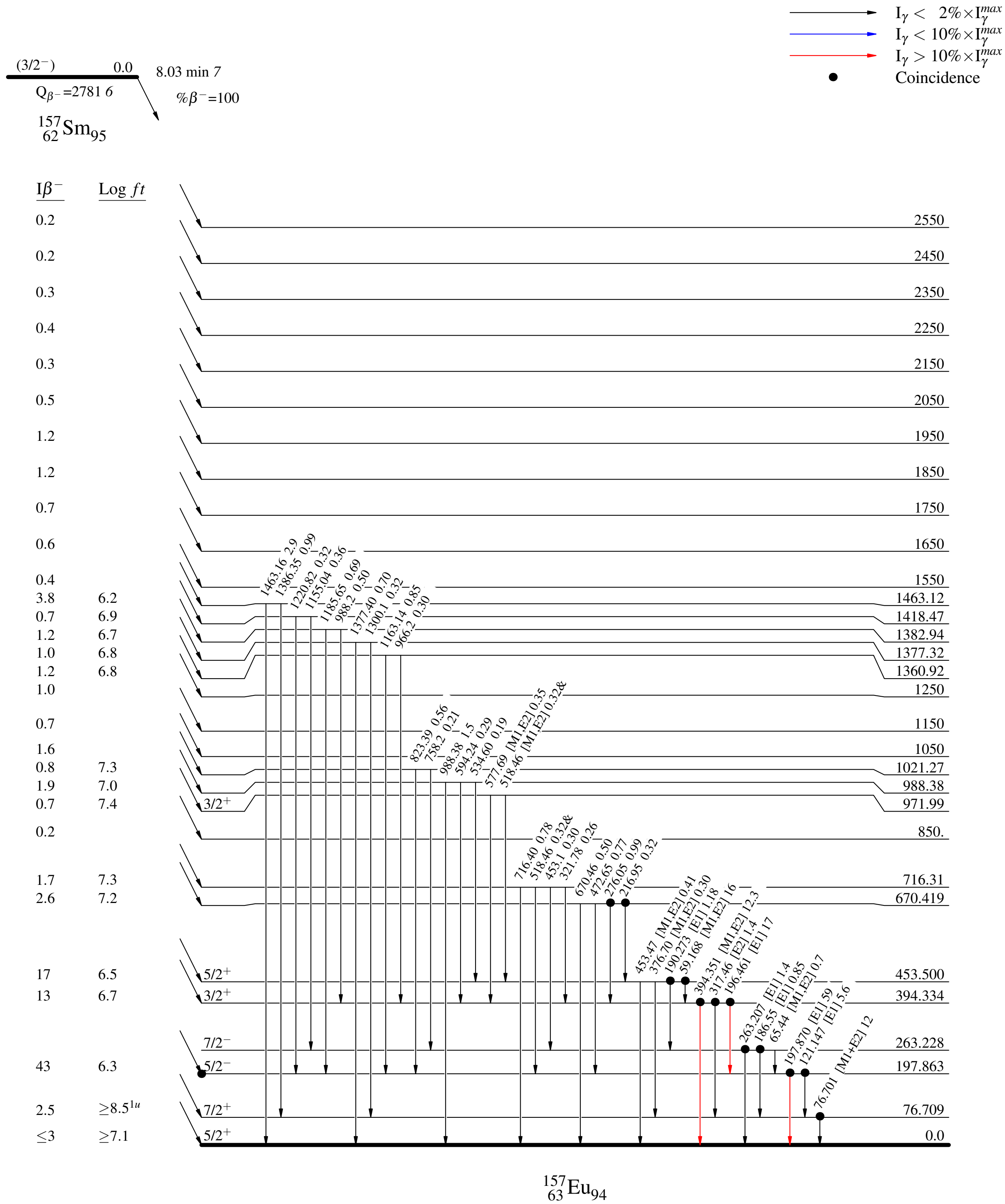
Decay Scheme

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



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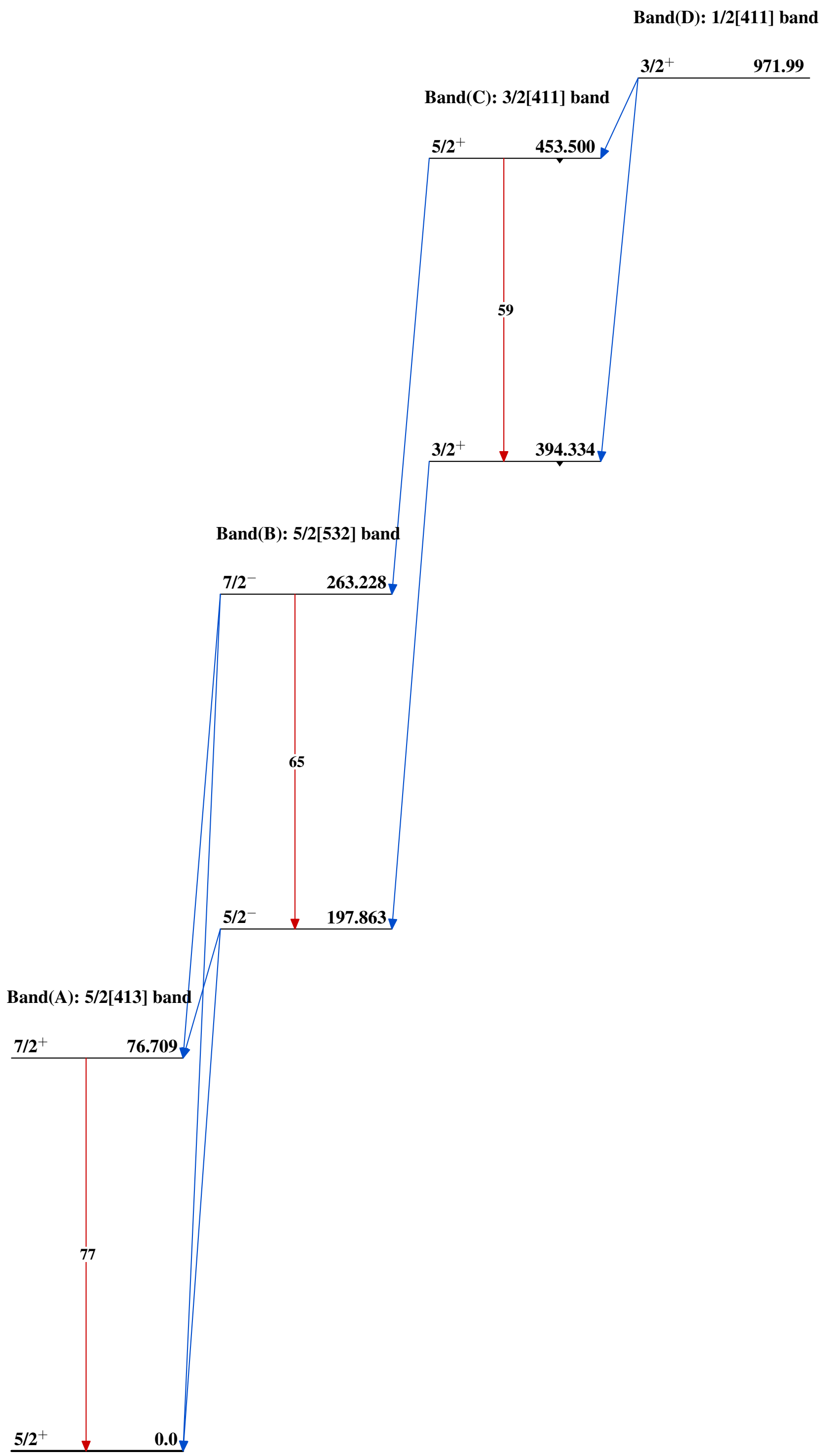

$^{157}_{63}Eu_{94}$