^{256}Es β^- decay (7.6 h) 1989Ha10

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh	NDS 141, 327 (2017)	22-Mar-2017

Parent: ^{256}Es: E=0.0+x; J^π=(8^+); $T_{1/2}$=7.6 h; Q(β^-)=1700 *SY*; %β^- decay=100.0
^{256}Es-J^π,$T_{1/2}$: From ^{256}Es Adopted Levels.
^{256}Es-Q(β^-): 1700 *100* (syst,2017Wa10).
Fermium K- and L-x rays and delayed SF activities were observed by 1976HoZB.

^{256}Fm Levels

E(level)†	J^π‡	$T_{1/2}$	Comments
0.0#	0^+		
48.3# *3*	2^+		
159.7# *3*	4^+		
332.3# *4*	6^+		
563.4# *4*	8^+		
682.30@ *20*	(2^+)		
725.7@ *3*	(3^+)		
783.3@ *3*	(4^+)		
853.5@ *5*	(5^+)		
881.7& *3*	(2^-)		
922.2& *3*	(3^-)		
938.9@ *16*	(6^+)		
978.4& *6*	(4^-)		
1039.1@ *4*	(7^+)		
1045.3& *6*	(5^-)		
1099.9a *3*	(3^+)		
1123.2& *5*	(6^-)		
1150.3?@	(8^+)		
1150.5a *5*	(4^+)		
1213.7?& *12*	(7^-)		
1251.8b *5*	(5^+)		J^π: γ transitions to (3^+), (4^+) and probably to (5^+) states; 1989Ha10 suggested that the 1328.4- and 1251.8-keV levels are members of a band, as indicated by their energy differences.
1328.4?b *4*	(6^+)		
1425.2 *4*	(7^-)	70 ns *5*	%IT=100 K^π=(7^-). $T_{1/2}$: determined by 1989Ha10 from (231γ)β(t) measurements. If π(1560 level)=+ and 134.7γ is E1, then π(1425.5 level)=−. The corresponding log *ft* of 5.2 (for Iβ=86%) is quite low for a first-forbidden β decay from 8^+ parent. Additional information 1.
1559.9 *4*	(7^+,8^+)		J^π: from probable allowed character of the β transition to the 1559.9-keV level from the (8^+) parent state, and γ to (7^-).

† From least-squares fit to Eγ values.
‡ From Adopted Levels.
# Band(A): $K^\pi=0^+$ g.s. band.
@ Band(B): $K^\pi=2^+$ γ-vibrational band.
& Band(C): $K^\pi=2^-$ octupole-vibrational band.

Continued on next page (footnotes at end of table)

^{256}Es β^- decay (7.6 h) 1989Ha10 (continued)

^{256}Fm Levels (continued)

[a] Band(D): $K^\pi=(3^+)$ band.
[b] Band(E): $K^\pi=(5^+)$ band.

β^- radiations

E(decay)	E(level)	Iβ^-[†]	Log *ft*	Comments
(140 *SY*)	1559.9	≈14	≈5.1	av Eβ=37 *28*
(274 *SY*)	1425.2	≈86	≈5.2	av Eβ=75 *30* Note that log *ft* is quite low for a first-forbidden transition.

[†] Absolute intensity per 100 decays.

$\gamma(^{256}Fm)$

Iγ normalization: Summed transition intensity from the 1425 level=100, assuming the main β feeding to this level.
The 7.6-h ^{256}Es β^- decay scheme is presented as constructed by 1989Ha10 from their Eγ, Iγ, $\gamma\gamma$- and $\beta\gamma$-coincidence data.

E$_\gamma$[†]	I$_\gamma$[‡a]	E$_i$(level)	J$_i^\pi$	E$_f$	J$_f^\pi$	Mult.	α[&]	Comments
(48.3[@])		48.3	2$^+$	0.0	0$^+$	[E2]	832	α(L)=597 *9*; α(M)=171.8 *24* α(N)=48.9 *7*; α(O)=12.31 *18*; α(P)=1.93 *3*; α(Q)=0.00466 *7*
(50.8[@])		1150.5	(4$^+$)	1099.9	(3$^+$)			
(67.0[@])		1045.3	(5$^-$)	978.4	(4$^-$)			
(76.8[@])		1328.4?	(6$^+$)	1251.8	(5$^+$)			
(78.0[@])		1123.2	(6$^-$)	1045.3	(5$^-$)			
(90.5[@])		1213.7?	(7$^-$)	1123.2	(6$^-$)			
96.8 *2*	2.55	1425.2	(7$^-$)	1328.4?	(6$^+$)	(E1)	0.1697	α(L)=0.1266 *18*; α(M)=0.0317 *5* α(N)=0.00877 *13*; α(O)=0.00222 *4*; α(P)=0.000365 *6*; α(Q)=1.140×10^{-5} *16* Intensity balance at the 1328.4 level implies E1 character for 96.8γ.
[x]103.6 *5*	0.80							
[x]105.8 *2*	5.12							
111.6 *2*	2.79	159.7	4$^+$	48.3	2$^+$	[E2]	15.96	α(L)=11.45 *16*; α(M)=3.30 *5* α(N)=0.937 *14*; α(O)=0.237 *4*; α(P)=0.0379 *6*; α(Q)=0.0001575 *22*
[x]126.0 *5*	0.71							
134.7 *2*	5.12	1559.9	(7$^+$,8$^+$)	1425.2	(7$^-$)	[E1]	0.0735	α(134.7γ)=6.79 for E2 and 4.44 for M1.
141[#] *2*	0.09	922.2	(3$^-$)	783.3	(4$^+$)	[E1]	0.0656	α(L)=0.0490 *7*; α(M)=0.01220 *17* α(N)=0.00338 *5*; α(O)=0.000863 *12*; α(P)=0.0001481 *21*; α(Q)=5.21×10^{-6} *8* γ was seen in coincidence with 623.5γ (1989Ha10).
[x]150.2 *2*	1.16							
156[#] *2*	0.08	881.7	(2$^-$)	725.7	(3$^+$)	[E1]	0.199	α(K)=0.1481 *21*; α(L)=0.0381 *6*; α(M)=0.00948 *14* α(N)=0.00263 *4*; α(O)=0.000673 *10*; α(P)=0.0001165 *17*; α(Q)=4.22×10^{-6} *6* γ was seen in coincidence with 677.5γ (1989Ha10).
[x]158.9 *5*	0.31							
[x]165.2 *5*	0.50							
172.6 *2*	9.70	332.3	6$^+$	159.7	4$^+$	[E2]	2.40	α(K)=0.1412 *20*; α(L)=1.625 *23*; α(M)=0.465 *7*

Continued on next page (footnotes at end of table)

^{256}Es β^- decay (7.6 h) 1989Ha10 (continued)

$\gamma(^{256}Fm)$ (continued)

E_γ[†]	I_γ[‡a]	E_i(level)	J_i^π	E_f	J_f^π	Mult.	α[&]	Comments
								α(N)=0.1322 *19*; α(O)=0.0335 *5*; α(P)=0.00545 *8*; α(Q)=3.47×10^{-5} *5*
178.0[b] *2*	1.10[b]	1099.9	(3$^+$)	922.2	(3$^-$)	[E1]	0.1487	α(K)=0.1118 *16*; α(L)=0.0276 *4*; α(M)=0.00685 *10* α(N)=0.00190 *3*; α(O)=0.000488 *7*; α(P)=8.54×10^{-5} *12*; α(Q)=3.21×10^{-6} *5*
178.0[b] *2*	1.10[b]	1328.4?	(6$^+$)	1150.5	(4$^+$)			
[x]181.5 *5*	0.28							
185.7 *5*	0.25	1039.1	(7$^+$)	853.5	(5$^+$)	[E2]	1.79	α(K)=0.1404 *20*; α(L)=1.184 *17*; α(M)=0.338 *5* α(N)=0.0961 *14*; α(O)=0.0244 *4*; α(P)=0.00398 *6*; α(Q)=2.76×10^{-5} *4*
[x]190.1 *5*	0.55							
192[#] *2*	0.12	1045.3	(5$^-$)	853.5	(5$^+$)	[E1]	0.1257	α(K)=0.0950 *14*; α(L)=0.0230 *4*; α(M)=0.00570 *8* α(N)=0.001579 *23*; α(O)=0.000406 *6*; α(P)=7.15×10^{-5} *10*; α(Q)=2.75×10^{-6} *4* γ was seen in coincidence with 693.8γ (authors of 1989Ha10 listed it as being in coincidence with 696γ).
197.4[c] *5*	0.79	922.2	(3$^-$)	725.7	(3$^+$)	[E1]	0.1183	α(K)=0.0895 *13*; α(L)=0.0215 *3*; α(M)=0.00533 *8* α(N)=0.001477 *21*; α(O)=0.000380 *6*; α(P)=6.71×10^{-5} *10*; α(Q)=2.60×10^{-6} *4*
199.3 *2*	1.40	881.7	(2$^-$)	682.30	(2$^+$)	[E1]	0.1158	α(K)=0.0877 *13*; α(L)=0.0210 *3*; α(M)=0.00521 *8* α(N)=0.001443 *21*; α(O)=0.000372 *6*; α(P)=6.56×10^{-5} *10*; α(Q)=2.55×10^{-6} *4*
211.2[bc] *5*	0.87[b]	1150.3?	(8$^+$)	938.9	(6$^+$)			
211.2[bc] *5*	0.87[b]	1425.2	(7$^-$)	1213.7?	(7$^-$)	[M1+E2]	3.3 *22*	α(K)=2.2 *21*; α(L)=0.80 *12*; α(M)=0.211 *17* α(N)=0.059 *5*; α(O)=0.0154 *14*; α(P)=0.0028 *5*; α(Q)=1.00×10^{-4} *82*
218.1 *2*	5.69	1099.9	(3$^+$)	881.7	(2$^-$)	(E1)	0.0949	α(K)=0.0723 *11*; α(L)=0.01696 *24*; α(M)=0.00420 *6* α(N)=0.001163 *17*; α(O)=0.000300 *5*; α(P)=5.33×10^{-5} *8*; α(Q)=2.12×10^{-6} *3* Intensity balance at the 881.8 level suggests E1 multipolarity for the 218.1γ.
[x]229.0 *5*	0.65							
231.1 *2*	12.0	563.4	8$^+$	332.3	6$^+$	[E2]	0.772	α(K)=0.1188 *17*; α(L)=0.470 *7*; α(M)=0.1336 *19* α(N)=0.0379 *6*; α(O)=0.00964 *14*; α(P)=0.001594 *23*; α(Q)=1.439×10^{-5} *21*
[x]232.7 *5*	0.58							
[x]240.3 *5*	0.36							
[x]242.0 *5*	0.79							
[x]247.4 *5*	0.38							
[x]252[#] *2*	0.07							γ was seen in coincidence with 677.5γ (1989Ha10).
252.7 *5*	0.25	978.4	(4$^-$)	725.7	(3$^+$)	[E1]	0.0690	α(K)=0.0529 *8*; α(L)=0.01202 *17*; α(M)=0.00297 *5* α(N)=0.000823 *12*; α(O)=0.000213 *3*; α(P)=3.82×10^{-5} *6*; α(Q)=1.581×10^{-6} *23*
[x]255.3 *5*	0.55							
[x]258.2 *5*	0.65							
[x]264.1 *5*	0.38							
269.5 *5*	0.75	1123.2	(6$^-$)	853.5	(5$^+$)	[E1]	0.0601	α(K)=0.0463 *7*; α(L)=0.01037 *15*; α(M)=0.00256 *4*

Continued on next page (footnotes at end of table)

^{256}Es β^- decay (7.6 h) 1989Ha10 (continued)

$\gamma(^{256}Fm)$ (continued)

E_γ [†]	I_γ [‡a]	E_i(level)	J_i^π	E_f	J_f^π	Mult.	α [&]	Comments
								α(N)=0.000709 *10*; α(O)=0.000184 *3*; α(P)=3.31×10^{-5} *5*; α(Q)=1.392×10^{-6} *20*
275.3[c] *2*	1.15	1425.2	(7$^-$)	1150.3?	(8$^+$)	[E1]	0.0575	α(K)=0.0443 *7*; α(L)=0.00988 *14*; α(M)=0.00244 *4* α(N)=0.000676 *10*; α(O)=0.0001749 *25*; α(P)=3.16×10^{-5} *5*; α(Q)=1.335×10^{-6} *19*
[x]277.3 *5*	0.60							
[x]297.5 *5*	0.52							
302.0 *5*	0.82	1425.2	(7$^-$)	1123.2	(6$^-$)	[M1+E2]	1.16 *86*	α(K)=0.82 *74*; α(L)=0.249 *89*; α(M)=0.064 *19* α(N)=0.0180 *53*; α(O)=0.0047 *15*; α(P)=8.7×10^{-4} *32*; α(Q)=3.7×10^{-5} *30*
316.4 *2*	1.02	1099.9	(3$^+$)	783.3	(4$^+$)	[M1+E2]	1.02 *76*	α(K)=0.73 *65*; α(L)=0.215 *81*; α(M)=0.055 *18* α(N)=0.0155 *49*; α(O)=0.0041 *14*; α(P)=7.5×10^{-4} *30*; α(Q)=3.2×10^{-5} *26*
[x]326.7 *2*	1.37							
[x]333.2 *5*	0.36							
[x]343.0 *5*	0.49							
374.2 *2*	1.43	1099.9	(3$^+$)	725.7	(3$^+$)	[M1+E2]	0.64 *48*	α(K)=0.46 *41*; α(L)=0.129 *57*; α(M)=0.033 *13* α(N)=0.0092 *36*; α(O)=0.00241 *97*; α(P)=4.5×10^{-4} *21*; α(Q)=2.0×10^{-5} *17*
380.0 *5*	0.38	1425.2	(7$^-$)	1045.3	(5$^-$)	[E2]	0.1534	α(K)=0.0594 *9*; α(L)=0.0681 *10*; α(M)=0.0189 *3* α(N)=0.00534 *8*; α(O)=0.001368 *20*; α(P)=0.000234 *4*; α(Q)=3.97×10^{-6} *6*
397.2[c] *5*	0.74	1251.8	(5$^+$)	853.5	(5$^+$)	[M1+E2]	0.6 *5*	
[x]410.0 *5*	0.38							
417.6 *2*	1.53	1099.9	(3$^+$)	682.30	(2$^+$)	[M1+E2]	0.47 *36*	α(K)=0.34 *30*; α(L)=0.093 *45*; α(M)=0.024 *11* α(N)=0.0066 *29*; α(O)=0.00173 *76*; α(P)=3.3×10^{-4} *16*; α(Q)=1.5×10^{-5} *12*
450.8[#] *15*	0.15	783.3	(4$^+$)	332.3	6$^+$			γ was seen in coincidence with 172.6γ (1989Ha10).
468.4 *5*	0.90	1251.8	(5$^+$)	783.3	(4$^+$)	[M1+E2]	0.34 *26*	α(K)=0.25 *22*; α(L)=0.066 *34*; α(M)=0.0168 *79* α(N)=0.0047 *22*; α(O)=0.00123 *59*; α(P)=2.3×10^{-4} *12*; α(Q)=1.10×10^{-5} *86*
526.1 *5*	0.82	1251.8	(5$^+$)	725.7	(3$^+$)			
566.0 *5*	0.50	725.7	(3$^+$)	159.7	4$^+$			
586.6[#c] *15*	0.2	1150.3?	(8$^+$)	563.4	8$^+$			γ was seen in coincidence with 231.1γ (1989Ha10).
[x]602.8 *5*	0.77							
606.6[#] *15*	0.4	938.9	(6$^+$)	332.3	6$^+$			γ was seen in coincidence with 172.6γ (1989Ha10).
623.5 *2*	1.12	783.3	(4$^+$)	159.7	4$^+$			
634.0 *2*	1.73	682.30	(2$^+$)	48.3	2$^+$			
677.5 *2*	2.21	725.7	(3$^+$)	48.3	2$^+$			
682.3 *2*	1.84	682.30	(2$^+$)	0.0	0$^+$			
693.8[#] *15*	0.8	853.5	(5$^+$)	159.7	4$^+$			γ was seen in coincidence with 111.6γ (1989Ha10).
706.8 *2*	1.15	1039.1	(7$^+$)	332.3	6$^+$			
762.7 *2*	2.28	922.2	(3$^-$)	159.7	4$^+$			
[x]768.1 *2*	2.25							
833.5 *2*	5.45	881.7	(2$^-$)	48.3	2$^+$			
[x]846.7 *2*	2.02							
861.8 *2*	19.66	1425.2	(7$^-$)	563.4	8$^+$			
940.1[#] *15*	0.8	1099.9	(3$^+$)	159.7	4$^+$			γ was seen in coincidence with 96.8γ (1989Ha10).

Continued on next page (footnotes at end of table)

^{256}Es β^- decay (7.6 h) 1989Ha10 (continued)

$\gamma(^{256}Fm)$ (continued)

E_γ [†]	I_γ [‡ a]	E_i(level)	J_i^π	E_f	J_f^π
1051.5 *2*	2.56	1099.9	(3^+)	48.3	2^+
1092.9 *2*	9.24	1425.2	(7^-)	332.3	6^+

† Measurements of 1989Ha10. For transitions with Iγ≥1.0, uncertainty is 0.15 keV (1989Ha10). For gammas that were observed in coincidence spectra and not resolved in singles, uncertainty was typically 1.5 keV (1989Ha10). Evaluator assigns 0.2 keV for Iγ≥1, 0.5 keV for Iγ<1, and 1.5 or 2 keV when γ is seen only in coincidence data.

‡ Relative photon intensity, measured by 1989Ha10, uncertainties are not given by the authors.

γ was not resolved in singles spectrum (1989Ha10).

@ The transition was not observed. Eγ is from decay scheme.

& Theoretical values from BrIcc code (2008Ki07) using "Frozen orbital" approximation, value overlaps M1 and E2, when mixing ratio is unknown.

a For absolute intensity per 100 decays, multiply by ≈2.56.

b Multiply placed with undivided intensity.

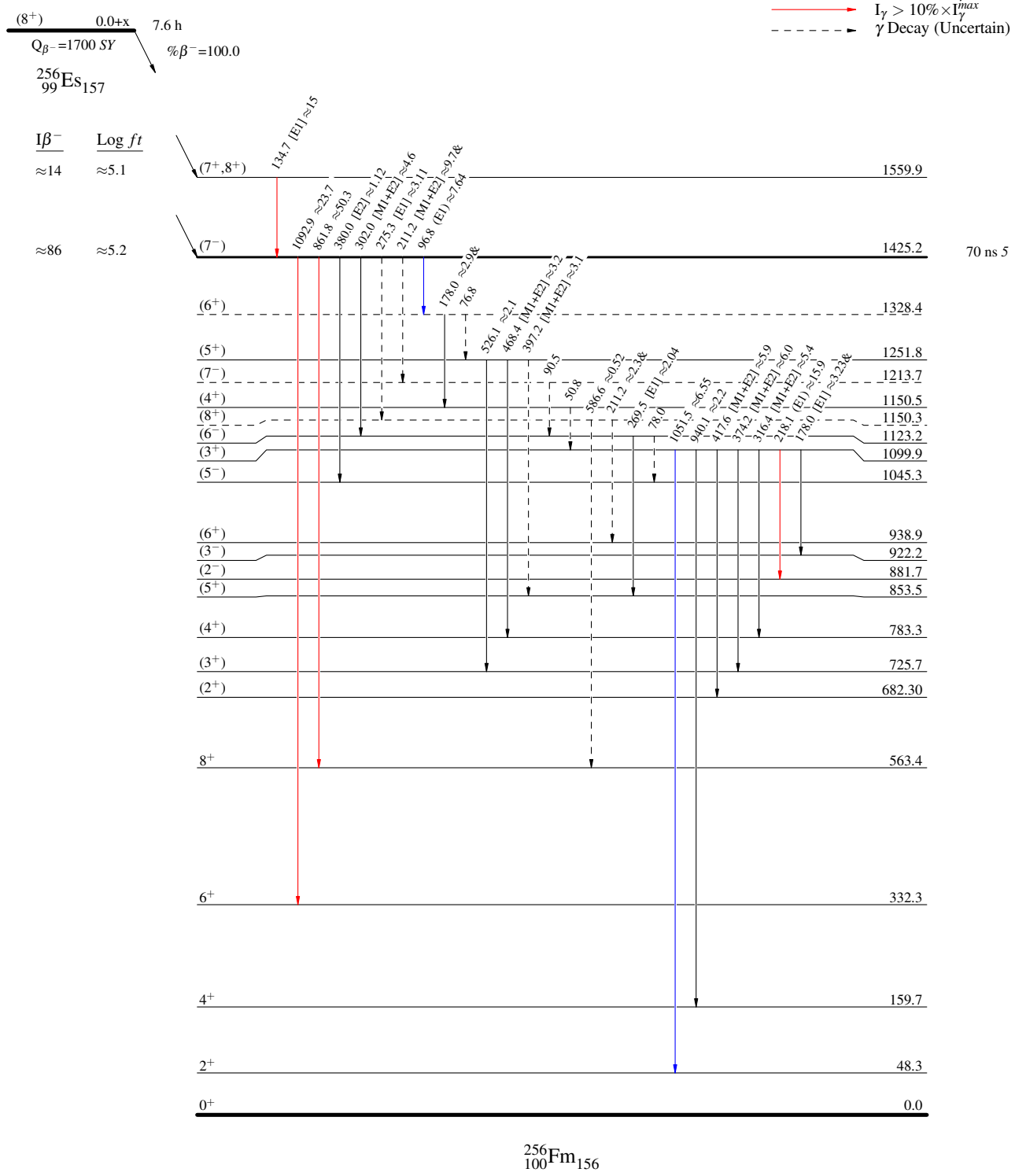
c Placement of transition in the level scheme is uncertain.

x γ ray not placed in level scheme.

^{256}Es β^- decay (7.6 h) 1989Ha10

Decay Scheme

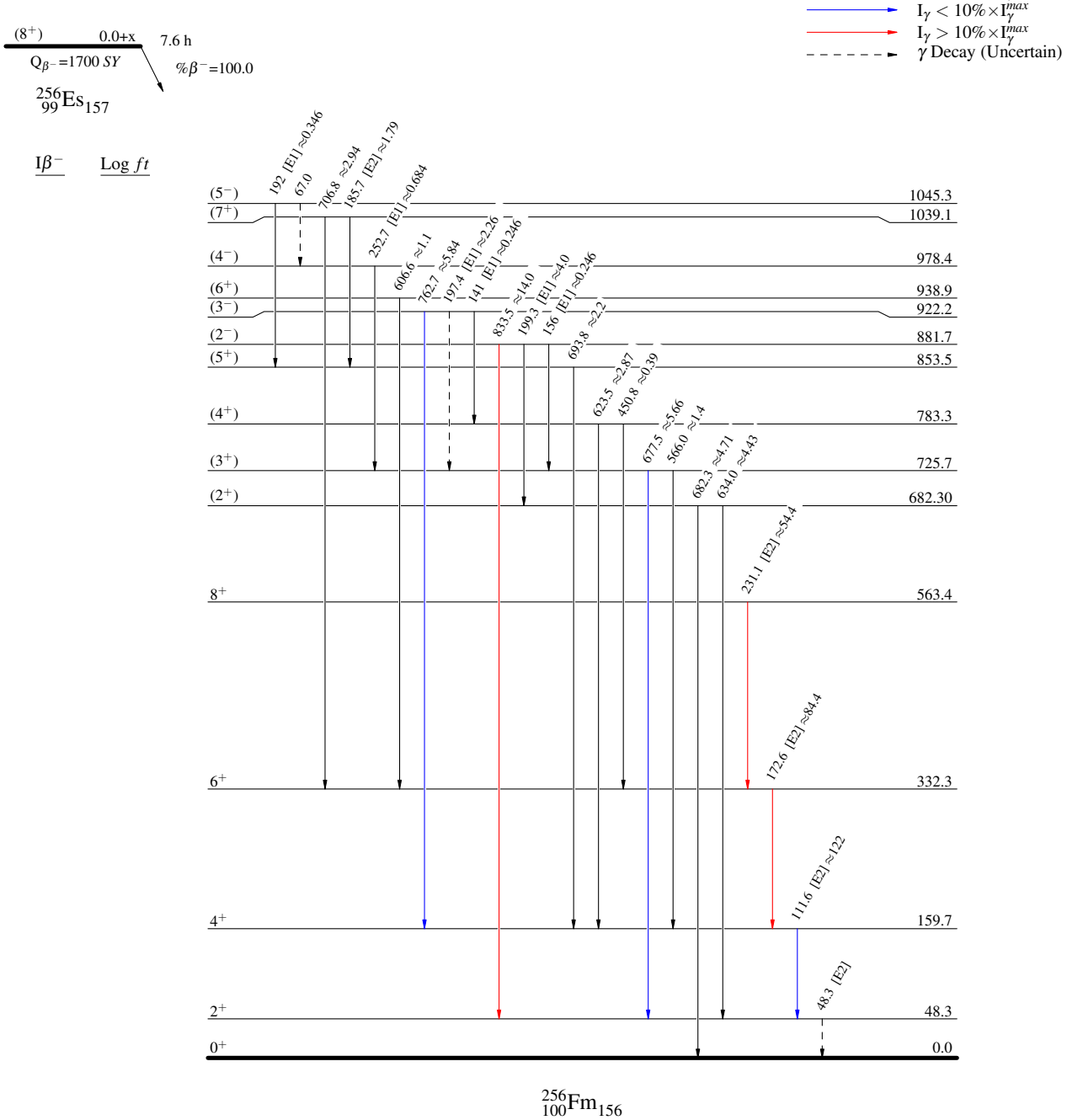
Intensities: $I_{(\gamma+ce)}$ per 100 parent decays
& Multiply placed: undivided intensity given



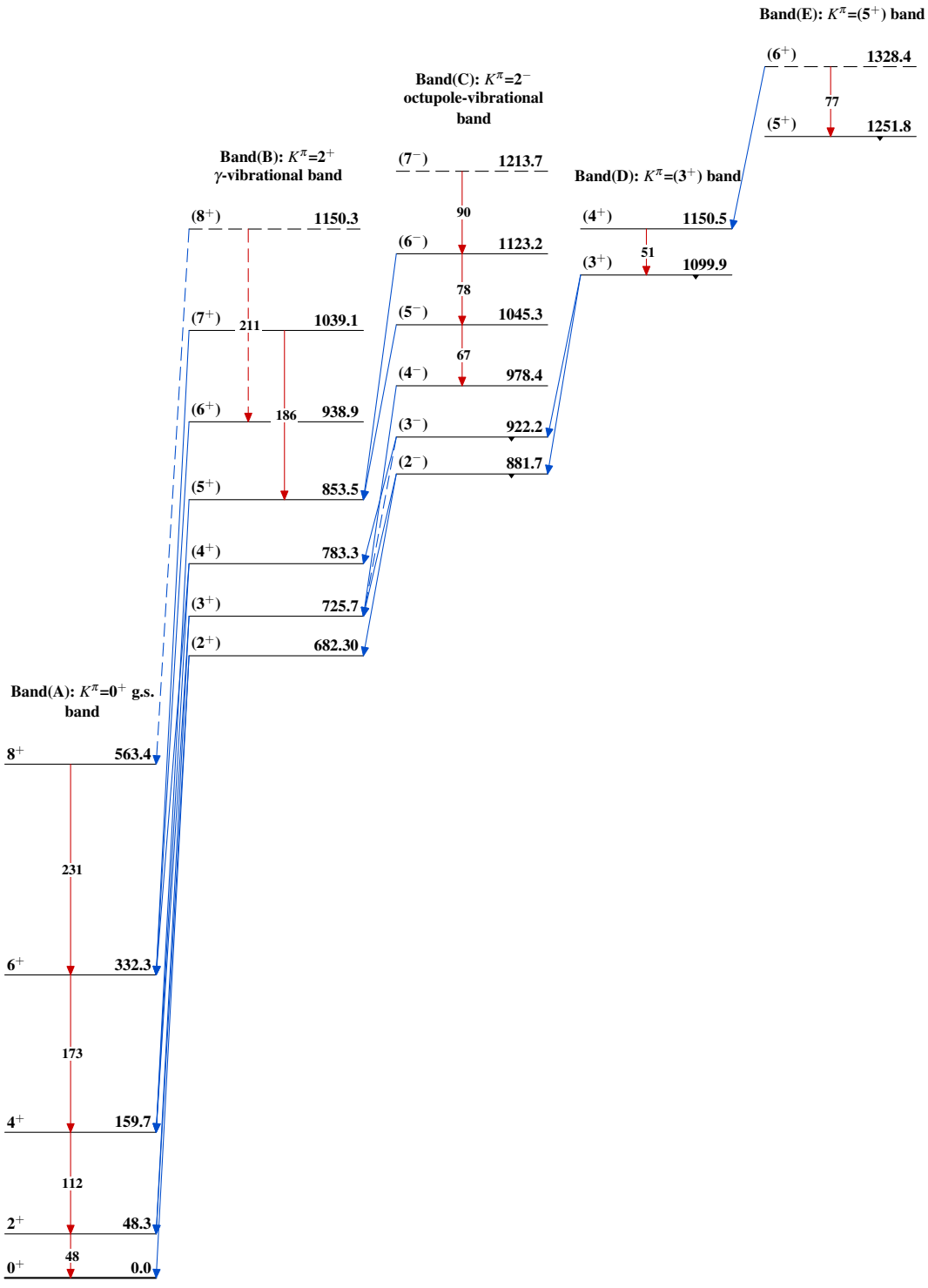
^{256}Es β^- decay (7.6 h) 1989Ha10

Decay Scheme (continued)

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



^{256}Es β^- decay (7.6 h) 1989Ha10



$^{256}_{100}Fm_{156}$